

PROJECT MANUAL

City of Wenatchee WWTP Digester # 4

Project #: 1810

Bid Documents

October 2021



Funded in part by the Washington State Department of Ecology



Prepared For:

City of Wenatchee
1350 McKittrick St.
Wenatchee, WA 98801

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DIVISION 00

**PROCUREMENT AND CONTRACTING
REQUIREMENTS**



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00 01 07



SEALS AND SIGNATURES



Owner Name: City of Wenatchee, WA




Facility or Site Name: City of Wenatchee Wastewater Treatment Plant

Project Name: City of Wenatchee Wastewater Treatment Plant Digester No. 4 Project

Engineer: HDR Engineering, Inc.

 <p>10/4/2021</p> <p>Andrew Donn Staples, PE License No. 44738</p>	<p>The seal and signature to the left applies to the following Specifications divisions and sections of this project manual:</p> <ul style="list-style-type: none">• Division 0, Procurement and Contracting Requirements• Division 1, General Requirements
 <p>10/4/2021</p> <p>James Wodrich, PE License No. 29178</p>	<p>The seal and signature to the left applies to the following Specifications divisions and sections of this project manual:</p> <ul style="list-style-type: none">• Division 1, General Requirements• Division 2, Existing Conditions• 09 96 00 – High Performance Industrial Coatings• 23 21 00 – Hydronic Specialties• 23 52 00 - Boilers• 40 05 00 - Pipe and Pipe Fittings - Basic Requirements• 40 05 07 - Pipe Support Systems• 40 05 17 - Pipe - Copper• 40 05 19 - Pipe - Ductile• 40 05 23 - Pipe - Stainless Steel• 40 05 24 - Pipe - Steel• 40 05 25 - Pipe - Underground, Prefabricated, Insulated, and Jacketed• 40 05 26 - Pipe - Cast-Iron Soil• 40 05 31 - Pipe - Plastic• 40 05 51 - Valves - Basic Requirements• 40 05 52 - Miscellaneous Valves• 40 05 62 - Plug Valves• 40 05 63 - Ball Valves• 40 05 64 - Butterfly Valves• 40 05 66 - Check Valves• 40 10 15 - Fiberglass Reinforced Plastic Duct• 40 42 00 - Pipe, Duct and Equipment Insulation

	<ul style="list-style-type: none"> • 40 61 96 - Process Control Descriptions • Division 41, Material Processing and Handling Equipment • Division 43, Process Gas and Liquid Handling, Purification, and Storage Equipment • Division 46, Water and Wastewater Equipment
 <p style="text-align: right;">10/4/2021</p> <p>Chan Cheang, Registered Architect License No. 9849</p>	<p>The seal and signature to the left applies to the following Specifications divisions and sections of this project manual:</p> <ul style="list-style-type: none"> • Division 6, Wood, Plastics, and Composites • Division 7, Thermal and Moisture Protection • Division 8, Openings • 09 22 16 - Non-structural Metal Framing • 09 29 00 - Gypsum Board • 09 77 61 - FRP Panels • 09 91 10 - Architectural Painting • Division 10, Specialties • Division 11, Equipment
 <p style="text-align: right;">10/4/2021</p> <p>Karl Sutton, PE License No. 42415</p>	<p>The seal and signature to the left applies to the following Specifications divisions and sections of this project manual:</p> <ul style="list-style-type: none"> • Division 22, Plumbing • 23 05 92 - HVAC Systems - Balancing and Testing • 23 09 00 - Instrumentation and Control for HVAC Systems • 23 31 00 - HVAC - Ductwork • 23 34 00 - HVAC - Fans • 23 80 00 - HVAC - Equipment

 <p style="text-align: right;">10/4/2021</p> <p>Kellen Roberts License No. 49341</p>	<p>The seal and signature to the left applies to the following Specifications divisions and sections of this project manual:</p> <ul style="list-style-type: none"> • Division 26, Electrical • 40 41 13 - Heat Tracing Cable
 <p style="text-align: right;">10/4/2021</p> <p>Zachary Sachsenmaier License No. 51772</p>	<p>The seal and signature to the left applies to the following Specifications divisions and sections of this project manual:</p> <ul style="list-style-type: none"> • Division 28, Electronic Safety and Security
 <p style="text-align: right;">10/4/2021</p> <p>Troy Gibbs License No. 46825</p>	<p>The seal and signature to the left applies to the following Specifications divisions and sections of this project manual:</p> <ul style="list-style-type: none"> • 31 10 00 - Site Clearing • 31 23 00 - Earthwork • 31 23 19 - Dewatering • 31 23 33 - Trenching, Backfilling, and Compacting for Utilities • 31 25 00 - Soil Erosion and Sediment Control • 31 50 00 - Excavation Support and Protection • Division 32, Exterior Improvements • Division 33, Utilities





10/4/2021

Matt Gurrad, Landscape Architect
License No. 1094

The seal and signature to the left applies to the following Specifications divisions and sections of this project manual:

- 32 84 00 – Irrigations System
- 32 91 13 – Topsoiling and Finished Grading
- 32 92 00 – Seeding, Sodding and Landscaping

 <p>JON M. CONNER, PE, SE License No. 44672</p>	<p>The seal and signature to the left applies to the following Specifications divisions and sections of this project manual:</p> <ul style="list-style-type: none"> • 03 05 05 – Concrete Testing and Inspection • 03 11 13 – Formwork • 03 15 19 – Anchorage to Concrete • 03 21 00 – Reinforcement • 03 31 30 – Concrete materials and proportioning • 03 31 31 – Concrete Mixing, Placing, Jointing, and Curing • 03 35 00 – Concrete Finishing and Repair of Surface Defects • 03 41 33 – Precast and Prestressed Concrete • 05 12 00 – Structural Steel • 05 50 00 – Metal Fabrications • 05 52 02 – Aluminum Railings
 <p>CLAYTON C. ANDERSON, PE License No. 54353</p>	<p>The seal and signature to the left applies to the following Specifications divisions and sections of this project manual:</p> <ul style="list-style-type: none"> • 27 10 00 – Structured Cabling • 40 61 13 - Process Control Systems General Requirements • 40 61 96 - Process Control Descriptions • 40 63 43 - PLC Control System • 40 67 00 - Control System Equipment Panels and Racks • 40 71 00 - Flow Instrumentation • 40 72 00 - Level Instrumentation • 40 73 00 - Pressure Instrumentation • 40 74 00 - Temperature Instrumentation • 40 78 00 - Panel Mounted Instruments • 40 91 10 - Primary Meters and Transmitters

It is a violation of applicable laws and regulations governing professional licensing and registration for any person, unless acting under the direction of the licensed and registered design professional(s) indicated above, to alter in any way the Specifications in this project manual.

END OF SEALS AND SIGNATURES

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1.0 PURPOSE AND INTENDED USE OF THE DOCUMENT

City of Wenatchee

301 Yakima Street
Wenatchee, WA 98801

ADVERTISEMENT FOR BIDS

Notice is hereby given that sealed Bid Proposals will be received **until 10:00 a.m. November 10, 2021**, for the construction of the **City of Wenatchee WWTP Digester 4, Project No.1810**. Bid Proposals will be received by the City Clerk at Wenatchee City Hall, 301 Yakima St., and will then and there be opened, read, and tabulated publicly. Proposals received after the time fixed for opening will not be considered.

The Project Work to be performed under this Contract includes constructing the Work broadly described below, in accordance with the Contract Documents, with all related appurtenances. Work shown on the Drawings, or indicated in the Specifications, or indicated elsewhere in the Contract Documents is part of the Work, regardless of whether indicated below.

The Work includes, but is not limited to construction of a new, fixed-cover, anaerobic digester with associated mixing, heating, and gas handling elements as well as construction of a new Mechanical Building for the housing of various equipment and storage associated with the project. New equipment will include a boiler and heat exchanger, rotary screen thickeners, pumps, piping, electrical and control system improvements, reconstructing portions of the plant water system, HVAC, landscaping, and other site improvements.

Project duration is set at **385** Working Days.

Complete digital project Bidding documents are available at www.wenatcheewa.gov/e-plans or www.questcdn.com. Bidders may download the digital plan set for \$30.00 by entering **Quest Project #8038659** on the website's Project Search page. Please contact QuestCDN.com at (952) 233-1632 or info@questcdn.com for assistance in free membership registration. A review set will be at the City of Wenatchee Department of Public Works Office, 1350 McKittrick Street, Wenatchee, Washington.:

Each bid proposal shall be accompanied by a Bid Proposal deposit in cash, certified check, cashier's check, postal money order, or Surety bond in an amount equal to at least 5 percent of the amount of the Bid Proposal. Checks shall be made payable to The City of Wenatchee. Should the successful Bidder fail to enter into such Contract and furnish satisfactory performance and payment bond within the time stated in the Specifications, the Bid Proposal deposit shall be forfeited to the City of Wenatchee. The City of Wenatchee reserves the right to reject any or all Bids and to waive irregularities in the Bid or in the Bidding.

A pre-bid conference for the Project will be held on October 28, 2021 at 10:00 a.m. at the City of Wenatchee Department of Public Works office, 1350 McKittrick Street, Wenatchee, WA 98801. Attendance at the pre-bid conference is encouraged but not required. A Site visit is scheduled at or near 11:00 a.m. following the pre-bid conference.

It is anticipated that this project will be funded in part by the Washington State Department of Ecology. Neither the State of Washington nor any of its departments or employees are, or shall be, a party to any contract or any subcontract resulting from this solicitation for bids.

The Successful bidder will be required to conform to the wage requirements prescribed by the federal Davis-Bacon and Relate Acts which requires that all laborers and mechanics employed by contractors and subcontractors performing on contracts funded in whole or in part by SRF appropriations in excess of \$2000 pay their laborers and mechanics not less than the prevailing wage rates and fringe benefits, and determined by the Secretary of Labor, for corresponding classes of laborers and mechanics employed on similar projects in the area.

The City of Wenatchee, in accordance with Title VI of the Civil Rights Act of 1964, 78 Stat. 252, 42 U.S.C. 2000d to 2000d-4 and Title 49, Code of Federal Regulations, Department of Transportation, subtitle A, Office of the Secretary, Part 21, nondiscrimination in federally assisted programs of the

Department of Transportation issued pursuant to such Act, hereby notifies all Bidders that it will affirmatively ensure that in any Contract entered into pursuant to this advertisement, disadvantaged business enterprises as defined at 49 CFR Part 26 will be afforded full opportunity to submit Bids in response to this invitation and will not be discriminated against on the grounds of race, color, national origin, or sex in consideration for an award.

Contractor shall assure to City of Wenatchee that all services provided through this contract shall be completed in full compliance with the Americans with Disabilities Act ("ADA") and Architectural and Transportation Barriers Compliance Board, Federal Register 36 CFR Parts 1190 and 1191, Accessibility Guidelines for Buildings and Facilities; Architectural Barriers Act (ABA) Accessibility Guidelines; proposed rule, published in the Federal Register on July 23, 2004. No bidder may withdraw his Proposal after the hours set for the opening thereof, or before award of Contract, unless said award is delayed for a period exceeding forty-five (45) days.

Published: Wenatchee World, Daily Journal of Commerce on
October 5, 2021 and October 12, 2021

INSTRUCTIONS TO BIDDERS

FOR CONSTRUCTION CONTRACT

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ARTICLE 1—DEFINED TERMS

- 1.01 Terms used in these Instructions to Bidders have the meanings indicated in the General Conditions and Supplementary Conditions. Additional terms used in these Instructions to Bidders have the meanings indicated below:
- A. *Issuing Office*—The office from which the Bidding Documents are to be issued, and which registers plan holders.

ARTICLE 2—BIDDING DOCUMENTS

- 2.01 Bidder shall obtain a complete set of Bidding Requirements and proposed Contract Documents (together, the Bidding Documents). See the Agreement for a list of the Contract Documents. It is Bidder's responsibility to determine that it is using a complete set of documents in the preparation of a Bid. Bidder assumes sole responsibility for errors or misinterpretations resulting from the use of incomplete documents, by Bidder itself or by its prospective Subcontractors and Suppliers.
- 2.02 Bidding Documents are made available for the sole purpose of obtaining Bids for completion of the Project and permission to download or distribution of the Bidding Documents does not confer a license or grant permission or authorization for any other use, nor does it grant or confer ownership or any property interest in the Bidding Documents and other documents distributed for the Project. Authorization to download documents, or other distribution, includes the right for Bidding Documents holders to print documents solely for their use, and the use of their prospective Subcontractors and Suppliers, provided the Bidding Documents holder pays all costs associated with printing or reproduction. Paper or other types of printed documents may not be re-sold under any circumstances.
- 2.03 Owner has established a Bidding Documents Website as indicated in the Advertisement or invitation to bid. Owner recommends that Bidder register as a Bidding Documents holder with the Issuing Office at such website, and obtain a complete set of the Bidding Documents from such website. Bidders may rely that sets of Bidding Documents obtained from the Bidding Documents Website are complete, unless an omission is blatant. Registered Bidding Documents holders will receive Addenda issued by Owner or Issuing Office.
- 2.04 Bidder may register as a Bidding Documents holder and obtain complete sets of Bidding Documents, in the 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 Bidding Documents holders will receive Addenda issued by Owner or Issuing Office.
- 2.05 Plan rooms (including construction information subscription services, and electronic and virtual plan rooms) may distribute the Bidding Documents, or make them available for examination. Those prospective bidders that obtain an electronic (digital) copy of the Bidding Documents from a plan room are encouraged to register as Bidding Documents holders from the Bidding Documents Website or Issuing Office. Owner is not responsible for omissions in Bidding

Documents or other documents obtained from plan rooms or other such sources (such as other prospective bidders), or for a Bidder's failure to obtain Addenda from a plan room.

2.06 *Electronic Documents*

- A. When the Bidding Requirements indicate that electronic (digital) copies of the Bidding Documents are available, such documents will be made available to prospective 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. 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 any bidder's or 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 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 certain documents that were developed by Engineer as part of the Project design process, as Electronic Documents in native file formats as originally prepared by Engineer.
 - 1. Electronic Documents that are available in native file format include:
 - a. AutoDesk BIM 360 file format *.rvt.
 - 2. Release of such documents will be solely for the convenience of the Contractor and subject to additional requirements, if any, for such release as indicated in Specifications Section 01 31 26 – Electronic Communication Protocols. 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 electronic/digital information provided in Electronic Documents is appropriate and adequate for Contractor's specific purposes.
 - 4. In no case will Contractor be entitled to additional compensation or time for completion due to any differences between the actual Contract Documents and any related document in native file format.

ARTICLE 3—QUALIFICATIONS OF BIDDERS

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

ARTICLE 4—PRE-BID CONFERENCE

- 4.01 A non-mandatory pre-bid conference will be held at the time and location indicated in the Advertisement or invitation to bid. Representatives of Owner and Engineer will be present to discuss the Project. Bidders are encouraged to attend and participate in the conference; however, attendance at this conference is not required to submit a Bid.
- 4.02 Information presented at the pre-bid conference does not alter the Bidding Documents. Owner or Issuing Office will issue Addenda to make any changes to the Bidding Documents that result from discussions at the pre-bid conference. Information presented, and statements made at the pre-bid conference will not be binding or legally effective unless incorporated in an Addendum.

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

- 5.01 *Site and Other Areas*
- A. The Site is identified in the Bidding Documents, including in Specifications Section 01 11 00 – Summary of Work. By definition, the Site includes rights-of-way, easements, and other lands furnished by Owner for the use of the Contractor. Any additional lands required for temporary construction facilities, construction equipment, or storage of materials and equipment, and any access needed for such additional lands, are to be obtained and paid for by Contractor.

5.02 *Existing Site Conditions*

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

1. The Supplementary Conditions identify the following regarding existing conditions at or adjacent to the Site:
 - a. Those reports of explorations and tests of subsurface conditions at or adjacent to the Site that contain Technical Data.
 - b. Those drawings known to Owner of existing physical conditions at or adjacent to the Site, including those drawings depicting existing surface or subsurface structures at or adjacent to the Site (except Underground Facilities), that contain Technical Data.
 - c. Reports and drawings known to Owner relating to Hazardous Environmental Conditions that have been identified at or adjacent to the Site.
 - d. Technical Data contained in such reports and drawings.
2. Owner will make copies of reports and drawings referenced above available to any prospective Bidder on request. These reports and drawings are not part of the Contract Documents, but the Technical Data contained therein upon whose accuracy Bidder is entitled to rely, as provided in the General Conditions, has been identified and established in the Supplementary Conditions. Bidder is responsible for any interpretation or conclusion Bidder draws from any Technical Data or any other data, interpretations, opinions, or information contained in such reports or shown or indicated in such drawings.
3. If the Supplementary Conditions do not identify Technical Data, the default definition of Technical Data set forth in Article 1 of the General Conditions will apply.

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

5.03 *Other Site-Related Documents*

- A. In addition to the documents regarding existing Site conditions referred to in Paragraph 5.02.A of these Instructions to Bidders, the following other documents relating to conditions at or adjacent to the Site are known to Owner and made available to Bidders for reference:
1. 1957 Plan Set
 2. 1990 Plan Set
 3. 2004 Plan Set
 4. 2013 Plan Set

Owner will make copies of these other Site-related documents available to any Bidder on request.

- B. Owner has not verified the contents of these other Site-related documents, and Bidder may not rely on the accuracy of any data or information in such documents. Bidder is responsible for any interpretation or conclusion Bidder draws from the other Site-related documents.
- C. The other Site-related documents are not part of the Contract Documents.
- D. Bidders are encouraged to review the other Site-related documents, but Bidders will not be held accountable for any data or information in such documents. The requirement to review and take responsibility for documentary Site information is limited to information in (1) the Contract Documents and (2) the Technical Data.
- E. No other Site-related documents are available.

5.04 *Site Visit and Testing by Bidders*

- A. A Site visit is scheduled on the date, time, and location as indicated on the Advertisement for Bids. The location of the Site is indicated in the Bidding Documents, including in Specifications Section 01 11 00 – Summary of Work.
- B. Bidders visiting the Site are required to: (1) arrange their own transportation to the Site; and (2) each Bidder visiting the Site is responsible for providing and using its own personal protective equipment appropriate for the Site and conditions, and in accordance with posted requirements, if any. Comply with Paragraph 5.05 of these Instructions to Bidders.
- C. 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:

Jeremy Hoover, PE
 Project Manager
 P 509-888-3212
 E jhoover@wenatcheewa.gov

Bidder must conduct the required Site visit during normal working hours, Mondays through Fridays.

- D. Bidder is not required to conduct any subsurface testing, or exhaustive investigations of Site conditions.
- E. On request, and to the extent Owner has control over the Site, and schedule permitting, the Owner will provide Bidder general access to the Site to conduct such additional examinations, investigations, explorations, tests, and studies as Bidder deems necessary for preparing and submitting a successful Bid. Owner will not have any obligation to grant such access if doing so is not practical because of existing operations, security or safety concerns, or restraints on Owner's authority regarding the Site. Bidder is responsible for establishing access needed to reach specific selected test sites.
- F. Bidder must comply with Laws and Regulations regarding excavation and location of utilities, obtain necessary permits, and comply with all terms and conditions established by Owner or by property owners or other entities controlling the Site with respect to schedule, access, existing operations, security, liability insurance, and applicable safety programs.
- G. Bidder must fill all holes and clean up and restore the Site to its former condition upon completion of such explorations, investigations, tests, and studies.

5.05 *Owner's Safety Program*

- A. Site visits and work at the Site may be governed by an Owner safety program. If an Owner safety program exists, it will be indicated in the Supplementary Conditions. Where the Bidding Documents indicate an Owner's safety program, visitors to the Site during the bidding phase and at other times shall comply with Owner's safety programs.

5.06 *Other Work at the Site*

- A. Reference is made to Specifications Section 01 11 00 – Summary of Work, 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 potentially confidential matters), if any.

ARTICLE 6—BIDDER'S REPRESENTATIONS AND CERTIFICATIONS

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

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

ARTICLE 7—INTERPRETATIONS AND ADDENDA

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

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

- A. Andrew Staples, PE
HDR Engineering, Inc.
835 N Post Street, Suite 101
P 509-343-8459
E Andrew.staples@hdrinc.com

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

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

Documents unless set forth in an Addendum that expressly modifies or supplements the Bidding Documents.

ARTICLE 8—BID SECURITY

8.01 *Required Form and Amount of Bid Security*

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

8.02 *Bid Security of Successful Bidder*

- A. The Bid security of the apparent Successful Bidder will be retained until Owner awards the Contract to such Bidder, and such Bidder has signed the Contract, furnished the required Contract security, and met the other conditions of the Notice of Award, whereupon the Successful Bidder's bid security will be released.
- B. If the Successful Bidder fails to sign and deliver the Contract and furnish the required Contract security within the number of days, indicated in Paragraph 20.01 of these Instructions to Bidders, 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.
- C. Upon Successful Bidder's default:
 - 1. When the bid security is a penal sum bid bond, the entire penal sum amount of the bid bond will be forfeit and due Owner.
 - 2. When the bid security is a damages form of bid bond, to the extent of Owner's damages will be forfeit and due Owner.
 - 3. If a type of bid security other than a bid bond is allowed and is furnished, the amount that will be forfeit and due Owner will be the same as for the form of bid bond included in the Bidding Documents. Owner will so notify the defaulting Bidder in writing of the annulment and the amount of the forfeiture, with documentation of the amount forfeited.
- D. Such forfeiture will be Owner's exclusive remedy if Bidder defaults.

8.03 *Bid Security of Bidders other than the Successful Bidder*

- A. 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 seven days after the Effective Date of the Contract or 75 days after the Bid opening, whereupon bid security furnished by such Bidders will be released.
- B. Bid security of other Bidders that Owner believes do not have a reasonable chance of receiving the award will be released within seven days after the bid opening.
- C. Release of Bid Security: Owner may release any Bidder's bid security by returning such bid security to the associated Bidder. When bid security is in the form of a bid bond, Owner may dispose of or destroy the bid bond and so advise the associated Bidder in writing that the bid bond has been released.

ARTICLE 9—CONTRACT TIMES

- 9.01 The number of days within which, or the dates by which, the Work is to be (a) substantially completed and (b) ready for final payment, and (c) Milestones (if any), are to be achieved are set forth in the Agreement.
- 9.02 Provisions for liquidated and special damages, if any, for failure to timely attain a Milestone, Substantial Completion, or completion of the Work in readiness for final payment, are set forth in the Agreement.

ARTICLE 10—SUBSTITUTE AND “OR EQUAL” ITEMS

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

ARTICLE 11—SUBCONTRACTORS, SUPPLIERS, AND OTHERS

- 11.01 A Bidder must be prepared to retain specific Subcontractors and Suppliers for the performance of the Work if required to do so in the Specifications or elsewhere in the Bidding Documents. If a prospective Bidder objects to retaining any such Subcontractor or Supplier and the concern is not relieved by an Addendum, then the prospective Bidder should not submit a Bid.
- 11.02 The apparent Successful Bidder, and any other Bidder so requested by Owner or Engineer, must submit to Owner (with a copy to Engineer) a list of the Subcontractors and Suppliers or name itself for the following portions of the Work within one hour of the published Bid submittal time:
- A. Electrical
 - B. Plumbing
 - C. HVAC

Within forty-eight hours after the published Bid submittal time, the names of the subcontractors with whom the bidder, if awarded the contract, will subcontract for performance of the work of structural steel installation and rebar installation.

ARTICLE 12—PREPARATION OF BID

- 12.01 The Bid Form is included with the Bidding Documents.
- A. All blanks on the Bid Form must be completed in ink and the Bid Form signed in ink. Erasures or alterations must be initialed in ink by the person signing the Bid Form. A Bid price must be indicated for each section, Bid item, alternate, adjustment unit price item, and unit price item listed therein.
 - B. If the Bid Form expressly indicates that submitting pricing on a specific alternate item is optional, and Bidder elects to not furnish pricing for such optional alternate item, then Bidder may enter the words “No Bid” or “Not Applicable.”
- 12.02 If Bidder has obtained the Bidding Documents as Electronic Documents, then Bidder shall prepare its Bid on a paper copy of the Bid Form printed from the Electronic Documents version of the Bidding Documents. The printed copy of the Bid Form must be clearly legible, printed on 8.5inch by 11-inch paper and as closely identical in appearance to the Electronic Document version of the Bid Form as may be practical. The Owner reserves the right to accept Bid Forms which nominally vary in appearance from the original paper version of the Bid Form, providing that all required information and submittals are included with the Bid.
- 12.03 A Bid by a corporation must be signed in the corporate name by a corporate officer (whose title must appear under the signature), accompanied by evidence of authority to sign. The corporate address and state of incorporation must be shown.
- 12.04 A Bid by a partnership must be executed in the partnership name and signed by a partner (whose title must appear under the signature), accompanied by evidence of authority to sign. The official address of the partnership must be shown.
- 12.05 A Bid by a limited liability company must be signed in the name of the firm by a member or other authorized person and accompanied by evidence of authority to sign. The state of formation of the firm and the official address of the firm must be shown.
- 12.06 A Bid by an individual must show the Bidder’s name and official address.
- 12.07 A Bid by a joint venture must be signed by an authorized representative of each joint venturer in the manner indicated on the Bid Form. The joint venture must have been formally established prior to submittal of a Bid, and the official address of the joint venture must be shown.
- 12.08 All names must be printed in ink below the signatures.
- 12.09 The Bid must contain an acknowledgment of receipt of all Addenda, the numbers of which must be filled in on the Bid Form.
- 12.10 Postal and e-mail addresses and telephone number for communications regarding the Bid must be indicated on the Bid Form.
- 12.11 The Bid must contain evidence of Bidder’s authority to do business in the state where the Project is located, or Bidder must certify in writing that it will obtain such authority within the time for acceptance of Bids and attach such certification to the Bid.
- 12.12 If Bidder is required to be licensed to submit a Bid or perform the Work in the state where the Project is located, the Bid must contain evidence of Bidder’s licensure, or Bidder must certify in writing that it will obtain such licensure within the time for acceptance of Bids and attach such

certification to the Bid. Bidder's state contractor license number, if any, must also be shown on the Bid Form.

- 12.13 It is anticipated that this project will be funded in part by the Washington State Department of Ecology. Neither the State Of Washington nor any of its departments or employees are, or shall be, a party to this contract or any subcontract.

ARTICLE 13—BASIS OF BID

13.01 Lump Sum

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

ARTICLE 14—SUBMITTAL OF BID

14.01 The Bidding Documents include one separate, unbound copy of the Bid Form, and, where required, the Bid Bond Form and other supplements to the Bid Form. The unbound copy of the Bid Form and supplements (if any) is to be completed and submitted with the Bid security and the other documents required with the Bid by Article 2 of the Bid Form.

14.02 A Bid must be received no later than the date and time prescribed and at the place indicated in the Advertisement or invitation to bid and must be enclosed in a plainly marked package with the Project title, and, if applicable, the designated portion of the Project for which the Bid is submitted, and 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 method, 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 or invitation to bid.

14.03 Bids received after the date and time prescribed for the opening of Bids, or not submitted at the correct location or in the designated manner, will not be accepted and will be returned to the Bidder unopened. Owner accepts no responsibility for delays in returning Bids submitted or delivered to the incorrect location.

ARTICLE 15—MODIFICATION AND WITHDRAWAL OF BID

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

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

15.03 If, within 24 hours after Bids are opened, any Bidder files a duly signed, written notice with Owner and promptly thereafter demonstrates to the reasonable satisfaction of Owner that there was a material and substantial mistake in the preparation of its Bid, the Bidder may withdraw its Bid,

and the bid security will be returned. Thereafter, if the Work is rebid, the Bidder will be disqualified from further bidding on the Work.

ARTICLE 16—OPENING OF BIDS

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

ARTICLE 17—BIDS TO REMAIN SUBJECT TO ACCEPTANCE

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

ARTICLE 18—EVALUATION OF BIDS AND AWARD OF CONTRACT

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

18.02 Owner will reject the Bid of any Bidder that Owner finds, after reasonable inquiry and evaluation, to not be responsible. Owner may reject the Bid of any Bidder that fails to demonstrate appropriate qualifications, experience, and resources for the Work, in accordance with Article 3 of these Instructions to Bidders.

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

18.04 *Basis for Award of Contract*

A. If Owner awards the contract for the Work, such award will be to the responsible Bidder submitting the lowest-priced, responsive Bid that has not otherwise been disqualified.

18.05 *Evaluation of Bids*

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

18.06 In evaluating whether a Bidder is responsible, Owner will consider the qualifications, experience, and resources of the Bidder and may consider the qualifications, experience, and resources of

Subcontractors and Suppliers proposed for those portions of the Work for which the identity of Subcontractors and Suppliers must be submitted as provided in the Bidding Documents.

- 18.07 Owner, with or without Engineer's assistance, may conduct such investigations as Owner deems necessary to establish the responsibility, qualifications, and financial ability of Bidders and any proposed Subcontractors or Suppliers.

ARTICLE 19—BONDS AND INSURANCE

- 19.01 Paragraph 2.01 and Article 6 of the General Conditions, as may be modified by the Supplementary Conditions, set forth Owner's requirements as to performance and payment bonds, other required bonds (if any), and insurance. When the Successful Bidder delivers the signed Agreement to Owner (or Owner's representative), it must be accompanied by required bonds and insurance documentation.
- 19.02 Article 8 ("Bid Security") of these Instructions to Bidders addresses any requirements for providing bid bonds as part of the bidding process.

ARTICLE 20—SIGNING OF AGREEMENT

- 20.01 When Owner issues a Notice of Award to the Successful Bidder, it will be accompanied by the unsigned 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 required bonds and insurance documentation (as required by the Contract Documents) to Owner. Within 10 days thereafter, Owner will deliver one fully signed counterpart of the Agreement to Successful Bidder, together with printed and electronic copies of the Contract Documents as stated in Paragraph 2.02 of the General Conditions.

ARTICLE 21—SALES AND USE TAXES

- 21.01 Owner is not exempt from Washington state sales tax, local sales tax, and use taxes on materials and equipment to be incorporated in the Work.. Said taxes must be included in the Bid Form in the line shown. Refer to Paragraph SC-7.10 of the Supplementary Conditions for additional information.

BID FORMS

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

3.01 *Lump Sum Bids*

A. Bidder will complete the Work in accordance with the Contract Documents for the following lump sum (stipulated) prices:

1. Lump Sum Prices

Lump Sum Mobilization	\$
Lump Sum Bid Price	\$
Trench Safety System (RCW 39.04.180)	\$

B. All specified cash allowance(s) are included in the price(s) set forth below, and have been computed in accordance with Paragraph 13.02 of the General Conditions.

Lump Sum for Cash Allowance 1-Removal of undefined debris or garbage.	\$10,000.00
Lump Sum for Cash Allowance 2-Repair of undefined items as follows; 1. Conduit 2. Process Pipe 3. Misc Pipe 4. Electrical cables and conductors 5. Instrumentation Cables	\$50,000.00
Lump Sum for Cash Allowance 3 – Record Drawings	\$12,500.00
Total for all Lump Sum for Cash Allowances	\$60,000.00

3.02 *Total Bid Price (Lump Sum and Cash Allowances)*

Subtotal Bid Price (Total of all Lump Sums and Cash Allowances)	\$
Sales Tax, 8.5%	\$
Total Bid Price (Sales Tax + Subtotal Bid Price)	\$

ARTICLE 4—TIME OF COMPLETION

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

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

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

5.01 *Bid Acceptance Period*

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

5.02 *Instructions to Bidders*

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

5.03 *Receipt of Addenda*

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

Addendum Number	Addendum Date

ARTICLE 6—BIDDER’S REPRESENTATIONS AND CERTIFICATIONS

6.01 *Bidder’s Representations*

- A. In submitting this Bid, Bidder represents the following:
 1. Bidder has examined and carefully studied the Bidding Documents, including Addenda.
 2. Bidder has visited the Site, conducted a thorough visual examination of the Site and adjacent areas, and become familiar with the general, local, and Site conditions that may affect cost, progress, and performance of the Work.
 3. Bidder is familiar with all Laws and Regulations that may affect cost, progress, and performance of the Work.
 4. Bidder has carefully studied the reports of explorations and tests of subsurface conditions at or adjacent to the Site and the drawings of physical conditions relating to existing surface or subsurface structures at the Site that have been identified in the Supplementary Conditions, with respect to the Technical Data in such reports and drawings.
 5. Bidder has carefully studied the reports and drawings relating to Hazardous Environmental Conditions, if any, at or adjacent to the Site that have been identified in the Supplementary Conditions, with respect to Technical Data in such reports and drawings.
 6. Bidder has considered the information known to Bidder itself; information commonly known to contractors doing business in the locality of the Site; information and observations obtained from visits to the Site; the Bidding Documents; and the Technical Data identified in the Supplementary Conditions or by definition, with respect to the effect of such information, observations, and Technical Data on (a) the cost, progress, and

performance of the Work; (b) the means, methods, techniques, sequences, and procedures of construction to be employed by Bidder, if selected as Contractor; and (c) Bidder's (Contractor's) safety precautions and programs.

7. Based on the information and observations referred to in the preceding paragraph, Bidder agrees that no further examinations, investigations, explorations, tests, studies, or data are necessary for the performance of the Work at the Contract Price, within the Contract Times, and in accordance with the other terms and conditions of the Contract.
8. Bidder is aware of the general nature of work to be performed by Owner and others at the Site that relates to the Work as indicated in the Bidding Documents.
9. Bidder has given Engineer written notice of all conflicts, errors, ambiguities, or discrepancies that Bidder has discovered in the Bidding Documents, and of discrepancies between Site conditions and the Contract Documents, and the written resolution thereof by Engineer is acceptable to Contractor.
10. The Bidding Documents are generally sufficient to indicate and convey understanding of all terms and conditions for performance and furnishing of the Work.
11. The submission of this Bid constitutes an incontrovertible representation by Bidder that without exception the Bid and all prices in the Bid are premised upon performing and furnishing the Work required by the Bidding Documents.

6.02 *Bidder's Certifications*

A. The Bidder certifies the following:

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

BIDDER hereby submits this Bid as set forth above:

Bidder:

(typed or printed name of organization)

By: _____
(individual's signature)

Name: _____
(typed or printed)

Title: _____
(typed or printed)

Date: _____
(typed or printed)

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

Attest: _____
(individual's signature)

Name: _____
(typed or printed)

Title: _____
(typed or printed)

Date: _____
(typed or printed)

Bidder's Address for giving notices:

Bidder's Contact Person:

Name: _____
(typed or printed)

Title: _____
(typed or printed)

Phone: _____

Email: _____

Address: _____

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

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Subcontractor List

1. RCW 39.30.060 requires every invitation to bid on a prime contract that is expected to cost one million dollars or more for the construction, alteration, or repair of any public building or public work of the state or a state agency or municipality as defined under RCW 39.04.010 or an institution of higher education as defined under RCW 28B.10.016 shall require each prime contract bidder to submit:
 - a) Within one hour after the published bid submittal time, the names of the subcontractors with whom the bidder, if awarded the contract, will subcontract for performance of the work of: HVAC (heating, ventilation, and air conditioning); plumbing as described in chapter 18.106 RCW; and electrical as described in chapter 19.28 RCW, or to name itself for the work; or
 - b) Within forty-eight hours after the published bid submittal time, the names of the subcontractors with whom the bidder, if awarded the contract, will subcontract for performance of the work of structural steel installation and rebar installation.
2. The prime contract bidder shall not list more than one subcontractor for each category of work identified, unless subcontractors vary with bid alternates, in which case the prime contract bidder must indicate which subcontractor will be used for which alternate. Failure of the prime contract bidder to submit as part of the bid the names of such subcontractors or to name itself to perform such work or the naming of two or more subcontractors to perform the same work shall render the prime contract bidder's bid nonresponsive and, therefore, void.
3. The requirement of this section to name the prime contract bidder's proposed subcontractors applies only to proposed HVAC, plumbing, electrical, structural steel installation, and rebar installation subcontractors who will contract directly with the prime contract bidder submitting the bid to the public entity.
4. This section does not apply to job order contract requests for proposals under RCW 39.10.420.

SEE FOLLOWING PAGE FOR SUBCONTRACTOR LIST

REQUIRED SUBCONTRACTOR LIST

Subcontractor Name: _____
Category of Work: _____
Address: _____
Phone No.: _____
Contractor License No.: _____
Firm's Status (MBE/WBE or non-MBE/WBE): _____

Subcontractor Name: _____
Category of Work: _____
Address: _____
Phone No.: _____
Contractor License No.: _____
Firm's Status (MBE/WBE or non-MBE/WBE): _____

Subcontractor Name: _____
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Contractor License No.: _____
Firm's Status (MBE/WBE or non-MBE/WBE): _____

Subcontractor Name: _____
Category of Work: _____
Address: _____
Phone No.: _____
Contractor License No.: _____
Firm's Status (MBE/WBE or non-MBE/WBE): _____

Subcontractor Name: _____
Category of Work: _____
Address: _____
Phone No.: _____
Contractor License No.: _____
Firm's Status (MBE/WBE or non-MBE/WBE): _____

BIDDER'S QUALIFICATION CERTIFICATE

The undersigned hereby certifies and submits the following qualifications:

1. Name and Address

2. State of Washington Registration Number and expiration _____

3. Number of years in contracting business under present firm name _____

4. Particular types of construction Work performed by your company:

5. List several recent construction projects performed:

Amount	Type	Owner	Name	Phone

6. Gross amount of Contracts now in hand:

7. Bank reference(s):

By (Authorized Signature): _____

Title _____

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WASHINGTON STATE DEPARTMENT OF ECOLOGY
WATER POLLUTION CONTROL REVOLVING FUND
SPECIFICATIONS INSERT

Revised 3/4/14

The following clauses will be incorporated into construction contracts receiving financial assistance from the Washington State Department of Ecology Water Pollution Control Revolving Fund. In the event of conflict within the contract these clauses shall take precedence

Required Bid Submittals

The following submittals are required to be submitted with the bid proposal:

- Certification Of Non-segregated Facilities (attachment 3)
- DBE Subcontractor Utilization Form (EPA Form 6100-4)
- One copy of DBE Subcontractor Performance Form (EPA Form 6100-3) for each DBE subcontractor.
- Complete Bidders List.

Compliance with State and Local Laws

The Contractor shall assure compliance with all applicable federal, state, and local laws, requirements, and ordinances as they pertain to the design, implementation, and administration of the approved project.

State Interest Exclusion

It is anticipated that this project will be funded in part by the Washington State Department of Ecology . Neither the State Of Washington nor any of its departments or employees are, or shall be, a party to this contract or any subcontract.

Third Party Beneficiary

Partial funding of this project is being provided through the Washington State Department of Ecology Water Pollution Control Revolving Fund. All parties agree that the State of Washington shall be, and is hereby, named as an express third-party beneficiary of this contract, with full rights as such.

Access to the construction site and to records

The contractor shall provide for the safe access to the construction site and to the contractor's records by Washington State Department of Ecology and Environmental Protection Agency (EPA) personnel.

The Contractor shall maintain accurate records and accounts to facilitate the Owner's audit requirements and shall ensure that all subcontractors maintain auditable records.

These Project records shall be separate and distinct from the Contractor's other records and accounts.

All such records shall be available to the Owner and to Washington State Department of Ecology and EPA personnel for examination. All records pertinent to this project shall be retained by the Contractor for a period of three (3) years after the final audit.

Protection of the Environment

No construction related activity shall contribute to the degradation of the environment, allow material to enter surface or ground waters, or allow particulate emissions to the atmosphere, which exceed state or federal standards. Any actions that potentially allow a discharge to state waters must have prior approval of the Washington State Department of Ecology.

Funding Recognition

All site-specific projects must have a sign of sufficient size to be seen from nearby roadways acknowledging department financial assistance and left in place throughout the life of the project. Department logos must be on all signs and documents. Logos will be provided as needed.

Inadvertent Discovery Of Archeological Resources

The contractor shall obtain a copy of the Inadvertent Discovery Plan from the Project Owner. The contractor shall keep a copy of the inadvertent discovery plan for the project on the work site at all times. The contractor shall immediately stop all work if human remains, cultural, or archeological resources are discovered in the course of construction. The contractor shall follow the inadvertent discovery plan in dealing with the human remains, cultural, or archeological resources.

Use Of American Iron And Steel

This provision applies to projects for the construction, alteration, maintenance, or repair of a "treatment works" as defined in the Federal Water Pollution Control Act (33 USC 1381 et seq.). This provision does not apply if the engineering plans and specifications for the project were approved by the Ecology prior to January 17, 2014.

The Contractor acknowledges to and for the benefit of the Project Owner and the State of Washington that it understands the goods and services under this Agreement are being funded with monies made available by the Water Pollution Control Revolving Fund which contains provisions commonly known as "American Iron and Steel;" that requires all of the iron and steel products used in the project be produced in the United States ("American Iron and Steel Requirements") including iron and steel products provided by the Contactor pursuant to this Agreement. "Iron and Steel products" means the following products made primarily of iron or steel: lined or unlined pipes and fittings, manhole covers and other municipal castings, hydrants, tanks, flanges, pipe clamps and restraints, valves, structural steel, reinforced precast concrete, and construction materials.

The Contractor hereby represents and warrants to and for the benefit of the Project Owner and the State that:

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

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

Prevailing Wage

The work performed under this contract is subject to the wage requirements of the Davis-Bacon Act. The Contractor shall conform to the wage requirements prescribed by the federal Davis-Bacon and Relate Acts which requires that all laborers and mechanics employed by contractors and subcontractors performing on contracts funded in whole or in part by SRF appropriations in excess of \$2000 pay their laborers and mechanics not less than the prevailing wage rates and fringe benefits, and determined by the Secretary of Labor, for corresponding classes of laborers and mechanics employed on similar projects in the area. Attachment 1 to this specification insert and an up to date wage determination shall be included in full into this contract and in any subcontract in excess of \$2,000. Wage determinations can be found at <http://www.wdol.gov>.

The Contractor agrees that the Contractor is legally and financially responsible for compliance with the Davis-Bacon Act wage rules. All laborers and mechanics employed by contractors and subcontractors employed as part of this contract shall be paid wages at rates not less than those prevailing on projects of a character similar in the locality as determined by the Secretary of Labor in accordance with subchapter IV of chapter 31 of title 40, United States Code.

Certification Regarding Suspension, Debarment, Ineligibility Or Voluntary Exclusion

1. The CONTRACTOR, by signing this agreement, certifies that it is not suspended, debarred, proposed for debarment, declared ineligible or otherwise excluded from contracting with the federal government, or from receiving contracts paid for with federal funds. If the CONTRACTOR is unable to certify to the statements contained in the certification, they must provide an explanation as to why they cannot.
2. The CONTRACTOR shall provide immediate written notice to the Department if at any time the CONTRACTOR learns that its certification was erroneous when submitted or had become erroneous by reason of changed circumstances.
3. The terms covered transaction, debarred, suspended, ineligible, lower tier covered transaction, participant, person, primary covered transaction, principal, proposal, and voluntarily excluded, as used in this clause, have the meaning set out in the Definitions and Coverage sections of rules implementing Executive Order 12549. You may contact the department for assistance in obtaining a copy of those regulations.
4. The CONTRACTOR agrees it shall not knowingly enter into any lower tier covered transaction with a person who is proposed for debarment under the applicable Code of Federal Regulations, debarred, suspended, declared ineligible, or voluntarily excluded from participation in this covered transaction.
5. The CONTRACTOR further agrees by signing this agreement, that it will include this clause titled “Certification Regarding Suspension, Debarment, Ineligibility Or Voluntary Exclusion” without modification in all lower tier covered transactions and in all solicitations for lower tier covered transactions.
6. Pursuant to 2CFR180.330, the CONTRACTOR is responsible for ensuring that any lower tier covered transaction complies with certification of suspension and debarment requirements.
7. CONTRACTOR acknowledges that failing to disclose the information required in the Code of Federal Regulations may result in the delay or negation of this funding agreement, or pursuance of legal remedies, including suspension and debarment.
8. CONTRACTOR agrees to keep proof in its agreement file, that it, and all lower tier recipients or contractors, are not suspended or debarred, and will make this proof available to the Department upon request. RECIPIENT/CONTRACTOR must run a search in <http://www.sam.gov/> and print a copy of completed searches to document proof of compliance.

This term and condition supersedes EPA Form 5700-49, “Certification Regarding Debarment, Suspension, and Other Responsibility Matters.”

Disadvantaged Business Enterprises

General Compliance (40 CFR Part 33).

The contractor shall comply with the requirements of the Environmental Protection Agency's Program for Participation By Disadvantaged Business Enterprises (DBE) 40 CFR Part 33.

Non-discrimination Provision (40CFR Appendix A to Part 33).

The contractor shall not discriminate on the basis of race, color, national origin or sex in the performance of this contract. The contractor shall carry out applicable requirements of 40 CFR part 33 in the award and administration of contracts awarded under EPA financial assistance agreements. Failure by the contractor to carry out these requirements is a material breach of this contract which may result in the termination of this contract or other legally available remedies.

The contractor shall comply with all federal and state nondiscrimination laws, including, but not limited to Title VI and VII of the Civil Rights Act of 1964, Section 504 of the Rehabilitation Act of 1973, Title IX of the Education Amendments of 1972, the Age Discrimination Act of 1975, and Chapter 49.60 RCW, Washington's Law Against Discrimination, and 42 U.S.C. 12101 et seq, the Americans with Disabilities Act (ADA).

Six Good Faith Efforts (40 CFR Part 33 Subpart C).

The contractor agrees to make the following good faith efforts whenever procuring subcontracts, equipment, services and supplies. The contractor shall retain records documenting compliance with the following six good faith efforts.

1. Ensuring Disadvantaged Business Enterprises are made aware of contracting opportunities to the fullest extent practicable through outreach and recruitment activities. For Indian Tribal, State and Local and Government recipients, this will include placing Disadvantaged Business Enterprises on solicitation lists and soliciting them whenever they are potential sources. Qualified Women and Minority business enterprises may be found on the Internet at www.omwbe.wa.gov or by contacting the Washington State Office of Minority and Women's Enterprises at (866) 208-1064.
2. Making information on forthcoming opportunities available to Disadvantaged Business Enterprises and arrange time frames for contracts and establish delivery schedules, where the requirements permit, in a way that encourages and facilitates participation by Disadvantaged Business Enterprises in the competitive process. This includes, whenever possible, posting solicitations for bids or proposals for a minimum of thirty (30) calendar days before the bid or proposal closing date.
3. Considering in the contracting process whether firms competing for large contracts could subcontract with Disadvantaged Business Enterprises. For Indian Tribal, State and local Government recipients, this will include dividing total requirements when economically feasible into smaller tasks or quantities to permit maximum participation by Disadvantaged Business Enterprises in the competitive process.
4. Encourage contracting with a consortium of Disadvantaged Business Enterprises when a contract is too large for one of these firms to handle individually.
5. Using services and assistance of the Small Business Administration and the Minority Business Development Agency of the Department of Commerce.

6. If the prime contractor awards subcontracts, requiring the subcontractors to take the six good faith efforts in paragraphs 1 through 5 above.

MBE/WBE Reporting (40 CFR Part 33 Parts 33.302, 33.502 and 33.503).

1. The contractor shall complete the DBE Subcontractor Utilization Form (EPA Form 6100-4).
2. The contractor shall require all DBE subcontractors to complete the DBE Subcontractor Performance Form (EPA Form 6100-3). The DBE Subcontractor Performance Form is only required to be completed by certified DBE subcontractors.
3. The contractor shall submit DBE Subcontractor Utilization Form (EPA Form 6100-4) and all completed DBE Subcontractor Performance Form(s) (EPA Form 6100-3) as part of the bid, or within one hour after the published bid submittal time (consistent with RCW 39.30.060)
4. The contractor shall provide DBE Subcontractor Participation Form (EPA Form 6100-2) to all DBE subcontractors. These subcontractors may submit Subcontractor Participation Form (EPA Form 6100-2) to the EPA Region 10 DBE coordinator in order to document issues or concerns with their usage or payment for a subcontract.

The 6100 forms can be found at:

<http://www.ecy.wa.gov/programs/wq/funding/GrantLoanMgmtDocs/Eng/GrantLoanMgmtEngRes.html>

Bidders List (40 CFR Part 33 part 33.501)

All bidders shall submit the following information for all firms that bid or quote on subcontracts (including both DBE and non-DBE firms) as part of the bid, or within one hour after the published bid submittal time (consistent with RCW 39.30.060).

1. Firm's name with point of contact;
2. Firm's mailing address, telephone number, and e-mail address;
3. The work on which the firm bid or quoted, and when the firm bid or quoted; and
4. Firm's status as an MBE/WBE or non-MBE/WBE.

Contract Administration Provisions (40 CFR part 33.302).

The contractor shall comply with the contract administration provisions of 40 CFR, Part 33.302.

1. The contractor shall pay its subcontractor for satisfactory performance no more than 30 days from the contractor's receipt of payment.
2. The contractor shall notify the owner in writing prior to any termination of a DBE subcontractor.
3. If a DBE subcontractor fails to complete work under the subcontract for any reason, the contractor shall employ the six good faith efforts when soliciting a replacement subcontractor.
4. The contractor shall employ the six good faith efforts even if the contractor has achieved its fair share objectives.

Equal Opportunity (EEO)

If this Contract exceeds \$10,000, the Contractor shall comply with Executive Order 11246, "Equal Employment Opportunity," as amended by Executive Order 11375, "Amending Executive Order 11246 Relating to Equal Employment Opportunity," and as supplemented by regulations at 41 CFR part 60.

Contractor's compliance with Executive Order 11246 shall be based on implementation of the Equal Opportunity Clause, and specific affirmative active obligations required by the Standard Federal Equal Employment Opportunity Construction Contract Specifications, as set forth in 41 CFR Part 60-4.

Equal Opportunity Clause (41 CFR part 60-1.4(b))

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

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

Order 11246 of September 24, 1965, or by rule, regulation, or order of the Secretary of Labor, or as otherwise provided by law.

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

Federal Equal Employment Opportunity Construction Contract Specifications
(Executive Order 11246 and 41 CFR part 60-4.3)

1. As used in these specifications:
 - a. "Covered area" means the geographical area described in the solicitation from which this contract resulted;
 - b. "Director" means Director, Office of Federal Contract Compliance Programs, United States Department of Labor, or any person to whom the Director delegates authority;
 - c. "Employer identification number" means the Federal Social Security number used on the Employer's Quarterly Federal Tax Return, U.S. Treasury Department Form 941.
 - d. "Minority" includes:
 - i. Black (all persons having origins in any of the Black African racial groups not of Hispanic origin);
 - ii. Hispanic (all persons of Mexican, Puerto Rican, Cuban, Central or South American or other Spanish Culture or origin, regardless of race);
 - iii. Asian and Pacific Islander (all persons having origins in any of the original peoples of the Far East, Southeast Asia, the Indian Subcontinent, or the Pacific Islands); and
 - iv. American Indian or Alaskan Native (all persons having origins in any of the original peoples of North America and maintaining identifiable tribal affiliations through membership and participation or community identification).
2. Whenever the Contractor, or any Subcontractor at any tier, subcontracts a portion of the work involving any construction trade, it shall physically include in each subcontract in excess of \$10,000 the provisions of these specifications and the Notice which contains the applicable goals for minority and female participation and which is set forth in the solicitations from which this contract resulted.
3. If the Contractor is participating (pursuant to 41 CFR 60-4.5) in a Hometown Plan approved by the U.S. Department of Labor in the covered area either individually or through an association, its affirmative action obligations on all work in the Plan area (including goals and timetables) shall be in accordance with that Plan for those trades which have unions participating in the Plan. Contractors must be able to demonstrate their participation in and compliance with the provisions of any such Hometown Plan. Each Contractor or Subcontractor participating in an approved Plan is individually

required to comply with its obligations under the EEO clause, and to make a good faith effort to achieve each goal under the Plan in each trade in which it has employees. The overall good faith performance by other Contractors or Subcontractors toward a goal in an approved Plan does not excuse any covered Contractor's or Subcontractor's failure to take good faith efforts to achieve the Plan goals and timetables.

4. The Contractor shall implement the specific affirmative action standards provided in paragraphs 7 a through p of these specifications. The goals set forth in the solicitation from which this contract resulted are expressed as percentages of the total hours of employment and training of minority and female utilization the Contractor should reasonably be able to achieve in each construction trade in which it has employees in the covered area. Covered Construction contractors performing construction work in geographical areas where they do not have a Federal or federally assisted construction contract shall apply the minority and female goals established for the geographical area where the work is being performed. Goals are published periodically in the Federal Register notice form, and such notices may be obtained from any Office of Federal Contract Compliance Programs office or from Federal procurement contracting officers. The Contractor is expected to make substantially uniform progress in meeting its goals in each craft during the period specified.
5. Neither the provisions of any collective bargaining agreement, nor the failure by a union with whom the Contractor has a collective bargaining agreement, to refer either minorities or women shall excuse the Contractor's obligations under these specifications, Executive Order 11246, or the regulations promulgated pursuant thereto.
6. In order for the nonworking training hours of apprentices and trainees to be counted in meeting the goals, such apprentices and trainees must be employed by the Contractor during the training period, and the Contractor must have made a commitment to employ the apprentices and trainees at the completion of their training, subject to the availability of employment opportunities. Trainees must be trained pursuant to training programs approved by the U.S. Department of Labor.
7. The Contractor shall take specific affirmative actions to ensure equal employment opportunity. The evaluation of the Contractor's compliance with these specifications shall be based upon its effort to achieve maximum results from its actions. The Contractor shall document these efforts fully, and shall implement affirmative action steps at least as extensive as the following:
 - a. Ensure and maintain a working environment free of harassment, intimidation, and coercion at all sites, and in all facilities at which the Contractor's employees are assigned to work. The Contractor, where possible, will assign two or more women to each construction project. The Contractor shall specifically ensure that all foremen, superintendents, and other on-site supervisory personnel are aware of and carry out the Contractor's obligation to maintain such a working environment, with specific attention to minority or female individuals working at such sites or in such facilities.
 - b. Establish and maintain a current list of minority and female recruitment sources, provide written notification to minority and female recruitment sources and to community organizations when the Contractor or its unions have employment opportunities available, and maintain a record of the organizations' responses.
 - c. Maintain a current file of the names, addresses and telephone numbers of each minority and female off-the-street applicant and minority or female referral from a union, a recruitment source or community organization and of what action was taken

with respect to each such individual. If such individual was sent to the union hiring hall for referral and was not referred back to the Contractor by the union or, if referred, not employed by the Contractor, this shall be documented in the file with the reason therefor, along with whatever additional actions the Contractor may have taken.

- d. Provide immediate written notification to the Director when the union or unions with which the Contractor has a collective bargaining agreement has not referred to the Contractor a minority person or woman sent by the Contractor, or when the Contractor has other information that the union referral process has impeded the Contractor's efforts to meet its obligations.
- e. Develop on-the-job training opportunities and/or participate in training programs for the area which expressly include minorities and women, including upgrading programs and apprenticeship and trainee programs relevant to the Contractor's employment needs, especially those programs funded or approved by the Department of Labor. The Contractor shall provide notice of these programs to the sources compiled under 7b above.
- f. Disseminate the Contractor's EEO policy by providing notice of the policy to unions and training programs and requesting their cooperation in assisting the Contractor in meeting its EEO obligations; by including it in any policy manual and collective bargaining agreement; by publicizing it in the company newspaper, annual report, etc.; by specific review of the policy with all management personnel and with all minority and female employees at least once a year; and by posting the company EEO policy on bulletin boards accessible to all employees at each location where construction work is performed.
- g. Review, at least annually, the company's EEO policy and affirmative action obligations under these specifications with all employees having any responsibility for hiring, assignment, layoff, termination or other employment decisions including specific review of these items with onsite supervisory personnel such as Superintendents, General Foremen, etc., prior to the initiation of construction work at any job site. A written record shall be made and maintained identifying the time and place of these meetings, persons attending, subject matter discussed, and disposition of the subject matter.
- h. Disseminate the Contractor's EEO policy externally by including it in any advertising in the news media, specifically including minority and female news media, and providing written notification to and discussing the Contractor's EEO policy with other Contractors and Subcontractors with whom the Contractor does or anticipates doing business.
- i. Direct its recruitment efforts, both oral and written, to minority, female and community organizations, to schools with minority and female students and to minority and female recruitment and training organizations serving the Contractor's recruitment area and employment needs. Not later than one month prior to the date for the acceptance of applications for apprenticeship or other training by any recruitment source, the Contractor shall send written notification to organizations such as the above, describing the openings, screening procedures, and tests to be used in the selection process.
- j. Encourage present minority and female employees to recruit other minority persons and women and, where reasonable, provide after school, summer and vacation

- employment to minority and female youth both on the site and in other areas of a Contractor's work force.
- k. Validate all tests and other selection requirements where there is an obligation to do so under 41 CFR part 60–3.
 - l. Conduct, at least annually, an inventory and evaluation at least of all minority and female personnel for promotional opportunities and encourage these employees to seek or to prepare for, through appropriate training, etc., such opportunities.
 - m. Ensure that seniority practices, job classifications, work assignments and other personnel practices, do not have a discriminatory effect by continually monitoring all personnel and employment related activities to ensure that the EEO policy and the Contractor's obligations under these specifications are being carried out.
 - n. Ensure that all facilities and company activities are non-segregated except that separate or single-user toilet and necessary changing facilities shall be provided to assure privacy between the sexes.
 - o. Document and maintain a record of all solicitations of offers for subcontracts from minority and female construction contractors and suppliers, including circulation of solicitations to minority and female contractor associations and other business associations.
 - p. Conduct a review, at least annually, of all supervisors' adherence to and performance under the Contractor's EEO policies and affirmative action obligations.
8. Contractors are encouraged to participate in voluntary associations which assist in fulfilling one or more of their affirmative action obligations (7a through p). The efforts of a contractor association, joint contractor-union, contractor-community, or other similar group of which the contractor is a member and participant, may be asserted as fulfilling any one or more of its obligations under 7a through p of these Specifications provided that the contractor actively participates in the group, makes every effort to assure that the group has a positive impact on the employment of minorities and women in the industry, ensures that the concrete benefits of the program are reflected in the Contractor's minority and female workforce participation, makes a good faith effort to meet its individual goals and timetables, and can provide access to documentation which demonstrates the effectiveness of actions taken on behalf of the Contractor. The obligation to comply, however, is the Contractor's and failure of such a group to fulfill an obligation shall not be a defense for the Contractor's noncompliance.
9. A single goal for minorities and a separate single goal for women have been established. The Contractor, however, is required to provide equal employment opportunity and to take affirmative action for all minority groups, both male and female, and all women, both minority and non-minority. Consequently, the Contractor may be in violation of the Executive Order if a particular group is employed in a substantially disparate manner (for example, even though the Contractor has achieved its goals for women generally, the Contractor may be in violation of the Executive Order if a specific minority group of women is underutilized).
10. The Contractor shall not use the goals and timetables or affirmative action standards to discriminate against any person because of race, color, religion, sex, or national origin.
11. The Contractor shall not enter into any Subcontract with any person or firm debarred from Government contracts pursuant to Executive Order 11246.
12. The Contractor shall carry out such sanctions and penalties for violation of these specifications and of the Equal Opportunity Clause, including suspension, termination

and cancellation of existing subcontracts as may be imposed or ordered pursuant to Executive Order 11246, as amended, and its implementing regulations, by the Office of Federal Contract Compliance Programs. Any Contractor who fails to carry out such sanctions and penalties shall be in violation of these specifications and Executive Order 11246, as amended.

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

Reporting Requirements (EEO-1)

On or before September 30 of each year, a contractor that is subject to Title VII of the Civil Rights Act of 1964, as amended, and that has 100 or more employees, shall file with the EEOC or its delegate an "Employer Information Report EEO-1". Instructions on how to file are available on the EEOC's website at <http://www.eeoc.gov/employers/eo1survey/howtofile.cfm>. The contractor shall retain a copy of the most recent report filed.

Segregated Facilities (41 CFR part 60-1.8)

The contractor shall ensure that facilities provided for employees are provided in such a manner that segregation on the basis of race, color, religion, sex or national origin cannot result. The contractor may neither require such segregated use by written or oral policies nor tolerate such use by employee custom. The contractor's obligation extends further to ensuring that its employees are not assigned to perform their services at any location, under the contractor's control, where the facilities are segregated. This obligation extends to all contracts containing the equal opportunity clause regardless of the amount of the contract. The term "facilities," as used in this section, means waiting rooms, work areas, restaurants and other eating areas, time clocks, restrooms, wash rooms, locker rooms, and other storage or dressing areas, parking lots, drinking fountains, recreation or entertainment areas, transportation, and housing provided for employees;

Provided, That separate or single-user restrooms and necessary dressing or sleeping areas shall be provided to assure privacy between the sexes.

Attachments:

1. Wage Rate Requirements For Subrecipients
2. Current Wage Rate Determination (to be provided by project owner)
3. Certification Of Non-segregated Facilities
4. Notice To Labor Unions Or Other Organization Of Workers: Non-Discrimination In Employment

EPA Form 6100-4, EPA Form 6100.3, EPA Form 6100-2

ATTACHMENT 1 - WAGE RATE REQUIREMENTS FOR SUBRECIPIENTS. (To be included in full in any contract in excess of \$2,000)

The following terms and conditions specify how recipients will assist EPA in meeting its Davis-Bacon (DB) responsibilities when DB applies to EPA awards of financial assistance under the FY 2013 Continuing Resolution with respect to State recipients and subrecipients that are governmental entities. If a subrecipient has questions regarding when DB applies, obtaining the correct DB wage determinations, DB provisions, or compliance monitoring, it may contact the State recipient. If a State recipient needs guidance, the recipient may contact Lorraine Fleury at fleury.lorraine@epa.gov or at 215-814-2341 of EPA, Region III Grants and Audit Management Branch for guidance. The recipient or subrecipient may also obtain additional guidance from DOL's web site at <http://www.dol.gov/whd/>

1. Applicability of the Davis- Bacon (DB) prevailing wage requirements.

Under the FY 2013 Appropriations Act, DB prevailing wage requirements apply to the construction, alteration, and repair of treatment works carried out in whole or in part with assistance made available by a State water pollution control revolving fund and to any construction project carried out in whole or in part by assistance made available by a drinking water treatment revolving loan fund. If a subrecipient encounters a unique situation at a site that presents uncertainties regarding DB applicability, the subrecipient must discuss the situation with the recipient State before authorizing work on that site.

2. Obtaining Wage Determinations.

(a) Subrecipients shall obtain the wage determination for the locality in which a covered activity subject to DB will take place prior to issuing requests for bids, proposals, quotes or other methods for soliciting contracts (solicitation) for activities subject to DB. These wage determinations shall be incorporated into solicitations and any subsequent contracts. Prime contracts must contain a provision requiring that subcontractors follow the wage determination incorporated into the prime contract.

(i) While the solicitation remains open, the subrecipient shall monitor www.wdol.gov weekly to ensure that the wage determination contained in the solicitation remains current. The subrecipients shall amend the solicitation if DOL issues a modification more than 10 days prior to the closing date (i.e. bid opening) for the solicitation. If DOL modifies or supersedes the applicable wage determination less than 10 days prior to the closing date, the subrecipients may request a finding from the State recipient that there is not a reasonable time to notify interested contractors of the modification of the wage determination. The State recipient will provide a report of its findings to the subrecipient.

(ii) If the subrecipient does not award the contract within 90 days of the closure of the solicitation, any modifications or supersedes DOL makes to the wage determination contained in the solicitation shall be effective unless the State recipient, at the request of the subrecipient, obtains an extension of the 90 day period from DOL pursuant to 29 CFR 1.6(c)(3)(iv). The subrecipient shall monitor www.wdol.gov on a weekly basis if it does not award the contract within 90 days of closure of the solicitation to ensure that wage determinations contained in the solicitation remain current.

(b) If the subrecipient carries out activity subject to DB by issuing a task order, work assignment or similar instrument to an existing contractor (ordering instrument) rather than by publishing a solicitation, the subrecipient shall insert the appropriate DOL wage determination from www.wdol.gov into the ordering instrument.

(c) Subrecipients shall review all subcontracts subject to DB entered into by prime contractors to verify that the prime contractor has required its subcontractors to include the applicable wage determinations.

(d) As provided in 29 CFR 1.6(f), DOL may issue a revised wage determination applicable to a subrecipient's contract after the award of a contract or the issuance of an ordering instrument if DOL determines that the subrecipient has failed to incorporate a wage determination or has used a wage determination that clearly does not apply to the contract or ordering instrument. If this occurs, the subrecipient shall either terminate the contract or ordering instrument and issue a revised solicitation or ordering instrument or incorporate DOL's wage determination retroactive to the beginning of the contract or ordering instrument by change order. The subrecipient's contractor must be compensated for any increases in wages resulting from the use of DOL's revised wage determination.

3. Contract and Subcontract provisions.

(a) The Recipient shall insure that the subrecipient(s) shall insert in full in any contract in excess of \$2,000 which is entered into for the actual construction, alteration and/or repair, including painting and decorating, of a treatment work under the CWSRF or a construction project under the DWSRF financed in whole or in part from Federal funds or in accordance with guarantees of a Federal agency or financed from funds obtained by pledge of any contract of a Federal agency to make a loan, grant or annual contribution (except where a different meaning is expressly indicated), and which is subject to the labor standards provisions of any of the acts listed in § 5.1 or the FY 2012 Appropriations Act , the following clauses:

(1) Minimum wages.

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

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

Subrecipients may obtain wage determinations from the U.S. Department of Labor's web site, www.wdol.gov.

(ii)(A) The subrecipient(s), on behalf of EPA, shall require that any class of laborers or mechanics, including helpers, which is not listed in the wage determination and which is to be employed under the contract shall be classified in conformance with the wage determination. The State award official shall approve a request for an additional classification and wage rate and fringe benefits therefore only when the following criteria have been met:

(1) The work to be performed by the classification requested is not performed by a classification in the wage determination; and

(2) The classification is utilized in the area by the construction industry; and

(3) The proposed wage rate, including any bona fide fringe benefits, bears a reasonable relationship to the wage rates contained in the wage determination.

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

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

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

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

(iv) If the contractor does not make payments to a trustee or other third person, the contractor may consider as part of the wages of any laborer or mechanic the amount of any costs reasonably

anticipated in providing bona fide fringe benefits under a plan or program, Provided, That the Secretary of Labor has found, upon the written request of the contractor, that the applicable standards of the Davis-Bacon Act have been met. The Secretary of Labor may require the contractor to set aside in a separate account assets for the meeting of obligations under the plan or program.

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

(3) Payrolls and basic records.

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

(ii)(A) The contractor shall submit weekly, for each week in which any contract work is performed, a copy of all payrolls to the subrecipient, that is, the entity that receives the sub-grant or loan from the State capitalization grant recipient. Such documentation shall be available on request of the State recipient or EPA. As to each payroll copy received, the subrecipient shall provide written confirmation in a form satisfactory to the State indicating whether or not the project is in compliance with the requirements of 29 CFR 5.5(a)(1) based on the most recent payroll copies for the specified week. The payrolls shall set out accurately and completely all of the information required to be maintained under 29 CFR 5.5(a)(3)(i), except that full social security numbers and home addresses shall not be included on the weekly payrolls. Instead the payrolls shall only need to include an individually identifying number for each employee (e.g., the last four digits of the employee's social security number). The required weekly payroll information may be submitted in any form desired. Optional

Form WH-347 is available for this purpose from the Wage and Hour Division Web site at <http://www.dol.gov/whd/programs/dbra/wh347.htm> or its successor site. The prime contractor is responsible for the submission of copies of payrolls by all subcontractors. Contractors and subcontractors shall maintain the full social security number and current address of each covered worker, and shall provide them upon request to the subrecipient(s) for transmission to the State or EPA if requested by EPA, the State, the contractor, or the Wage and Hour Division of the Department of Labor for purposes of an investigation or audit of compliance with prevailing wage requirements. It is not a violation of this section for a prime contractor to require a subcontractor to provide addresses and social security numbers to the prime contractor for its own records, without weekly submission to the subrecipient(s).

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

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

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

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

(C) The weekly submission of a properly executed certification set forth on the reverse side of Optional Form WH-347 shall satisfy the requirement for submission of the “Statement of Compliance” required by paragraph (a)(3)(ii)(B) of this section.

(D) The falsification of any of the above certifications may subject the contractor or subcontractor to civil or criminal prosecution under section 1001 of title 18 and section 231 of title 31 of the United States Code.

(iii) The contractor or subcontractor shall make the records required under paragraph (a)(3)(i) of this section available for inspection, copying, or transcription by authorized representatives of the State, EPA or the Department of Labor, and shall permit such representatives to interview employees during working hours on the job. If the contractor or subcontractor fails to submit the required records or to make them available, the Federal agency or State may, after written notice to the contractor, sponsor, applicant, or owner, take such action as may be necessary to cause the suspension of any further payment, advance, or guarantee of funds. Furthermore, failure to submit the required records upon request or to make such records available may be grounds for debarment action pursuant to 29 CFR 5.12.

(4) Apprentices and trainees--

(i) Apprentices. Apprentices will be permitted to work at less than the predetermined rate for the work they performed when they are employed pursuant to and individually registered in a bona fide apprenticeship program registered with the U.S. Department of Labor, Employment and Training Administration, Office of Apprenticeship Training, Employer and Labor Services, or with a State Apprenticeship Agency recognized by the Office, or if a person is employed in his or her first 90 days of probationary employment as an apprentice in such an apprenticeship program, who is not individually registered in the program, but who has been certified by the Office of Apprenticeship Training, Employer and Labor Services or a State Apprenticeship Agency (where appropriate) to be eligible for probationary employment as an apprentice. The allowable ratio of apprentices to journeymen on the job site in any craft classification shall not be greater than the ratio permitted to the contractor as to the entire work force under the registered program. Any worker listed on a payroll at an apprentice wage rate, who is not registered or otherwise employed as stated above, shall be paid not less than the applicable wage rate on the wage determination for the classification of work actually performed. In addition, any apprentice performing work on the job site in excess of the ratio permitted under the registered program shall be paid not less than the applicable wage rate on the wage determination for the work actually performed. Where a contractor is performing construction on a project in a locality other than that in which its program is registered, the ratios and wage rates (expressed in percentages of the journeyman's hourly rate) specified in the contractor's or subcontractor's registered program shall be observed. Every apprentice must be paid at not less than the rate specified in the registered program for the apprentice's level of progress, expressed as a percentage of the journeymen hourly rate specified in the applicable wage determination. Apprentices shall be paid fringe benefits in accordance with the provisions of the apprenticeship program. If the apprenticeship program does not specify fringe benefits, apprentices must be paid the full amount of fringe benefits listed on the wage determination for the applicable classification. If the Administrator determines that a different practice prevails for the applicable apprentice classification, fringes shall be paid in accordance with that determination. In the event the Office of Apprenticeship Training, Employer and Labor Services, or a State Apprenticeship Agency recognized by the Office, withdraws approval of an apprenticeship program, the contractor will no longer be permitted to utilize apprentices at less than the applicable predetermined rate for the work performed until an acceptable program is approved.

(ii) Trainees. Except as provided in 29 CFR 5.16, trainees will not be permitted to work at less than the predetermined rate for the work performed unless they are employed pursuant to and individually registered in a program which has received prior approval, evidenced by formal certification by the U.S. Department of Labor, Employment and Training Administration. The ratio of trainees to journeymen on the job site shall not be greater than permitted under the plan approved by the Employment and Training Administration. Every trainee must be paid at not less than the rate specified in the approved program for the trainee's level of progress, expressed as a percentage of the journeyman hourly rate specified in the applicable wage determination. Trainees shall be paid fringe benefits in accordance with the provisions of the trainee program. If the trainee program does not mention fringe benefits, trainees shall be paid the full amount of fringe benefits listed on the wage determination unless the Administrator of the Wage and Hour Division determines that there is an apprenticeship program associated with the corresponding journeyman wage rate on the wage determination which provides for less than full fringe benefits for apprentices. Any employee listed on the payroll at a trainee rate who is not registered and participating in a training plan approved by the Employment and Training Administration shall be paid not less than the applicable wage rate on the wage determination for the classification of work actually performed. In addition, any trainee performing work on the job site in excess of the

ratio permitted under the registered program shall be paid not less than the applicable wage rate on the wage determination for the work actually performed. In the event the Employment and Training Administration withdraws approval of a training program, the contractor will no longer be permitted to utilize trainees at less than the applicable predetermined rate for the work performed until an acceptable program is approved.

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

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

(6) Subcontracts. The contractor or subcontractor shall insert in any subcontracts the clauses contained in 29 CFR 5.5(a)(1) through (10) and such other clauses as the EPA determines may be appropriate, and also a clause requiring the subcontractors to include these clauses in any lower tier subcontracts. The prime contractor shall be responsible for the compliance by any subcontractor or lower tier subcontractor with all the contract clauses in 29 CFR 5.5.

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

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

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

(10) Certification of eligibility.

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

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

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

4. **Contract Provision for Contracts in Excess of \$100,000.**

(a) Contract Work Hours and Safety Standards Act. The subrecipient shall insert the following clauses set forth in paragraphs (a)(1), (2), (3), and (4) of this section in full in any contract in an amount in excess of \$100,000 and subject to the overtime provisions of the Contract Work Hours and Safety Standards Act. These clauses shall be inserted in addition to the clauses required by Item 3, above or 29 CFR 4.6. As used in this paragraph, the terms laborers and mechanics include watchmen and guards.

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

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

(3) Withholding for unpaid wages and liquidated damages. The subrecipient, upon written request of the EPA Award Official or an authorized representative of the Department of Labor, shall withhold or cause to be withheld, from any moneys payable on account of work performed by the contractor or subcontractor under any such contract or any other Federal contract with the same prime contractor, or any other federally-assisted contract subject to the Contract Work Hours and Safety Standards Act, which is held by the same prime contractor, such sums as may be determined to be necessary to satisfy any liabilities of such contractor or subcontractor for unpaid wages and liquidated damages as provided in the clause set forth in paragraph (b)(2) of this section.

(4) Subcontracts. The contractor or subcontractor shall insert in any subcontracts the clauses set forth in paragraph (a)(1) through (4) of this section and also a clause requiring the subcontractors to include these clauses in any lower tier subcontracts. The prime contractor shall be responsible for compliance by any subcontractor or lower tier subcontractor with the clauses set forth in paragraphs (a)(1) through (4) of this section.

(b) In addition to the clauses contained in Item 3, above, in any contract subject only to the Contract Work Hours and Safety Standards Act and not to any of the other statutes cited in 29 CFR 5.1, the Subrecipient shall insert a clause requiring that the contractor or subcontractor shall maintain payrolls and basic payroll records during the course of the work and shall preserve them for a period of three years from the completion of the contract for all laborers and mechanics, including guards and watchmen, working on the contract. Such records shall contain the name and address of each such employee, social security number, correct classifications, hourly rates of wages paid, daily and weekly number of hours worked, deductions made, and actual wages paid. Further, the Subrecipient shall insert in any such contract a clause providing that the records to be maintained under this paragraph shall be made available by the contractor or subcontractor for inspection, copying, or transcription by authorized representatives

of the (write the name of agency) and the Department of Labor, and the contractor or subcontractor will permit such representatives to interview employees during working hours on the job.

5. Compliance Verification

(a) The subrecipient shall periodically interview a sufficient number of employees entitled to DB prevailing wages (covered employees) to verify that contractors or subcontractors are paying the appropriate wage rates. As provided in 29 CFR 5.6(a)(6), all interviews must be conducted in confidence. The subrecipient must use Standard Form 1445 (SF 1445) or equivalent documentation to memorialize the interviews. Copies of the SF 1445 are available from EPA on request.

(b) The subrecipient shall establish and follow an interview schedule based on its assessment of the risks of noncompliance with DB posed by contractors or subcontractors and the duration of the contract or subcontract. Subrecipients must conduct more frequent interviews if the initial interviews or other information indicates that there is a risk that the contractor or subcontractor is not complying with DB. Subrecipients shall immediately conduct necessary interviews in response to an alleged violation of the prevailing wage requirements. All interviews shall be conducted in confidence.

(c) The subrecipient shall periodically conduct spot checks of a representative sample of weekly payroll data to verify that contractors or subcontractors are paying the appropriate wage rates. The subrecipient shall establish and follow a spot check schedule based on its assessment of the risks of noncompliance with DB posed by contractors or subcontractors and the duration of the contract or subcontract. At a minimum, if practicable, the subrecipient should spot check payroll data within two weeks of each contractor or subcontractor's submission of its initial payroll data and two weeks prior to the completion date the contract or subcontract. Subrecipients must conduct more frequent spot checks if the initial spot check or other information indicates that there is a risk that the contractor or subcontractor is not complying with DB. In addition, during the examinations the subrecipient shall verify evidence of fringe benefit plans and payments thereunder by contractors and subcontractors who claim credit for fringe benefit contributions.

(d) The subrecipient shall periodically review contractors and subcontractors use of apprentices and trainees to verify registration and certification with respect to apprenticeship and training programs approved by either the U.S Department of Labor or a state, as appropriate, and that contractors and subcontractors are not using disproportionate numbers of, laborers, trainees and apprentices. These reviews shall be conducted in accordance with the schedules for spot checks and interviews described in Item 5(b) and (c) above.

(e) Subrecipients must immediately report potential violations of the DB prevailing wage requirements to the EPA DB contact listed above and to the appropriate DOL Wage and Hour District Office listed at <http://www.dol.gov/whd/america2.htm>.

ATTACHMENT 2

DAVIS-BACON WAGE RATE DETERMINATION

[SRF Assistance Recipient to insert applicable wage determinations here]

How to obtain a Wage Determination:

1. www.wdol.gov
2. Click “Selecting DBA WDs”
3. Select the State and county where the work will be performed
4. Select the “Construction Type”: Heavy, Building, Highway, or Residential
5. Click on one of the wage determinations. Verify that the wage determination displayed is the correct wage determination, and not for “Heavy Dredging”.
6. Select the text box displaying the Wage Determination and copy the text of the Wage Determination.
7. Click “Sign Up for Alert Service” to receive notification if the Wage Determination is updated.

When to update the wage determination:

1. If DOL updates the Wage Determination, you must update the Wage Determination through an addendum to the bid specifications.
2. If the update occurs less than 10 days prior to the date of bid opening, you are not required to update the Wage Determination.

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ATTACHMENT 3

CERTIFICATION OF NONSEGREGATED FACILITIES

(Applicable to federally assisted construction contracts and related subcontracts exceeding \$10,000 which are not exempt from the Equal Opportunity clause.)

The federally assisted construction contractor certifies that he does not maintain or provide for his employees any segregated facilities at any of his establishments, and that he does not permit his employees to perform their services at any location, under his control, where segregated facilities are maintained. The federally assisted construction contractor certified, further that he will not maintain or provide for his employees any segregated facilities at any of his establishments, and that he will not permit his employees to perform their services at any location, under his control, where segregated facilities are maintained. The federally assisted construction contractor agrees that a breach of this certification is a violation of the Equal Opportunity clause in this contract.

As used in this certification, the term "segregated facilities" means any waiting rooms, work area, rest rooms and wash rooms, restaurants and other eating areas, time clocks, locker rooms and other storage or dressing areas, parking lots, drinking fountains, recreation or entertainment areas, transportation, and housing facilities provided for employees which are segregated by explicit directive or area, in fact, segregated on the basis of race, creed, color, or national origin, because of habit, local custom, or otherwise. The federally assisted construction contractor agrees that (except where he has obtained identical certifications from proposed contractors for specific time periods) he will obtain identical certifications from proposed subcontractors prior to the award of subcontracts exceeding \$10,000 which are not exempt from the provisions of the Equal Opportunity clause, and that he will retain such, certification in this file.

Signature _____ Date _____

Name and title of signer (please type)

[THIS FORM SHALL BE COMPLETED IN FULL AND SUBMITTED WITH THE BID PROPOSAL]

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ATTACHMENT 4

NOTICE TO LABOR UNIONS OR OTHER ORGANIZATION OF WORKERS: NON-DISCRIMINATION IN EMPLOYMENT

TO: _____
(name of union or organization of worker)

The undersigned currently holds contract(s) with _____
(name of applicant)
_____ involving funds or credit of the U.S. Government or (a)
subcontract(s) with a prime contractor holding such contract(s).

You are advised that under the provisions of the above contract(s) or subcontract(s) and in accordance with Section 202 of Executive Order 11246 dated September 24, 1965, the undersigned is obliged not to discriminate against any employee or applicant for employment because of race, color, creed, or national origin. This obligation not to discriminate in employment includes, but is not limited to, the following:

EMPLOYMENT, UPGRADING, TRANSFER OR DEMOTION

RECRUITMENT AND ADVERTISING

RATES OF PAY OR OTHER FORMS OF COMPENSATION

SELECTION FOR TRAINING INCLUDING APPRENTICESHIP, LAYOFF OR TERMINATION

This notice is furnished you pursuant to the provisions of the above contract(s) or subcontract(s) and Executive Order 11246.

Copies of this notice will be posted by the undersigned in conspicuous places available to employees or applicants for employment.

(contractor or subcontractor(s))

(Date)

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**Disadvantaged Business Enterprise (DBE) Program
DBE Subcontractor Participation Form**

An EPA Financial Assistance Agreement Recipient must require its prime contractors to provide this form to its DBE subcontractors. This form gives a DBE¹ subcontractor² the opportunity to describe work received and/or report any concerns regarding the EPA-funded project (e.g., in areas such as termination by prime contractor, late payments, etc.). The DBE subcontractor can, as an option, complete and submit this form to the EPA DBE Coordinator at any time during the project period of performance.

Subcontractor Name Click here to enter text.		Project Name Click here to enter text.	
Bid/ Proposal No. Click here to enter text.	Assistance Agreement ID No. (if known) Click here to enter text.	Point of Contact Click here to enter text.	
Address Click here to enter text.			
Telephone No. Click here to enter text.		Email Address Click here to enter text.	
Prime Contractor Name Click here to enter text.		Issuing/Funding Entity Department of Ecology	

Contract Item Number	Description of Work Received from the Prime Contractor Involving Construction, Services, Equipment, or Supplies	Amount Received by Prime Contractor
Click here to enter text.	Click here to enter text.	Click here to enter text.

¹ A DBE is a Disadvantaged, Minority, or Woman Business Enterprise that has been certified by an entity from which EPA accepts certifications as described in 40 CFR 33.204-33.205 or certified by EPA. EPA accepts certifications from entities that meet or exceed EPA certification standards as described in 40 CFR 33.202.

² Subcontractor is defined as a company, firm, joint venture, or individual who enters into an agreement with a contractor to provide services pursuant to an EPA award of financial assistance.



**Disadvantaged Business Enterprise (DBE) Program
DBE Subcontractor Participation Form**

Please use the space below to report any concerns regarding the above EPA-funded project:

[Click here to enter text.](#)

Subcontractor Signature	Print Name
Title	Date
Click here to enter text.	Click here to enter text.



**Disadvantaged Business Enterprise (DBE) Program
DBE Subcontractor Performance Form**

This form is intended to capture the DBE¹ subcontractor's² description of work to be performed and the price of the work submitted to the prime contractor. An EPA Financial Assistance Agreement Recipient must require its prime contractor to have its DBE subcontractors complete this form and include all completed forms in the prime contractors bid or proposal package.

Subcontractor Name Click here to enter text.		Project Name Click here to enter text.	
Bid/ Proposal No. Click here to enter text.	Assistance Agreement ID No. (if known) Click here to enter text.	Point of Contact Click here to enter text.	
Address Click here to enter text.			
Telephone No. Click here to enter text.		Email Address Click here to enter text.	
Prime Contractor Name Click here to enter text.		Issuing/Funding Entity Department of Ecology	

Contract Item Number	Description of Work Submitted to the Prime Contractor Involving Construction, Services, Equipment, or Supplies	Price of Work Submitted to the Prime Contractor
Click here to enter text.	Click here to enter text.	Click here to enter text.
DBE Certified By: <input type="checkbox"/> DOT <input type="checkbox"/> SBA <input type="checkbox"/> Other: Click here to enter text.		Meets/ exceeds EPA certification standards? <input type="checkbox"/> YES <input type="checkbox"/> NO <input type="checkbox"/> Unknown

¹ A DBE is a Disadvantaged, Minority, or Woman Business Enterprise that has been certified by an entity from which EPA accepts certifications as described in 40 CFR 33.204-33.205 or certified by EPA. EPA accepts certifications from entities that meet or exceed EPA certification standards as described in 40 CFR 33.202.

² Subcontractor is defined as a company, firm, joint venture, or individual who enters into an agreement with a contractor to provide services pursuant to an EPA award of financial assistance.



**Disadvantaged Business Enterprise (DBE) Program
DBE Subcontractor Performance Form**

I certify under penalty of perjury that the forgoing statements are true and correct. Signing this form does not signify a commitment to utilize the subcontractors above. I am aware of that in the event of a replacement of a subcontractor, I will adhere to the replacement requirements set forth in 40 CFR Part 33 Section 33.302 (c).

Prime Contractor Signature	Print Name
Title	Date
Click here to enter text.	Click here to enter text.

Subcontractor Signature	Print Name
Title	Date
Click here to enter text.	Click here to enter text.



**Disadvantaged Business Enterprise (DBE) Program
DBE Subcontractor Utilization Form**

This form is intended to capture the prime contractor's actual and/or anticipated use of identified certified DBE¹ subcontractors² and the estimated dollar amount of each subcontract. An EPA Financial Assistance Agreement Recipient must require its prime contractors to complete this form and include it in the bid or proposal package. Prime contractors should also maintain a copy of this form on file.

Prime Contractor Name Click here to enter text.		Project Name Click here to enter text.	
Bid/ Proposal No. Click here to enter text.	Assistance Agreement ID No. (if known) Click here to enter text.	Point of Contact Click here to enter text.	
Address Click here to enter text.			
Telephone No. Click here to enter text.		Email Address Click here to enter text.	
Issuing/Funding Entity Department of Ecology			

I have identified potential DBE certified subcontractors <input type="checkbox"/> YES <input type="checkbox"/> NO			
If yes, please complete the table below. If no, please explain: Click here to enter text.			
Subcontractor Name/ Company Name	Company Address/ Phone/ Email	Estimated Dollar Amount	Currently DBE Certified?
Click here to enter text.	Click here to enter text.	Click here to enter text.	Click here to enter text.
Click here to enter text.	Click here to enter text.	Click here to enter text.	Click here to enter text.
Click here to enter text.	Click here to enter text.	Click here to enter text.	Click here to enter text.

Add more lines if needed

¹ A DBE is a Disadvantaged, Minority, or Woman Business Enterprise that has been certified by an entity from which EPA accepts certifications as described in 40 CFR 33.204-33.205 or certified by EPA. EPA accepts certifications from entities that meet or exceed EPA certification standards as described in 40 CFR 33.202.

² Subcontractor is defined as a company, firm, joint venture, or individual who enters into an agreement with a contractor to provide services pursuant to an EPA award of financial assistance.



**Disadvantaged Business Enterprise (DBE) Program
DBE Subcontractor Utilization Form**

I certify under penalty of perjury that the forgoing statements are true and correct. Signing this form does not signify a commitment to utilize the subcontractors above. I am aware of that in the event of a replacement of a subcontractor, I will adhere to the replacement requirements set forth in 40 CFR Part 33 Section 33.302 (c).

Prime Contractor Signature	Print Name
Title	Date
Click here to enter text.	Click here to enter text.



This form must be submitted with the Bid Proposal or as a Supplement to the Bid no later than 24 hours after the time for delivery of the Bid Proposal, as provided for in Section 1-02.9 of the Contract Provisions.

Certification of Compliance with Wage Payment Statutes

The bidder hereby certifies that, within the three-year period immediately preceding the bid solicitation date November 10, 2021 the bidder is not a “willful” violator, as defined in RCW 49.48.082, of any provision of chapters 49.46, 49.48, or 49.52 RCW, as determined by a final and binding citation and notice of assessment issued by the Department of Labor and Industries or through a civil judgment entered by a court of limited or general jurisdiction.

I certify under penalty of perjury under the laws of the State of Washington that the foregoing is true and correct.

Bidder’s Business Name

Signature of Authorized Official*

Printed Name

Title

Date

City

State

Check One:

Sole Proprietorship Partnership Joint Venture Corporation

State of Incorporation, or if not a corporation, State where business entity was formed:

If a co-partnership, give firm name under which business is transacted:

** If a corporation, proposal must be executed in the corporate name by the president or vice-president (or any other corporate officer accompanied by evidence of authority to sign). If a co-partnership, proposal must be executed by a partner*

CONTRACT FORMS

BID BOND

KNOW ALL MEN BY THESE PRESENTS, that we, the undersigned,
_____ as Principal, and _____

as Surety, are hereby held and firmly bound unto the City of Wenatchee as OWNER in the penal sum of _____ dollars for the payment of which, well and truly to be made, we hereby jointly and severally bind ourselves, successors and assigns.

Signed, this _____ day of _____, 2021.

The conditions of the above obligation is such that whereas the Principal has submitted to the City of Wenatchee a certain BID, attached hereto and hereby made a part hereof to enter into a Contract in writing, for the

**CITY OF WENATCHEE WWTP DIGESTER #4
PROJECT #1810**

NOW THEREFORE,

- a) If said BID shall be rejected, or
- b) If said BID shall be accepted and the principal shall execute and deliver a contract in the Form of Contract attached hereto (properly completed in accordance with said BID) and shall furnish a BOND for his faithful performance of said contract, and for the payment of all persons performing work or furnishing materials in connection therewith, and shall in all other respects perform the agreement created by the acceptance of said BID, then this obligation shall be void, otherwise the same shall remain in force and effect; it being expressly understood and agreed that the liability of the Surety for any and all claims hereunder shall, in no event, exceed the penal amount of this obligation as herein stated.

The Surety, for value received, hereby stipulates and agrees that the obligations of said Surety and its BOND shall be in no way impaired or affected by any extensions of the time within which the OWNER may accept such BID; and said Surety does hereby waive notice of any such extension.

IN WITNESS WHEREOF, the Principal and the Surety have hereunto set their hands and seals, and such of them as are corporations have caused their corporate seals to be hereto affixed and these presents to be signed by their proper officers, the day and year first set forth above.

Principal

Surety

BY: _____

IMPORTANT: Surety companies executing BONDS must appear on the Treasury Department's most current list (Circular 570 as amended) and be authorized to transact business in the State of Washington.

C O N T R A C T

THIS AGREEMENT, made and entered into this ____ day of _____, 2022, between the CITY OF WENATCHEE, a Municipal Corporation of the State of Washington, and _____, hereinafter called the Contractor;

WITNESSETH:

That in consideration of the payments, covenants, and agreements hereinafter mentioned and attached and made a part of this agreement to be made and performed by the parties hereto, the parties hereto covenant and agree as follows:

1. The Contractor shall do all Work and furnish all tools, materials, and equipment for City of Wenatchee Project 1810 – CITY OF WENATCHEE DIGESTER #4, in the amount of (\$ _____) (including applicable sales tax) in accordance with and as described in the attached Plans and Specifications and in full compliance with the terms, conditions, and stipulations herein set forth and attached, now referred to and by such reference incorporated herein and made a part hereof as fully for all purposes as if set forth at length, and shall perform any alterations in, or additions to, the Work covered by this Contract and every part thereof and any force account Work which may be ordered as provided in this Contract and every part thereof.

The Contractor shall provide and be at the expense of all materials, labor, carriage, tools, implements and conveniences, and things of every description that may be requisite for the transfer of materials and for constructing and completing the Work provided for in this Contract and every part thereof, except such as mentioned in the Specifications to be furnished by the City of Wenatchee.

2. The City of Wenatchee hereby promises and agrees with the Contractor to employ, and does employ the Contractor to provide the materials and to do and cause to be done the above described work and to complete and finish the same according to the attached Plans and Specifications and the terms and conditions herein contained, and hereby contracts to pay for the same according to the attached Specifications and the Schedule of unit or itemized prices hereto attached, at the time and in the manner and upon the conditions provided for in this Contract and every part thereof. The City further agrees to employ the Contractor to perform any alterations or additions to the Work covered by this Contract and every part thereof and any force account Work that may be ordered and to pay for the same under the terms of this Contract and the attached Plans and Specifications.
3. The Contractor for himself, and for his heirs, executors, administrators, successors, and assigns, does hereby agree to the full performance of all the covenants herein contained upon the part of the Contractor.
4. It is further provided that no liability shall attach to the City by reason of entering into this Contract, except as expressly provided for herein.

5. Contractor agrees that he shall actively solicit the employment of minority group members. Contractor further agrees that he shall actively solicit Bids for the subcontracting of goods or services from qualified minority businesses. Contractor shall furnish evidence of his compliance with these requirements of minority employment and solicitation. Contractor further agrees to consider the grant of subcontracts to said minority Bidders on the basis of substantially equal Proposals in the light most favorable to said minority businesses. The Contractor shall be required to submit evidence of compliance with this Section as part of the Bid.

IN WITNESS WHEREOF the said parties and each of them have caused these presents to be duly executed by its proper officers and in the proper person or persons, the day and year first above written.

ATTEST:

CITY OF WENATCHEE
A Municipal Corporation

City Clerk

Frank Kuntz, Mayor

Contractor

By _____



CERTIFICATE OF LIABILITY INSURANCE

DATE (MM/DD/YYYY)

THIS CERTIFICATE IS ISSUED AS A MATTER OF INFORMATION ONLY AND CONFERS NO RIGHTS UPON THE CERTIFICATE HOLDER. THIS CERTIFICATE DOES NOT AFFIRMATIVELY OR NEGATIVELY AMEND, EXTEND OR ALTER THE COVERAGE AFFORDED BY THE POLICIES BELOW. THIS CERTIFICATE OF INSURANCE DOES NOT CONSTITUTE A CONTRACT BETWEEN THE ISSUING INSURER(S), AUTHORIZED REPRESENTATIVE OR PRODUCER, AND THE CERTIFICATE HOLDER.

IMPORTANT: If the certificate holder is an ADDITIONAL INSURED, the policy(ies) must be endorsed. If SUBROGATION IS WAIVED, subject to the terms and conditions of the policy, certain policies may require an endorsement. A statement on this certificate does not confer rights to the certificate holder in lieu of such endorsement(s).

PRODUCER	CONTACT NAME:	
	PHONE (A/C No. Ext):	FAX (A/C, No):
	E-MAIL ADDRESS:	
	INSURER(S) AFFORDING COVERAGE	NAIC #
INSURED	INSURER A :	
	INSURER B :	
	INSURER C :	
	INSURER D :	
	INSURER E :	
	INSURER F :	

COVERAGES

CERTIFICATE NUMBER:

REVISION NUMBER:

THIS IS TO CERTIFY THAT THE POLICIES OF INSURANCE LISTED BELOW HAVE BEEN ISSUED TO THE INSURED NAMED ABOVE FOR THE POLICY PERIOD INDICATED. NOTWITHSTANDING ANY REQUIREMENT, TERM OR CONDITION OF ANY CONTRACT OR OTHER DOCUMENT WITH RESPECT TO WHICH THIS CERTIFICATE MAY BE ISSUED OR MAY PERTAIN, THE INSURANCE AFFORDED BY THE POLICIES DESCRIBED HEREIN IS SUBJECT TO ALL THE TERMS, EXCLUSIONS AND CONDITIONS OF SUCH POLICIES. LIMITS SHOWN MAY HAVE BEEN REDUCED BY PAID CLAIMS.

INSR LTR	TYPE OF INSURANCE	ADDL INSR	SUBR WVD	POLICY NUMBER	POLICY EFF (MM/DD/YYYY)	POLICY EXP (MM/DD/YYYY)	LIMITS
	GENERAL LIABILITY						EACH OCCURRENCE \$
	<input type="checkbox"/> COMMERCIAL GENERAL LIABILITY						DAMAGE TO RENTED PREMISES (Ea occurrence) \$
	<input type="checkbox"/> CLAIMS-MADE <input type="checkbox"/> OCCUR						MED EXP (Any one person) \$
							PERSONAL & ADV INJURY \$
							GENERAL AGGREGATE \$
	GEN'L AGGREGATE LIMIT APPLIES PER:						PRODUCTS - COMP/OP AGG \$
	<input type="checkbox"/> POLICY <input type="checkbox"/> PRO-JECT <input type="checkbox"/> LOC						\$
	AUTOMOBILE LIABILITY						COMBINED SINGLE LIMIT (Ea accident) \$
	<input type="checkbox"/> ANY AUTO						BODILY INJURY (Per person) \$
	<input type="checkbox"/> ALL OWNED AUTOS						BODILY INJURY (Per accident) \$
	<input type="checkbox"/> HIRED AUTOS						PROPERTY DAMAGE (Per accident) \$
	<input type="checkbox"/> SCHEDULED AUTOS						\$
	<input type="checkbox"/> NON-OWNED AUTOS						
	UMBRELLA LIAB						EACH OCCURRENCE \$
	<input type="checkbox"/> OCCUR						AGGREGATE \$
	EXCESS LIAB						\$
	<input type="checkbox"/> CLAIMS-MADE						
	DED <input type="checkbox"/> RETENTION \$						
	WORKERS COMPENSATION AND EMPLOYERS' LIABILITY						WC STATUTORY LIMITS
	ANY PROPRIETOR/PARTNER/EXECUTIVE OFFICE/MEMBER EXCLUDED? (Mandatory in NH)						OTHER
	If yes, describe under DESCRIPTION OF OPERATIONS below						E.L. EACH ACCIDENT \$
							E.L. DISEASE - EA EMPLOYEE \$
							E.L. DISEASE - POLICY LIMIT \$

DESCRIPTION OF OPERATIONS / LOCATIONS / VEHICLES (Attach ACORD 101, Additional Remarks Schedule, if more space is required)

CERTIFICATE HOLDER**CANCELLATION**

	SHOULD ANY OF THE ABOVE DESCRIBED POLICIES BE CANCELLED BEFORE THE EXPIRATION DATE THEREOF, NOTICE WILL BE DELIVERED IN ACCORDANCE WITH THE POLICY PROVISIONS.
	AUTHORIZED REPRESENTATIVE

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City of Wenatchee
Department of Public Works

Final Contract
Voucher Certificate

Contractor			
Street Address			
City	State	Zip	Date
City Project Number 1810	Ecology Agreement No: WQC-2022-WENATCH-00023		Highway Number
Job Title City of Wenatchee WWTP Digester #4			
Date Work Physically Completed		Final Amount	

Contractor's Certification

I, The undersigned, having first been duly sworn, certify that I am authorized to sign for the claimant; that in connection with the work performed and to the best of my knowledge no loan, gratuity or gift in any form whatsoever has been extended to any employee of the City of Wenatchee nor have I rented or purchased any equipment or materials from any employee of the City of Wenatchee; I further certify that the attached final estimate is a true and correct statement showing all the monies due me from the City of Wenatchee for work performed and materials furnished under this contract; that I have carefully examined said final estimate and understand the same and that I hereby release the City of Wenatchee from any and all claims of whatsoever nature which I may have, arising out of the performance of said contract, which are not set forth in said estimate.

Contractor Authorized Signature Required

Type Signature Name

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

X _____ Notary Public in and for the State of Washington,
residing at _____

City of Wenatchee

City of Wenatchee hereby accepts the completed contract pursuant to Section 1-05.12 of the contract provisions.

Mayor/or Designee

Date of Acceptance

CONTRACT BOND

KNOW ALL MEN BY THESE PRESENTS, That

Of _____, as Principal, and _____ as Surety, are jointly and severally held and bound unto the **City of Wenatchee** in the penal sum of Dollars (\$ _____), for the payment of which we jointly and severally bind ourselves, our heirs, and executors, administrators, and assigns, and successors and assigns, firmly by these presents.

THE CONDITION of this bond is such that whereas, on the _____ day of _____ A.D., 20__, the said _____ Principal, herein, executed a certain contract with the **City of Wenatchee** by the items, conditions and provisions of which contract the said _____ Principal, herein, agree to furnish all materials and do certain Work, to wit: That _____ will undertake and complete the construction of a new, fixed-cover, anaerobic digester with associated mixing, heating, and gas handling elements as well as construction of a new Mechanical Building for the housing of various equipment and storage associated with the project including boiler and heat exchanger, rotary screen thickeners, pumps, piping, electrical and control system improvements, plant water system improvements, HVAC, landscaping, and other Work according to the Plans and Specifications made a part of said Contract, which Contract as so executed, is hereunto attached, is now referred to and by reference is incorporated herein and made a part hereof as fully for all purposes as if here set forth at length. The bond shall cover all approved change orders as if they were in the original Contract.

NOW, THEREFORE, If the Principal herein shall faithfully and truly observe and comply with the terms, conditions and provisions of said Contract in all respects and shall well and truly and fully do and perform all matters and things by undertaken to be performed under said Contract, upon the terms proposed therein, and within the time prescribed therein, and until the same is accepted, and shall pay all laborers, mechanics, Subcontractors and material men, and all persons who shall supply such Contractor or Subcontractor with provisions and supplies for the carrying on of such Work, and shall in all respects faithfully perform said Contract according to law, then this obligation to be void, otherwise to remain in full force and effect.

WITNESS our hands this _____ day of _____, 20__

PRINCIPAL

ATTORNEY-IN-FACT, SURETY

NAME AND ADDRESS LOCAL OFFICE OF AGENT

APPROVED:

CITY

By: _____
APPROVING AUTHORITY

Date: _____, 2021

SURETY BOND NUMBER

CONTRACT NUMBER

SUPPLEMENTAL CONTRACT TERMS

ARTICLE 1—WORK

- 1.01 Contractor shall complete all Work as specified or indicated in the Contract Documents. The Work is generally described as follows:
- Construction of a new, 45-foot diameter, 25-foot tall fixed-cover Digester 4, and associated mixing, heating, and gas handling for the digester.
 - Construction of a new Mechanical Building for the housing of various equipment and storage associated with the project.
 - Associated equipment improvements: new boiler and heat exchanger, new rotary screen thickeners, electrical and control system improvements, relocating/replacing the plant non-potable water system, HVAC improvements for existing solids handling building, and site improvements. Installation and relocation of new and existing instrumentation and controls.

ARTICLE 2—THE PROJECT

- 2.01 The Project refers to the total undertaking to be accomplished for Owner by engineers, contractors, and others, including planning, study design, construction, testing, commissioning and start-up, of which the Work is a part.

ARTICLE 3—ENGINEER

- 3.01 The Owner has retained HDR Engineering, Inc., 835 N Post Street, Suite 101, Spokane, WA 99201 (“Engineer”) to act as Owner’s representative, assume all duties and responsibilities of Engineer, and have the rights and authority assigned to Engineer in the Contract.
- 3.02 The part of the Project that pertains to the Work has been designed by Engineer.

ARTICLE 4—CONTRACT TIMES

- 4.01 *Time is of the Essence*
- A. All time limits for Milestones, if any, Substantial Completion, and completion and readiness for final payment as stated in the Contract Documents are of the essence of the Contract.
- 4.02 *Contract Times: Dates*
- A. The Work will consist of 385 working days. The Work will be substantially complete on or before _____, and completed and ready for final payment in accordance with Paragraph 15.06 of the General Conditions on or before _____.
- 4.03 *Not Used.*
- 4.04 *Not Used.*
- 4.05 *Liquidated Damages*
- A. Contractor and Owner recognize that time is of the essence as stated in Paragraph 4.01 above and that Owner will suffer financial and other losses if the Work

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

1. *Substantial Completion*: Contractor shall pay Owner \$1,750.00 for each calendar day that expires after the time (as duly adjusted pursuant to the Contract) specified above for Substantial Completion, until the Work is substantially complete.
 2. *Completion of Remaining Work*: After Substantial Completion, if Contractor shall neglect, refuse, or fail to complete the remaining Work within the Contract Times (as duly adjusted pursuant to the Contract) for completion and readiness for final payment, Contractor shall pay Owner \$500.00 for each calendar day that expires after such time until the Work is completed and ready for final payment.
 3. Liquidated damages for failing to timely attain Milestones, Substantial Completion, and final completion are not additive, and will not be imposed concurrently.
- B. If Owner recovers liquidated damages for a delay in completion by Contractor, then such liquidated damages are Owner's sole and exclusive remedy for such delay, and Owner is precluded from recovering any other damages, whether actual, direct, excess, or consequential, for such delay, except for special damages (if any) specified in this Agreement.

4.06 Not Used.

4.07 Owner reserves the right to withhold from payments due Contractor under the Contract amounts for liquidated damages (if any), special damages (if any), and performance damages (if any) in accordance with the Contract.

ARTICLE 5—CONTRACT PRICE

5.01 Owner shall pay Contractor for completion of the Work in accordance with the Contract Documents, the amounts shown above, subject to adjustment under the Contract.

ARTICLE 6—PAYMENT PROCEDURES

6.01 *Submittal and Processing of Payments*

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

6.02 *Progress Payments; Retainage*

- A. Owner shall make progress payments on the basis of Contractor's Applications for Payment on or about the fourth Thursday of each month during performance of the Work as provided in Paragraph 6.02.A.1 below, provided that such Applications for Payment have been submitted in a timely manner and otherwise meet the requirements of the Contract. All such payments will be measured by the Schedule of Values established as provided in the General Conditions (and in the case of Unit Price Work based on the number of units completed) or, in the event there is no Schedule of Values, as provided elsewhere in the Contract.

1. Prior to Substantial Completion, progress payments will be made in an amount equal to the percentage indicated below but, in each case, less the aggregate of payments previously made and less such amounts as Owner may withhold, including but not limited to liquidated damages, in accordance with the Contract.
 - a. 95 percent of the value of the Work completed (with the balance being retainage).
 - B. Upon Substantial Completion, Owner shall pay an amount sufficient to increase total payments to Contractor to 95 percent of the Work completed, less such amounts set off by Owner pursuant to Paragraph 15.01.E of the General Conditions, and less 100 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. The Contractor at any time may request the retainage be reduced to 100 percent of the value of the uncompleted Work per RCW 60.28.011(3).
- 6.03 *Final Payment*
- A. Upon final completion and acceptance of the Work, and acceptance of all (prime and subs) Affidavits of Wages Paid paperwork by Labor and Industries, Owner shall pay the remainder of the Contract Price in accordance with Paragraph 15.06 of the General Conditions.
- 6.04 *Consent of Surety*
- A. Owner will not make final payment, or return or release retainage at Substantial Completion or any other time, unless Contractor submits written consent of the surety to such payment, return, or release.
- 6.05 *Interest*
- A. All amounts not paid when due will bear interest at the rate of twelve percent per annum.

ARTICLE 7—CONTRACT DOCUMENTS

7.01 *Contents*

- A. The Contract Documents consist of all of the following:
 1. This Agreement.
 2. Bonds:
 - a. Performance bond (together with power of attorney).
 - b. Payment bond (together with power of attorney).
 3. General Conditions.
 4. Supplementary Conditions.
 5. Wage Determination Schedule.
 6. Statutory and Funding-Financing Entity Requirements.
 7. Specifications as listed in the table of contents of the project manual (copy of list attached).

8. Drawings (not attached but incorporated by reference) consisting of _____ sheets with each sheet bearing the following general title: City of Wenatchee WWTP Digester 4 Project.
9. Drawings listed on the attached sheet index.
10. Addenda (numbers _____ to _____, inclusive).
11. Exhibits to this Agreement (enumerated as follows):
 - a. _____
12. The following which may be delivered or issued on or after the Effective Date of the Contract and are not attached hereto:
 - a. Notice to Proceed.
 - b. Work Change Directives.
 - c. Change Orders.
 - d. Field Orders.
 - e. Warranty Bond, if any.
- B. The Contract Documents listed in Paragraph 7.01.A are attached to this Agreement (except as expressly noted otherwise above).
- C. The Contract Documents may only be amended, modified, or supplemented as provided in the Contract.
- D. In the event of conflicts or discrepancies among the Contract Documents, interpretations will be based on the following priorities:
 - a. Modifications to the Contract Documents
 - b. The Contract
 - c. Addenda
 - d. The Supplementary Conditions
 - e. The General Conditions
 - f. Division 1 of the Specifications
 - g. Divisions 2 – 49 of the Specifications
 - h. Drawings
 - i. Other documents specifically identified in the Contract as part of the Contract Documents.

ARTICLE 8—REPRESENTATIONS, CERTIFICATIONS, AND STIPULATIONS

8.01 Contractor's Representations

- A. In order to induce Owner to enter into this Contract, Contractor makes the following representations:
 1. Contractor has examined and carefully studied the Contract Documents, including Addenda.

2. Contractor is familiar with all Laws and Regulations that may affect cost, progress, and performance of the Work.
4. Contractor has considered the information known to Contractor itself; information commonly known to contractors doing business in the locality of the Site; information and observations obtained from visits to the Site; the Contract Documents; and the Technical Data identified in the Supplementary Conditions or by definition, with respect to the effect of such information, observations, and Technical Data on (a) the cost, progress, and performance of the Work; (b) the means, methods, techniques, sequences, and procedures of construction to be employed by Contractor; and (c) Contractor's safety precautions and programs.
7. Based on the information and observations referred to in the preceding paragraph, Contractor agrees that no further examinations, investigations, explorations, tests, studies, or data are necessary for the performance of the Work at the Contract Price, within the Contract Times, and in accordance with the other terms and conditions of the Contract.
8. Contractor is aware of the general nature of work to be performed by Owner and others at the Site that relates to the Work as indicated in the Contract Documents.
9. Contractor has given Engineer written notice of all conflicts, errors, ambiguities, or discrepancies that Contractor has discovered in the Contract Documents, and of discrepancies between Site conditions and the Contract Documents, and the written resolution thereof by Engineer is acceptable to Contractor.
10. The Contract Documents are generally sufficient to indicate and convey understanding of all terms and conditions for performance and furnishing of the Work.
11. Contractor's entry into this Contract constitutes an incontrovertible representation by Contractor that without exception all prices in the Agreement are premised upon performing and furnishing the Work required by the Contract Documents.
12. The Contractor acknowledges to and for the benefit of the City of Wenatchee, WA ("Purchaser") and the State of Washington (the "State") that it understands the goods and services under this Agreement are being funded with monies made available by the Clean Water State Revolving Fund and/or Drinking Water State Revolving Fund that have statutory requirements commonly known as "American Iron and Steel;" that requires all of the iron and steel products used in the project to be produced in the United States ("American Iron and Steel Requirement") including iron and steel products provided by the Contractor pursuant to this Agreement. The Contractor hereby represents and warrants to and for the benefit of the Purchaser and the State that (a) the Contractor has reviewed and understands the American Iron and Steel Requirement, (b) all of the iron and steel products used in the project will be and/or have been produced in the United States in a manner that complies with the American Iron and Steel Requirement, unless a waiver of the requirement is approved, and (c) the Contractor will provide any further verified information, certification or assurance of compliance with this paragraph, or information necessary to support a waiver of the American Iron and Steel Requirement, as may be requested by the Purchaser or the State. Notwithstanding any other provision of this Agreement, any failure to comply with this paragraph by the Contractor shall permit the Purchaser or State to recover as damages against the Contractor any loss, expense, or cost (including without

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

8.02 Contractor's Certifications

- A. Contractor certifies that it has not engaged in corrupt, fraudulent, collusive, or coercive practices in competing for or in executing the Contract. For the purposes of this Paragraph 8.02:
1. "corrupt practice" means the offering, giving, receiving, or soliciting of anything of value likely to influence the action of a public official in the bidding process or in the Contract execution;
 2. "fraudulent practice" means an intentional misrepresentation of facts made (a) to influence the bidding process or the execution of the Contract to the detriment of Owner, (b) to establish Bid or Contract prices at artificial non-competitive levels, or (c) to deprive Owner of the benefits of free and open competition;
 3. "collusive practice" means a scheme or arrangement between two or more Bidders, with or without the knowledge of Owner, a purpose of which is to establish Bid prices at artificial, non-competitive levels; and
 4. "coercive practice" means harming or threatening to harm, directly or indirectly, persons or their property to influence their participation in the bidding process or affect the execution of the Contract.

8.03 Standard General Conditions

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

STANDARD GENERAL CONDITIONS

OF THE CONSTRUCTION CONTRACT

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STANDARD GENERAL CONDITIONS

OF THE CONSTRUCTION CONTRACT

ARTICLE 1—DEFINITIONS AND TERMINOLOGY

1.01 *Defined Terms*

- A. Wherever used in the Bidding Requirements or Contract Documents, a term printed with initial capital letters, including the term's singular and plural forms, will have the meaning indicated in the definitions below. In addition to terms specifically defined, terms with initial capital letters in the Contract Documents include references to identified articles and paragraphs, and the titles of other documents or forms.
1. *Addenda*—Written or graphic instruments issued prior to the opening of Bids which clarify, correct, or change the Bidding Requirements or the proposed Contract Documents.
 2. *Agreement*—The written instrument, executed by Owner and Contractor, that sets forth the Contract Price and Contract Times, identifies the parties and the Engineer, and designates the specific items that are Contract Documents.
 3. *Application for Payment*—The document prepared by Contractor, in a form acceptable to Engineer, to request progress or final payments, and which is to be accompanied by such supporting documentation as is required by the Contract Documents.
 4. *Bid*—The offer of a Bidder submitted on the prescribed form setting forth the prices for the Work to be performed.
 5. *Bidder*—An individual or entity that submits a Bid to Owner.
 6. *Bidding Documents*—The Bidding Requirements, the proposed Contract Documents, and all Addenda.
 7. *Bidding Requirements*—The Advertisement or invitation to bid, Instructions to Bidders, Bid Bond or other Bid security, if any, the Bid Form, and the Bid with any attachments.
 8. *Change Order*—A document which is signed by Contractor and Owner and authorizes an addition, deletion, or revision in the Work or an adjustment in the Contract Price or the Contract Times, or other revision to the Contract, issued on or after the Effective Date of the Contract.
 9. *Change Proposal*—A written request by Contractor, duly submitted in compliance with the procedural requirements set forth herein, seeking an adjustment in Contract Price or Contract Times; contesting an initial decision by Engineer concerning the requirements of the Contract Documents or the acceptability of Work under the Contract Documents; challenging a set-off against payments due; or seeking other relief with respect to the terms of the Contract.
 10. *Claim*
 - a. A demand or assertion by Owner directly to Contractor, duly submitted in compliance with the procedural requirements set forth herein, seeking an adjustment of Contract Price or Contract Times; contesting an initial decision by Engineer concerning the

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

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

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

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

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

1.02 Terminology

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

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

ARTICLE 2—PRELIMINARY MATTERS

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

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

2.02 *Copies of Documents*

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

2.03 *Before Starting Construction*

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

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

2.04 *Preconstruction Conference; Designation of Authorized Representatives*

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

2.05 *Acceptance of Schedules*

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

2.06 *Electronic Transmittals*

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

ARTICLE 3—CONTRACT DOCUMENTS: INTENT, REQUIREMENTS, REUSE

3.01 *Intent*

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

3.02 *Reference Standards*

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

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

3.03 *Reporting and Resolving Discrepancies*

A. *Reporting Discrepancies*

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

B. *Resolving Discrepancies*

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

3.04 *Requirements of the Contract Documents*

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

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

3.05 *Reuse of Documents*

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

ARTICLE 4—COMMENCEMENT AND PROGRESS OF THE WORK

4.01 *Commencement of Contract Times; Notice to Proceed*

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

4.02 *Starting the Work*

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

4.03 *Reference Points*

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

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

4.04 *Progress Schedule*

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

4.05 *Delays in Contractor's Progress*

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

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

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

5.01 *Availability of Lands*

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

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

5.02 *Use of Site and Other Areas*

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

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

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

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

5.03 *Subsurface and Physical Conditions*

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

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

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

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

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

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

5.04 *Differing Subsurface or Physical Conditions*

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

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

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

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

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

5.05 *Underground Facilities*

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

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

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

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

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

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

5.06 *Hazardous Environmental Conditions at Site*

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

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

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

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

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

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

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

ARTICLE 6—BONDS AND INSURANCE

6.01 *Performance, Payment, and Other Bonds*

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

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

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

6.02 *Insurance—General Provisions*

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

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

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

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

6.03 *Contractor's Insurance*

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

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

6.04 *Builder's Risk and Other Property Insurance*

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

6.05 *Property Losses; Subrogation*

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

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

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

6.06 *Receipt and Application of Property Insurance Proceeds*

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

ARTICLE 7—CONTRACTOR'S RESPONSIBILITIES

7.01 *Contractor's Means and Methods of Construction*

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

7.02 *Supervision and Superintendence*

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

7.03 *Labor; Working Hours*

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

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

7.04 *Services, Materials, and Equipment*

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

7.05 *"Or Equals"*

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

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

7.06 *Substitutes*

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

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

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

7.07 *Concerning Subcontractors and Suppliers*

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

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

7.08 *Patent Fees and Royalties*

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

7.09 *Permits*

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

7.10 *Taxes*

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

7.11 *Laws and Regulations*

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

7.12 *Record Documents*

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

7.13 *Safety and Protection*

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

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

7.14 *Hazard Communication Programs*

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

7.15 *Emergencies*

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

7.16 *Submittals*

A. *Shop Drawing and Sample Requirements*

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

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

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

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

D. Resubmittal Procedures for Shop Drawings and Samples

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

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

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

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

7.17 Contractor's General Warranty and Guarantee

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

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

7.18 *Indemnification*

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

7.19 *Delegation of Professional Design Services*

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

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

ARTICLE 8—OTHER WORK AT THE SITE

8.01 *Other Work*

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

- E. If the proper execution or results of any part of Contractor's Work depends upon work performed by others, Contractor shall inspect such other work and promptly report to Engineer in writing any delays, defects, or deficiencies in such other work that render it unavailable or unsuitable for the proper execution and results of Contractor's Work. Contractor's failure to so report will constitute an acceptance of such other work as fit and proper for integration with Contractor's Work except for latent defects and deficiencies in such other work.
- F. The provisions of this article are not applicable to work that is performed by third-party utilities or other third-party entities without a contract with Owner, or that is performed without having been arranged by Owner. If such work occurs, then any related delay, disruption, or interference incurred by Contractor is governed by the provisions of Paragraph 4.05.C.3.

8.02 *Coordination*

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

8.03 *Legal Relationships*

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

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

ARTICLE 9—OWNER'S RESPONSIBILITIES

9.01 *Communications to Contractor*

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

9.02 *Replacement of Engineer*

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

9.03 *Furnish Data*

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

9.04 *Pay When Due*

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

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

ARTICLE 10—ENGINEER'S STATUS DURING CONSTRUCTION

10.01 *Owner's Representative*

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

10.02 *Visits to Site*

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

10.03 *Resident Project Representative*

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

10.04 *Engineer's Authority*

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

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

10.05 *Determinations for Unit Price Work*

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

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

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

10.07 *Limitations on Engineer's Authority and Responsibilities*

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

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

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

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

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

10.08 *Compliance with Safety Program*

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

ARTICLE 11—CHANGES TO THE CONTRACT

11.01 *Amending and Supplementing the Contract*

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

11.02 *Change Orders*

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

11.03 *Work Change Directives*

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

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

11.04 *Field Orders*

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

11.05 *Owner-Authorized Changes in the Work*

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

11.06 *Unauthorized Changes in the Work*

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

11.07 *Change of Contract Price*

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

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

11.08 *Change of Contract Times*

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

11.09 *Change Proposals*

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

B. *Change Proposal Procedures*

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

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

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

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

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

11.10 *Notification to Surety*

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

ARTICLE 12—CLAIMS

12.01 *Claims*

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

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

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

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

13.01 *Cost of the Work*

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

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

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

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

c. *Construction Equipment Rental*

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

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

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

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

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

D. *Contractor's Fee*

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

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

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

13.02 Allowances

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

13.03 Unit Price Work

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

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

E. *Adjustments in Unit Price*

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

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

14.01 *Access to Work*

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

14.02 *Tests, Inspections, and Approvals*

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

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

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

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

14.03 *Defective Work*

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

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

14.04 *Acceptance of Defective Work*

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

14.05 *Uncovering Work*

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

14.06 *Owner May Stop the Work*

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

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

14.07 *Owner May Correct Defective Work*

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

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

15.01 *Progress Payments*

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

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

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

C. *Review of Applications*

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

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

D. *Payment Becomes Due*

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

E. *Reductions in Payment by Owner*

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

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

15.02 Contractor's Warranty of Title

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

15.03 Substantial Completion

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

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

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

15.04 *Partial Use or Occupancy*

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

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

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

15.05 *Final Inspection*

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

15.06 *Final Payment*

A. *Application for Payment*

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

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

15.07 *Waiver of Claims*

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

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

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

15.08 *Correction Period*

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

- F. Contractor's obligations under this paragraph are in addition to all other obligations and warranties. The provisions of this paragraph are not to be construed as a substitute for, or a waiver of, the provisions of any applicable statute of limitation or repose.

ARTICLE 16—SUSPENSION OF WORK AND TERMINATION

16.01 *Owner May Suspend Work*

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

16.02 *Owner May Terminate for Cause*

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

attorneys, and other professionals) sustained by Owner, such excess will be paid to Contractor. If the cost to complete the Work including such related claims, costs, losses, and damages exceeds such unpaid balance, Contractor shall pay the difference to Owner. Such claims, costs, losses, and damages incurred by Owner will be reviewed by Engineer as to their reasonableness and, when so approved by Engineer, incorporated in a Change Order. When exercising any rights or remedies under this paragraph, Owner shall not be required to obtain the lowest price for the Work performed.

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

16.03 *Owner May Terminate for Convenience*

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

16.04 *Contractor May Stop Work or Terminate*

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

provisions of this paragraph are not intended to preclude Contractor from submitting a Change Proposal for an adjustment in Contract Price or Contract Times or otherwise for expenses or damage directly attributable to Contractor's stopping the Work as permitted by this paragraph.

ARTICLE 17—FINAL RESOLUTION OF DISPUTES

17.01 *Methods and Procedures*

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

ARTICLE 18—MISCELLANEOUS

18.01 *Giving Notice*

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

18.02 *Computation of Times*

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

18.03 *Cumulative Remedies*

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

18.04 *Limitation of Damages*

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

18.05 *No Waiver*

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

18.06 *Survival of Obligations*

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

18.07 *Controlling Law*

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

18.08 *Assignment of Contract*

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

18.09 *Successors and Assigns*

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

18.10 *Headings*

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

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SUPPLEMENTARY CONDITIONS
OF THE CONSTRUCTION CONTRACT

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SUPPLEMENTARY CONDITIONS

OF THE CONSTRUCTION CONTRACT

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

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

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

These Supplementary Conditions may also contain Agreement information following the modifications to the General Conditions.

ARTICLE 1—DEFINITIONS AND TERMINOLOGY

SC-1.01.A.40 Add the following to Paragraph 1.01.A.40:

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

SC-1.01.A.44 Add the following to Paragraph 1.01.A.44:

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

ARTICLE 2—PRELIMINARY MATTERS

2.02 *Copies of Documents*

SC-2.02 Add the following new paragraph immediately after Paragraph 2.02.B:

- C. Conformed documents incorporate and integrate Addenda and amendments negotiated prior to the Effective Date of the Contract. The conformed documents are produced for the convenience of the user and are not binding on the Owner nor do conformed documents take the place of the Contract Documents.

SC-2.07 The following is added after Section 2.06:

Funding

A. It is anticipated that this project will be funded in part by the Washington State Department of Ecology. Neither the State of Washington nor any of its departments or employees are, or shall be, a party to this contract or any subcontract.

ARTICLE 3—CONTRACT DOCUMENTS: INTENT, REQUIREMENTS, REUSE

SC-3.01 Add the following new paragraphs immediately after Paragraph 3.01.E:

- F. The Specifications and other verbal components of the Contract Documents may vary in form, format, and style. Some Specification sections are written in varying degrees of streamlined or declarative style and some Specifications sections may, in comparison, employ a more-narrative style. Omissions of such words and phrases as "Contractor shall," "in conformity with," "as shown," or "as specified" are intentional in streamlined language in the Contract Documents. Omitted words and phrases are incorporated by inference. Similar types of provisions may appear in various parts of a Specifications section or elsewhere in the Contract Documents. Contractor shall not attempt to take advantage of any variation of form, format or style in Change Proposal(s) and Claim(s).
- G. Cross referencing of Specification sections in a Specifications section's heading "Related Sections includes, but are not necessarily limited to:" and elsewhere within each Specifications section is provided as an aid and convenience to Contractor. Contractor shall not rely on cross-referencing indicated and is responsible for coordinating the entire Work and providing a complete Project whether or not cross-referencing is provided in each Specifications section or whether or not cross-referencing is complete.

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
Geotechnical Data Report Wenatchee Digester #4	December 10, 2020	Geotechnical Data Report

Exhibit C—Geotechnical Baseline Report Supplement to the Supplementary Conditions.

EJCDC® C-800, Supplementary Conditions of the Construction Contract.

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Report Title	Date of Report	Technical Data

SC-5.04.A Add the following new paragraph immediately after Paragraph 5.04.A.4:

5. Contractor encounters human remains, recognizes the existence of burial markers, archaeological sites, historical sites, artifacts of potential archaeological or historical interest, or wetlands not shown or indicated in the Contract Documents, Contractor shall immediately cease operations that may disturb such area(s) and secure the adjacent Work; and Owner shall promptly take any action necessary to obtain governmental authorization required to resume the operations (Contractor shall continue to suspend such operations until otherwise instructed by Owner but shall continue with all other operations that do not affect those remains or features);

5.06 *Hazardous Environmental Conditions*

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

4. No reports or drawings related to Hazardous Environmental Conditions at the Site are known to Owner.

ARTICLE 6—BONDS AND INSURANCE

SC-6.02 Insurance – General Provisions

SC-6.02.B Add the following sentence after the last sentence of Paragraph 6-02.B:

Owner insurance will not provide a rating for their insurance. Owner’s insurance is a risk pool – a joint self-insured program.

SC-6.02.E Remove this paragraph in its entirety and replace it with the following:

Owner shall deliver to Contractor, certificates of insurance 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, 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.

SC-6.03 Contractor’s Insurance

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

- D. *Workers’ Compensation and Employer’s Liability:* Contractor shall purchase and maintain workers’ compensation and employer’s liability insurance, including, as applicable, United States Longshoreman and Harbor Workers’ Compensation Act, Jones Act, stop-gap employer’s liability coverage for monopolistic states, and foreign voluntary workers’ compensation (from available sources, notwithstanding the jurisdictional requirement of Paragraph 6.02.B of the General Conditions).

Workers' Compensation and Related Policies	Policy limits of not less than:
Workers' Compensation	
State	Statutory
Applicable Federal (e.g., Longshoreman's)	Statutory
Foreign voluntary workers' compensation (employer's responsibility coverage), if applicable	Statutory
Employer's Liability	
Each accident	\$ 1,000,000
Each employee	\$ 1,000,000
Policy limit	\$ 1,000,000
Stop-gap Liability Coverage	
For work performed in monopolistic states, stop-gap liability coverage must be endorsed to either the worker's compensation or commercial general liability policy with a minimum limit of:	\$ 1,000,000

- F. *Commercial General Liability—Claims Covered:* Contractor shall purchase and maintain commercial general liability insurance, covering all operations by or on behalf of Contractor, on an occurrence basis, against claims for:
1. damages because of bodily injury, sickness or disease, or death of any person other than Contractor's employees,
 2. damages insured by reasonably available personal injury liability coverage, and
 3. damages because of injury to or destruction of tangible property wherever located, including loss of use resulting therefrom.
- G. *Commercial General Liability—Form and Content:* Contractor's commercial liability policy must be written on a 1996 (or later) Insurance Services Organization, Inc. (ISO) commercial general liability form (occurrence form) (ISO 00 01 or equivalent, as acceptable to Owner) and include the following coverages and endorsements:
1. Products and completed operations coverage.
 - a. Such insurance must be maintained for three years after final payment.
 - b. Contractor shall furnish Owner additional insured (as identified in the Supplementary Conditions or elsewhere in the Contract) evidence of continuation of such insurance at final payment and three years thereafter.
 2. Blanket contractual liability coverage, including but not limited to coverage of Contractor's contractual indemnity obligations in Paragraph 7.18.
 3. Severability of interests and no insured-versus-insured or cross-liability exclusions.
 4. Underground, explosion, and collapse coverage.
 5. Personal injury coverage.

6. Additional insured endorsements that include both ongoing operations and products and completed operations coverage through ISO Endorsements CG 20 10 10 01 and CG 20 37 10 01 (together). If Contractor demonstrates to Owner that the specified ISO endorsements are not commercially available, then Contractor may satisfy this requirement by providing equivalent endorsements.
 7. For design professional additional insureds, ISO Endorsement CG 20 32 07 04 “Additional Insured—Engineers, Architects or Surveyors Not Engaged by the Named Insured” or its equivalent.
- H. *Commercial General Liability—Excluded Content:* The commercial general liability insurance policy, including its coverages, endorsements, and incorporated provisions, must not include any of the following:
1. Any modification of the standard definition of “insured contract” (except to delete the railroad protective liability exclusion if Contractor is required to indemnify a railroad or others with respect to Work within 50 feet of railroad property).
 2. Any exclusion for water intrusion or water damage.
 3. Any provisions resulting in the erosion of insurance limits by defense costs other than those already incorporated in ISO form CG 00 01.
 4. Any exclusion of coverage relating to earth subsidence or movement.
 5. Any exclusion for the insured’s vicarious liability, strict liability, or statutory liability (other than worker’s compensation).
 6. Any limitation or exclusion based on the nature of Contractor’s work.
 7. Any professional liability exclusion broader in effect than the most recent edition of ISO form CG 22 79.
- I. *Commercial General Liability—Minimum Policy Limits*

Commercial General Liability	Policy limits of not less than:
General Aggregate	\$ 2,000,000
Products—Completed Operations Aggregate	\$ 2,000,000
Personal and Advertising Injury	\$ 1,000,000
Bodily Injury and Property Damage—Each Occurrence	\$ 1,000,000
Each Occurrence	\$ 1,000,000

- J. *Automobile Liability:* Contractor shall purchase and maintain automobile liability insurance for damages because of bodily injury or death of any person or property damage arising out of the ownership, maintenance, or use of any motor vehicle. The automobile liability policy must be written on an occurrence basis and shall be written on ISO form CA 00 01 or a substitute form (acceptable to Owner) providing equivalent liability coverage.

Automobile Liability	Policy limits of not less than:
Combined Single Limit (bodily injury and property damage) Per Accident	\$1,000,000
Each Accident	\$1,000,000

K. *Not Used.*

Not NNot UsedL. *Not Used.*

M. *Not Used.* N. *Contractor’s Professional Liability Insurance:* If Contractor will provide or furnish professional services under this Contract, through a delegation of professional design services or otherwise, then Contractor shall be responsible for purchasing and maintaining applicable professional liability insurance. This insurance must cover negligent acts, errors, or omissions in the performance of professional design or related services by the insured or others for whom the insured is legally liable. The insurance must be maintained throughout the duration of the Contract and for a minimum of two years after Substantial Completion. The retroactive date on the policy must pre-date the commencement of furnishing services on the Project.

Contractor’s Professional Liability	Policy limits of not less than:
Each Claim	\$ 1,000,000
Annual Aggregate	\$ 1,000,000

P. *Unmanned Aerial Vehicle Liability Insurance:* If Contractor uses unmanned aerial vehicles (UAV—commonly referred to as drones) at the Site or in support of any aspect of the Work, Contractor shall obtain UAV liability insurance in the amounts stated; name Owner, Engineer, and all individuals and entities identified in the Supplementary Conditions as additional insureds; and provide a certificate to Owner confirming Contractor’s compliance with this requirement. Such insurance will provide coverage for property damage, bodily injury or death, and invasion of privacy.

Unmanned Aerial Vehicle Liability Insurance	Policy limits of not less than:
Each Claim	\$ 1,000,000
General Aggregate	\$ 1,000,000

6.04 *Builder's Risk and Other Property Insurance*

SC-6.04 Supplement Paragraph 6.04 with the following provisions:

A. *Builder's Risk Requirements:* The builder's risk insurance must:

1. be written on a builder's risk "all risk" policy form that at a minimum includes insurance for physical loss or damage to the Work, temporary buildings, falsework, and materials and equipment

F. *Builder's Risk Requirements:* The builder's risk insurance must:

1. be written on a builder's risk "all risk" policy form that at a minimum includes insurance for physical loss or damage to the Work, temporary buildings, falsework, and materials and equipment stored and in transit, and must not exclude the coverage of the following risks: fire; windstorm; hail; flood; earthquake, volcanic activity, and other earth movement; lightning; riot; civil commotion; terrorism; vehicle impact; aircraft; smoke; theft; vandalism and malicious mischief; mechanical breakdown, boiler explosion, and artificially generated electric current; collapse; explosion; debris removal; demolition occasioned by enforcement of Laws and Regulations; and water damage (other than that caused by flood).
 - a. Such policy will include an exception that results in coverage for ensuing losses from physical damage or loss with respect to any defective workmanship, methods, design, or materials exclusions.
 - b. If insurance against mechanical breakdown, boiler explosion, and artificially generated electric current; earthquake, volcanic activity, and other earth movement; or flood, are not commercially available under builder's risk policies, by endorsement or otherwise, such insurance will be provided through other insurance policies acceptable to Owner and Contractor.
2. cover, as insured property, at least the following: (a) the Work and all materials, supplies, machinery, apparatus, equipment, fixtures, and other property of a similar nature that are to be incorporated into or used in the preparation, fabrication, construction, erection, or completion of the Work, including Owner-furnished or assigned property; (b) spare parts inventory required within the scope of the Contract; and (c) temporary works which are not intended to form part of the permanent constructed Work but which are intended to provide working access to the Site, or to the Work under construction, or which are intended to provide temporary support for the Work under construction, including scaffolding, form work, fences, shoring, falsework, and temporary structures.
3. cover expenses incurred in the repair or replacement of any insured property (including but not limited to fees and charges of contractors, engineers, and architects).
4. extend to cover damage or loss to insured property while in temporary storage at the Site or in a storage location outside the Site (but not including property stored at the premises of a manufacturer or Supplier). If this coverage is subject to a sublimit, such sublimit will be a minimum of \$225,000.
5. extend to cover damage or loss to insured property while in transit. If this coverage is subject to a sublimit, such sublimit will be a minimum of \$225,000.

Exhibit C—Geotechnical Baseline Report Supplement to the Supplementary Conditions.

EJCDC® C-800, Supplementary Conditions of the Construction Contract.

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6. allow for the waiver of the insurer's subrogation rights, as set forth in this Contract.
 7. allow for partial occupancy or use by Owner by endorsement, and without cancellation or lapse of coverage.
 8. include performance/hot testing and start-up, if applicable.
 9. be maintained in effect until the Work is complete, as set forth in Paragraph 15.06.D of the General Conditions, or until written confirmation of Owner's procurement of property insurance following Substantial Completion, whichever occurs first.
 10. include as named insureds the Owner, Contractor, Subcontractors (of every tier), and any other individuals or entities required by this Contract to be insured under such builder's risk policy. For purposes of Paragraphs 6.04, 6.05, and 6.06 of the General Conditions, and this and all other corresponding Supplementary Conditions, the parties required to be insured will be referred to collectively as "insureds." In addition to Owner, Contractor, and Subcontractors of every tier, include as insureds the following:
 11. include, in addition to the Contract Price amount, the value of the following equipment and materials to be installed by the Contractor but furnished by the Owner or third parties: None
 12. If debris removal in connection with repair or replacement of insured property is subject to a coverage sublimit, such sublimit will be a minimum of \$50,000.
 13. In addition to the coverage sublimits stated above, the following coverages are also subject to sublimits, as follows: _____
 14. Contractor shall name Owner as an additional insured on the Builder's Risk policy and provide Owner with a copy of the policy as requested by Owner.
- a. None.SC-6.04 Delete Paragraph 6.04 B in its entirety. Replace with:
B. Not Used.
- SC-6.04 Delete Paragraph 6.04 C in its entirety. Replace with:
C. Not Used.
- SC-6.04 Supplement Paragraph 6.04 of the General Conditions with the following provisions:
- H. *Builder's Risk and Other Property Insurance Deductibles:* The purchaser of any required builder's risk or other property insurance will be responsible for costs not covered because of the application of a policy deductible.
1. The builder's risk policy will be subject to a deductible amount of not more than \$25,000 for direct physical loss in any one occurrence.

ARTICLE 7—CONTRACTOR'S RESPONSIBILITIES

7.02 *Supervision and Superintendence*

SC-7.02 Add the following to Paragraph 7.01, following Paragraph 7.02.B:

- C. Unless Owner otherwise agrees in writing, the superintendent will be Contractor's representative at the Site and shall have authority to act on behalf of Contractor. All communications given to or received from the superintendent shall be binding on Contractor. Any project manager, superintendent, foreman, or other personnel, who repeatedly fails to follow the Engineer's written or oral orders, directions, instructions or determinations, shall be subject to removal from the project. Upon the written request of the Engineer, the contractor shall immediately remove such superintendent or other personnel and name a replacement in writing. Noncompliance with the Engineer's request to remove and replace personnel at any level shall be grounds for terminating the Contract.

7.03 *Labor; Working Hours*

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

1. Regular working hours will be 7:00 a.m. to 6:00 p.m.
2. Owner's legal holidays are:
 - New Year's Day
 - Martin Luther King Jr. Birthday
 - Presidents' Day
 - Memorial Day
 - Independence Day
 - Labor Day
 - Veterans' Day
 - Thanksgiving Day and Day After
 - Christmas Day and Half-day Before

SC-7.03 Amend the first and second sentences of Paragraph 7.03.C to state "...all Work at the Site must be performed during regular working hours, Monday through Friday. Contractor will not perform Work on a Saturday, Sunday, or any legal holiday." The balance of Paragraph 7.03.C remains unchanged except for the foregoing.

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

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

SC-7.05 Modify Paragraph 7.05, A.1 as follows:

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 *may* deem it an “or equal” item...

SC-7.07 Amend Article H to also include:

Subcontractors must submit a NOI and certificate of insurance prior to any payments being made for that subcontracted work.

SC 7.12 To Article A, modify the last sentence to include:

Upon completion of the Work, Contractor shall deliver both hard paper copies and electronic copies of these record documents to both the Owner and Engineer.

SC-7.13 Add the following new paragraph immediately after Paragraph 7.13.J:

- K. *Protection of the Environment*: No construction related activity shall contribute to the degradation of the environment, allow material to enter surface or ground waters, or allow particulate emissions to the atmosphere, which exceed state or federal standards. Any actions that potentially allow a discharge to state waters must have prior approval of the Washington State Department of Ecology.

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

- B. *Single Prime Contract*: Contractor shall be responsible for coordinating exchange of 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 and Regulations. Contractor shall provide a centralized location for the maintenance of the safety data sheets or other hazard communication information required to be made available by any employer on the Site. Location of the material safety data sheets or other hazard communication information shall be readily accessible to the employees of employers on the Site.

SC-7.17 To Article D.1, modify to say:

1. Observations by Owner or Engineer

SC-7.18 *Indemnification*

Remove Section 7.18.A in its entirety and replace it with the following:

- 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, defend 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.

Should a court of competent jurisdiction determine that this Agreement is subject to RCW 4.24.115, then, in the event of liability for damages arising out of bodily injury to persons or damages to property caused by or resulting from the concurrent negligence of the Contractor and the Owner, its officers, officials, employees, and volunteers, the Contractor's liability hereunder shall be only to the extent of the Contractor's negligence. It is further specifically and expressly understood that the indemnification provided herein constitutes the Contractor's waiver of immunity under Industrial Insurance, Title 51 RCW, solely for the purposes of this indemnification. This waiver has been mutually negotiated by the parties. The provisions of this section shall survive the expiration or termination of this Agreement.

ARTICLE 8—OTHER WORK AT THE SITE

8.02 Coordination

SC-8.02 Add the following new Paragraph 8.02.C immediately after Paragraph 8.02.B:

- C. Owner may contract with others for the performance of other work at or adjacent to the Site, which, if known at the time of bidding of the Project, is indicated in Specifications Section 01 11 00 – Summary of Work
 - 1. Owner's wastewater treatment plant (WWTP) superintendent shall have authority and responsibility for coordination of the various contractors and work forces at the Site when retained by Owner under separate contracts;
 - 2. The following specific matters are to be covered by such authority and responsibility: Resolving disagreements between separate contractors seeking to work at the same time in the same work area(s) of the Site and, in such event, establishing which contractor's work will have priority.
 - 3. The extent of such authority and responsibilities is: To provide direction on priorities of conflicting work under separate contracts to Engineer and, as applicable, the separate contractors and to communicate the needs for, and effects of (including effects on price and time) to others in Owner's organization, especially relative to matters that may require a Change Order for Contractor due to delays incurred in the Work by the potential prioritization of another contractor's work.

ARTICLE 9— OWNER'S RESPONSIBILITIES

9.12 Safety Programs

SC-9.12 Add the following new paragraphs immediately after Paragraph 9.12.B:

- C. Owner has provided a Confined Space Entry Program in Specification Section 00 73 01A.

ARTICLE 10—ENGINEER'S STATUS DURING CONSTRUCTION

10.03 Resident Project Representative

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

- C. The Resident Project Representative (RPR) will be Engineer's representative at the Site. RPR's dealings in matters pertaining to the Work in general will be with Engineer and Contractor. RPR's dealings with Subcontractors will only be through or with the full knowledge or approval of Contractor. The RPR will:
1. *Conferences and Meetings:* Attend meetings with Contractor, such as preconstruction conferences, progress meetings, job conferences, and other Project-related meetings (but not including Contractor's safety meetings), and as appropriate prepare and circulate copies of minutes thereof.
 2. *Safety Compliance:* Comply with Site safety programs, as they apply to RPR, and if required to do so by such safety programs, receive safety training specifically related to RPR's own personal safety while at the Site.
 3. *Liaison*
 - a. Serve as Engineer's liaison with Contractor. Working principally through Contractor's authorized representative or designee, assist in providing information regarding the provisions and intent of the Contract Documents.
 - b. Assist Engineer in serving as Owner's liaison with Contractor when Contractor's operations affect Owner's on-Site operations.
 - c. Assist in obtaining from Owner additional details or information, when required for Contractor's proper execution of the Work.
 4. *Review of Work; Defective Work*
 - a. Conduct on-Site observations of the Work to assist Engineer in determining, to the extent set forth in Paragraph 10.02, if the Work is in general proceeding in accordance with the Contract Documents.
 - b. Observe whether any Work in place appears to be defective. This does not impose on either RPR or Engineer any obligation to find all, or any specific element of, defective Work, for which Contractor remains solely responsible.
 - c. Observe whether any Work in place should be uncovered for observation, or requires special testing, inspection or approval.
 5. *Inspections and Tests*
 - a. Observe Contractor-arranged inspections required by Laws and Regulations, including but not limited to (1) code-required tests and special inspections, and (2) those performed by public or other agencies having jurisdiction over the Work.
 - b. Observe specific tests, inspections, and other field quality control required by the Contract Documents and performed by Contractor, Subcontractor, Supplier, or by testing or laboratories retained by any of them, .
 - c. Accompany visiting inspectors representing public or other agencies having jurisdiction over the Work.
 6. *Payment Requests:* Review Applications for Payment with Contractor and advise Contractor regarding quantities or extent of the Work eligible for payment.

Exhibit C—Geotechnical Baseline Report Supplement to the Supplementary Conditions.

EJCDC® C-800, Supplementary Conditions of the Construction Contract.

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7. *Completion*

- a. Participate in Engineer's visits regarding inspection for Substantial Completion.
- b. Assist in the augmenting or amending the punch list of items to be completed or corrected prior to final inspection.
- c. *Final Inspection*: Participate in Engineer's visit to the Site, in the company of Owner and Contractor, regarding completion of the Work, and prepare a final punch list (if any) of items to be completed or corrected by Contractor.
- d. Observe whether items on the final punch list have been completed or corrected.
- e. *Record Documents*: Periodically during the Work, review with Contractor the status of Contractor's record documents required by the Contract Documents and advise Contractor on whether such record documents appear to comply with the Contract's requirements for record documents. Review final record documents submitted by Contractor.

D. The RPR will not:

1. Authorize any deviation from the Contract Documents or substitution of materials, equipment (including "or-equal" items), or procedures or sequences indicated in the Contract Documents.
2. Exceed limitations of Engineer's authority as set forth in the Contract Documents.
3. Undertake any of the responsibilities of Contractor, Subcontractors, or Suppliers.
4. Advise on, issue directions relative to, or assume control or responsibility over any aspect of the means, methods, techniques, sequences, or procedures of construction.
5. Advise on, issue directions regarding, or assume control over security protection, or safety practices, precautions, and programs in connection with the activities or operations of Owner or Contractor.
6. Participate in specialized field or laboratory tests or inspections conducted off-site by others except as specifically authorized by Engineer.
7. Authorize Owner to occupy the Project in whole or in part.

ARTICLE 11—CHANGES TO THE CONTRACT

SC-11.06 Add the following sentence immediately after the first sentence of Paragraph 11.06.A:

Failure to submit a Change Proposal in accordance with the 30-day period shall constitute a waiver of the relief sought by Contractor.

SC-11.09.A Remove the first sentence of the first paragraph and replace it with the following:

Owner, Engineer or 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.

ARTICLE 12—CLAIMS

SC-12.01.B Add the following sentence immediately after the first sentence of Paragraph 12.01.B:

Failure to submit a Claim within the 30-day period shall constitute a waiver of the relief sought by the party.

ARTICLE 13—Cost of the Work; Allowances; Unit Price Work

Supplement Paragraph 13.01.B.5.c.(1) by adding the following subparagraphs:

- a) Prior to commencing Work at the Site, submit to Owner, through Engineer, copies of the equipment rental agreements for Owner’s approval.
- b) Should Contractor perform Work using rented construction equipment or machinery without Owner’s written approval of the associated rental agreement and the parties subsequently disagree on the applicable rental rates, use of such construction equipment and machinery will be compensated on the basis of the rental rate book indicated in Paragraph SC-13.01.B.5.c.(2).
- c) When the rental rate book is used basis for determining compensation for construction equipment and machinery leased from a rental firm, the hourly rate for such equipment shall be determined in accordance with Paragraph 13.01.B.5.(2) of the General Conditions.

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” by EquipmentWatch.

Supplement Paragraph 13.01.B.5.c by adding the following subparagraphs:

- 4) Rental of construction equipment and machinery shall cease when the use thereof is no longer necessary for the Work. Periods of inactivity for such construction equipment or machinery will not be compensable unless agreed upon in writing by Owner, unless the costs of disassembly, removal, transportation, reassembly, and remobilization, as submitted to and accepted by Owner (with advice of Engineer) would exceed the cost of continuing to rent the item(s) during the period(s) of inactivity. Contractor is responsible for obtaining Owner’s written approval for compensation for construction equipment and machinery for periods of inactivity. Owner is not responsible for retroactively approving such inactivity. “Period of inactivity” for such items includes periods when the construction equipment or machinery is not used or necessary for the logical and efficient progression of the Work, or when other, available equipment or machinery is suitable for performing the given task.
- 5) Construction equipment and machinery will be compensable only for serviceable construction equipment and machinery capable of efficiently performing its intended

function at the Site. Construction equipment and machinery not in compliance with this Paragraph SC-13.01.B.5.c.5) is not eligible for compensation.

- 6) Compensation paid Contractor for a given item of Contractor-owned construction equipment or machinery will be capped at, and shall not exceed, the comparable purchase price of such item of equal or comparable capacity and capability.

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

For purposes of this paragraph, “small tools and hand tools” means items in one or more of the following categories: (1) Items that are ordinarily required for the performing worker’s job function, including but not limited to equipment which ordinarily has no associated licensing, insurance, or substantive storage costs; such as hammers, wrenches, socket tools, manual saws, power saws, chainsaws, common power tools, impact drills, threaders, benders, transits and theodolites and related equipment, and other tools transportable by hand, regardless of ownership of such items; (2) Items such as gang-boxes, ladders, hand carts and similar wheeled items manually operated by workers, extension cords, and similar items; (3) common testing equipment such as insulation testers (megger-testing equipment), amp meters, gas detectors, pressure gauges, and similar items; (4) A purchase price (if purchased new, at retail) of \$500, although such limit is not absolute, and certain items may be deemed by Owner or Engineer as “small tools or hand tools” (and not eligible for compensation) even though such item may have a purchase price greater than the amount indicated in this Paragraph 13.01.C.2.

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

15.01 Progress Payments

SC-15.01.D.1 Modify Paragraph 15.01.D.1 by replacing the word, “Ten” with the word, “Thirty.”

15.03 Substantial Completion

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

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

SC-15.06.E The last sentence of paragraph 15.06.E shall be removed and replaced with the following:

Owner shall pay the resulting balance due to Contractor within 45 - 60 days of Owner’s receipt of the final Application for Payment from Engineer, provided that Contractor has met its statutory

obligations, including providing Owner with Affidavits of Wages Paid (Contractor and sub-contractors).

SC-15.07.B Remove paragraph 15.07.B in its entirety and replace it with the following:

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

SC-15.08.A Remove the first paragraph in its entirety and replace it with the following:

If within ~~one~~ two years 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:

ARTICLE 16—SUSPENSION OF WORK AND TERMINATION

No Supplementary Conditions in this Article.

ARTICLE 17—FINAL RESOLUTIONS OF DISPUTES

Time Limitation and Jurisdiction

(November 30, 2018 APWA GSP)

Revise this section to read:

For the convenience of the parties to the Contract it is mutually agreed by the parties that any claims or causes of action which the Contractor has against the Owner arising from the Contract shall be brought within 30 calendar days from the date of final acceptance of the Contract by the Owner; and it is further agreed that any such claims or causes of action shall be brought only in the Superior Court of the county where the Owner headquarters is located, provided that where an action is asserted against a county, RCW 36.01.050 shall control venue and jurisdiction. The parties understand and agree that the Contractor's failure to bring suit within the time period provided, shall be a complete bar to any such claims or causes of action. It is further mutually agreed by the parties that when any claims or causes of action which the Contractor asserts against the Owner arising from the Contract are filed with the Owner or initiated in court, the Contractor shall permit the Owner to have timely access to any records deemed necessary by the Owner to assist in evaluating the claims or action.

ARTICLE 18—MISCELLANEOUS

SC-18.12 Add a new paragraph immediately after Paragraph 18.11, to read as follows:

SC-18.12 *Publicity*

- A. Contractor shall not disclose to any third party the nature of its Work on the Project, nor engage in publicity or public media disclosures with respect to the Project without the prior written consent of Owner.

SC-18.13 Add a new paragraph immediately after Paragraph 18.12, to read as follows:

SC-18.13 *Third Party Beneficiary*

- A. All parties agree that the State of Washington shall be, and is hereby, named as an express third-party beneficiary of this contract, with full rights as such.

SC-19 Add new article immediately after Article 18, to read as follows:

ARTICLE 19—STATUTORY REQUIREMENTS

SC-19.01 This article contains portions of certain Laws or Regulations which, by provision of Laws or Regulations, are required to be included in the Contract Documents. The matters addressed in this Article SC-19 may not be complete or current. Contractor's obligation to comply with all Laws and Regulations is set forth in Paragraph 7.11 of the General Conditions.

SC-19.02 The Successful bidder will be required to conform to the wage requirements prescribed by the federal Davis-Bacon and Related Acts, which requires that all laborers and mechanics employed by contractors and subcontractors performing on contracts funded in whole or in part by SRF appropriations in excess of \$2,000 pay their laborers and mechanics not less than the prevailing wage rates and fringe benefits, and determined by the Secretary of Labor, for corresponding classes of laborers and mechanics employed on similar projects in the area.

The Federal wage rates for Heavy Construction incorporated in this contract have been established by the Secretary of Labor under United States Department of Labor General Decision No. _____. These rates are applicable to heavy construction.



Confined Space Entry Program

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Purpose

This program presents requirements for practices and procedures that must be followed to protect the safety of those working in confined spaces as specified in Chapter 296-809 of the Washington State Administrative Code.

Overview

Scope of Requirements

The requirements for establishing and certifying a safe working environment in a confined space are intended to protect the safety of:

- City employees.
- Employees of contractors engaged to provide service to the City of Wenatchee.

This confined space entry program identifies all permit-required confined spaces in the workplace and describes the city's procedures for worker safety and health in permit-required confined spaces. Employees will participate in developing and implementing the program by participating in training, following the program procedures, and notifying a supervisor immediately of any unsafe condition or equipment problem.

The City of Wenatchee will treat all confined spaces as permit-required until they have been evaluated and are documented to be non-permit confined spaces.

General Requirements

To comply with the requirements of WAC 296-809, the City of Wenatchee is required to:

- Develop and implement a written Confined Space Entry Program that is available for inspection by employees and their authorized agents.
- Evaluate the workplace to determine if any spaces are permit-required confined spaces. Department heads/supervisors must survey all facilities under their responsibility to identify permit-required confined spaces as defined in this practice.
- A list of confined space locations must be provided to the Human Resource Department and attached to this program (see Exhibit 1).
- Provide procedures and equipment for evaluating confined spaces and hazards to determine the appropriate entry procedure for the space.
- Take effective measures to prevent employees from entering permit-required confined spaces if and when the City of Wenatchee decides that employees will not be permitted to enter the spaces (e.g., evaluation determines that a hazard exists in a space that does not allow safe entry and work).
- Periodically review the program and provide regular training for employees.



Definitions

The following chart defines the terms used in this practice.



Term	Definition
Attendant	<p>A designated employee who:</p> <ul style="list-style-type: none"> • Remains outside the permit-required confined space. • Monitors authorized entrants. • Performs any other duties (e.g., performing the needed atmospheric testing, erecting proper barrier and signs) that may be assigned to him or her as part of this program. <p>An “entry supervisor” also may serve as an attendant as long as that person is trained and equipped as required for each role that he or she may be filling.</p>
Authorized Entrant	<p>An employee who is authorized by the employer to enter a permit-required confined space.</p>
CFM	<p>Cubic Feet per Minute: describes the volume of air that ventilating equipment can move.</p>
Confined Space	<p>A space with all of the following characteristics:</p> <ul style="list-style-type: none"> • Is large enough and so configured that an employee can fully enter and perform assigned work. • Has limited or restricted means of entry or exit (e.g., tanks, vessels, storage bins, hoppers, and pits are spaces that might have limited means of entry or exit). • Is not designed for continuous employee occupancy.
Employee	<p>A person employed by the City of Wenatchee. This term as used in this practice, also includes workers contracted by the city to perform services.</p>
Engulfment	<p>The surrounding and effective capture of a person by a liquid or finely divided (flow able) solid substance that can be aspirated to cause death by filling or plugging the respiratory system or that can exert enough force on the body to cause death by strangulation, constriction, or crushing.</p>
Entry	<p>The action by which a person passes through an opening into a permit-required confined space and includes activities in that space. Entry is considered to have occurred as soon as any part of the entrant’s body breaks the plane of an opening into the space.</p> <p>Note: If the opening is large enough for the worker to fully enter the space, a permit is required even for partial body entry. Permits are not required for partial body entry where the opening is not large enough for full entry.</p>



Entry permit (permit)	The written or printed document that is provided by you to allow and control entry into a permit-required confined space and that contains the information required in WAC 296-809-500, Permit Entry Procedures.
Entry Supervisor	<p>The person (supervisor or crew leader) who is responsible for:</p> <ul style="list-style-type: none"> • Evaluating the conditions in and around any confined space that is to be entered. • Determining if acceptable entry conditions are present at a permit space. • Authorizing entry and overseeing entry operations. • Terminating or preventing entry, as required, if conditions warrant. <p>An entry supervisor may also serve as an attendant as long as that person is trained and equipped as required for each role that he or she may be filling.</p>
Hazardous Atmosphere	<p>An atmosphere that might expose employees to the risk of death, incapacitation, impairment of ability to self-rescue (i.e., escape unaided from a permit space), injury, or acute illness from one or more of the following causes:</p> <ul style="list-style-type: none"> • Flammable gas, vapor, or mist in excess of 10% of its lower explosive limit (LEL). • Airborne combustible dust at a concentration that meets or exceeds its lower flammable limit. • Atmospheric oxygen concentration less than 19.5% or more than 23.5%. • Atmospheric concentration of any substance in excess of the permissible exposure limit set by OSHA. • Any other atmospheric condition that is immediately dangerous to life or health.
LEL	Lower Explosive Limit
MSDS	Material Safety Data Sheet
Non-Permit Confined Space	A confined space that does not contain actual hazards or potential hazards capable of causing death or serious physical harm.
OSHA	Occupational Safety and Health Administration



Permit-Required Confined Space/Permit Space	<p>A confined space, as defined previously, that has one or more of the following hazardous characteristics capable of causing death or serious physical harm:</p> <ul style="list-style-type: none">• Contains or has the potential to contain a hazardous atmosphere.• Contains a material that has the potential for engulfing an entrant.• Has an internal configuration such that an entrant could be trapped or asphyxiated by inwardly converging walls or by a floor that slopes downward and tapers to a smaller cross-section.• Contains any physical hazard.• Contains any other recognized serious safety or health hazard that could either: impair the ability to self-rescue or result in a situation that presents an immediate danger to life or health.
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Control of Confined Space Entry

The City of Wenatchee uses the following methods to inform employees about the existence and hazards of confined spaces, and prevent unauthorized entry:

- Posting danger signs at each permit space reading "Danger-Confined Space-Do Not Enter"
- Using barriers both temporary and permanent
- Specialized tools or locks under management's control to open the space
- Training of new and current employees

Permit-required Confined Space Entry

Entry Permit & Training

Before an employee is allowed to enter a permit-required confined space, the Department Head/Designate must be contacted to arrange for an entry permit and required training.

Posting the Warning Sign



When the entry supervisor determines that a confined space could be a permit-required confined space, he or she must immediately post a sign (Permit-Required Confined Space warning – see example Exhibit 2).

The sign must remain posted permanently or until the conditions that made the space a permit-required confined space are removed.

Guarding the Opening to Permit Spaces

Any condition making it unsafe to remove the cover of a permit-required confined space must be eliminated before removing the entrance cover. When the entrance cover has been removed, the entrance must be guarded by a railing, temporary cover, or other temporary barrier that will:

- Prevent an accidental fall through the opening.
- Protect any employee working in the confined space from foreign objects entering the space.

Atmosphere

The following sections describe:

- Testing the atmosphere.
- Ventilating the space.
- Alleviating atmospheric hazards.

Before an employee enters a permit-required confined space, the atmosphere in the space must be tested (in the order listed) with a calibrated, direct-reading instrument for the following:

- Oxygen content.
- Flammable gasses and vapors.
- Potentially toxic air contaminants

NOTE: See the definition for the term hazardous atmosphere on permissible concentrations of hazardous materials and other details.

If Testing Indicates That...	Then the Entry Supervisor Must...
No hazards are present	Prepare written certification to indicate that: <ul style="list-style-type: none">• Testing was conducted.• No hazards were indicated.• The space was ventilated if needed.• Entry into the space is authorized.



A hazard exists

Prevent access to the space and determine what measures to take to eliminate the hazard.

NOTE: City of Wenatchee employees must not, under any circumstances, enter a permit-required confined space that has a hazardous atmosphere.

Alleviating Atmospheric Hazards

When testing indicated that an atmospheric hazard exists in the permit-required confined space, the space must be ventilated. After ventilating the space for the prescribed time:

- The atmosphere must be retested and certified safe by the entry supervisor before employees are allowed in the space.
- Ventilation must be used continuously while employees work in the space.
- The entry supervisor must continuously test the atmosphere with a meter that continuously samples the atmosphere in the space to ensure that the ventilation is preventing the accumulation of a hazardous atmosphere.
- The entry supervisor must be present the entire time that employees are in the space.

NOTE: If the hazard cannot be eliminated or attempts to eliminate the hazard fail, then no employee is allowed to work in the space. City of Wenatchee employees must not, under any circumstances, enter a permit-required confined space that has a hazardous atmosphere.

Ventilating Time Requirements

Time Needed to Adequately Ventilate a Confined Space Before Entry



Space Volume (cubic feet)	Effective Blower Capacity (in cubic feet per minute)						Time (in minutes) to Purge a Confined Space
	500	600	700	800	900	1000	
100	5	5	5	5	5	5	
200	5	5	5	5	5	5	
300	5	5	5	5	5	5	
400	6	5	5	5	5	5	
500	8	7	6	5	5	5	
600	10	8	7	6	5	5	
700	11	9	8	7	6	5	
800	13	10	9	8	7	6	
900	14	11	10	9	8	7	
1000	15	12	11	10	9	8	

Notes:

1. When 1-60% of the lower explosive limit (LEL) of a combustible gas is detected in a deep neck confined space, double the purging time.
2. The effective blower capacity is reduced for each 90° bend in the blower's output hose and when more than one length of output is used. Capacity reductions are:
 - One 90° bend reduces blower's output to 70% of its rated capacity.
 - Two 90° bends reduce blower's output to 49% of its rated capacity.
 - Three 90° bends reduce blower's output to 34% of its rated capacity.
 - Each additional length of output hose reduces blower's output the same as adding one 90° bend.
3. If two blowers are used, add the effective blower capacities of both.
4. Determine the volume of the confined space by estimating its length, width, and height. Then use the following equation to calculate the volume: length X width X height. For example if the chamber had the following dimensions: length = 6 feet, width = 4 feet, height = 5 feet, the volume would be 6 X 4 X 5 = 120 cubic feet.

Permits



Before City of Wenatchee employees can enter a permit-required confined space, the appropriate department head must be contacted to arrange for an entry permit and required training.

Before entry to a permit-required confined space is authorized, the City of Wenatchee is required to document the successful completion of:

- Testing the space's environment.
- Any measures taken to alleviate any hazards found in the space.

The entry supervisor must:

- Verify that a confined space is safe for entry.
- Document the verification on the Permit to Enter Permit-Required Confined Space (see Exhibit 3).
- Retain the Permit for one year.

The Permit must present the following information:

- Description or identification (location) of the confined space to be entered.
- Purpose for the entry.
- Date on which the verification is made.
- Date and authorized duration of the Permit.
- Hazards that were or could be found in the confined space.
- Basis for determining that all hazards in the space have been eliminated (e.g., "by testing with the _____ tester").

NOTE: Gases tested for and test readings must be listed.

- Results of the initial and periodic tests performed to evaluate the space's atmosphere; names or initials of the tests; an indication of when the tests were conducted.

NOTE: Because periodic testing occurs during the duration of the Permit, the Permit must be modified by adding the required information about the testing.

- Description of acceptable entry conditions.
- Description of the measures taken to eliminate or control the hazards in the space to allow for safe entry.
- Authorized entrants (by name or any other method that lets the attendant determine which entrant(s) is in the space at any time).
- Name of the individual serving as attendant.
- Name of the individual serving as entry supervisor, who can also be the attendant.
- Signature of the entry supervisor who is:
- Verifying the space's safety.



- Authorizing entry

NOTE: A separate space on the Permit is allotted for the signature of the entry supervisor who is authorizing entry into the space.

- Names of the rescue and emergency services that can be summoned and the communication method used (e.g., via telephone using telephone number 911).
- Description of the communication methods employed by the attendants and entrants.
- Description of any equipment needed to comply with the requirement to provide a safe working environment. For example:
 - Personal protective equipment.
 - Testing equipment.
 - Communications equipment.
- Description of any other type of permits that have been issued to authorize work in the confined space (e.g., permits for "hot work").
- Any other information deemed pertinent to the safety of entrants by the employee in charge.

This permit is the authorization required for workers to enter a permit-required confined space.

. The Permit must be:

- Completed and signed by the entry supervisor.
- Posted at the entry to the permit-required confined space (or by any other equally effective method) to let entrants confirm that pre-entry preparations are complete.

This completed permit is to be made available to each employee entering the space if they request to see it or have a copy of it. (Copies need not be provided "on the spot," but can be provided at a later time.)

The Permit can cover only a period of eight hours or less based on the time needed to complete the task in the confined space. If the needed working time exceeds an eight-hour period, more testing must be conducted and an additional permit(s) must be prepared. The entry supervisor must cancel the Permit and entry into the confined space when any of the following situations occur:

- The tasks in the confined space have been completed.
- A condition that is not allowed under the entry permit arises in or near the confined space.

Review of the Permit

The City of Wenatchee is required to review the permit-required confined space program annually (within a year of each permitted entry). Therefore, the entry supervisor must maintain cancelled permits for at least one year. This review is to evaluate the success of the program's efforts to ensure the safety of those who work in confined spaces. The cancelled permits are an integral part of the required review.

The required review is to:



- Prompt any needed revisions in the program.
- Correct deficiencies.
- Increase the program's effectiveness in preserving workers' safety.

Non-permit Confined Space Entry

The confined space must meet these conditions to be classified as a non-permit confined space:

- The confined space doesn't contain an actual or potential hazardous atmosphere
- The confined space doesn't contain hazards capable of causing death or serious physical harm. This includes recognized health or safety hazards.

If an employee must enter to remove hazards, the space must be treated as a permit-required confined space until hazards have been eliminated. If hazards develop, employees must exit the space immediately and determine whether it must be reclassified as a permit-required confined space.

To classify a confined space as non-permit the employee must document how he or she determined the confined space contained no permit-required confined space hazards. This certification must be completed every time a permit-required confined space is reclassified as a non-permit space. For water meter chambers, the tap jacket will be used for documentation. Exhibit 4 contains a general certification form when a tap jacket is not applicable. Exhibit 5 is the flow chart used by the water crew for classifying confined spaces.

Communicating and Coordinating with Contractors

The City of Wenatchee and contractors are both responsible for maintaining communication that ensures a safe work environment for employees.

Regarding confined spaces, the City of Wenatchee will inform contractors in writing of the:

- Elements that make the space a permit-required confined space.
- Hazards identified in the space.
- Any past experience with the space.
- Precautions or procedures that the city has implemented to protect employees in or near the space.

After the contractor is apprised of the situation, the City of Wenatchee and the contractor must coordinate entry operations when employees of the contractor and/or employees of the city will be working in or near the space. The city also requires contractors to have a current confined space program and to submit that program as part of post-award documentation.

Once informed of the City of Wenatchee's confined space entry program, contractors are required to inform the city of any hazards confronted or created in the permit-required confined space.



Personnel and Training

The City of Wenatchee will provide confined space training to all employees that work in or around confined spaces or may be designated to one of the following positions during a permit-required confined space entry:

- Entry supervisor.
- Attendant.
- Authorized entrant

NOTE: An entry supervisor may serve as an attendant as long as that person is trained and equipped as required for each role that he or she may be filling.

- Attendants are permitted to be assigned monitoring responsibilities for more than one permit-required confined space if they can effectively perform all the duties assigned to them for each of the spaces they might be assigned to monitor.

Additionally, the City of Wenatchee must ensure that those designated for an active role must be adequately trained to perform the role. Part of this training must include procedures to follow in the event of an emergency. To be certified to work at permit-required confined space, trainees must know how to:

- Summon rescue and emergency services.
- Provide emergency care for rescued employees.
- Prevent unauthorized persons from participating in a confined space entry or attempting a rescue.
- Participate in annual permit-required confined space rescue training.

Training must also include how to properly use the equipment involved in the activities at a permit-required confined space entry and non-permit confined space entry.

Equipment

The City of Wenatchee provides equipment and training on how to use the equipment as a part of the program to protect the safety of employees working in confined spaces. All equipment should be checked prior to each use. The City of Wenatchee provides the following equipment (or items):

- Testing and monitoring equipment (for testing and monitoring atmosphere for combustible gasses and oxygen deficiency).
- Ventilating equipment (500 CFM forced air blower or larger).
- Personal protective equipment (PPE) to protect employees from hazards of the space or the work performed
- Communications equipment that lets the attendant:
 - Monitor entrant's status.
 - Alert entrant of the need to evacuate the space.



NOTE: Communications equipment is required only if unassisted voice communication cannot effectively be maintained.

- Lighting needed to let employees:
 - See well enough to work safely.
 - Exit the space quickly during an emergency.
 - Work safely in an area where there is a potential for flammable gases.
- Barriers and shield as required.
- Ladders or other items needed for safe ingress and egress.
- Material Safety Data Sheets (MSDSs) for any substances that are hazardous or potentially hazardous and that are known to be in or likely to be in the space.
- Rescue and emergency equipment that would specifically facilitate a rescue from a particular space.
- Any other equipment necessary for safe entry into permit-required confined spaces.

Rescue & Emergency services

The attendant is responsible for identifying emergency situations and initiating a response to the situation. Some possible emergencies include, but are not limited to:

- The air quality in the space becomes unsafe for continued occupancy
- The entrant becomes trapped in the space
- The entrant is injured or unconscious
- A new hazard is identified.

The attendant should follow these steps in case of emergency:

1. Attempt to communicate with the entrant and request that he or she evacuate immediately.
2. If the entrant is unable to exit unassisted, the attendant will deny entry to the space. An attendant must remain outside of the space at all times.
3. For an emergency in a non-permit confined space, contact the supervisor or lead worker to mobilize rescue equipment. (During a permit-required entry rescue equipment will be on-site).
4. If entrant is non-responsive or injured, call 911 to mobilize additional emergency services.
5. Scan the immediate area for possible hazards, such as exhaust from a vehicle or power tools. If possible, eliminate these hazards.
6. Declassify the confined space by verifying the air quality and assessing the space for other hazards.
7. Begin ventilation if available.
8. Stay in communication with the entrant, if he or she is conscious.
9. Communicate all known hazards, air quality, and condition of the entrant to emergency responders.



Retrieval Systems

To facilitate a rescue without having the rescuers enter the confined space, retrieval systems or methods must be employed for each authorized entrant in a permit-required confined space.

NOTE: If the retrieval equipment would increase the overall risk of entry or would not contribute to the rescue of the entrant, then the systems need not be used.

When retrieval systems are use, each authorized entrant is to use a full body harness with a retrieval line attached:

- At the center of the entrant's back.
- Near shoulder level.
- Above the entrant's head.

The other end of the retrieval line must be attached to a fixed point (or to a mechanical device) outside the permit space in such a manner that a rescue can begin as soon as the rescuer is aware that a rescue is necessary. A mechanical device (Tripod and Winch) must be available to retrieve personnel from vertical-type permit spaces.

Exhibit 1

List of Confined Spaces

This list represents the known confined spaces in the City of Wenatchee. There may be other confined spaces that are not listed below. This list will be updated as needed.

Water

- Meter chambers**
- Vaults**

Wastewater

- Sewer manholes**
- Lift stations**
 - Broadview**
 - Quail Hollow**
 - Riverfront Park – Walla Walla**
 - Squilchuck**
 - Sunnyslope**
- Grease Interceptors**
- Wet well**
- Digesters**
- Clarifiers**

Stormwater

- Manholes**

Lighting

- Vaults**



City pool
Pump well
Filter vault

Parks
Vaults

Facilities
Convention Center Fountain

Exhibit 2

Permit-Required Confined Space Warning

DANGER

**Permit-
Required
Confined
Space**



Exhibit 3



CONFINED SPACE ENTRY PERMIT

Description of Location of Confined Space: _____

Work to be Performed: _____

Circle Hazards Expected: Welding / Corrosives / Flammables / Toxic Materials / Oxygen Deficiency /
Electrical / Hot Equipment / Other

Permit Issued: Date: _____ Time: _____

*LIST PERSONS NAMES ON BACK OF PERMIT AS NECESSARY

THE FOLLOWING ITEMS ARE COMPLETE:

	YES	NO	N/A
1. Contents Removed/Purged			
2. Electrical/Mechanical Lockout			
3. Continuous Ventilation in Use			
4. Rescue Equipment Available			

Circle Personal Protective Equipment Required for Entry: Safety Glasses, Goggles, Face Shield / Hard Hat / Safety Shoes, Boots / Gloves / Ear Plugs, Muffs / Chemical Protective Suit / Other:

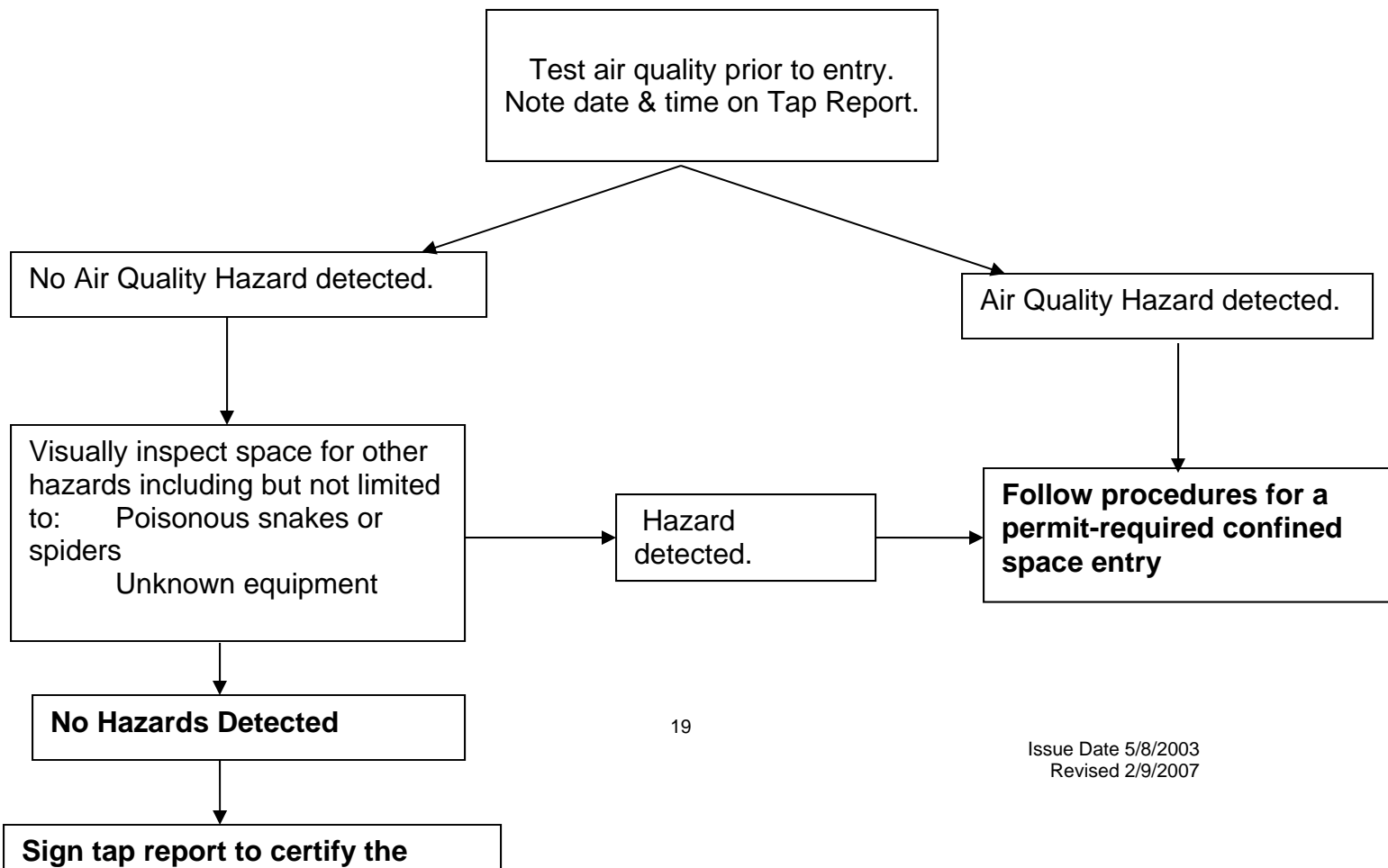
Circle Safety Equipment Required at Site: Radio / Lifeline, Harness / First Aid Kit Flashlight / Tripod / Oxygen / Gas Detector / Fans / Other:

Air Quality Testers Tag Attached: YES / NO

Exhibit 5

Non-permit Confined Space Entry Program – Water Division

This procedure should be followed every time a non-permit confined space entry is made.



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Benefit Code Key – Effective 9/1/2021 thru 3/2/2022

Overtime Codes

Overtime calculations are based on the hourly rate actually paid to the worker. On public works projects, the hourly rate must be not less than the prevailing rate of wage minus the hourly rate of the cost of fringe benefits actually provided for the worker.

1. ALL HOURS WORKED IN EXCESS OF EIGHT (8) HOURS PER DAY OR FORTY (40) HOURS PER WEEK SHALL BE PAID AT ONE AND ONE-HALF TIMES THE HOURLY RATE OF WAGE.
 - B. All hours worked on Saturdays shall be paid at one and one-half times the hourly rate of wage. All hours worked on Sundays and holidays shall be paid at double the hourly rate of wage.
 - C. The first two (2) hours after eight (8) regular hours Monday through Friday and the first ten (10) hours on Saturday shall be paid at one and one-half times the hourly rate of wage. All other overtime hours and all hours worked on Sundays and holidays shall be paid at double the hourly rate of wage.
 - D. The first two (2) hours before or after a five-eight (8) hour workweek day or a four-ten (10) hour workweek day and the first eight (8) hours worked the next day after either workweek shall be paid at one and one-half times the hourly rate of wage. All additional hours worked and all worked on Sundays and holidays shall be paid at double the hourly rate of wage.
 - E. The first two (2) hours after eight (8) regular hours Monday through Friday and the first eight (8) hours on Saturday shall be paid at one and one-half times the hourly rate of wage. All other hours worked Monday through Saturday, and all hours worked on Sundays and holidays shall be paid at double the hourly rate of wage.
 - F. The first two (2) hours after eight (8) regular hours Monday through Friday and the first ten (10) hours on Saturday shall be paid at one and one-half times the hourly rate of wage. All other overtime hours worked, except Labor Day, shall be paid at double the hourly rate of wage. All hours worked on Labor Day shall be paid at three times the hourly rate of wage.
 - G. The first ten (10) hours worked on Saturdays and the first ten (10) hours worked on a fifth calendar weekday in a four-ten hour schedule, shall be paid at one and one-half times the hourly rate of wage. All hours worked in excess of ten (10) hours per day Monday through Saturday and all hours worked on Sundays and holidays shall be paid at double the hourly rate of wage.
 - H. All hours worked on Saturdays (except makeup days if work is lost due to inclement weather conditions or equipment breakdown) shall be paid at one and one-half times the hourly rate of wage. All hours worked Monday through Saturday over twelve (12) hours and all hours worked on Sundays and holidays shall be paid at double the hourly rate of wage.
 - I. All hours worked on Sundays and holidays shall also be paid at double the hourly rate of wage.
 - J. The first two (2) hours after eight (8) regular hours Monday through Friday and the first ten (10) hours on Saturday shall be paid at one and one-half times the hourly rate of wage. All hours worked over ten (10) hours Monday through Saturday, Sundays and holidays shall be paid at double the hourly rate of wage.
 - K. All hours worked on Saturdays and Sundays shall be paid at one and one-half times the hourly rate of wage. All hours worked on holidays shall be paid at double the hourly rate of wage.
 - M. All hours worked on Saturdays (except makeup days if work is lost due to inclement weather conditions) shall be paid at one and one-half times the hourly rate of wage. All hours worked on Sundays and holidays shall be paid at double the hourly rate of wage.
 - N. All hours worked on Saturdays (except makeup days) shall be paid at one and one-half times the hourly rate of wage. All hours worked on Sundays and holidays shall be paid at double the hourly rate of wage.

Overtime Codes Continued

1. O. The first ten (10) hours worked on Saturday shall be paid at one and one-half times the hourly rate of wage. All hours worked on Sundays, holidays and after twelve (12) hours, Monday through Friday and after ten (10) hours on Saturday shall be paid at double the hourly rate of wage.
- P. All hours worked on Saturdays (except makeup days if circumstances warrant) and Sundays shall be paid at one and one-half times the hourly rate of wage. All hours worked on holidays shall be paid at double the hourly rate of wage.
- Q. The first two (2) hours after eight (8) regular hours Monday through Friday and up to ten (10) hours worked on Saturdays shall be paid at one and one-half times the hourly rate of wage. All hours worked in excess of ten (10) hours per day Monday through Saturday and all hours worked on Sundays and holidays (except Christmas day) shall be paid at double the hourly rate of wage. All hours worked on Christmas day shall be paid at two and one-half times the hourly rate of wage.
- R. All hours worked on Sundays and holidays shall be paid at two times the hourly rate of wage.
- U. All hours worked on Saturdays shall be paid at one and one-half times the hourly rate of wage. All hours worked on Sundays and holidays (except Labor Day) shall be paid at two times the hourly rate of wage. All hours worked on Labor Day shall be paid at three times the hourly rate of wage.
- V. All hours worked on Sundays and holidays (except Thanksgiving Day and Christmas day) shall be paid at one and one-half times the hourly rate of wage. All hours worked on Thanksgiving Day and Christmas day shall be paid at double the hourly rate of wage.
- W. All hours worked on Saturdays and Sundays (except make-up days due to conditions beyond the control of the employer)) shall be paid at one and one-half times the hourly rate of wage. All hours worked on holidays shall be paid at double the hourly rate of wage.
- X. The first four (4) hours after eight (8) regular hours Monday through Friday and the first twelve (12) hours on Saturday shall be paid at one and one-half times the hourly rate of wage. All hours worked over twelve (12) hours Monday through Saturday, Sundays and holidays shall be paid at double the hourly rate of wage. When holiday falls on Saturday or Sunday, the day before Saturday, Friday, and the day after Sunday, Monday, shall be considered the holiday and all work performed shall be paid at double the hourly rate of wage.
- Y. All hours worked outside the hours of 5:00 am and 5:00 pm (or such other hours as may be agreed upon by any employer and the employee) and all hours worked in excess of eight (8) hours per day (10 hours per day for a 4 x 10 workweek) and on Saturdays and holidays (except labor day) shall be paid at one and one-half times the hourly rate of wage. (except for employees who are absent from work without prior approval on a scheduled workday during the workweek shall be paid at the straight-time rate until they have worked 8 hours in a day (10 in a 4 x 10 workweek) or 40 hours during that workweek.) All hours worked Monday through Saturday over twelve (12) hours and all hours worked on Sundays and Labor Day shall be paid at double the hourly rate of wage.
- Z. All hours worked on Saturdays and Sundays shall be paid at one and one-half times the hourly rate of wage. All hours worked on holidays shall be paid the straight time rate of pay in addition to holiday pay.

Overtime Codes Continued

2. ALL HOURS WORKED IN EXCESS OF EIGHT (8) HOURS PER DAY OR FORTY (40) HOURS PER WEEK SHALL BE PAID AT ONE AND ONE-HALF TIMES THE HOURLY RATE OF WAGE.
- B. All hours worked on holidays shall be paid at one and one-half times the hourly rate of wage.
 - F. The first eight (8) hours worked on holidays shall be paid at the straight hourly rate of wage in addition to the holiday pay. All hours worked in excess of eight (8) hours on holidays shall be paid at double the hourly rate of wage.
 - M. This code appears to be missing. All hours worked on Saturdays, Sundays and holidays shall be paid at double the hourly rate of wage.
 - O. All hours worked on Sundays and holidays shall be paid at one and one-half times the hourly rate of wage.
 - R. All hours worked on Sundays and holidays and all hours worked over sixty (60) in one week shall be paid at double the hourly rate of wage.
 - U. All hours worked on Saturdays shall be paid at one and one-half times the hourly rate of wage. All hours worked over 12 hours in a day or on Sundays and holidays shall be paid at double the hourly rate of wage.
3. ALL HOURS WORKED IN EXCESS OF EIGHT (8) HOURS PER DAY OR FORTY (40) HOURS PER WEEK SHALL BE PAID AT ONE AND ONE-HALF TIMES THE HOURLY RATE OF WAGE.
- F. All hours worked on Saturday shall be paid at one and one-half times the hourly rate of wage. All hours worked on Sunday shall be paid at two times the hourly rate of wage. All hours worked on paid holidays shall be paid at two and one-half times the hourly rate of wage including holiday pay.
 - H. All work performed on Sundays between March 16th and October 14th and all Holidays shall be compensated for at two (2) times the regular rate of pay. Work performed on Sundays between October 15th and March 15th shall be compensated at one and one half (1-1/2) times the regular rate of pay.
 - J. All hours worked between the hours of 10:00 pm and 5:00 am, Monday through Friday, and all hours worked on Saturdays shall be paid at a one and one-half times the hourly rate of wage. All hours worked on Sundays and holidays shall be paid at double the hourly rate of wage.
 - K. Work performed in excess of eight (8) hours of straight time per day, or ten (10) hours of straight time per day when four ten (10) hour shifts are established, or forty (40) hours of straight time per week, Monday through Friday, or outside the normal 5 am to 6pm shift, and all work on Saturdays shall be paid at one and one-half times the hourly rate of wage. All work performed after 6:00 pm Saturday to 5:00 am Monday and Holidays, and all hours worked in excess of twelve (12) hours in a single shift shall be paid at double the hourly rate of wage.
- After an employee has worked eight (8) hours at an applicable overtime rate, all additional hours shall be at the applicable overtime rate until such time as the employee has had a break of eight (8) hours or more. When an employee returns to work without at least eight (8) hours time off since their previous shift, all such time shall be a continuation of shift and paid at the applicable overtime rate until he/she shall have the eight (8) hours rest period.
4. ALL HOURS WORKED IN EXCESS OF EIGHT (8) HOURS PER DAY OR FORTY (40) HOURS PER WEEK SHALL BE PAID AT ONE AND ONE-HALF TIMES THE HOURLY RATE OF WAGE.
- A. All hours worked in excess of eight (8) hours per day or forty (40) hours per week shall be paid at double the hourly rate of wage. All hours worked on Saturdays, Sundays and holidays shall be paid at double the hourly rate of wage.

Overtime Codes Continued

4. C. On Monday through Friday, the first four (4) hours of overtime after eight (8) hours of straight time work shall be paid at one and one half (1-1/2) times the straight time rate of pay, unless a four (4) day ten (10) hour workweek has been established. On a four (4) day ten (10) hour workweek scheduled Monday through Thursday, or Tuesday through Friday, the first two (2) hours of overtime after ten (10) hours of straight time work shall be paid at one and one half (1-1/2) times the straight time rate of pay. On Saturday, the first twelve (12) hours of work shall be paid at one and one half (1-1/2) times the straight time rate of pay, except that if the job is down on Monday through Friday due to weather conditions or other conditions outside the control of the employer, the first ten (10) hours on Saturday may be worked at the straight time rate of pay. All hours worked over twelve (12) hours in a day and all hours worked on Sunday and Holidays shall be paid at two (2) times the straight time rate of pay.

D. All hours worked in excess of eight (8) hours per day or forty (40) hours per week shall be paid at double the hourly rate of wage. All hours worked on Saturday, Sundays and holidays shall be paid at double the hourly rate of pay. Rates include all members of the assigned crew.

EXCEPTION:

On all multipole structures and steel transmission lines, switching stations, regulating, capacitor stations, generating plants, industrial plants, associated installations and substations, except those substations whose primary function is to feed a distribution system, will be paid overtime under the following rates:

The first two (2) hours after eight (8) regular hours Monday through Friday of overtime on a regular workday, shall be paid at one and one-half times the hourly rate of wage. All hours in excess of ten (10) hours will be at two (2) times the hourly rate of wage. The first eight (8) hours worked on Saturday will be paid at one and one-half (1-1/2) times the hourly rate of wage. All hours worked in excess of eight (8) hours on Saturday, and all hours worked on Sundays and holidays will be at the double the hourly rate of wage.

All overtime eligible hours performed on the above described work that is energized, shall be paid at the double the hourly rate of wage.

E. The first two (2) hours after eight (8) regular hours Monday through Friday and the first eight (8) hours on Saturday shall be paid at one and one-half times the hourly rate of wage. All other hours worked Monday through Saturday, and all hours worked on Sundays and holidays shall be paid at double the hourly rate of wage.

On a four-day, ten-hour weekly schedule, either Monday thru Thursday or Tuesday thru Friday schedule, all hours worked after ten shall be paid at double the hourly rate of wage. The Monday or Friday not utilized in the normal four-day, ten hour work week, and Saturday shall be paid at one and one half (1½) times the regular shift rate for the first eight (8) hours. All other hours worked Monday through Saturday, and all hours worked on Sundays and holidays shall be paid at double the hourly rate of wage.

G. All hours worked on Saturdays shall be paid at one and one-half times the hourly rate of wage. All hours worked Monday through Saturday over twelve (12) hours and all hours worked on Sundays and holidays shall be paid at double the hourly rate of wage.

I. The First eight (8) hours worked on Saturdays shall be paid at one and one-half times the hourly rate of wage. All hours worked in excess of eight (8) per day on Saturdays shall be paid at double the hourly rate of wage. All hours worked on Sundays and holidays shall be paid at double the hourly rate of wage.

Overtime Codes Continued

4. J. The first eight (8) hours worked on a Saturday shall be paid at one and one-half times the hourly rate of wage. All hours worked in excess of eight (8) hours on a Saturday shall be paid at double the hourly rate of wage. All hours worked over twelve (12) in a day, and all hours worked on Sundays and Holidays shall be paid at double the hourly rate of wage.
- K. All hours worked on a Saturday shall be paid at one and one-half times the hourly rate of wage, so long as Saturday is the sixth consecutive day worked. All hours worked over twelve (12) in a day Monday through Saturday, and all hours worked on Sundays and Holidays shall be paid at double the hourly rate of wage.
- L. The first twelve (12) hours worked on a Saturday shall be paid at one and one-half times the hourly rate of wage. All hours worked on a Saturday in excess of twelve (12) hours shall be paid at double the hourly rate of pay. All hours worked over twelve (12) in a day Monday through Friday, and all hours worked on Sundays shall be paid at double the hourly rate of wage. All hours worked on a holiday shall be paid at one and one-half times the hourly rate of wage, except that all hours worked on Labor Day shall be paid at double the hourly rate of pay.
- U. The first four (4) hours after eight (8) regular hours Monday through Friday and the first twelve (12) hours on Saturday shall be paid at one and one-half times the hourly rate of wage. (Except on makeup days if work is lost due to inclement weather, then the first eight (8) hours on Saturday may be paid the regular rate.) All hours worked over twelve (12) hours Monday through Saturday, and all hours worked on Sundays and holidays shall be paid at double the hourly rate of wage.
- V. Work performed in excess of ten (10) hours of straight time per day when four ten (10) hour shifts are established or outside the normal shift (5 am to 6pm), and all work on Saturdays, except for make-up days shall be paid at time and one-half (1 ½) the straight time rate.

In the event the job is down due to weather conditions, then Saturday may, be worked as a voluntary make-up day at the straight time rate. However, Saturday shall not be utilized as a make-up day when a holiday falls on Friday. All work performed on Sundays and holidays and work in excess of twelve (12) hours per day shall be paid at double (2x) the straight time rate of pay.

After an employee has worked eight (8) hours at an applicable overtime rate, all additional hours shall be at the applicable overtime rate until such time as the employee has had a break of eight (8) hours.

When an employee returns to work without a break of eight (8) hours since their previous shift, all such time shall be a continuation of shift and paid at the applicable overtime rate until such time as the employee has had a break of eight (8) hours.

- W. All hours worked on Saturdays (except makeup days if work is lost due to inclement weather conditions) shall be paid at one and one-half times the hourly rate of wage. All hours worked on Sundays and holidays shall be paid at double the hourly rate of wage.

When an employee returns to work without at least eight (8) hours time off since their previous shift, all such time shall be a continuation of shift and paid at the applicable overtime rate until such time as the employee has had a break of eight (8) hours.

Overtime Codes Continued

4. X. All hours worked on Saturdays shall be paid at one and one-half times the hourly rate of wage. All hours worked on Sundays and holidays shall be paid at double the hourly rate of wage. Work performed outside the normal shift of 6 am to 6pm shall be paid at one and one-half the straight time rate, (except for special shifts or three shift operations). All work performed on Sundays and holidays shall be paid at double the hourly rate of wage. Shifts may be established when considered necessary by the Employer.

The Employer may establish shifts consisting of eight (8) or ten (10) hours of work (subject to WAC 296-127-022), that shall constitute a normal forty (40) hour work week. The Employer can change from a 5-eight to a 4-ten hour schedule or back to the other. All hours of work on these shifts shall be paid for at the straight time hourly rate. Work performed in excess of eight hours (or ten hours per day (subject to WAC 296-127-022) shall be paid at one and one-half the straight time rate.

When due to conditions beyond the control of the Employer, or when contract specifications require that work can only be performed outside the regular day shift, then by mutual agreement a special shift may be worked at the straight time rate, eight (8) hours work for eight (8) hours pay. The starting time shall be arranged to fit such conditions of work.

When an employee returns to work without at a break of eight (8) hours since their previous shift, all such time shall be a continuation of shift and paid at the applicable overtime rate until such time as the employee has had a break of eight (8) hours.

- Y. Work performed in excess of eight (8) hours of straight time per day, or ten (10) hours of straight time per day when four ten (10) hour shifts are established, or forty (40) hours of straight time per week, Monday through Friday, or outside the normal shift, and all work on Saturdays shall be paid at time and one-half the straight time rate. All work performed after 6:00 pm Saturday to 6:00 am Monday and holidays shall be paid at double the straight time rate of pay.

Any shift starting between the hours of 6:00 pm and midnight shall receive an additional one dollar (\$1.00) per hour for all hours worked that shift.

After an employee has worked eight (8) hours at an applicable overtime rate, all additional hours shall be at the applicable overtime rate until such time as the employee has had a break of eight (8) hours or more.

- Z. All hours worked between the hours of 6:00 pm and 6:00 am, Monday through Saturday, shall be paid at a premium rate of 20% over the hourly rate of wage. Work performed on Sundays may be paid at double time. All hours worked on holidays shall be paid at double the hourly rate of wage.

11. ALL HOURS WORKED IN EXCESS OF EIGHT (8) HOURS PER DAY OR FORTY (40) HOURS PER WEEK SHALL BE PAID AT ONE AND ONE-HALF TIMES THE HOURLY RATE OF WAGE.

- B After an employee has worked eight (8) hours, all additional hours worked shall be paid at the applicable overtime rate until such time as the employee has had a break of eight (8) hours or more.

- C The first two (2) hours after eight (8) regular hours Monday through Friday and the first eight (8) hours on Saturday shall be paid at one and one-half times the hourly rate of wage. All other overtime hours worked, except Labor Day, and all hours on Sunday shall be paid at double the hourly rate of wage. All hours worked on Labor Day shall be paid at three times the hourly rate of wage. All non-overtime and non-holiday hours worked between 4:00 pm and 5:00 am, Monday through Friday, shall be paid at a premium rate of 15% over the hourly rate of wage.

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- D. All hours worked on Saturdays and holidays shall be paid at one and one-half times the hourly rate of wage. All hours worked on Sundays shall be paid at double the hourly rate of wage.

After an employee has worked eight (8) hours, all additional hours worked shall be paid at the applicable overtime rate until such time as the employee has had a break of eight (8) hours or more.

- E. The first two (2) hours after eight (8) regular hours Monday through Friday, the first ten (10) hours on Saturday, and the first ten (10) hours worked on Holidays shall be paid at one and one-half times the hourly rate of wage. All hours worked over ten (10) hours Monday through Saturday, and Sundays shall be paid at double the hourly rate of wage.

After an employee has worked eight (8) hours, all additional hours worked shall be paid at the applicable overtime rate until such time as the employee has had a break of eight (8) hours or more.

Holiday Codes

5. A. Holidays: New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day, Friday after Thanksgiving Day, and Christmas Day (7).
- B. Holidays: New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day, Friday after Thanksgiving Day, the day before Christmas, and Christmas Day (8).
- C. Holidays: New Year's Day, Presidents' Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day, the Friday after Thanksgiving Day, And Christmas Day (8).
- D. Holidays: New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day, the Friday and Saturday after Thanksgiving Day, And Christmas Day (8).
- H. Holidays: New Year's Day, Memorial Day, Independence Day, Thanksgiving Day, the Day after Thanksgiving Day, And Christmas (6).
- I. Holidays: New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day, and Christmas Day (6).
- J. Holidays: New Year's Day, Memorial Day, Independence Day, Thanksgiving Day, Friday after Thanksgiving Day, Christmas Eve Day, And Christmas Day (7).
- K. Holidays: New Year's Day, Presidents' Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day, Friday After Thanksgiving Day, The Day Before Christmas, And Christmas Day (9).
- L. Holidays: New Year's Day, Martin Luther King Jr. Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day, Friday after Thanksgiving Day, And Christmas Day (8).
- N. Holidays: New Year's Day, Presidents' Day, Memorial Day, Independence Day, Labor Day, Veterans' Day, Thanksgiving Day, The Friday After Thanksgiving Day, And Christmas Day (9).
- P. Holidays: New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day, Friday And Saturday After Thanksgiving Day, The Day Before Christmas, And Christmas Day (9). If A Holiday Falls On Sunday, The Following Monday Shall Be Considered As A Holiday.
- Q. Paid Holidays: New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day, and Christmas Day (6).

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Holiday Codes Continued

- R. Paid Holidays: New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day, Day After Thanksgiving Day, One-Half Day Before Christmas Day, And Christmas Day. (7 1/2).
 - S. Paid Holidays: New Year's Day, Presidents' Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day, And Christmas Day (7).
 - Z. Holidays: New Year's Day, Memorial Day, Independence Day, Labor Day, Veterans Day, Thanksgiving Day, the Friday after Thanksgiving Day, And Christmas Day (8).
- 6.
- G. Paid Holidays: New Year's Day, Martin Luther King Jr. Day, Presidents' Day, Memorial Day, Independence Day, Labor Day, Veterans' Day, Thanksgiving Day, the Friday after Thanksgiving Day, Christmas Day, and Christmas Eve Day (11).
 - H. Paid Holidays: New Year's Day, New Year's Eve Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day, Friday After Thanksgiving Day, Christmas Day, The Day After Christmas, And A Floating Holiday (10).
 - T. Paid Holidays: New Year's Day, Presidents' Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day, The Friday After Thanksgiving Day, The Last Working Day Before Christmas Day, And Christmas Day (9).
 - Z. Holidays: New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day, Friday after Thanksgiving Day, And Christmas Day (7). If a holiday falls on Saturday, the preceding Friday shall be considered as the holiday. If a holiday falls on Sunday, the following Monday shall be considered as the holiday.
- 7.
- A. Holidays: New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day, the Friday and Saturday after Thanksgiving Day, And Christmas Day (8). Any Holiday Which Falls On A Sunday Shall Be Observed As A Holiday On The Following Monday. If any of the listed holidays falls on a Saturday, the preceding Friday shall be a regular work day.
 - B. Holidays: New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day, the Friday and Saturday after Thanksgiving Day, And Christmas Day (8). Any holiday which falls on a Sunday shall be observed as a holiday on the following Monday. Any holiday which falls on a Saturday shall be observed as a holiday on the preceding Friday.
 - C. Holidays: New Year's Day, Martin Luther King Jr. Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day, the Friday after Thanksgiving Day, And Christmas Day (8). Any holiday which falls on a Sunday shall be observed as a holiday on the following Monday. Any holiday which falls on a Saturday shall be observed as a holiday on the preceding Friday.
 - D. Paid Holidays: New Year's Day, Memorial Day, Independence Day, Labor Day, Veteran's Day, Thanksgiving Day, the Friday after Thanksgiving Day, And Christmas Day (8). Unpaid Holidays: President's Day. Any paid holiday which falls on a Sunday shall be observed as a holiday on the following Monday. Any paid holiday which falls on a Saturday shall be observed as a holiday on the preceding Friday.
 - E. Holidays: New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day, the Friday after Thanksgiving Day, And Christmas Day (7). Any holiday which falls on a Sunday shall be observed as a holiday on the following Monday. Any holiday which falls on a Saturday shall be observed as a holiday on the preceding Friday.

Holiday Codes Continued

7. F. Holidays: New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day, the Friday after Thanksgiving Day, the last working day before Christmas day and Christmas day (8). Any holiday which falls on a Sunday shall be observed as a holiday on the following Monday. Any holiday which falls on a Saturday shall be observed as a holiday on the preceding Friday.
- G. Holidays: New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day, and Christmas Day (6). Any holiday which falls on a Sunday shall be observed as a holiday on the following Monday.
- H. Holidays: New Year's Day, Martin Luther King Jr. Day, Independence Day, Memorial Day, Labor Day, Thanksgiving Day, the Friday after Thanksgiving Day, the Last Working Day before Christmas Day and Christmas Day (9). Any holiday which falls on a Sunday shall be observed as a holiday on the following Monday. Any holiday which falls on a Saturday shall be observed as a holiday on the preceding Friday.
- I. Holidays: New Year's Day, President's Day, Independence Day, Memorial Day, Labor Day, Thanksgiving Day, The Friday After Thanksgiving Day, The Day Before Christmas Day And Christmas Day (9). Any holiday which falls on a Sunday shall be observed as a holiday on the following Monday. Any holiday which falls on a Saturday shall be observed as a holiday on the preceding Friday.
- J. Holidays: New Year's Day, Independence Day, Memorial Day, Labor Day, Thanksgiving Day and Christmas Day (6). Any holiday which falls on a Sunday shall be observed as a holiday on the following Monday. Any holiday which falls on a Saturday shall be observed as a holiday on the preceding Friday.
- K. Holidays: New Year's Day, Memorial Day, Independence Day, Thanksgiving Day, the Friday and Saturday after Thanksgiving Day, And Christmas Day (8). Any holiday which falls on a Sunday shall be observed as a holiday on the following Monday. Any holiday which falls on a Saturday shall be observed as a holiday on the preceding Friday.
- L. Holidays: New Year's Day, Memorial Day, Labor Day, Independence Day, Thanksgiving Day, the Last Work Day before Christmas Day, And Christmas Day (7). Any holiday which falls on a Sunday shall be observed as a holiday on the following Monday. Any holiday which falls on a Saturday shall be observed as a holiday on the preceding Friday.
- N. Holidays: New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day, the Friday after Thanksgiving Day, And Christmas Day (7). Any holiday which falls on a Sunday shall be observed as a holiday on the following Monday. When Christmas falls on a Saturday, the preceding Friday shall be observed as a holiday.
- P. Holidays: New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day, Friday after Thanksgiving Day, And Christmas Day (7). Any holiday which falls on a Sunday shall be observed as a holiday on the following Monday.
- Q. Holidays: New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day, the Friday after Thanksgiving Day, the Last Working Day before Christmas Day and Christmas Day (8). Any holiday which falls on a Sunday shall be observed as a holiday on the following Monday. If any of the listed holidays falls on a Saturday, the preceding Friday shall be a regular work day.
- S. Paid Holidays: New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day, Friday after Thanksgiving Day, Christmas Day, the Day after Christmas, and A Floating Holiday (9). If any of the listed holidays falls on a Sunday, the day observed by the Nation shall be considered a holiday and compensated accordingly.
- V. Holidays: New Year's Day, President's Birthday, Memorial Day, Independence Day, Labor Day, Thanksgiving Day, the Friday after Thanksgiving Day, Christmas Day, the day before or after Christmas, and the day before or after New Year's Day. If any of the above listed holidays falls on a Sunday, the day observed by the Nation shall be considered a holiday and compensated accordingly.

Holiday Codes Continued

7. W. Holidays: New Year's Day, Day After New Year's, Memorial Day, Independence Day, Labor Day, Thanksgiving Day, the Friday after Thanksgiving Day, Christmas Eve Day, Christmas Day, the day after Christmas, the day before New Year's Day, and a Floating Holiday.
- X. Holidays: New Year's Day, Day before or after New Year's Day, Presidents' Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day, the Friday after Thanksgiving Day, Christmas Day, and the day before or after Christmas day. If a holiday falls on a Saturday or on a Friday that is the normal day off, then the holiday will be taken on the last normal workday. If the holiday falls on a Monday that is the normal day off or on a Sunday, then the holiday will be taken on the next normal workday.
- Y. Holidays: New Year's Day, Presidents' Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day, the Friday after Thanksgiving Day, and Christmas Day. (8) If the holiday falls on a Sunday, then the day observed by the federal government shall be considered a holiday and compensated accordingly.
- G. New Year's Day, Washington's Birthday, Memorial Day, Independence Day, Labor Day, Thanksgiving Day, The Friday After Thanksgiving Day, the last scheduled workday before Christmas, and Christmas Day (9). If any of the listed holidays falls on a Sunday, the day observed by the Nation shall be considered a holiday and compensated accordingly.
- H. Holidays: New Year's Day, Martin Luther King Jr. Day, Independence Day, Memorial Day, Labor Day, Thanksgiving Day, the Friday after Thanksgiving Day, the Last Working Day before Christmas Day and Christmas Day (9). Any holiday which falls on a Sunday shall be observed as a holiday on the following Monday. Any holiday which falls on a Saturday shall be observed as a holiday on the preceding Friday.
- I. Holidays: New Year's Day, President's Day, Independence Day, Memorial Day, Labor Day, Thanksgiving Day, The Friday After Thanksgiving Day, The Day Before Christmas Day And Christmas Day (9). Any holiday which falls on a Sunday shall be observed as a holiday on the following Monday. Any holiday which falls on a Saturday shall be observed as a holiday on the preceding Friday.
- J. Holidays: New Year's Day, Independence Day, Memorial Day, Labor Day, Thanksgiving Day and Christmas Day (6). Any holiday which falls on a Sunday shall be observed as a holiday on the following Monday. Any holiday which falls on a Saturday shall be observed as a holiday on the preceding Friday.
- K. Holidays: New Year's Day, Memorial Day, Independence Day, Thanksgiving Day, the Friday and Saturday after Thanksgiving Day, And Christmas Day (8). Any holiday which falls on a Sunday shall be observed as a holiday on the following Monday. Any holiday which falls on a Saturday shall be observed as a holiday on the preceding Friday.
- L. Holidays: New Year's Day, Memorial Day, Labor Day, Independence Day, Thanksgiving Day, the Last Work Day before Christmas Day, And Christmas Day (7). Any holiday which falls on a Sunday shall be observed as a holiday on the following Monday. Any holiday which falls on a Saturday shall be observed as a holiday on the preceding Friday.
- N. Holidays: New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day, the Friday after Thanksgiving Day, And Christmas Day (7). Any holiday which falls on a Sunday shall be observed as a holiday on the following Monday. When Christmas falls on a Saturday, the preceding Friday shall be observed as a holiday.
- P. Holidays: New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day, Friday after Thanksgiving Day, And Christmas Day (7). Any holiday which falls on a Sunday shall be observed as a holiday on the following Monday.

Holiday Codes Continued

7. Q. Holidays: New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day, the Friday after Thanksgiving Day, the Last Working Day before Christmas Day and Christmas Day (8). Any holiday which falls on a Sunday shall be observed as a holiday on the following Monday. If any of the listed holidays falls on a Saturday, the preceding Friday shall be a regular work day.
- S. Paid Holidays: New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day, Friday after Thanksgiving Day, Christmas Day, the Day after Christmas, and A Floating Holiday (9). If any of the listed holidays falls on a Sunday, the day observed by the Nation shall be considered a holiday and compensated accordingly.
- V. Holidays: New Year's Day, President's Birthday, Memorial Day, Independence Day, Labor Day, Thanksgiving Day, the Friday after Thanksgiving Day, Christmas Day, the day before or after Christmas, and the day before or after New Year's Day. If any of the above listed holidays falls on a Sunday, the day observed by the Nation shall be considered a holiday and compensated accordingly.
- W. Holidays: New Year's Day, Day After New Year's, Memorial Day, Independence Day, Labor Day, Thanksgiving Day, the Friday after Thanksgiving Day, Christmas Eve Day, Christmas Day, the day after Christmas, the day before New Year's Day, and a Floating Holiday.
- X. Holidays: New Year's Day, Day before or after New Year's Day, Presidents' Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day, the Friday after Thanksgiving Day, Christmas Day, and the day before or after Christmas day. If a holiday falls on a Saturday or on a Friday that is the normal day off, then the holiday will be taken on the last normal workday. If the holiday falls on a Monday that is the normal day off or on a Sunday, then the holiday will be taken on the next normal workday.
- Y. Holidays: New Year's Day, Presidents' Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day, the Friday after Thanksgiving Day, and Christmas Day. (8) If the holiday falls on a Sunday, then the day observed by the federal government shall be considered a holiday and compensated accordingly.
15. G. New Year's Day, Washington's Birthday, Memorial Day, Independence Day, Labor Day, Thanksgiving Day, The Friday After Thanksgiving Day, the last scheduled workday before Christmas, and Christmas Day (9). If any of the listed holidays falls on a Sunday, the day observed by the Nation shall be considered a holiday and compensated accordingly.
- H. Holidays: New Year's Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day, Friday after Thanksgiving Day, Christmas Eve Day, and Christmas Day (8). When the following holidays fall on a Saturday (New Year's Day, Independence Day, and Christmas Day) the preceding Friday will be considered as the holiday; should they fall on a Sunday, the following Monday shall be considered as the holiday.
- I. Holidays: New Year's Day, President's Day, Memorial Day, Labor Day, Thanksgiving Day, the Friday after Thanksgiving Day, Christmas Day, the last regular workday before Christmas (8). Any holiday which falls on a Sunday shall be observed as a holiday on the following Monday.

Benefit Code Key – Effective 9/1/2021 thru 3/2/2022

Note Codes

8. D. Workers working with supplied air on hazmat projects receive an additional \$1.00 per hour.
- L. Workers on hazmat projects receive additional hourly premiums as follows -Level A: \$0.75, Level B: \$0.50, And Level C: \$0.25.
- M. Workers on hazmat projects receive additional hourly premiums as follows: Levels A & B: \$1.00, Levels C & D: \$0.50.
- N. Workers on hazmat projects receive additional hourly premiums as follows -Level A: \$1.00, Level B: \$0.75, Level C: \$0.50, And Level D: \$0.25.
- S. Effective August 31, 2012 – A Traffic Control Supervisor shall be present on the project whenever flagging or spotting or other traffic control labor is being utilized. Flaggers and Spotters shall be posted where shown on approved Traffic Control Plans or where directed by the Engineer. All flaggers and spotters shall possess a current flagging card issued by the State of Washington, Oregon, Montana, or Idaho. This classification is only effective on or after August 31, 2012.
- T. Effective August 31, 2012 – A Traffic Control Laborer performs the setup, maintenance and removal of all temporary traffic control devices and construction signs necessary to control vehicular, bicycle, and pedestrian traffic during construction operations. Flaggers and Spotters shall be posted where shown on approved Traffic Control Plans or where directed by the Engineer. All flaggers and spotters shall possess a current flagging card issued by the State of Washington, Oregon, Montana, or Idaho. This classification is only effective on or after August 31, 2012.
- U. Workers on hazmat projects receive additional hourly premiums as follows – Class A Suit: \$2.00, Class B Suit: \$1.50, And Class C Suit: \$1.00. Workers performing underground work receive an additional \$0.40 per hour for any and all work performed underground, including operating, servicing and repairing of equipment. The premium for underground work shall be paid for the entire shift worked. Workers who work suspended by a rope or cable receive an additional \$0.50 per hour. The premium for work suspended shall be paid for the entire shift worked. Workers who do “pioneer” work (break open a cut, build road, etc.) more than one hundred fifty (150) feet above grade elevation receive an additional \$0.50 per hour.
- V. In addition to the hourly wage and fringe benefits, the following depth and enclosure premiums shall be paid. The premiums are to be calculated for the maximum depth and distance into an enclosure that a diver reaches in a day. The premiums are to be paid one time for the day and are not used in calculating overtime pay.
- Depth premiums apply to depths of fifty feet or more. Over 50' to 100' - \$2.00 per foot for each foot over 50 feet. Over 101' to 150' - \$3.00 per foot for each foot over 101 feet. Over 151' to 220' - \$4.00 per foot for each foot over 220 feet. Over 221' - \$5.00 per foot for each foot over 221 feet.
- Enclosure premiums apply when divers enter enclosures (such as pipes or tunnels) where there is no vertical ascent and is measured by the distance travelled from the entrance. 25' to 300' - \$1.00 per foot from entrance. 300' to 600' - \$1.50 per foot beginning at 300'. Over 600' - \$2.00 per foot beginning at 600'.
- W. Meter Installers work on single phase 120/240V self-contained residential meters. The Lineman/Groundmen rates would apply to meters not fitting this description.

Note Codes Continued

8. X. Workers on hazmat projects receive additional hourly premiums as follows - Class A Suit: \$2.00, Class B Suit: \$1.50, Class C Suit: \$1.00, and Class D Suit: \$0.50. Special Shift Premium: Basic hourly rate plus \$2.00 per hour.

When due to conditions beyond the control of the Employer or when an owner (not acting as the contractor), a government agency or the contract specifications requires that work can only be performed outside the normal 5 am to 6pm shift, then the special shift premium will be applied to the basic hourly rate. When an employee works on a special shift, they shall be paid a special shift premium for each hour worked unless they are in OT or Double-time status. (For example, the special shift premium does not waive the overtime requirements for work performed on Saturday or Sunday.)

Tide Work: When employees are called out between the hours of 6:00 p.m. and 6:00 a.m. to work on tide work (work located in the tide plane) all time worked shall be at one and one-half times the hourly rate of pay.

Swinging Stage/Boatswains Chair: Employees working on a swinging state or boatswains chair or under conditions that require them to be tied off to allow their hands to be free shall receive seventy-five cents (\$0.75) per hour above the classification rate.

- Z. Workers working with supplied air on hazmat projects receive an additional \$1.00 per hour.

Special Shift Premium: Basic hourly rate plus \$2.00 per hour. When due to conditions beyond the control of the Employer or when an owner (not acting as a contractor), a government agency or the contract specifications require that more than (4) hours of a special shift can only be performed outside the normal 6 am to 6pm shift, then the special shift premium will be applied to the basic straight time for the entire shift. When an employee works on a special shift, they will be paid a special shift premium for each hour worked unless they are in overtime or double-time status. (For example, the special shift premium does not waive the overtime requirements for work performed on Saturday or Sunday.)

9. A. Workers working with supplied air on hazmat projects receive an additional \$1.00 per hour.

Special Shift Premium: Basic hourly rate plus \$2.00 per hour. When due to conditions beyond the control of the Employer or when an owner (not acting as the contractor), a government agency or the contract specifications require that more than four (4) hours of a special shift can only be performed outside the normal 6 am to 6pm shift, then the special shift premium will be applied to the basic straight time for the entire shift. When an employee works on a special shift, they shall be paid a special shift premium for each hour worked unless they are in overtime or double-time status. (For example, the special shift premium does not waive the overtime requirements for work performed on Saturday or Sunday.)

Certified Crane Operator Premium: Crane operators requiring certifications shall be paid \$0.50 per hour above their classification rate.

Boom Pay Premium: All cranes including tower shall be paid as follows based on boom length:

(A) – 130' to 199' – \$0.50 per hour over their classification rate.

(B) – 200' to 299' – \$0.80 per hour over their classification rate.

(C) – 300' and over – \$1.00 per hour over their classification rate.

Note Codes Continued

9. B. The highest pressure registered on the gauge for an accumulated time of more than fifteen (15) minutes during the shift shall be used in determining the scale paid.

Tide Work: When employees are called out between the hours of 6:00 p.m. and 6:00 a.m. to work on tide work (work located in the tide plane) all time worked shall be at one and one-half times the hourly rate of pay. Swinging Stage/Boatswains Chair: Employees working on a swinging stage or boatswains chair or under conditions that require them to be tied off to allow their hands to be free shall receive seventy-five cents (\$0.75) per hour above the classification rate.

- C. Tide Work: When employees are called out between the hours of 6:00 p.m. and 6:00 a.m. to work on tide work (work located in the tide plane) all time worked shall be at one and one-half times the hourly rate of pay. Swinging Stage/Boatswains Chair: Employees working on a swinging stage or boatswains chair or under conditions that require them to be tied off to allow their hands to be free shall receive seventy-five cents (\$0.75) per hour above the classification rate.

Effective August 31, 2012 – A Traffic Control Supervisor shall be present on the project whenever flagging or spotting or other traffic control labor is being utilized. A Traffic Control Laborer performs the setup, maintenance and removal of all temporary traffic control devices and construction signs necessary to control vehicular, bicycle, and pedestrian traffic during construction operations. Flaggers and Spotters shall be posted where shown on approved Traffic Control Plans or where directed by the Engineer. All flaggers and spotters shall possess a current flagging card issued by the State of Washington, Oregon, Montana, or Idaho. These classifications are only effective on or after August 31, 2012.

- D. Industrial Painter wages are required for painting within industrial facilities such as treatment plants, pipelines, towers, dams, bridges, power generation facilities and manufacturing facilities such as chemical plants, etc., or anywhere abrasive blasting is necessary to prepare surfaces, or hazardous materials encapsulation is required.
- E. Heavy Construction includes construction, repair, alteration or additions to the production, fabrication or manufacturing portions of industrial or manufacturing plants, hydroelectric or nuclear power plants and atomic reactor construction. Workers on hazmat projects receive additional hourly premiums as follows -Level A: \$1.00, Level B: \$0.75, Level C: \$0.50, And Level D: \$0.25.
- F. Industrial Painter wages are required for painting within industrial facilities such as treatment plants, pipelines, towers, dams, power generation facilities and manufacturing facilities such as chemical plants, etc., or anywhere abrasive blasting is necessary to prepare surfaces, or hazardous materials encapsulation is required.

State of Washington
 Department of Labor & Industries
 Prevailing Wage Section - Telephone 360-902-5335
 PO Box 44540, Olympia, WA 98504-4540

Washington State Prevailing Wage

The PREVAILING WAGES listed here include both the hourly wage rate and the hourly rate of fringe benefits. On public works projects, worker's wage and benefit rates must add to not less than this total. A brief description of overtime calculation requirements are provided on the Benefit Code Key.

Journey Level Prevailing Wage Rates for the Effective Date: 9/23/2021

<u>County</u>	<u>Trade</u>	<u>Job Classification</u>	<u>Wage</u>	<u>Holiday</u>	<u>Overtime</u>	<u>Note</u>	<u>*Risk Class</u>
Chelan	Asbestos Abatement Workers	Journey Level	\$44.12	<u>5D</u>	<u>1H</u>		View
Chelan	Boilermakers	Journey Level	\$70.79	<u>5N</u>	<u>1C</u>		View
Chelan	Brick Mason	Journey Level	\$53.34	<u>5A</u>	<u>1M</u>		View
Chelan	Building Service Employees	Janitor	\$13.69		<u>1</u>		View
Chelan	Building Service Employees	Shampooer	\$13.69		<u>1</u>		View
Chelan	Building Service Employees	Waxer	\$13.69		<u>1</u>		View
Chelan	Building Service Employees	Window Cleaner	\$13.69		<u>1</u>		View
Chelan	Cabinet Makers (In Shop)	Journey Level	\$22.09		<u>1</u>		View
Chelan	Carpenters	Acoustical Worker	\$51.25	<u>7E</u>	4X	<u>8N</u>	View
Chelan	Carpenters	Bridge, Dock And Wharf Carpenters	\$64.94	<u>7A</u>	<u>4C</u>		View
Chelan	Carpenters	Floor Layer & Floor Finisher	\$51.25	<u>7E</u>	4X	<u>8N</u>	View
Chelan	Carpenters	Form Builder	\$51.25	<u>7E</u>	4X	<u>8N</u>	View
Chelan	Carpenters	General Carpenter	\$51.25	<u>7E</u>	4X	<u>8N</u>	View
Chelan	Carpenters	Heavy Construction Carpenter	\$56.71	<u>7E</u>	4X	<u>9E</u>	View
Chelan	Carpenters	Scaffold/Shoring Erecting & Dismantling	\$56.71	<u>7E</u>	4X	<u>8N</u>	View
Chelan	Cement Masons	Journey Level	\$46.83	<u>7B</u>	<u>1N</u>		View
Chelan	Divers & Tenders	Bell/Vehicle or Submersible Operator (Not Under Pressure)	\$118.80	<u>7A</u>	<u>4C</u>		View
Chelan	Divers & Tenders	Dive Supervisor/Master	\$81.98	<u>7A</u>	<u>4C</u>		View
Chelan	Divers & Tenders	Diver	\$118.80	<u>7A</u>	<u>4C</u>	<u>8V</u>	View
Chelan	Divers & Tenders	Diver On Standby	\$76.98	<u>7A</u>	<u>4C</u>		View
Chelan	Divers & Tenders	Diver Tender	\$69.91	<u>7A</u>	<u>4C</u>		View
Chelan	Divers & Tenders	Manifold Operator	\$69.91	<u>7A</u>	<u>4C</u>		View

Chelan	Divers & Tenders	Manifold Operator Mixed Gas	\$74.91	7A	4C		View
Chelan	Divers & Tenders	Remote Operated Vehicle Operator/Technician	\$69.91	7A	4C		View
Chelan	Divers & Tenders	Remote Operated Vehicle Tender	\$65.19	7A	4C		View
Chelan	Dredge Workers	Assistant Engineer	\$73.62	5D	3F		View
Chelan	Dredge Workers	Assistant Mate (Deckhand)	\$73.05	5D	3F		View
Chelan	Dredge Workers	Boatmen	\$73.62	5D	3F		View
Chelan	Dredge Workers	Engineer Welder	\$75.03	5D	3F		View
Chelan	Dredge Workers	Leverman, Hydraulic	\$76.53	5D	3F		View
Chelan	Dredge Workers	Mates	\$73.62	5D	3F		View
Chelan	Dredge Workers	Oiler	\$73.05	5D	3F		View
Chelan	Drywall Applicator	Journey Level	\$51.25	7E	4X	8N	View
Chelan	Drywall Tapers	Journey Level	\$46.18	7E	1P		View
Chelan	Electrical Fixture Maintenance Workers	Journey Level	\$13.69		1		View
Chelan	Electricians - Inside	Cable Splicer	\$81.21	7H	1E		View
Chelan	Electricians - Inside	Construction Stock Person	\$40.04	7H	1D		View
Chelan	Electricians - Inside	Journey Level	\$76.12	7H	1E		View
Chelan	Electricians - Motor Shop	Craftsman	\$15.37		1		View
Chelan	Electricians - Motor Shop	Journey Level	\$14.69		1		View
Chelan	Electricians - Powerline Construction	Cable Splicer	\$82.39	5A	4D		View
Chelan	Electricians - Powerline Construction	Certified Line Welder	\$75.64	5A	4D		View
Chelan	Electricians - Powerline Construction	Groundperson	\$49.17	5A	4D		View
Chelan	Electricians - Powerline Construction	Heavy Line Equipment Operator	\$75.64	5A	4D		View
Chelan	Electricians - Powerline Construction	Journey Level Lineperson	\$75.64	5A	4D		View
Chelan	Electricians - Powerline Construction	Line Equipment Operator	\$64.54	5A	4D		View
Chelan	Electricians - Powerline Construction	Meter Installer	\$49.17	5A	4D	8W	View
Chelan	Electricians - Powerline Construction	Pole Sprayer	\$75.64	5A	4D		View
Chelan	Electricians - Powerline Construction	Powderperson	\$56.49	5A	4D		View
Chelan	Electronic Technicians	Electronic Technicians Journey Level	\$47.28	5B	1B		View
Chelan	Elevator Constructors	Mechanic	\$100.51	7D	4A		View
Chelan	Elevator Constructors	Mechanic In Charge	\$108.53	7D	4A		View
Chelan	Fabricated Precast Concrete Products	Journey Level	\$13.69		1		View
Chelan	Fabricated Precast Concrete Products	Journey Level - In-Factory Work Only	\$13.69		1		View
Chelan	Fence Erectors	Fence Erector	\$41.44	7A	4V	8Y	View
Chelan	Fence Erectors	Fence Laborer	\$41.44	7A	4V	8Y	View
Chelan	Flaggers	Journey Level	\$41.44	7A	4V	8Y	View
Chelan	Glaziers	Journey Level	\$35.56	7L	4L		View
Chelan	Heat & Frost Insulators And Asbestos Workers	Journey Level	\$82.02	15H	11C		View
Chelan	Heating Equipment Mechanics	Journey Level	\$61.36	6Z	1B		View
Chelan	Hod Carriers & Mason Tenders	Journey Level	\$46.42	7A	4V	8Y	View

Chelan	Industrial Power Vacuum Cleaner	Journey Level	\$13.69		<u>1</u>		View
Chelan	Inland Boatmen	Journey Level	\$13.69		<u>1</u>		View
Chelan	Inspection/Cleaning/Sealing Of Sewer & Water Systems By Remote Control	Cleaner Operator, Foamer Operator	\$13.69		<u>1</u>		View
Chelan	Inspection/Cleaning/Sealing Of Sewer & Water Systems By Remote Control	Grout Truck Operator	\$13.69		<u>1</u>		View
Chelan	Inspection/Cleaning/Sealing Of Sewer & Water Systems By Remote Control	Head Operator	\$13.69		<u>1</u>		View
Chelan	Inspection/Cleaning/Sealing Of Sewer & Water Systems By Remote Control	Technician	\$13.69		<u>1</u>		View
Chelan	Inspection/Cleaning/Sealing Of Sewer & Water Systems By Remote Control	Tv Truck Operator	\$13.69		<u>1</u>		View
Chelan	Insulation Applicators	Journey Level	\$51.25	<u>7E</u>	<u>4X</u>	<u>8N</u>	View
Chelan	Ironworkers	Journeyman	\$65.91	<u>7N</u>	<u>1O</u>		View
Chelan	Laborers	Erosion Control Worker	\$44.12	<u>7A</u>	<u>4V</u>	<u>8Y</u>	View
Chelan	Laborers	Air, Gas Or Electric Vibrating Screed	\$44.12	<u>7A</u>	<u>4V</u>	<u>8Y</u>	View
Chelan	Laborers	Airtrac Drill Operator	\$45.42	<u>7A</u>	<u>4V</u>	<u>8Y</u>	View
Chelan	Laborers	Ballast Regular Machine	\$44.12	<u>7A</u>	<u>4V</u>	<u>8Y</u>	View
Chelan	Laborers	Batch Weighman	\$41.44	<u>7A</u>	<u>4V</u>	<u>8Y</u>	View
Chelan	Laborers	Brick Pavers	\$44.12	<u>7A</u>	<u>4V</u>	<u>8Y</u>	View
Chelan	Laborers	Brush Cutter	\$44.12	<u>7A</u>	<u>4V</u>	<u>8Y</u>	View
Chelan	Laborers	Brush Hog Feeder	\$44.12	<u>7A</u>	<u>4V</u>	<u>8Y</u>	View
Chelan	Laborers	Burner	\$44.12	<u>7A</u>	<u>4V</u>	<u>8Y</u>	View
Chelan	Laborers	Caisson Worker	\$45.42	<u>7A</u>	<u>4V</u>	<u>8Y</u>	View
Chelan	Laborers	Carpenter Tender	\$44.12	<u>7A</u>	<u>4V</u>	<u>8Y</u>	View
Chelan	Laborers	Cement Dumper-paving	\$44.87	<u>7A</u>	<u>4V</u>	<u>8Y</u>	View
Chelan	Laborers	Cement Finisher Tender	\$44.12	<u>7A</u>	<u>4V</u>	<u>8Y</u>	View
Chelan	Laborers	Change House Or Dry Shack	\$44.12	<u>7A</u>	<u>4V</u>	<u>8Y</u>	View
Chelan	Laborers	Chipping Gun (30 Lbs. And Over)	\$44.87	<u>7A</u>	<u>4V</u>	<u>8Y</u>	View
Chelan	Laborers	Chipping Gun (Under 30 Lbs.)	\$44.12	<u>7A</u>	<u>4V</u>	<u>8Y</u>	View
Chelan	Laborers	Choker Setter	\$44.12	<u>7A</u>	<u>4V</u>	<u>8Y</u>	View
Chelan	Laborers	Chuck Tender	\$44.12	<u>7A</u>	<u>4V</u>	<u>8Y</u>	View
Chelan	Laborers	Clary Power Spreader	\$44.87	<u>7A</u>	<u>4V</u>	<u>8Y</u>	View
Chelan	Laborers	Clean-up Laborer	\$44.12	<u>7A</u>	<u>4V</u>	<u>8Y</u>	View
Chelan	Laborers	Concrete Dumper/Chute Operator	\$44.87	<u>7A</u>	<u>4V</u>	<u>8Y</u>	View
Chelan	Laborers	Concrete Form Stripper	\$44.12	<u>7A</u>	<u>4V</u>	<u>8Y</u>	View
Chelan	Laborers	Concrete Placement Crew	\$44.87	<u>7A</u>	<u>4V</u>	<u>8Y</u>	View
Chelan	Laborers	Concrete Saw Operator/Core Driller	\$44.87	<u>7A</u>	<u>4V</u>	<u>8Y</u>	View
Chelan	Laborers	Crusher Feeder	\$41.44	<u>7A</u>	<u>4V</u>	<u>8Y</u>	View
Chelan	Laborers	Curing Laborer	\$44.12	<u>7A</u>	<u>4V</u>	<u>8Y</u>	View

Chelan	Laborers	Demolition: Wrecking & Moving (Incl. Charred Material)	\$44.12	7A	4V	8Y	View
Chelan	Laborers	Ditch Digger	\$44.12	7A	4V	8Y	View
Chelan	Laborers	Diver	\$45.42	7A	4V	8Y	View
Chelan	Laborers	Drill Operator (Hydraulic, Diamond)	\$44.87	7A	4V	8Y	View
Chelan	Laborers	Dry Stack Walls	\$44.12	7A	4V	8Y	View
Chelan	Laborers	Dump Person	\$44.12	7A	4V	8Y	View
Chelan	Laborers	Epoxy Technician	\$44.12	7A	4V	8Y	View
Chelan	Laborers	Faller & Bucker Chain Saw	\$44.87	7A	4V	8Y	View
Chelan	Laborers	Fine Graders	\$44.12	7A	4V	8Y	View
Chelan	Laborers	Firewatch	\$41.44	7A	4V	8Y	View
Chelan	Laborers	Form Setter	\$44.12	7A	4V	8Y	View
Chelan	Laborers	Gabian Basket Building	\$44.12	7A	4V	8Y	View
Chelan	Laborers	Gaurdrail Erector	\$44.12	7A	4V	8Y	View
Chelan	Laborers	General Laborer	\$44.12	7A	4V	8Y	View
Chelan	Laborers	Grade Checker & Transit Person	\$46.42	7A	4V	8Y	View
Chelan	Laborers	Grinders	\$44.12	7A	4V	8Y	View
Chelan	Laborers	Grout Machine Tender	\$44.12	7A	4V	8Y	View
Chelan	Laborers	Groutmen (Pressure) Including Post Tension Beams	\$44.87	7A	4V	8Y	View
Chelan	Laborers	Hazardous Waste Worker (Level A)	\$45.42	7A	4V	8Y	View
Chelan	Laborers	Hazardous Waste Worker (Level B)	\$44.87	7A	4V	8Y	View
Chelan	Laborers	Hazardous Waste Worker (Level C)	\$44.12	7A	4V	8Y	View
Chelan	Laborers	High Scaler	\$45.42	7A	4V	8Y	View
Chelan	Laborers	Jackhammer	\$44.87	7A	4V	8Y	View
Chelan	Laborers	Laserbeam Operator	\$44.87	7A	4V	8Y	View
Chelan	Laborers	Maintenance Person	\$44.12	7A	4V	8Y	View
Chelan	Laborers	Manhole Builder-Mudman	\$44.87	7A	4V	8Y	View
Chelan	Laborers	Material Yard Person	\$44.12	7A	4V	8Y	View
Chelan	Laborers	Motorman-Dinky Locomotive	\$44.87	7A	4V	8Y	View
Chelan	Laborers	Nozzleman (Concrete Pump, Green Cutter When Using Combination Of High Pressure Air & Water On Concrete & Rock, Sandblast, Gunite, Shotcrete, Water Blaster, Vacuum Blaster)	\$46.42	7A	4V	8Y	View
Chelan	Laborers	Pavement Breaker	\$44.87	7A	4V	8Y	View
Chelan	Laborers	Pilot Car	\$41.44	7A	4V	8Y	View
Chelan	Laborers	Pipe Layer (Lead)	\$46.42	7A	4V	8Y	View
Chelan	Laborers	Pipe Layer/Tailor	\$44.87	7A	4V	8Y	View
Chelan	Laborers	Pipe Pot Tender	\$44.87	7A	4V	8Y	View
Chelan	Laborers	Pipe Reliner	\$44.87	7A	4V	8Y	View

Chelan	Laborers	Pipe Wrapper	\$44.87	7A	4V	8Y	View
Chelan	Laborers	Pot Tender	\$44.12	7A	4V	8Y	View
Chelan	Laborers	Powderman	\$45.42	7A	4V	8Y	View
Chelan	Laborers	Powderman's Helper	\$44.12	7A	4V	8Y	View
Chelan	Laborers	Power Jacks	\$44.87	7A	4V	8Y	View
Chelan	Laborers	Railroad Spike Puller - Power	\$44.87	7A	4V	8Y	View
Chelan	Laborers	Raker - Asphalt	\$46.42	7A	4V	8Y	View
Chelan	Laborers	Re-timberman	\$45.42	7A	4V	8Y	View
Chelan	Laborers	Remote Equipment Operator	\$44.87	7A	4V	8Y	View
Chelan	Laborers	Rigger/Signal Person	\$44.87	7A	4V	8Y	View
Chelan	Laborers	Rip Rap Person	\$44.12	7A	4V	8Y	View
Chelan	Laborers	Rivet Buster	\$44.87	7A	4V	8Y	View
Chelan	Laborers	Rodder	\$44.87	7A	4V	8Y	View
Chelan	Laborers	Scaffold Erector	\$44.12	7A	4V	8Y	View
Chelan	Laborers	Scale Person	\$44.12	7A	4V	8Y	View
Chelan	Laborers	Sloper (Over 20")	\$44.87	7A	4V	8Y	View
Chelan	Laborers	Sloper Sprayer	\$44.12	7A	4V	8Y	View
Chelan	Laborers	Spreader (Concrete)	\$44.87	7A	4V	8Y	View
Chelan	Laborers	Stake Hopper	\$44.12	7A	4V	8Y	View
Chelan	Laborers	Stock Piler	\$44.12	7A	4V	8Y	View
Chelan	Laborers	Tamper & Similar Electric, Air & Gas Operated Tools	\$44.87	7A	4V	8Y	View
Chelan	Laborers	Tamper (Multiple & Self-propelled)	\$44.87	7A	4V	8Y	View
Chelan	Laborers	Timber Person - Sewer (Lagger, Shorer & Cribber)	\$44.87	7A	4V	8Y	View
Chelan	Laborers	Toolroom Person (at Jobsite)	\$44.12	7A	4V	8Y	View
Chelan	Laborers	Topper	\$44.12	7A	4V	8Y	View
Chelan	Laborers	Track Laborer	\$44.12	7A	4V	8Y	View
Chelan	Laborers	Track Liner (Power)	\$44.87	7A	4V	8Y	View
Chelan	Laborers	Traffic Control Laborer	\$43.92	7A	4V	9C	View
Chelan	Laborers	Traffic Control Supervisor	\$46.86	7A	4V	9C	View
Chelan	Laborers	Truck Spotter	\$44.12	7A	4V	8Y	View
Chelan	Laborers	Tugger Operator	\$44.87	7A	4V	8Y	View
Chelan	Laborers	Tunnel Work-Guage and Lock Tender	\$46.52	7A	4V	8Y	View
Chelan	Laborers	Tunnel Work-Guage and Lock Tender	\$46.52	7A	4V	8Y	View
Chelan	Laborers	Vibrator	\$44.87	7A	4V	8Y	View
Chelan	Laborers	Vinyl Seamer	\$44.12	7A	4V	8Y	View
Chelan	Laborers	Watchmen	\$37.80	7A	4V	8Y	View
Chelan	Laborers	Welder	\$44.87	7A	4V	8Y	View

Chelan	Laborers	Well Point Laborer	\$44.87	7A	4V	8Y	View
Chelan	Laborers	Window Washer/Cleaner	\$37.80	7A	4V	8Y	View
Chelan	Laborers - Underground Sewer & Water	General Laborer & Topman	\$44.12	7A	4V	8Y	View
Chelan	Laborers - Underground Sewer & Water	Pipe Layer	\$44.87	7A	4V	8Y	View
Chelan	Landscape Construction	Landscape Construction/landscaping Or Planting Laborers	\$37.80	7A	4V	8Y	View
Chelan	Landscape Construction	Landscape Operator	\$69.33	7A	3K	8X	View
Chelan	Landscape Maintenance	Groundskeeper	\$13.69		1		View
Chelan	Lathers	Journey Level	\$51.25	7E	4X	8N	View
Chelan	Marble Setters	Journey Level	\$53.34	5A	1M		View
Chelan	Metal Fabrication (In Shop)	Fitter	\$15.04		1		View
Chelan	Metal Fabrication (In Shop)	Laborer	\$13.69		1		View
Chelan	Metal Fabrication (In Shop)	Machine Operator	\$13.69		1		View
Chelan	Metal Fabrication (In Shop)	Painter	\$13.69		1		View
Chelan	Metal Fabrication (In Shop)	Welder	\$13.69		1		View
Chelan	Millwright	Journey Level	\$71.07	5A	1B		View
Chelan	Modular Buildings	Journey Level	\$14.11		1		View
Chelan	Painters	Commercial Painter	\$40.26	6Z	1W		View
Chelan	Painters	Industrial Painter	\$46.97	6Z	1W	9D	View
Chelan	Pile Driver	Crew Tender	\$69.91	7A	4C		View
Chelan	Pile Driver	Crew Tender/Technician	\$69.91	7A	4C		View
Chelan	Pile Driver	Hyperbaric Worker - Compressed Air Worker 0-30.00 PSI	\$80.76	7A	4C		View
Chelan	Pile Driver	Hyperbaric Worker - Compressed Air Worker 30.01 - 44.00 PSI	\$85.76	7A	4C		View
Chelan	Pile Driver	Hyperbaric Worker - Compressed Air Worker 44.01 - 54.00 PSI	\$89.76	7A	4C		View
Chelan	Pile Driver	Hyperbaric Worker - Compressed Air Worker 54.01 - 60.00 PSI	\$94.76	7A	4C		View
Chelan	Pile Driver	Hyperbaric Worker - Compressed Air Worker 60.01 - 64.00 PSI	\$97.26	7A	4C		View
Chelan	Pile Driver	Hyperbaric Worker - Compressed Air Worker 64.01 - 68.00 PSI	\$102.26	7A	4C		View
Chelan	Pile Driver	Hyperbaric Worker - Compressed Air Worker 68.01 - 70.00 PSI	\$104.26	7A	4C		View
Chelan	Pile Driver	Hyperbaric Worker - Compressed Air Worker 70.01 - 72.00 PSI	\$106.26	7A	4C		View
Chelan	Pile Driver	Hyperbaric Worker - Compressed Air Worker 72.01 - 74.00 PSI	\$108.26	7A	4C		View
Chelan	Pile Driver	Journey Level	\$65.19	7A	4C		View
Chelan	Plasterers	Journey Level	\$46.51	7K	1N		View

Chelan	Playground & Park Equipment Installers	Journey Level	\$13.69		<u>1</u>		View
Chelan	Plumbers & Pipefitters	Journey Level	\$59.97	<u>5A</u>	<u>1G</u>		View
Chelan	Power Equipment Operators	Asphalt Plant Operators	\$70.49	<u>7A</u>	<u>3K</u>	<u>8X</u>	View
Chelan	Power Equipment Operators	Assistant Engineer	\$66.30	<u>7A</u>	<u>3K</u>	<u>8X</u>	View
Chelan	Power Equipment Operators	Barrier Machine (zipper)	\$69.87	<u>7A</u>	<u>3K</u>	<u>8X</u>	View
Chelan	Power Equipment Operators	Batch Plant Operator: concrete	\$69.87	<u>7A</u>	<u>3K</u>	<u>8X</u>	View
Chelan	Power Equipment Operators	Bobcat	\$66.30	<u>7A</u>	<u>3K</u>	<u>8X</u>	View
Chelan	Power Equipment Operators	Brokk - Remote Demolition Equipment	\$66.30	<u>7A</u>	<u>3K</u>	<u>8X</u>	View
Chelan	Power Equipment Operators	Brooms	\$66.30	<u>7A</u>	<u>3K</u>	<u>8X</u>	View
Chelan	Power Equipment Operators	Bump Cutter	\$69.87	<u>7A</u>	<u>3K</u>	<u>8X</u>	View
Chelan	Power Equipment Operators	Cableways	\$70.49	<u>7A</u>	<u>3K</u>	<u>8X</u>	View
Chelan	Power Equipment Operators	Chipper	\$69.87	<u>7A</u>	<u>3K</u>	<u>8X</u>	View
Chelan	Power Equipment Operators	Compressor	\$66.30	<u>7A</u>	<u>3K</u>	<u>8X</u>	View
Chelan	Power Equipment Operators	Concrete Finish Machine - Laser Screed	\$66.30	<u>7A</u>	<u>3K</u>	<u>8X</u>	View
Chelan	Power Equipment Operators	Concrete Pump - Mounted Or Trailer High Pressure Line Pump, Pump High Pressure	\$69.33	<u>7A</u>	<u>3K</u>	<u>8X</u>	View
Chelan	Power Equipment Operators	Concrete Pump: Truck Mount With Boom Attachment Over 42 M	\$70.49	<u>7A</u>	<u>3K</u>	<u>8X</u>	View
Chelan	Power Equipment Operators	Concrete Pump: Truck Mount With Boom Attachment Up To 42m	\$69.87	<u>7A</u>	<u>3K</u>	<u>8X</u>	View
Chelan	Power Equipment Operators	Conveyors	\$69.33	<u>7A</u>	<u>3K</u>	<u>8X</u>	View
Chelan	Power Equipment Operators	Cranes friction: 200 tons and over	\$72.63	<u>7A</u>	<u>3K</u>	<u>8X</u>	View
Chelan	Power Equipment Operators	Cranes: 100 tons through 199 tons, or 150' of boom (including jib with attachments)	\$71.20	<u>7A</u>	<u>3K</u>	<u>8X</u>	View
Chelan	Power Equipment Operators	Cranes: 20 Tons Through 44 Tons With Attachments	\$69.87	<u>7A</u>	<u>3K</u>	<u>8X</u>	View
Chelan	Power Equipment Operators	Cranes: 200 tons- 299 tons, or 250' of boom including jib with attachments	\$71.93	<u>7A</u>	<u>3K</u>	<u>8X</u>	View
Chelan	Power Equipment Operators	Cranes: 300 tons and over or 300' of boom including jib with attachments	\$72.63	<u>7A</u>	<u>3K</u>	<u>8X</u>	View
Chelan	Power Equipment Operators	Cranes: 45 Tons Through 99 Tons, Under 150' Of Boom (including Jib With Attachments)	\$70.49	<u>7A</u>	<u>3K</u>	<u>8X</u>	View
Chelan	Power Equipment Operators	Cranes: A-frame - 10 Tons And Under	\$66.30	<u>7A</u>	<u>3K</u>	<u>8X</u>	View
Chelan	Power Equipment Operators	Cranes: Friction cranes through 199 tons	\$71.93	<u>7A</u>	<u>3K</u>	<u>8X</u>	View
Chelan	Power Equipment Operators	Cranes: through 19 tons with attachments, A-frame over 10 tons	\$69.33	<u>7A</u>	<u>3K</u>	<u>8X</u>	View
Chelan	Power Equipment Operators	Crusher	\$69.87	<u>7A</u>	<u>3K</u>	<u>8X</u>	View
Chelan	Power Equipment Operators	Deck Engineer/Deck Winches (power)	\$69.87	<u>7A</u>	<u>3K</u>	<u>8X</u>	View
Chelan	Power Equipment Operators	Derricks, On Building Work	\$70.49	<u>7A</u>	<u>3K</u>	<u>8X</u>	View
Chelan	Power Equipment Operators	Dozers D-9 & Under	\$69.33	<u>7A</u>	<u>3K</u>	<u>8X</u>	View
Chelan	Power Equipment Operators	Drill Oilers: Auger Type, Truck Or Crane Mount	\$69.33	<u>7A</u>	<u>3K</u>	<u>8X</u>	View

Chelan	Power Equipment Operators	Drilling Machine	\$71.20	7A	3K	8X	View
Chelan	Power Equipment Operators	Elevator And Man-lift: Permanent And Shaft Type	\$66.30	7A	3K	8X	View
Chelan	Power Equipment Operators	Finishing Machine, Bidwell And Gamaco & Similar Equipment	\$69.87	7A	3K	8X	View
Chelan	Power Equipment Operators	Forklift: 3000 Lbs And Over With Attachments	\$69.33	7A	3K	8X	View
Chelan	Power Equipment Operators	Forklifts: Under 3000 Lbs. With Attachments	\$66.30	7A	3K	8X	View
Chelan	Power Equipment Operators	Grade Engineer: Using Blue Prints, Cut Sheets, Etc	\$69.87	7A	3K	8X	View
Chelan	Power Equipment Operators	Gradechecker/Stakeman	\$66.30	7A	3K	8X	View
Chelan	Power Equipment Operators	Guardrail Punch	\$69.87	7A	3K	8X	View
Chelan	Power Equipment Operators	Hard Tail End Dump Articulating Off- Road Equipment 45 Yards. & Over	\$70.49	7A	3K	8X	View
Chelan	Power Equipment Operators	Hard Tail End Dump Articulating Off-road Equipment Under 45 Yards	\$69.87	7A	3K	8X	View
Chelan	Power Equipment Operators	Horizontal/Directional Drill Locator	\$69.33	7A	3K	8X	View
Chelan	Power Equipment Operators	Horizontal/Directional Drill Operator	\$69.87	7A	3K	8X	View
Chelan	Power Equipment Operators	Hydralifts/Boom Trucks Over 10 Tons	\$69.33	7A	3K	8X	View
Chelan	Power Equipment Operators	Hydralifts/Boom Trucks, 10 Tons And Under	\$66.30	7A	3K	8X	View
Chelan	Power Equipment Operators	Loader, Overhead 8 Yards. & Over	\$71.20	7A	3K	8X	View
Chelan	Power Equipment Operators	Loader, Overhead, 6 Yards. But Not Including 8 Yards	\$70.49	7A	3K	8X	View
Chelan	Power Equipment Operators	Loaders, Overhead Under 6 Yards	\$69.87	7A	3K	8X	View
Chelan	Power Equipment Operators	Loaders, Plant Feed	\$69.87	7A	3K	8X	View
Chelan	Power Equipment Operators	Loaders: Elevating Type Belt	\$69.33	7A	3K	8X	View
Chelan	Power Equipment Operators	Locomotives, All	\$69.87	7A	3K	8X	View
Chelan	Power Equipment Operators	Material Transfer Device	\$69.87	7A	3K	8X	View
Chelan	Power Equipment Operators	Mechanics, All (leadmen - \$0.50 Per Hour Over Mechanic)	\$71.20	7A	3K	8X	View
Chelan	Power Equipment Operators	Motor Patrol Graders	\$70.49	7A	3K	8X	View
Chelan	Power Equipment Operators	Mucking Machine, Mole, Tunnel Drill, Boring, Road Header And/or Shield	\$70.49	7A	3K	8X	View
Chelan	Power Equipment Operators	Oil Distributors, Blower Distribution & Mulch Seeding Operator	\$66.30	7A	3K	8X	View
Chelan	Power Equipment Operators	Outside Hoists (Elevators And Manlifts), Air Tuggers, Strato	\$69.33	7A	3K	8X	View
Chelan	Power Equipment Operators	Overhead, Bridge Type Crane: 20 Tons Through 44 Tons	\$69.87	7A	3K	8X	View
Chelan	Power Equipment Operators	Overhead, Bridge Type: 100 Tons And Over	\$71.20	7A	3K	8X	View
Chelan	Power Equipment Operators	Overhead, Bridge Type: 45 Tons Through 99 Tons	\$70.49	7A	3K	8X	View

Chelan	Power Equipment Operators	Pavement Breaker	\$66.30	7A	3K	8X	View
Chelan	Power Equipment Operators	Pile Driver (other Than Crane Mount)	\$69.87	7A	3K	8X	View
Chelan	Power Equipment Operators	Plant Oiler - Asphalt, Crusher	\$69.33	7A	3K	8X	View
Chelan	Power Equipment Operators	Posthole Digger, Mechanical	\$66.30	7A	3K	8X	View
Chelan	Power Equipment Operators	Power Plant	\$66.30	7A	3K	8X	View
Chelan	Power Equipment Operators	Pumps - Water	\$66.30	7A	3K	8X	View
Chelan	Power Equipment Operators	Quad 9, Hd 41, D10 And Over	\$70.49	7A	3K	8X	View
Chelan	Power Equipment Operators	Quick Tower - No Cab, Under 100 Feet In Height Based To Boom	\$66.30	7A	3K	8X	View
Chelan	Power Equipment Operators	Remote Control Operator On Rubber Tired Earth Moving Equipment	\$70.49	7A	3K	8X	View
Chelan	Power Equipment Operators	Rigger and Bellman	\$66.30	7A	3K	8X	View
Chelan	Power Equipment Operators	Rigger/Signal Person, Bellman (Certified)	\$69.33	7A	3K	8X	View
Chelan	Power Equipment Operators	Rollagon	\$70.49	7A	3K	8X	View
Chelan	Power Equipment Operators	Roller, Other Than Plant Mix	\$66.30	7A	3K	8X	View
Chelan	Power Equipment Operators	Roller, Plant Mix Or Multi-lift Materials	\$69.33	7A	3K	8X	View
Chelan	Power Equipment Operators	Roto-mill, Roto-grinder	\$69.87	7A	3K	8X	View
Chelan	Power Equipment Operators	Saws - Concrete	\$69.33	7A	3K	8X	View
Chelan	Power Equipment Operators	Scraper, Self Propelled Under 45 Yards	\$69.87	7A	3K	8X	View
Chelan	Power Equipment Operators	Scrapers - Concrete & Carry All	\$69.33	7A	3K	8X	View
Chelan	Power Equipment Operators	Scrapers, Self-propelled: 45 Yards And Over	\$70.49	7A	3K	8X	View
Chelan	Power Equipment Operators	Service Engineers - Equipment	\$69.33	7A	3K	8X	View
Chelan	Power Equipment Operators	Shotcrete/Gunite Equipment	\$66.30	7A	3K	8X	View
Chelan	Power Equipment Operators	Shovel, Excavator, Backhoe, Tractors Under 15 Metric Tons	\$69.33	7A	3K	8X	View
Chelan	Power Equipment Operators	Shovel, Excavator, Backhoe: Over 30 Metric Tons To 50 Metric Tons	\$70.49	7A	3K	8X	View
Chelan	Power Equipment Operators	Shovel, Excavator, Backhoes, Tractors: 15 To 30 Metric Tons	\$69.87	7A	3K	8X	View
Chelan	Power Equipment Operators	Shovel, Excavator, Backhoes: Over 50 Metric Tons To 90 Metric Tons	\$71.20	7A	3K	8X	View
Chelan	Power Equipment Operators	Shovel, Excavator, Backhoes: Over 90 Metric Tons	\$71.93	7A	3K	8X	View
Chelan	Power Equipment Operators	Slipform Pavers	\$70.49	7A	3K	8X	View
Chelan	Power Equipment Operators	Spreader, Topsider & Screedman	\$70.49	7A	3K	8X	View
Chelan	Power Equipment Operators	Subgrader Trimmer	\$69.87	7A	3K	8X	View
Chelan	Power Equipment Operators	Tower Bucket Elevators	\$69.33	7A	3K	8X	View
Chelan	Power Equipment Operators	Tower Crane Up To 175' In Height Base To Boom	\$71.20	7A	3K	8X	View
Chelan	Power Equipment Operators	Tower Crane: over 175' through 250' in height, base to boom	\$71.93	7A	3K	8X	View
Chelan	Power Equipment Operators	Tower Cranes: over 250' in height from base to	\$72.63	7A	3K	8X	View

		boom					
Chelan	Power Equipment Operators	Transporters, All Track Or Truck Type	\$70.49	7A	3K	8X	View
Chelan	Power Equipment Operators	Trenching Machines	\$69.33	7A	3K	8X	View
Chelan	Power Equipment Operators	Truck Crane Oiler/driver - 100 Tons And Over	\$69.87	7A	3K	8X	View
Chelan	Power Equipment Operators	Truck Crane Oiler/Driver Under 100 Tons	\$69.33	7A	3K	8X	View
Chelan	Power Equipment Operators	Truck Mount Portable Conveyor	\$69.87	7A	3K	8X	View
Chelan	Power Equipment Operators	Welder	\$70.49	7A	3K	8X	View
Chelan	Power Equipment Operators	Wheel Tractors, Farmall Type	\$66.30	7A	3K	8X	View
Chelan	Power Equipment Operators	Yo Yo Pay Dozer	\$69.87	7A	3K	8X	View
Chelan	Power Equipment Operators- Underground Sewer & Water	Asphalt Plant Operators	\$70.49	7A	3K	8X	View
Chelan	Power Equipment Operators- Underground Sewer & Water	Assistant Engineer	\$66.30	7A	3K	8X	View
Chelan	Power Equipment Operators- Underground Sewer & Water	Barrier Machine (zipper)	\$69.87	7A	3K	8X	View
Chelan	Power Equipment Operators- Underground Sewer & Water	Batch Plant Operator, Concrete	\$69.87	7A	3K	8X	View
Chelan	Power Equipment Operators- Underground Sewer & Water	Bobcat	\$66.30	7A	3K	8X	View
Chelan	Power Equipment Operators- Underground Sewer & Water	Brokk - Remote Demolition Equipment	\$66.30	7A	3K	8X	View
Chelan	Power Equipment Operators- Underground Sewer & Water	Brooms	\$66.30	7A	3K	8X	View
Chelan	Power Equipment Operators- Underground Sewer & Water	Bump Cutter	\$69.87	7A	3K	8X	View
Chelan	Power Equipment Operators- Underground Sewer & Water	Cableways	\$70.49	7A	3K	8X	View
Chelan	Power Equipment Operators- Underground Sewer & Water	Chipper	\$69.87	7A	3K	8X	View
Chelan	Power Equipment Operators- Underground Sewer & Water	Compressor	\$66.30	7A	3K	8X	View
Chelan	Power Equipment Operators- Underground Sewer & Water	Concrete Finish Machine - Laser Screed	\$66.30	7A	3K	8X	View
Chelan	Power Equipment Operators- Underground Sewer & Water	Concrete Pump - Mounted Or Trailer High Pressure Line Pump, Pump High Pressure	\$69.33	7A	3K	8X	View
Chelan	Power Equipment Operators- Underground Sewer & Water	Concrete Pump: Truck Mount With Boom Attachment Over 42 M	\$70.49	7A	3K	8X	View
Chelan	Power Equipment Operators- Underground Sewer & Water	Concrete Pump: Truck Mount With Boom Attachment Up To 42m	\$69.87	7A	3K	8X	View
Chelan	Power Equipment Operators- Underground Sewer & Water	Conveyors	\$69.33	7A	3K	8X	View
Chelan	Power Equipment Operators- Underground Sewer & Water	Cranes friction: 200 tons and over	\$72.63	7A	3K	8X	View

Chelan	Power Equipment Operators- Underground Sewer & Water	Cranes: 100 tons through 199 tons, or 150' of boom (including jib with attachments)	\$71.20	7A	3K	8X	View
Chelan	Power Equipment Operators- Underground Sewer & Water	Cranes: 20 Tons Through 44 Tons With Attachments	\$69.87	7A	3K	8X	View
Chelan	Power Equipment Operators- Underground Sewer & Water	Cranes: 200 tons- 299 tons, or 250' of boom including jib with attachments	\$71.93	7A	3K	8X	View
Chelan	Power Equipment Operators- Underground Sewer & Water	Cranes: 300 tons and over or 300' of boom including jib with attachments	\$72.63	7A	3K	8X	View
Chelan	Power Equipment Operators- Underground Sewer & Water	Cranes: 45 Tons Through 99 Tons, Under 150' Of Boom (including Jib With Attachments)	\$70.49	7A	3K	8X	View
Chelan	Power Equipment Operators- Underground Sewer & Water	Cranes: A-frame - 10 Tons And Under	\$66.30	7A	3K	8X	View
Chelan	Power Equipment Operators- Underground Sewer & Water	Cranes: Friction cranes through 199 tons	\$71.93	7A	3K	8X	View
Chelan	Power Equipment Operators- Underground Sewer & Water	Cranes: through 19 tons with attachments, A-frame over 10 tons	\$69.33	7A	3K	8X	View
Chelan	Power Equipment Operators- Underground Sewer & Water	Crusher	\$69.87	7A	3K	8X	View
Chelan	Power Equipment Operators- Underground Sewer & Water	Deck Engineer/Deck Winches (power)	\$69.87	7A	3K	8X	View
Chelan	Power Equipment Operators- Underground Sewer & Water	Derricks, On Building Work	\$70.49	7A	3K	8X	View
Chelan	Power Equipment Operators- Underground Sewer & Water	Dozers D-9 & Under	\$69.33	7A	3K	8X	View
Chelan	Power Equipment Operators- Underground Sewer & Water	Drill Oilers: Auger Type, Truck Or Crane Mount	\$69.33	7A	3K	8X	View
Chelan	Power Equipment Operators- Underground Sewer & Water	Drilling Machine	\$71.20	7A	3K	8X	View
Chelan	Power Equipment Operators- Underground Sewer & Water	Elevator And Man-lift: Permanent And Shaft Type	\$66.30	7A	3K	8X	View
Chelan	Power Equipment Operators- Underground Sewer & Water	Finishing Machine, Bidwell And Gamaco & Similar Equipment	\$69.87	7A	3K	8X	View
Chelan	Power Equipment Operators- Underground Sewer & Water	Forklift: 3000 Lbs And Over With Attachments	\$69.33	7A	3K	8X	View
Chelan	Power Equipment Operators- Underground Sewer & Water	Forklifts: Under 3000 Lbs. With Attachments	\$66.30	7A	3K	8X	View
Chelan	Power Equipment Operators- Underground Sewer & Water	Grade Engineer: Using Blue Prints, Cut Sheets, Etc	\$69.87	7A	3K	8X	View
Chelan	Power Equipment Operators- Underground Sewer & Water	Gradechecker/Stakeman	\$66.30	7A	3K	8X	View
Chelan	Power Equipment Operators- Underground Sewer & Water	Guardrail Punch	\$69.87	7A	3K	8X	View
Chelan	Power Equipment Operators- Underground Sewer & Water	Hard Tail End Dump Articulating Off- Road Equipment 45 Yards. & Over	\$70.49	7A	3K	8X	View

Chelan	Power Equipment Operators- Underground Sewer & Water	Hard Tail End Dump Articulating Off-road Equipment Under 45 Yards	\$69.87	7A	3K	8X	View
Chelan	Power Equipment Operators- Underground Sewer & Water	Horizontal/Directional Drill Locator	\$69.33	7A	3K	8X	View
Chelan	Power Equipment Operators- Underground Sewer & Water	Horizontal/Directional Drill Operator	\$69.87	7A	3K	8X	View
Chelan	Power Equipment Operators- Underground Sewer & Water	Hydralifts/Boom Trucks Over 10 Tons	\$69.33	7A	3K	8X	View
Chelan	Power Equipment Operators- Underground Sewer & Water	Hydralifts/Boom Trucks, 10 Tons And Under	\$66.30	7A	3K	8X	View
Chelan	Power Equipment Operators- Underground Sewer & Water	Loader, Overhead 8 Yards. & Over	\$71.20	7A	3K	8X	View
Chelan	Power Equipment Operators- Underground Sewer & Water	Loader, Overhead, 6 Yards. But Not Including 8 Yards	\$70.49	7A	3K	8X	View
Chelan	Power Equipment Operators- Underground Sewer & Water	Loaders, Overhead Under 6 Yards	\$69.87	7A	3K	8X	View
Chelan	Power Equipment Operators- Underground Sewer & Water	Loaders, Plant Feed	\$69.87	7A	3K	8X	View
Chelan	Power Equipment Operators- Underground Sewer & Water	Loaders: Elevating Type Belt	\$69.33	7A	3K	8X	View
Chelan	Power Equipment Operators- Underground Sewer & Water	Locomotives, All	\$69.87	7A	3K	8X	View
Chelan	Power Equipment Operators- Underground Sewer & Water	Material Transfer Device	\$69.87	7A	3K	8X	View
Chelan	Power Equipment Operators- Underground Sewer & Water	Mechanics, All (leadmen - \$0.50 Per Hour Over Mechanic)	\$71.20	7A	3K	8X	View
Chelan	Power Equipment Operators- Underground Sewer & Water	Motor Patrol Graders	\$70.49	7A	3K	8X	View
Chelan	Power Equipment Operators- Underground Sewer & Water	Mucking Machine, Mole, Tunnel Drill, Boring, Road Header And/or Shield	\$70.49	7A	3K	8X	View
Chelan	Power Equipment Operators- Underground Sewer & Water	Oil Distributors, Blower Distribution & Mulch Seeding Operator	\$66.30	7A	3K	8X	View
Chelan	Power Equipment Operators- Underground Sewer & Water	Outside Hoists (Elevators And Manlifts), Air Tuggers, Strato	\$69.33	7A	3K	8X	View
Chelan	Power Equipment Operators- Underground Sewer & Water	Overhead, Bridge Type Crane: 20 Tons Through 44 Tons	\$69.87	7A	3K	8X	View
Chelan	Power Equipment Operators- Underground Sewer & Water	Overhead, Bridge Type: 100 Tons And Over	\$71.20	7A	3K	8X	View
Chelan	Power Equipment Operators- Underground Sewer & Water	Overhead, Bridge Type: 45 Tons Through 99 Tons	\$70.49	7A	3K	8X	View
Chelan	Power Equipment Operators- Underground Sewer & Water	Pavement Breaker	\$66.30	7A	3K	8X	View
Chelan	Power Equipment Operators- Underground Sewer & Water	Pile Driver (other Than Crane Mount)	\$69.87	7A	3K	8X	View

Chelan	Power Equipment Operators- Underground Sewer & Water	Plant Oiler - Asphalt, Crusher	\$69.33	7A	3K	8X	View
Chelan	Power Equipment Operators- Underground Sewer & Water	Posthole Digger, Mechanical	\$66.30	7A	3K	8X	View
Chelan	Power Equipment Operators- Underground Sewer & Water	Power Plant	\$66.30	7A	3K	8X	View
Chelan	Power Equipment Operators- Underground Sewer & Water	Pumps - Water	\$66.30	7A	3K	8X	View
Chelan	Power Equipment Operators- Underground Sewer & Water	Quad 9, Hd 41, D10 And Over	\$70.49	7A	3K	8X	View
Chelan	Power Equipment Operators- Underground Sewer & Water	Quick Tower - No Cab, Under 100 Feet In Height Based To Boom	\$66.30	7A	3K	8X	View
Chelan	Power Equipment Operators- Underground Sewer & Water	Remote Control Operator On Rubber Tired Earth Moving Equipment	\$70.49	7A	3K	8X	View
Chelan	Power Equipment Operators- Underground Sewer & Water	Rigger and Bellman	\$66.30	7A	3K	8X	View
Chelan	Power Equipment Operators- Underground Sewer & Water	Rigger/Signal Person, Bellman (Certified)	\$69.33	7A	3K	8X	View
Chelan	Power Equipment Operators- Underground Sewer & Water	Rollagon	\$70.49	7A	3K	8X	View
Chelan	Power Equipment Operators- Underground Sewer & Water	Roller, Other Than Plant Mix	\$66.30	7A	3K	8X	View
Chelan	Power Equipment Operators- Underground Sewer & Water	Roller, Plant Mix Or Multi-lift Materials	\$69.33	7A	3K	8X	View
Chelan	Power Equipment Operators- Underground Sewer & Water	Roto-mill, Roto-grinder	\$69.87	7A	3K	8X	View
Chelan	Power Equipment Operators- Underground Sewer & Water	Saws - Concrete	\$69.33	7A	3K	8X	View
Chelan	Power Equipment Operators- Underground Sewer & Water	Scraper, Self Propelled Under 45 Yards	\$69.87	7A	3K	8X	View
Chelan	Power Equipment Operators- Underground Sewer & Water	Scrapers - Concrete & Carry All	\$69.33	7A	3K	8X	View
Chelan	Power Equipment Operators- Underground Sewer & Water	Scrapers, Self-propelled: 45 Yards And Over	\$70.49	7A	3K	8X	View
Chelan	Power Equipment Operators- Underground Sewer & Water	Service Engineers - Equipment	\$69.33	7A	3K	8X	View
Chelan	Power Equipment Operators- Underground Sewer & Water	Shotcrete/Gunite Equipment	\$66.30	7A	3K	8X	View
Chelan	Power Equipment Operators- Underground Sewer & Water	Shovel, Excavator, Backhoe, Tractors Under 15 Metric Tons	\$69.33	7A	3K	8X	View
Chelan	Power Equipment Operators- Underground Sewer & Water	Shovel, Excavator, Backhoe: Over 30 Metric Tons To 50 Metric Tons	\$70.49	7A	3K	8X	View
Chelan	Power Equipment Operators- Underground Sewer & Water	Shovel, Excavator, Backhoes, Tractors: 15 To 30 Metric Tons	\$69.87	7A	3K	8X	View

Chelan	Power Equipment Operators- Underground Sewer & Water	Shovel, Excavator, Backhoes: Over 50 Metric Tons To 90 Metric Tons	\$71.20	7A	3K	8X	View
Chelan	Power Equipment Operators- Underground Sewer & Water	Shovel, Excavator, Backhoes: Over 90 Metric Tons	\$71.93	7A	3K	8X	View
Chelan	Power Equipment Operators- Underground Sewer & Water	Slipform Pavers	\$70.49	7A	3K	8X	View
Chelan	Power Equipment Operators- Underground Sewer & Water	Spreader, Topsider & Screedman	\$70.49	7A	3K	8X	View
Chelan	Power Equipment Operators- Underground Sewer & Water	Subgrader Trimmer	\$69.87	7A	3K	8X	View
Chelan	Power Equipment Operators- Underground Sewer & Water	Tower Bucket Elevators	\$69.33	7A	3K	8X	View
Chelan	Power Equipment Operators- Underground Sewer & Water	Tower Crane Up To 175' In Height Base To Boom	\$71.20	7A	3K	8X	View
Chelan	Power Equipment Operators- Underground Sewer & Water	Tower Crane: over 175' through 250' in height, base to boom	\$71.93	7A	3K	8X	View
Chelan	Power Equipment Operators- Underground Sewer & Water	Tower Cranes: over 250' in height from base to boom	\$72.63	7A	3K	8X	View
Chelan	Power Equipment Operators- Underground Sewer & Water	Transporters, All Track Or Truck Type	\$70.49	7A	3K	8X	View
Chelan	Power Equipment Operators- Underground Sewer & Water	Trenching Machines	\$69.33	7A	3K	8X	View
Chelan	Power Equipment Operators- Underground Sewer & Water	Truck Crane Oiler/driver - 100 Tons And Over	\$69.87	7A	3K	8X	View
Chelan	Power Equipment Operators- Underground Sewer & Water	Truck Crane Oiler/Driver Under 100 Tons	\$69.33	7A	3K	8X	View
Chelan	Power Equipment Operators- Underground Sewer & Water	Truck Mount Portable Conveyor	\$69.87	7A	3K	8X	View
Chelan	Power Equipment Operators- Underground Sewer & Water	Welder	\$70.49	7A	3K	8X	View
Chelan	Power Equipment Operators- Underground Sewer & Water	Wheel Tractors, Farmall Type	\$66.30	7A	3K	8X	View
Chelan	Power Equipment Operators- Underground Sewer & Water	Yo Yo Pay Dozer	\$69.87	7A	3K	8X	View
Chelan	Power Line Clearance Tree Trimmers	Journey Level In Charge	\$55.03	5A	4A		View
Chelan	Power Line Clearance Tree Trimmers	Spray Person	\$52.24	5A	4A		View
Chelan	Power Line Clearance Tree Trimmers	Tree Equipment Operator	\$55.03	5A	4A		View
Chelan	Power Line Clearance Tree Trimmers	Tree Trimmer	\$49.21	5A	4A		View
Chelan	Power Line Clearance Tree Trimmers	Tree Trimmer Groundperson	\$37.47	5A	4A		View
Chelan	Refrigeration & Air Conditioning Mechanics	Journey Level	\$59.97	5A	1G		View
Chelan	Residential Brick Mason	Journey Level	\$19.38		1		View
Chelan	Residential Carpenters	Journey Level	\$21.00		1		View
Chelan	Residential Cement Masons	Journey Level	\$46.83	7B	1N		View

Chelan	Residential Drywall Applicators	Journey Level	\$25.84		<u>1</u>		View
Chelan	Residential Drywall Tapers	Journey Level	\$17.06		<u>1</u>		View
Chelan	Residential Electricians	Journey Level	\$22.02		<u>1</u>		View
Chelan	Residential Glaziers	Journey Level	\$16.50		<u>1</u>		View
Chelan	Residential Insulation Applicators	Journey Level	\$14.86		<u>1</u>		View
Chelan	Residential Laborers	Journey Level	\$19.06		<u>1</u>		View
Chelan	Residential Marble Setters	Journey Level	\$15.91		<u>1</u>		View
Chelan	Residential Painters	Journey Level	\$25.01		<u>1</u>		View
Chelan	Residential Plumbers & Pipefitters	Journey Level	\$38.21		<u>1</u>		View
Chelan	Residential Refrigeration & Air Conditioning Mechanics	Journey Level	\$17.25		<u>1</u>		View
Chelan	Residential Sheet Metal Workers	Journey Level (Field or Shop)	\$61.36	<u>5I</u>	<u>1B</u>		View
Chelan	Residential Soft Floor Layers	Journey Level	\$13.69		<u>1</u>		View
Chelan	Residential Sprinkler Fitters (Fire Protection)	Journey Level	\$17.71		<u>1</u>		View
Chelan	Residential Stone Masons	Journey Level	\$19.38		<u>1</u>		View
Chelan	Residential Terrazzo Workers	Journey Level	\$14.86		<u>1</u>		View
Chelan	Residential Terrazzo/Tile Finishers	Journey Level	\$13.69		<u>1</u>		View
Chelan	Residential Tile Setters	Journey Level	\$14.86		<u>1</u>		View
Chelan	Roofers	Journey Level	\$42.79	<u>5I</u>	<u>1R</u>		View
Chelan	Roofers	Using Irritable Bituminous Materials	\$44.79	<u>5I</u>	<u>1R</u>		View
Chelan	Sheet Metal Workers	Journey Level (Field or Shop)	\$61.36	<u>6Z</u>	<u>1B</u>		View
Chelan	Sign Makers & Installers (Electrical)	Journey Level	\$85.05	<u>7F</u>	<u>1E</u>		View
Chelan	Sign Makers & Installers (Non-Electrical)	Journey Level	\$17.48		<u>1</u>		View
Chelan	Soft Floor Layers	Journey Level	\$51.91	<u>5A</u>	<u>3J</u>		View
Chelan	Solar Controls For Windows	Journey Level	\$13.69		<u>1</u>		View
Chelan	Sprinkler Fitters (Fire Protection)	Journey Level	\$60.86	<u>7J</u>	<u>1R</u>		View
Chelan	Stage Rigging Mechanics (Non Structural)	Journey Level	\$13.69		<u>1</u>		View
Chelan	Stone Masons	Journey Level	\$53.34	<u>5A</u>	<u>1M</u>		View
Chelan	Street And Parking Lot Sweeper Workers	Journey Level	\$20.00		<u>1</u>		View
Chelan	Surveyors	Assistant Construction Site Surveyor	\$69.33	<u>7A</u>	<u>3K</u>	<u>8X</u>	View
Chelan	Surveyors	Chainman	\$66.30	<u>7A</u>	<u>3K</u>	<u>8X</u>	View
Chelan	Surveyors	Construction Site Surveyor	\$70.49	<u>7A</u>	<u>3K</u>	<u>8X</u>	View
Chelan	Telecommunication Technicians	Telecom Technician Journey Level	\$47.28	<u>5B</u>	<u>1B</u>		View
Chelan	Telephone Line Construction - Outside	Cable Splicer	\$38.27	<u>5A</u>	<u>2B</u>		View
Chelan	Telephone Line Construction - Outside	Hole Digger/Ground Person	\$25.66	<u>5A</u>	<u>2B</u>		View
Chelan	Telephone Line Construction - Outside	Telephone Equipment Operator (Light)	\$31.96	<u>5A</u>	<u>2B</u>		View
Chelan	Telephone Line Construction - Outside	Telephone Lineperson	\$36.17	<u>5A</u>	<u>2B</u>		View
Chelan	Terrazzo Workers	Journey Level	\$43.81	<u>5A</u>	<u>1M</u>		View
Chelan	Tile Setters	Journey Level	\$43.81	<u>5A</u>	<u>1M</u>		View

Chelan	Tile, Marble & Terrazzo Finishers	Journey Level	\$35.93	5A	1M		View
Chelan	Traffic Control Stripers	Journey Level	\$50.51	7A	1K		View
Chelan	Truck Drivers	Asphalt Mix Over 20 Yards	\$49.05	5D	1V	8M	View
Chelan	Truck Drivers	Asphalt Mix To 20 Yards	\$48.68	5D	1V	8M	View
Chelan	Truck Drivers	Dump Truck	\$48.68	5D	1V	8M	View
Chelan	Truck Drivers	Dump Truck & Trailer	\$49.05	5D	1V	8M	View
Chelan	Truck Drivers	Other Trucks	\$48.57	5D	1V	8M	View
Chelan	Truck Drivers - Ready Mix	Transit Mixers 20 yards and under	\$49.05	5D	1V	8M	View
Chelan	Truck Drivers - Ready Mix	Transit Mixers over 20 yards	\$49.38	5D	1V	8M	View
Chelan	Well Drillers & Irrigation Pump Installers	Irrigation Pump Installer	\$13.69		1		View
Chelan	Well Drillers & Irrigation Pump Installers	Oiler	\$13.69		1		View
Chelan	Well Drillers & Irrigation Pump Installers	Well Driller	\$18.00		1		View



INADVERTENT DISCOVERY PLAN PLAN AND PROCEDURES FOR THE DISCOVERY OF CULTURAL RESOURCES AND HUMAN SKELETAL REMAINS

To request ADA accommodation, including materials in a format for the visually impaired, call Ecology at 360-407-6000 or visit <https://ecology.wa.gov/accessibility>. People with impaired hearing may call Washington Relay Service at 711. People with a speech disability may call TTY at 877-833-6341.

Site Name(s): Location:

Project Lead/Organization: County:

If this Inadvertent Discovery Plan (IDP) is for multiple (batched) projects, ensure the location information covers all project areas.

1. INTRODUCTION

The IDP outlines procedures to perform in the event of a discovery of archaeological materials or human remains, in accordance with applicable state and federal laws. An IDP is required, as part of Agency Terms and Conditions for all grants and loans, for any project that creates disturbance above or below the ground. An IDP is not a substitute for a formal cultural resource review (Executive 21-02 or Section 106).

Once completed, **the IDP should always be kept at the project site** during all project activities. All staff, contractors, and volunteers should be familiar with its contents and know where to find it.

2. CULTURAL RESOURCE DISCOVERIES

A cultural resource discovery could be prehistoric or historic. Examples include (see images for further examples):

- An accumulation of shell, burned rocks, or other food related materials.
- Bones, intact or in small pieces.
- An area of charcoal or very dark stained soil with artifacts.
- Stone tools or waste flakes (for example, an arrowhead or stone chips).
- Modified or stripped trees, often cedar or aspen, or other modified natural features, such as rock drawings.
- Agricultural or logging materials that appear older than 50 years. These could include equipment, fencing, canals, spillways, chutes, derelict sawmills, tools, and many other items.
- Clusters of tin cans or bottles, or other debris that appear older than 50 years.
- Old munitions casings. **Always assume these are live and never touch or move.**
- Buried railroad tracks, decking, foundations, or other industrial materials.
- Remnants of homesteading. These could include bricks, nails, household items, toys, food containers, and other items associated with homes or farming sites.

The above list does not cover every possible cultural resource. When in doubt, assume the material is a cultural resource.

3. ON-SITE RESPONSIBILITIES

If any employee, contractor, or subcontractor believes that they have uncovered cultural resources or human remains at any point in the project, take the following steps to **Stop-Protect-Notify**. If you suspect that the discovery includes human remains, also follow Sections 5 and 6.

STEP A: Stop Work.

All work must stop immediately in the vicinity of the discovery.

STEP B: Protect the Discovery.

Leave the discovery and the surrounding area untouched and create a clear, identifiable, and wide boundary (30 feet or larger) with temporary fencing, flagging, stakes, or other clear markings. Provide protection and ensure integrity of the discovery until cleared by the Department of Archaeological and Historical Preservation (DAHP) or a licensed, professional archaeologist.

Do not permit vehicles, equipment, or unauthorized personnel to traverse the discovery site. Do not allow work to resume within the boundary until the requirements of this IDP are met.

STEP C: Notify Project Archaeologist (if applicable).

If the project has an archaeologist, notify that person. If there is a monitoring plan in place, the archaeologist will follow the outlined procedure.

STEP D: Notify Project and Washington Department of Ecology (Ecology) contacts.

Project Lead Contacts

Primary Contact

Name:
Organization:
Phone:
Email:

Alternate Contact

Name:
Organization:
Phone:
Email:

Ecology Contacts (completed by Ecology Project Manager)

Ecology Project Manager

Name:
Program:
Phone:
Email:

Alternate or Cultural Resource Contact

Name:
Program:
Phone:
Email:

STEP E: Ecology will notify DAHP.

Once notified, the Ecology Cultural Resource Contact or the Ecology Project Manager will contact DAHP to report and confirm the discovery. To avoid delay, the Project Lead/Organization will contact DAHP if they are not able to reach Ecology.

DAHP will provide the steps to assist with identification. DAHP, Ecology, and Tribal representatives may coordinate a site visit following any necessary safety protocols. DAHP may also inform the Project Lead/Organization and Ecology of additional steps to further protect the site.

Do not continue work until DAHP has issued an approval for work to proceed in the area of, or near, the discovery.

DAHP Contacts:

Name: Rob Whitlam, PhD
Title: State Archaeologist
Cell: 360-890-2615
Email: Rob.Whitlam@dahp.wa.gov
Main Office: 360-586-3065

Human Remains/Bones:

Name: Guy Tasa, PhD
Title: State Anthropologist
Cell: 360-790-1633 (24/7)
Email: Guy.Tasa@dahp.wa.gov

4. TRIBAL CONTACTS

In the event cultural resources are discovered, the following tribes will be contacted. See Section 10 for Additional Resources.

Tribe:	Colville Reservation	Tribe:	Yakama Nation
Name:	Guy Moura	Name:	Casey Barney
Title:	Cultural Resource Specialist	Title:	Cultural Resource Specialist
Phone:	(509) 634-2695	Phone:	(509) 865-5121
Email:	guy.moura@colvilletribes.com	Email:	Casey_Barney@yakama.com
Tribe:		Tribe:	
Name:		Name:	
Title:		Title:	
Phone:		Phone:	
Email:		Email:	

Please provide contact information for additional tribes within your project area, if needed, in Section 11.

5. FURTHER CONTACTS (if applicable)

If the discovery is confirmed by DAHP as a cultural or archaeological resource, or as human remains, and there is a partnering federal or state agency, Ecology or the Project Lead/Organization will ensure the partnering agency is immediately notified.

Federal Agency:

Agency:	
Name:	
Title:	
Phone:	
Email:	

State Agency:

Agency:	
Name:	
Title:	
Phone:	
Email:	

6. SPECIAL PROCEDURES FOR THE DISCOVERY OF HUMAN SKELETAL MATERIAL

Any human skeletal remains, regardless of antiquity or ethnic origin, will at all times be treated with dignity and respect. Follow the steps under **Stop-Protect-Notify**. For specific instructions on how to handle a human remains discovery, see: [RCW 68.50.645: Skeletal human remains—Duty to notify—Ground disturbing activities—Coroner determination—Definitions](#).

Suggestion: If you are unsure whether the discovery is human bone or not, contact Guy Tasa with DAHP, for identification and next steps. Do not pick up the discovery.

Guy Tasa, PhD State Physical Anthropologist
Guy.Tasa@dahp.wa.gov
(360) 790-1633 (Cell/Office)

For discoveries that are confirmed or suspected human remains, follow these steps:

1. Notify law enforcement and the Medical Examiner/Coroner using the contacts below. **Do not call 911** unless it is the only number available to you.

Enter contact information below (required):

- Local Medical Examiner or Coroner name and phone:

Wayne Harris, (509) 667-6431

- Local Law Enforcement main name and phone:

Brian Burnett, (509) 667-6851

- Local Non-Emergency phone number (911 if without a non-emergency number):

Kevin Dresker (509) 888-4203

2. The Medical Examiner/Coroner (with assistance of law enforcement personnel) will determine if the remains are human or if the discovery site constitutes a crime scene and will notify DAHP.
3. **DO NOT speak with the media, allow photography or disturbance of the remains, or release any information about the discovery on social media.**
4. If the remains are determined to be non-forensic, Cover the remains with a tarp or other materials (not soil or rocks) for temporary protection and to shield them from being photographed by others or disturbed.

Further activities:

- Per [RCW 27.44.055](#), [RCW 68.50](#), and [RCW 68.60](#), DAHP will have jurisdiction over non-forensic human remains. Ecology staff will participate in consultation. Organizations may also participate in consultation.
- Documentation of human skeletal remains and funerary objects will be agreed upon through the consultation process described in [RCW 27.44.055](#), [RCW 68.50](#), and [RCW 68.60](#).
- When consultation and documentation activities are complete, work in the discovery area may resume as described in Section 8.

If the project occurs on federal lands (such as a national forest or park or a military reservation) the provisions of the Native American Graves Protection and Repatriation Act of 1990 (NAGPRA) apply and the responsible federal agency will follow its provisions. Note that state highways that cross federal lands are on an easement and are not owned by the state.

If the project occurs on non-federal lands, the Project Lead/Organization will comply with applicable state and federal laws, and the above protocol.

7. DOCUMENTATION OF ARCHAEOLOGICAL MATERIALS

Archaeological resources discovered during construction are protected by state law [RCW 27.53](#) and assumed eligible for inclusion in the National Register of Historic Places under Criterion D until a formal Determination of Eligibility is made.

The Project Lead/Organization must ensure that proper documentation and field assessment are made of all discovered cultural resources in cooperation with all parties: the federal agencies (if any), DAHP, Ecology, affected tribes, and the archaeologist.

The archaeologist will record all prehistoric and historic cultural material discovered during project construction on a standard DAHP archaeological site or isolate inventory form. They will photograph site overviews, features, and artifacts and prepare stratigraphic profiles and soil/sediment descriptions for minimal subsurface exposures. They will document discovery locations on scaled site plans and site location maps.

Cultural features, horizons, and artifacts detected in buried sediments may require the archaeologist to conduct further evaluation using hand-dug test units. They will excavate units in a controlled fashion to expose features, collect samples from undisturbed contexts, or to interpret complex stratigraphy. They may also use a test unit or trench excavation to determine if an intact occupation surface is present. They will only use test units when necessary to gather information on the nature, extent, and integrity of subsurface cultural deposits to evaluate the site's significance. They will conduct excavations using standard archaeological techniques to precisely document the location of cultural deposits, artifacts, and features.

The archaeologist will record spatial information, depth of excavation levels, natural and cultural stratigraphy, presence or absence of cultural material, and depth to sterile soil, regolith, or bedrock for each unit on a standard form. They will complete test excavation unit level forms, which will include plan maps for each excavation level and artifact counts and material types, number, and vertical provenience (depth below

surface and stratum association where applicable) for all recovered artifacts. They will draw a stratigraphic profile for at least one wall of each test excavation unit.

The archaeologist will screen sediments excavated for purposes of cultural resources investigation through 1/8-inch mesh, unless soil conditions warrant 1/4-inch mesh.

The archaeologist will analyze, catalogue, and temporarily curate all prehistoric and historic artifacts collected from the surface and from probes and excavation units. The ultimate disposition of cultural materials will be determined in consultation with the federal agencies (if any), DAHP, Ecology, and the affected tribe(s).

Within 90 days of concluding fieldwork, the archaeologist will provide a technical report describing any and all monitoring and resultant archaeological excavations to the Project Lead/Organization, who will forward the report to Ecology, the federal agencies (if any), DAHP, and the affected tribe(s) for review and comment.

If assessment activities expose human remains (burials, isolated teeth, or bones), the archaeologist and Project Lead/Organization will follow the process described in **Section 6**.

8. PROCEEDING WITH WORK

The Project Lead/Organization shall work with the archaeologist, DAHP, and affected tribe(s) to determine the appropriate discovery boundary and where work can continue.

Work may continue at the discovery location only after the process outlined in this plan is followed and the Project Lead/Organization, DAHP, any affected tribe(s), Ecology, and the federal agencies (if any) determine that compliance with state and federal laws is complete.

9. ORGANIZATION RESPONSIBILITY

The Project Lead/Organization is responsible for ensuring:

- This IDP has complete and accurate information.
- This IDP is immediately available to all field staff at the sites and available by request to any party.
- This IDP is implemented to address any discovery at the site.
- That all field staff, contractors, and volunteers are instructed on how to implement this IDP.

10. ADDITIONAL RESOURCES

Informative Video

Ecology recommends that all project staff, contractors, and volunteers view this informative video explaining the value of IDP protocol and what to do in the event of a discovery. The target audience is anyone working on the project who could unexpectedly find cultural resources or human remains while excavating or digging. The video is also posted on DAHP's inadvertent discovery language website.

[Ecology's IDP Video](https://www.youtube.com/watch?v=ioX-4cXfbDY) (<https://www.youtube.com/watch?v=ioX-4cXfbDY>)

Informational Resources

[DAHP \(https://dahp.wa.gov\)](https://dahp.wa.gov)

[Washington State Archeology \(DAHP 2003\)](https://dahp.wa.gov/sites/default/files/Field%20Guide%20to%20WA%20Arch_0.pdf)

[\(https://dahp.wa.gov/sites/default/files/Field%20Guide%20to%20WA%20Arch_0.pdf\)](https://dahp.wa.gov/sites/default/files/Field%20Guide%20to%20WA%20Arch_0.pdf)

[Association of Washington Archaeologists \(https://www.archaeologyinwashington.com\)](https://www.archaeologyinwashington.com)

Potentially Interested Tribes

[Interactive Map of Tribes by Area](https://dahp.wa.gov/archaeology/tribal-consultation-information)

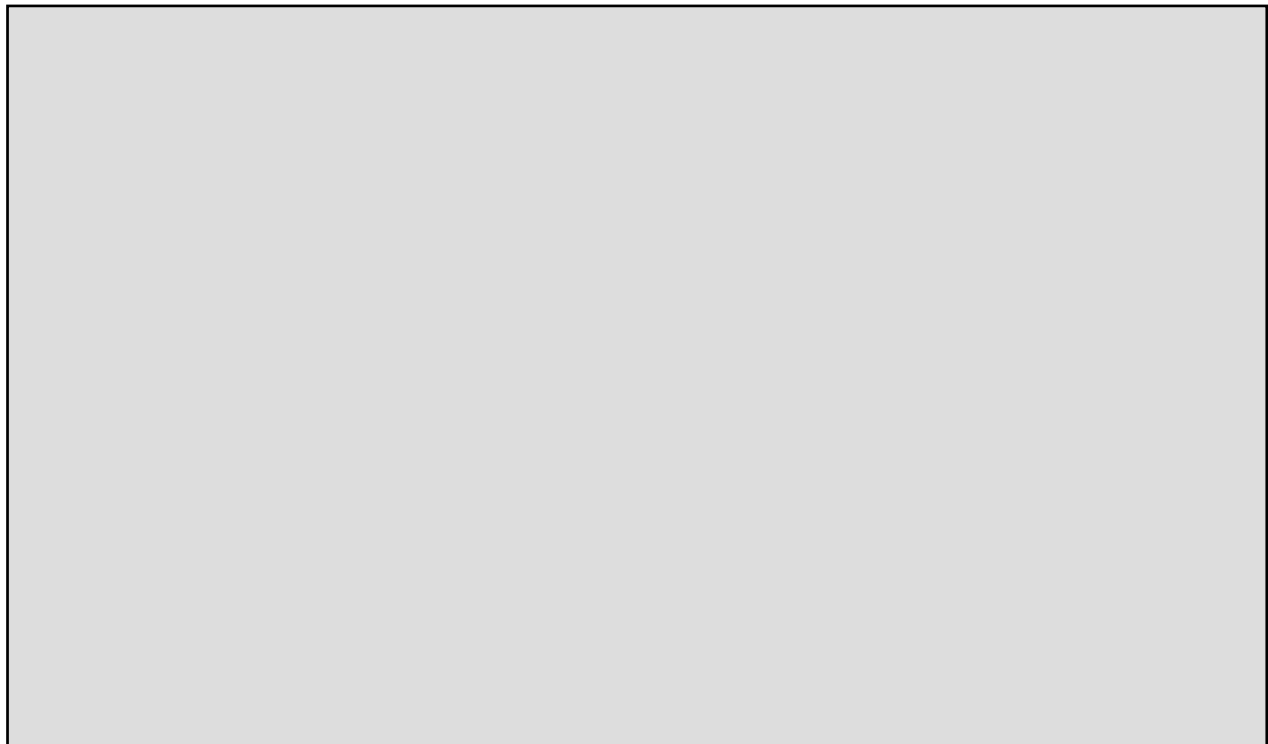
[\(https://dahp.wa.gov/archaeology/tribal-consultation-information\)](https://dahp.wa.gov/archaeology/tribal-consultation-information)

[WSDOT Tribal Contact Website](https://wsdot.wa.gov/tribal/TribalContacts.htm)

[\(https://wsdot.wa.gov/tribal/TribalContacts.htm\)](https://wsdot.wa.gov/tribal/TribalContacts.htm)

11. ADDITIONAL INFORMATION

Please add any additional contact information or other information needed within this IDP.



Implement the IDP if you see...

Chipped stone artifacts.

Examples are:

- Glass-like material.
- Angular material.
- “Unusual” material or shape for the area.
- Regularity of flaking.
- Variability of size.



Stone artifacts from Oregon.



Stone artifacts from Washington.



Biface-knife, scraper, or pre-form found in NE Washington. Thought to be a well knapped object of great antiquity. Courtesy of Methow Salmon Rec. Foundation.

Implement the IDP if you see...

Ground stone artifacts.

Examples are:

- Unusual or unnatural shapes or unusual stone.
- Striations or scratching.
- Etching, perforations, or pecking.
- Regularity in modifications.
- Variability of size, function, or complexity.



Above: Fishing Weight - credit [CRITFC Treaty Fishing Rights website](#).



Artifacts from unknown locations (left and right images).

Implement the IDP if you see...

Bone or shell artifacts, tools, or beads.

Examples are:

- Smooth or carved materials.
- Unusual shape.
- Pointed as if used as a tool.
- Wedge shaped like a “shoehorn”.
- Variability of size.
- Beads from shell (‘dentalium’) or tusk.



Upper Left: Bone Awls from Oregon.

Upper Center: Bone Wedge from California.

Upper Right: Plateau dentalium choker and bracelet, from Nez Perce National Historical Park, 19th century, made using Antalis pretiosa shells Credit: Nez Perce - Nez Perce National Historical Park, NEPE 8762, Public Domain.

Above: Tooth Pendants. Right: Bone Pendants. Both from Oregon and Washington.



Implement the IDP if you see...

Culturally modified trees, fiber, or wood artifacts.

Examples are:

- Trees with bark stripped or peeled, carvings, axe cuts, de-limbing, wood removal, and other human modifications.
- Fiber or wood artifacts in a wet environment.
- Variability of size, function, and complexity.



Left and Below: *Culturally modified tree and an old carving on an aspen (Courtesy of DAHP).*

Right, Top to Bottom: *Artifacts from Mud Bay, Olympia: Toy war club, two strand cedar rope, wet basketry.*



Implement the IDP if you see...

Strange, different, or interesting looking dirt, rocks, or shells.

Human activities leave traces in the ground that may or may not have artifacts associated with them. Examples are:

- “Unusual” accumulations of rock (especially fire-cracked rock).
- “Unusual” shaped accumulations of rock (such as a shape similar to a fire ring).
- Charcoal or charcoal-stained soils, burnt-looking soils, or soil that has a “layer cake” appearance.
- Accumulations of shell, bones, or artifacts. Shells may be crushed.
- Look for the “unusual” or out of place (for example, rock piles in areas with otherwise few rocks).



Shell Midden pocket in modern fill discovered in sewer trench.



Underground oven. Courtesy of DAHP.

Shell midden with fire cracked rock.



Hearth excavated near Hamilton, WA.

Implement the IDP if you see...

Historic period artifacts (historic archaeology considered older than 50 years).

Examples are:

- Agricultural or logging equipment. May include equipment, fencing, canals, spillways, chutes, derelict sawmills, tools, etc.
- Domestic items including square or wire nails, amethyst colored glass, or painted stoneware.



Left: Top to Bottom: *Willow pattern serving bowl and slip joint pocket knife discovered during Seattle Smith Cove shantytown (45-KI-1200) excavation.*



Right: *Collections of historic artifacts discovered during excavations in eastern Washington cities.*



Implement the IDP if you see...

Historic period artifacts (historic archaeology considered older than 50 years).

Examples are:

- Railway tokens, coins, and buttons.
- Spectacles, toys, clothing, and personal items.
- Items helping to understand a culture or identity.
- Food containers and dishware.



Main Image: *Dishes, bottles, workboot found at the North Shore Japanese bath house (ofuro) site, Courtesy Bob Muckle, Archaeologist, Capilano University, B.C. This is an example of an above ground resource.*



Right, from Top to Bottom:
Coins, token, spectacles and Montgomery Ward pitchfork toy discovered during Seattle Smith Cove shantytown (45-KI-1200) excavation.



Implement the IDP if you see...

- Old munition casings – if you see ammunition of any type – ***always assume they are live and never touch or move!***
- Tin cans or glass bottles with an older manufacturer's technique – maker's mark, distinct colors such as turquoise, or an older method of opening the container.



Far Left: .303 British cartridge found by a WCC planting crew on Skagit River. Don't ever touch something like this!
Left: Maker's mark on bottom of old bottle.



Right: Old beer can found in Oregon. ACME was owned by Olympia Brewery. Courtesy of Heather Simmons.



Logo employed by Whithall Tatum & Co. between 1924 to 1938 (Lockhart et al. 2016).



Can opening dates, courtesy of W.M. Schroeder.

Implement the IDP if you see...

You see historic foundations or buried structures.

Examples are:

- Foundations.
- Railroad and trolley tracks.
- Remnants of structures.



Counter Clockwise, Left to Right: *Historic structure 45KI924, in WSDOT right of way for SR99 tunnel. Remnants of Smith Cove shantytown (45-KI-1200) discovered during Ecology CSO excavation, City of Spokane historic trolley tracks uncovered during stormwater project, intact foundation of historic home that survived the Great Ellensburg Fire of July 4, 1889, uncovered beneath parking lot in Ellensburg.*

Implement the IDP if you see...

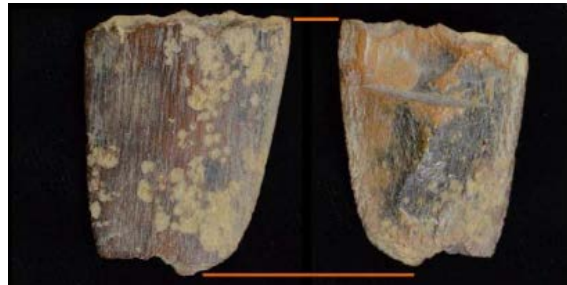
Potential human remains.

Examples are:

- Grave headstones that appear to be older than 50 years.
- Bones or bone tools--intact or in small pieces. It can be difficult to differentiate animal from human so they must be identified by an expert.
- These are all examples of animal bones and are not human.

Center: *Bone wedge tool, courtesy of Smith Cove Shantytown excavation (45KI1200).*

Other images (Top Right, Bottom Left, and Bottom) Center: Courtesy of DAHP.



Directly Above: This is a real discovery at an Ecology sewer project site.

What would you do if you found these items at a site? Who would be the first person you would call?

Hint: Read the plan!

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DIVISION 01

GENERAL REQUIREMENTS



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SECTION 01 11 00
SUMMARY OF WORK

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Location and Description of Work.
 - 2. Contracts for this Project.
 - 3. Work by Owner.
 - 4. Sequence and Progress of Work.
 - 5. Contractor's Use of Site.
 - 6. Easements and Rights-of-Way.
 - 7. Partial Utilization by Owner.
 - 8. Utility Owners.
 - 9. Tree Trimming, Clearing, and Tree Removal.
 - 10. Fences.

1.2 LOCATION AND DESCRIPTION OF WORK

- A. The Work is located in The City of Wenatchee, WA (City), at the wastewater treatment plant (WWTP).
- B. The Work to be performed under this Contract includes constructing the Work broadly described below, in accordance with the Contract Documents, with all related appurtenances. Work shown on the Drawings, or indicated in the Specifications, or indicated elsewhere in the Contract Documents is part of the Work, regardless of whether indicated below. The Work includes, but is not limited to, the following: The Work to be performed under this Contract includes constructing the Work broadly described below, in accordance with the Contract Documents, with all related appurtenances. Work shown on the Drawings, or indicated in the Specifications, or indicated elsewhere in the Contract Documents is part of the Work, regardless of whether indicated below. The Work includes, but is not limited to, the following:
 - 1. Construction of a new fixed-cover Digester 4, and associated mixing, heating, and gas handling for the digester.
 - 2. Construction of a new Mechanical Building for the housing of various equipment and storage associated with the project.
 - 3. Associated equipment improvements: new boiler and heat exchanger, new rotary screen thickeners, electrical and control system improvements, relocating/replacing the plant non-potable water system, HVAC improvements for existing solids handling building, and site improvements
- C. The Work is located at the Wenatchee WWTP. The plant address is 201 N. Worthen Street.
- D. Contracting Method: The Project will be constructed under a single prime construction contract.

1.3 WORK BY OWNER

- A. Owner will perform the following in connection with the Work:
 - 1. Operate all existing valves, flow-control gates, pumps, equipment, and appurtenances that will affect Owner's operations, unless otherwise specified or indicated.
 - 2. Indicate other work, if any, by Owner.

1.4 SEQUENCE AND PROGRESS OF WORK

- A. Requirements for sequencing and coordinating with Owner's operations, including maintenance of facility operations during construction, and requirements for tie-ins and shutdowns, are in Section 01 14 16 - Coordination with Owner's Operations.

1.5 CONTRACTOR'S USE OF SITE

- A. Contractors' use of the Site shall be confined to the areas shown on the Drawings.
- B. Move stored materials and equipment that interfere with operations of Owner, other contractors, and others performing work for Owner.
- C. Limits on Contractor's use of the Site are:
 - 1. Contractor cannot use Owner's sanitary facilities.
 - 2. Contractor cannot use Owner's power outlets.
 - 3. Contractor cannot use the Site for operations other than those required for the Project.
- D. Owner will occupy the Site jointly with Contractor during construction for performance of Owner's typical operations. Coordinate with Owner in all construction operations to minimize conflicts between Contractor and Owner's employees and others under Owner's control. If the Site is a treatment facility or other production facility, Owner will have Owner's suppliers for deliveries of chemicals and other items accessing the Site from time to time, possibly on a daily basis.

1.6 EASEMENTS AND RIGHTS-OF-WAY

- A. Easements and Rights-of-Way - General:
 - 1. Easements and rights-of-way required for the permanent improvements included in the Work will be provided by Owner in accordance with the General Conditions and Supplementary Conditions.
 - 2. Confine construction operations within Owner's property, public rights-of-way, easements obtained by Owner, and limits shown, and property for which Contractor has made arrangements directly with property owner(s).
 - 3. Use care in placing construction tools, machinery and equipment, excavated materials, and materials and equipment to be incorporated into the Work to avoid damaging property and interfering with traffic.
 - 4. Do not enter private property outside the construction limits without permission from the owner of the property.

1.7 UTILITY OWNERS

- A. Utilities known to Engineer who may have facilities (Underground Facilities or otherwise) in the vicinity of the Work are as follows:
 - 1. Storm Sewer
City of Wenatchee
1350 McKittrick Street, Suite A
Wenatchee, WA 98801-0519
Attention: Adam Nealy
Telephone: (509) 888-3230
 - 2. Traffic Signals and Lighting
City of Wenatchee
1350 McKittrick Street, Suite A
Wenatchee, WA 98801-0519
Attention: Josh Winn
Telephone: (509) 888-3222
 - 3. Water
City of Wenatchee
1350 McKittrick Street, Suite A
Wenatchee, WA 98801-0519
Attention: Terry O'Keefe
Telephone: (509) 888-3230

4. Power or Fiber Optic
Chelan County PUD
327 North Wenatchee Avenue
P.O. Box 1231
Wenatchee, WA 98807-1231
Attention: Tammy Fisher
Telephone: (509) 661-4617
5. Irrigation
Wenatchee Reclamation District
514 Easy St.
Wenatchee, WA 98801
Attention Alice Meyer
Telephone: (509) 663-0002
6. Telephone
ZiPLY
320 E. Penny Rd.
Wenatchee, WA 98801-0139
Attention: Steve Johnson
Telephone: (509) 662-1141
7. Television
Charter Communications
145 Easy Street
PO Box 1480
Wenatchee, WA 98801
Attention: Justen Harkness
Telephone: (509) 264-8391
8. City of Wenatchee Police Department
140 South Mission
Wenatchee, WA 98801
Attn: Doug Jones
Telephone: (509) 888-4200
9. Chelan County Fire Department
731 N Wenatchee Avenue
Wenatchee, WA 98801
Attn: Mike Burnett
Telephone: (509) 664-4734
10. Natural Gas
Cascade Natural Gas
614 N Mission Street
Wenatchee, WA 98801
Attn: Amanda Whimple
Telephone: (509) 406-6976
11. Call Before you Dig Utility Notification Center
811 or (800) 424-5555

1.8 FENCES

- A. All fences affected by the Work shall be maintained by the Contractor until completion of the Work. Fences disturbed by the Work shall be restored by Contractor to their original or better condition and to their original location unless otherwise indicated.

PART 2 - PRODUCTS - (NOT USED)

PART 3 - EXECUTION - (NOT USED)

END OF SECTION

SECTION 01 11 20
JOB CONDITIONS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Job conditions.
- B. Related Specification Sections include but are not necessarily limited to:
 - 1. Division 00 - Procurement and Contracting Requirements.
 - 2. Division 01 - General Requirements.

1.2 PROJECT CONDITIONS

- A. Prior to installation of material, equipment and other work, verify with subcontractors, material or equipment manufacturers, and installers that the substrate or surface to which those materials attach is acceptable for installation of those materials or equipment. (Substrate is defined as building surfaces to which materials or equipment is attached to i.e., floors, walls, ceilings, etc.).
- B. Correct unacceptable substrate until acceptable for installation of equipment or materials.

PART 2 - PRODUCTS - (NOT USED)

PART 3 - EXECUTION - (NOT USED)

END OF SECTION

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SECTION 01 14 16
COORDINATION WITH OWNER'S OPERATIONS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
1. Requirements for coordinating with Owner's operations during the Project.
 2. Requirements for tie-ins and shutdowns necessary to complete the Work without impact on Owner's operations except as allowed in this Specifications section.
- B. Scope:
1. Contractor shall provide all labor, materials, equipment, tools, and incidentals shown, specified, and required to coordinate with Owner's operations during the Work in accordance with this Specifications section.
 2. Except for shutdowns specified in this Specifications section, perform the Work such that Owner's facilities remain in continuous, satisfactory operation during the Project. Schedule and perform the Work such that the Work does not: impede Owner's production or processes, create potential hazards to operating equipment and personnel, reduce the quality of the facility's products or effluent, cause odors or other nuisances, does not affect the public health, safety, welfare, and convenience, and does not adversely affect the environment resulting in violation of Laws or Regulations.
 3. Work not specifically addressed in this Specifications section or in referenced sections may, in general, be performed, to be completed within the Contract Times, at any time during regular working hours in accordance with the Contract Documents, subject to the requirements in this section.
- C. Related Requirements: Include but are not necessarily limited to:
1. Section 01 11 00 - Summary of Work.
 2. Section 01 73 29 - Cutting and Patching.
 3. Section 01 75 00 - Checkout and Startup Procedures.
 4. Section 02 41 00 - Demolition.

1.2 REFERENCES

- A. Terminology:
1. Terminology indicated below are not defined terms and are not indicated with initial capital letters, but when used in this Specifications section have the meaning indicated below:
 - a. The term "Owner" is used throughout this section. When the facility is operated or managed by an entity other than Owner, references in this section to "Owner" as the operator or manager of the facility will be interpreted as referring to the facility manager.
 - b. A "shutdown" is when a portion of the normal operation of Owner's facility, whether equipment, systems, conduit (including piping and ducting), has to be temporarily suspended or taken out of service to perform the Work.
 - c. A "tie-in" is a connection of new Work to existing facilities, including connecting to existing conduits (including piping and ducting), electrical systems, structural elements, process/mechanical elements, and other physical connections. Some tie-ins may require that the tie-in be made without an associated shutdown.

1.3 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
1. Review construction procedures under other Specifications sections and coordinate Work that will be performed with or before the Work indicated in this Section.

- B. Sequencing and Scheduling:
 - 1. Refer to this Specifications sections articles on sequencing, tie-ins, and shutdowns.

1.4 SUBMITTALS

- A. Informational Submittals: Submit the following:
 - 1. Removal From Service (RFS) - Shutdown Planning Submittal:
 - a. For each shutdown, submit a Removal From Service (RFS) request describing the inventory of labor, materials, and equipment required to perform the shutdown and tie-in tasks, an estimate of time required to accomplish the complete shutdown including time for Owner to take down and start up existing equipment, systems, or conduits, and written description of steps required to complete the Work associated with the shutdown.
 - b. Furnish submittal to Engineer not less than 10 days prior to proposed shutdown start date. Do not start shutdown until obtaining Engineer's acceptance of shutdown planning Submittal-RFS.
 - 2. Shutdown Notification:
 - a. After Engineer's acceptance of shutdown planning Submittal and prior to starting the shutdown, submit written notification to Owner and Engineer of date and time each shutdown is to start. Submit notification not less than 72 HRS in advance of each shutdown.
 - b. The Removal From Service (RFS) form is attached to this specification.

1.5 GENERAL CONSTRAINTS

- A. Indicated in the Contract Documents are the sequence and shutdown durations, where applicable, for Owner's equipment, systems, and conduits (including piping and ducting) that are to be taken out of service temporarily for the Work. New materials and equipment may be used by Owner after the specified field quality control activities are successfully completed and the materials or equipment are substantially complete in accordance with the Contract Documents.
- B. The following constraints apply to coordination with Owner's operations:
 - 1. Operational Access: Owner's personnel shall have access to equipment and areas of the facility that remain in operation.
 - 2. Temporary Partitions and Enclosures: Provide temporary partitions and enclosures necessary to maintain dust-free, heated, and ventilated spaces in areas of the facility that are adjacent to the Work and that must be kept operational.
 - 3. Schedule and perform equipment and system start-ups in accordance with Section 01 75 00 - Checkout and Startup procedures. Equipment and systems shall not be placed into operation on Friday, Saturday, Sunday, or holidays without prior approval of Owner, unless specifically indicated otherwise in the Contract Documents.
 - 4. Dead End Valves or Conduits:
 - a. Provide blind flanges, waertight bulkheads, or valve at temporary and permanent terminuses of conduits, including piping and ducting.
 - b. Blind flanges and bulkheads shall be suitable for the service and braced and blocked, as required, or otherwise restrained as necessary or as required by Engineer.
 - c. Temporary valves shall be suitable for their associated service. Where valve is provided at permanent terminus of conduit, including piping or ducting, also provide on downstream side of valve a blind flange with drain/flushing connection.
 - 5. Owner will assist Contractor in dewatering process tanks, basins, conduits, and other work areas to be dewatered for shutdowns. Maintain clean, dry work area by pumping and properly disposing of fluid and other material that accumulates in work areas.
 - 6. Draining and Cleaning of Conduits, Tanks, and Basins:
 - a. Unless otherwise shown or indicated in the Contract Documents, Contractor shall dewater process tanks, basins, conduits (including piping) at beginning of each shutdown. Flush, wash down, and clean tanks, basins, conduits (including piping), and other work areas.

- b. Contractor shall remove liquids and solids and dispose of them at a appropriate location at the Site as directed by Engineer. Unless otherwise specified or indicated, contents of tanks, basins, and conduits (including piping) undergoing modifications shall be transferred to existing process tanks or conduits at the Site with capacity sufficient to accept such discharges, using hoses, temporary piping, temporary pumps, and other means provided by Contractor. Discharge of fluids across floors is not allowed.
- c. If drainage point is not available on the conduit (including piping) to be drained, provide a wet tap using tapping saddle and valve or other method approved by Engineer. Uncontrolled spillage of contents of conduits (including piping) is not allowed.
- d. Spillage shall be brought to Engineer's attention immediately, both orally and in writing, and reported in accordance with Laws and Regulations. Contractor shall wash down spillage to floor drains or sumps or other appropriate location and flush the system to prevent clogging and odors. If spillage is not suitable for discharge to the drainage system, such as chemical spills, as determined by Engineer, Contractor shall remove spillage by other means, such as vacuum truck, sorbents, or other method acceptable to Engineer.

1.6 WORK SEQUENCING/CONSTRAINTS

A. Site Work:

- 1. Locate and survey significant existing structures. Stake out new facilities.

1.7 REFERENCE POINTS AND SURVEYS

- A. Owner's Responsibilities: The Owner has established the reference marks shown on the Drawings.
- B. Location and elevation of benchmarks are shown on Drawings.
- C. Dimensions for lines and elevations for grades of structures, appurtenances, and utilities are indicated on the Drawings, together with other pertinent information required for laying out the Work. If conditions vary from those indicated, notify Engineer immediately, who will make minor adjustments required.
- D. Engineer may perform checks to verify accuracy on Contractor's layout Work and that completed Work complies with Contract Documents.
- E. Any existing survey points or other control markers destroyed without proper authorization will be replaced by Owner at the Contractor's expense.
- F. Contractor's Responsibilities:
 - 1. Provide additional survey and layout required to layout the Work.
 - 2. Check and establish exact location of existing facilities prior to construction of new facilities and any connections thereto.
 - 3. In event of discrepancy in data provided by Owner, request clarification before proceeding with Work.
 - 4. Retain professional land surveyor or civil engineer registered in state of Washington who shall perform or supervise engineering surveying necessary for additional construction staking and layout.
 - 5. Maintain complete accurate log of survey Work as it progresses as a Record Document.
 - 6. On request of Engineer, submit documentation.
 - 7. Provide competent employee(s), tools, stakes, and other equipment and materials as Engineer may require to: Check layout, survey, and measurement Work performed by others.

1.8 ADJACENT FACILITIES AND PROPERTIES

- A. Examination:
 - 1. After Effective Date of the Agreement and before Work at Site is started, Contractor, Engineer, and affected property owners and utility owners shall make a thorough examination of pre-existing conditions including existing buildings, structures, and other improvements in vicinity of Work, as applicable, which could be damaged by construction operations.
 - 2. Periodic reexamination shall be jointly performed to include, but not limited to, cracks in structures, settlement, leakage, and similar conditions.
- B. Documentation:
 - 1. Record and submit documentation of observations made on examination inspections in accordance with Article Construction Photographs.
 - 2. Upon receipt, Engineer will review, sign, and return one record copy of documentation to Contractor to be kept on file in field office.
 - 3. Such documentation shall be used as indisputable evidence in ascertaining whether and to what extent damage occurred as a result of Contractor's operations, and is for the protection of adjacent property owners, Contractor, and Owner.

1.9 SEQUENCE OF FACILITY OPERATIONS

- A. The Wenatchee Wastewater Treatment Facility discharges to the Columbia River. The discharge is permitted under the National Pollutant Discharge Elimination System. The Contractor's operations will be impacted by requirements of the permit. Only the plant operations staff may operate the plant, and may determine that construction operations must be modified as discharge conditions require. Operations staff will work in good faith to accommodate the contractor's approach as documented in the REMOVAL FROM SERVICE submittals.
- B. Continuous operation of Owner's facilities is of critical importance. Schedule and conduct activities to enable existing facilities to operate continuously, unless otherwise specified.
- C. Perform Work continuously during critical connections and changeovers, and as required to prevent interruption of Owner's operations.
- D. When necessary, plan, design, and provide various temporary service, including but not limited to groundwater dewatering, utilities, connections, temporary piping, and heating, access, and similar items to maintain continuous operations of Owner's facility.
- E. Do not close lines, open or close valves, or take other action which would affect the operation of existing systems, except as specifically required by the Contract Documents and after authorization by Owner and Engineer. Such authorization will be considered within 48 hours after receipt of Contractor's written request.
- F. Construct Work in the stages to allow for Owner's continuous occupancy and for uninterrupted operation during construction.
- G. Power outages will be considered upon 10 days written request to Owner and Engineer as provided, using the form: REMOVAL FROM SERVICE supplement. Describe the reason, anticipated length of time, and areas affected by the outage. Provide temporary provisions for continuous power supply to critical facility components.
- H. Install and maintain bypass facilities and temporary connections required to keep Owner's operations on-line. Sequences other than those specified will be considered upon written request to Owner and Engineer, provided they afford equivalent continuity of operations.
- I. Do not proceed with Work affecting a facility's operation without obtaining Owner's and Engineer's advance approval of the need for and duration of such work.

- J. Relocation of Existing Facilities:
 - 1. During construction, it is expected that minor relocations of Work will be necessary.
 - 2. Provide complete relocation of existing structures and Underground Facilities, including piping, utilities, equipment, structures, electrical conduit wiring, electrical duct bank, and other necessary items.
 - 3. Perform relocations to minimize downtime of existing facilities.
 - 4. Install new portions of existing facilities in their relocated position prior to removal of existing facilities, unless otherwise accepted by Engineer.
- K. Operator Safety: Contractor shall ensure that all operating facilities are accessible to operations staff at all times except as described in an approved Removal from Service. Operator safety is a critical component of operator access.
- L. Public Access:
 - 1. Facility is made available for guided tours by members of the public. Facilities within the construction zone will not be open to general tours. Special arrangements will be made with Contractor for special tours such as City or State employees.
 - 2. Contractor shall manage operations to minimize impact in areas available to the public:
 - a. Access routes through plant.
- M. Construct Work in the following stages to allow for Owner's continuous occupancy and for uninterrupted operation during construction.
- N. Operational Constraints:
 - 1. Provide 10 days advance written request for approval of need to shut down a process of facility to Owner and Engineer. See Part 1.4 and RFS Submittal Process.
 - 2. Power outages will be considered, upon 10 days advance written request to Owner and Engineer. Describe the reason, anticipated length of time, and areas affected by the outage. Provide temporary provisions for continuous power supply to critical facility components.
 - 3. Install and maintain bypass facilities or temporary connections as required. Sequences other than those specified will be considered upon written request to Owner and Engineer, provided they afford equivalent continuity of operations.
 - 4. Do not proceed with Work affecting facility's operation without obtaining Owner's and Engineer's advance approval of the need for and duration of such Work on the REMOVAL FROM SERVICE submittal.

1.10 FACILITY OPERATIONS AND WORK SEQUENCE

- A. Continuous operation of the Owner's facilities is of critical importance. Schedule and conduct activities to enable the existing facilities to operate continuously, unless otherwise specified.
- B. Perform work continuously during critical connections and changeovers, and as required to prevent interruptions of the Owner's operations. Under no circumstances cease work at the end of a normal working day if such actions may inadvertently cause a cessation of any facility operating process, in which cases, remain onsite until necessary repairs are complete. All such work shall be part of the lump sum bid.
- C. Perform the Work in the indicated sequence. Certain phases or stages of the Work may require working 24 HR days or work during hours outside of regular working hours. Work may be accelerated from a later stage to an earlier stage if Owner's operations are not adversely affected by proposed substitute sequence, with Engineer's approval. Stages specified in this article are sequence dependent.
- D. General Work Sequence for Digester 4 and Mechanical Building:
 - 1. Digester No.4 and Mechanical Building work shall be completed prior to taking Digesters 1, 2 and 3 off-line. Digesters 1, 2 and 3 must remain in operation until the Digester 4 and Mechanical Building work is substantially complete to the satisfaction of the Owner.
 - 2. The yard piping for the PS and WAS are also considered part of the Mechanical Building construction and are essential for continuing work within the existing Solids Handling Building. Only after Digester 4 and the Mechanical Building are running to the satisfaction

of the Owner may work proceed in the Solids Handling Building lower level sludge transfer area.

3. Note that some sludge and water will remain in digesters or ancillary piping. Contractor is responsible for managing the material during demolition and construction, disposing of sludge on site as directed by the Owner.
4. Once Digester 4 work is completed by the Contractor, the Contractor shall notify the Owner to fill Digester 4 with water to test for leakage and to complete functional testing of all equipment and instrumentation associated with Digester 4.
5. Digester 4 will then be heated to a minimum of 98F after completion of leakage testing.
6. Contractor will then resolve and address any leakage associated with the work for Digester 4.
7. Contractor shall assure and complete installation and testing of all safety equipment including monitoring equipment (particularly associated with digester gas detection) is operating correctly to the Owner's satisfaction.
8. Complete Functional Testing for Digester No. 4. Digester No. 4 shall run full of water for two weeks after completion of Functional Testing. Temperature of water within Digester 4 shall remain within a temperature range of 96F to 100F during this two week period.
9. Once all functional testing is complete and successful for Digester 4, the Owner will drain the heated water from the digester to the Plant Drain at a rate as not to exceed the allowable flow to the headworks of the WWTF. As water is drained from Digester 4, nitrogen gas shall be pumped into the digester to fill the headspace and purge the Digester 4 atmosphere of to bring oxygen levels to approximately 7.2 ppm, or diminishing returns. The headspace pressure in Digester 4 shall not exceed that of the pressure in Digester 2. Contractor will then draw down the water in Digester 4 and continue to fill the headspace with nitrogen, while maintaining air pressure consistent with that of Digester 2 (approximately 10" w.c.). Sludge may only be introduced after water has been drawn down and the headspace filled with nitrogen. Once sludge is introduced to Digester 4, the new gas piping must be fully connected to the existing system and opened to release gas buildup in Digester 4. Also note, the Waste Gas Burner pilot will need to be fed by a clean fuel source while the nitrogen is purged from the Digester Gas system. Also note, the Waste Gas Burner pilot will need to be fed by a clean fuel source while the nitrogen is purged from the Digester Gas system.
10. The Owner can then begin to transfer sludge from Digester 2 or Digester 3 as required by the Contractor's sequence of activities. The Owner will require a minimum of 10 days to transfer the sludge into Digester 4. While transferring sludge into Digester 4, the floating cover of Digester 2 will drop. The floating cover of Digester 2 must be kept at least 3 feet above the corbels in the Digester 2 tank to maintain proper system pressure. The corbels are what the cover of Digester 2 rests on when there is not sufficient gas in the system to keep the cover floating.
11. The Contractor shall complete the Performance testing on Digester No. 4.

E. General Work Sequence for Solids Building:

1. During the Construction period, sludge digestion operations will depend upon the continuous operation of the solids thickening, dewatering processes and Digesters 1, 2 and 3. Any activities that affect this operation or systems critical to Digesters 1, 2 and 3 will need to strictly adhere to the REMOVAL FROM SERVICE (RFS) process described in this section.
2. Do not close lines, open or close valves, or take other action which would affect the operation of existing systems, except as specifically required by the Contract Documents.
3. In general, Digester 4 and the Mechanical Building must be substantially complete to the satisfaction of the Owner prior to beginning work within the Solids Handling Building.

F. Applications Software Development: The Engineer will perform programming of application software for certain portions of the Process Instrumentation and Control Subsystem. Refer to specification section 406113 for additional requirements.

1. Sequencing: Contractor shall include sequencing constraints specified herein as part of the Contractor's Progress Schedule.

2. Engineer shall deliver Owner supplied hardware to the site within the constraints detailed in 40 61 13.
3. Allowance for interruptions to the Work due to testing by Engineer of Engineer developed applications software:
 - a. During the Functional Testing and Performance Testing, the Contractor shall plan for interruption of testing work to allow for the Engineer to investigate software problems, make software configuration changes, and conduct additional testing if necessary.
 - b. When applications software testing is delayed due to altered equipment interfaces or receipt of incorrect Shop Drawing information, any duration of delay shall be excluded from interruption allowance, unless notified otherwise by the Engineer.

1.11 TIE-INS

- A. Table of Significant Tie-Ins in this Specifications section lists connections by Contractor to existing facilities. Table of Significant Tie-Ins may not indicate all tie-ins required for the Work; Contractor shall perform tie-ins necessary and required to complete the Work as shown or indicated in the Contract Documents, regardless of whether tie-in is indicated in Table of Significant Tie-Ins. For tie-ins not indicated in Table of Significant Tie-Ins, obtain requirements for tie-ins from Engineer by requesting an interpretation or clarification.

1.12 SHUTDOWNS

- A. Shutdowns shall be in accordance with Table of Significant Tie-Ins of this Specifications section. Work requiring service interruptions for tie-ins shall be performed during scheduled shutdowns.
- B. Work that may interrupt normal operations shall be accomplished at times convenient to Owner unless otherwise indicated in the Contract Documents.
- C. If Contractor's operations cause an unscheduled interruption of Owner's operations, immediately re-establish satisfactory operation for Owner.
- D. Fines and Penalties Imposed by Authorities Having Jurisdiction:
 1. Unscheduled shutdowns or interruptions of continued safe and satisfactory operation of Owner's facilities that result in fines or penalties by a authorities having jurisdiction shall be paid solely by Contractor if, in Engineer's opinion, Contractor did not comply with requirements of the Contract Documents, or was negligent in the Work, or did not exercise proper precautions in performing the Work and complying with applicable permits, Laws, and Regulations.
 2. Owner or Engineer may deduct as set-offs such amounts from payments due Contractor.
- E. Temporary, short-term shutdowns of smaller conduits (including piping and ducting), equipment, and systems may not be included in Table of Significant Tie-Ins. Coordinate requirements for such shutdowns with Engineer and Owner. Where necessary, obtain Engineer's interpretation or clarification before proceeding.

PART 2 - PRODUCTS - (NOT USED)

PART 3 - EXECUTION

3.1 SUBSTITUTE PROCEDURES

- A. Proposal of Substitute Sequencing, Shutdowns, and Tie-Ins:
 1. As a substitute to the procedures indicated in this Specifications section, Contractor may propose providing additional temporary facilities that can eliminate or mitigate a constraint without additional cost to Owner, provided such additional temporary facilities: do not present hazards to the public, personnel, structures, and equipment; that such additional temporary facilities do not adversely affect Owner's ability to comply with Laws and Regulations, permits, and operating requirements; that such temporary facilities do not

- generate or foster the generation of odors and other nuisances; and that requirements of the Contract Documents are fulfilled.
2. Engineer will consider proposals for substitute procedures after the Effective Date of the Contract. All Bids shall be based on the requirements of the Contract Documents, including this section.
 3. Substitution Requests:
 - a. When proposing a substitute procedure for a tie-in or shutdown or other requirements of this section, comply with the requirements of the General Conditions and Supplementary Conditions (regarding substitutes).
 - b. When deviation from specified sequence or procedures is proposed, Contractor's proposal shall explain in detail the proposed sequence and procedures and associated effects, including evidence that Owner's operations will not be adversely affected, to an extent greater than originally contemplated in the Contract Documents, by proposed substitution. List benefits of proposed substitution, including benefits to Progress Schedule.

3.2 GENERAL PROVISIONS FOR COORDINATING WITH OWNER'S OPERATIONS

- A. When possible, combine multiple tie-ins into a single shutdown to reduce impacts on Owner's operations and processes.
- B. Operation of Existing Systems and Equipment during the Work:
 1. Do not shut off or disconnect existing operating systems or equipment, unless accepted by Engineer in writing.
 2. Operation of existing systems and equipment will be by Owner unless otherwise specified or indicated.
 3. Where necessary for the Work, Contractor shall seal or bulkhead Owner-operated gates and valves to prevent leakage that may affect the Work, Owner's operations, or both.
 4. Provide temporary watertight plugs, bulkheads, and line stops as necessary and as required. After completing the Work, remove seals, plugs, bulkhead, and line stops to satisfaction of Engineer.
- C. Bypassing:
 1. Diversion of flows around treatment processes is not allowed.
- D. Requirements for temporary pumping associated with specific shutdowns are indicated in this Specifications Section.
- E. Performing the Work of this section constitutes Contractor's approval of underlying work and field conditions prevailing at the time of the Work.

3.3 PREPARATION

- A. Coordinate preparations for removals with requirements of Section 01 73 29 - Cutting and Patching and Section 02 41 00 - Demolition, applicable.
- B. Shutdowns - General Preparation:
 1. Coordinate shutdowns with Owner and Engineer.
 2. Submit shutdown planning Submittals and shutdown notification Submittals in accordance with this Specifications section's "Submittals" Article.
 3. Furnish at the Site, in close proximity to the shutdown and tie-in work areas, tools, materials, equipment, spare parts, both temporary and permanent, necessary to successfully perform the shutdown. Complete to the extent possible, prefabrication of piping and other assemblies prior to commencing the associated shutdown. Demonstrate to Engineer's satisfaction that Contractor has complied with such requirements before commencing the shutdown.
 4. Engineer shall have no duty to Contractor to advise Contractor of inadequate preparations by Contractor; Contractor is solely responsible for the means, methods, procedures, techniques, and sequences of construction.

- C. Shutdowns of Electrical, Instrumentation and Controls Systems:
 1. Comply with Laws and Regulations, including the National Electric Code.
 2. Contractor shall lock out and tag circuit breakers and switches operated by Owner and shall verify that affected cables and wires are de-energized to ground potential before starting other Work associated with the shutdown.
 3. Upon completion of shutdown Work, remove the locks and tags and advise Engineer or Resident Project Representative (RPR) that facilities are available for use.

3.4 DETAILED SHUTDOWN REQUIREMENTS

- A. Shutdown A: Anticipated power outages for Electrical Modifications
 1. General:
 - a. Affected Equipment Operating Prior to Shut down: Existing MCC 4 and 4A (Existing Solids Building)
 - b. Impact on Other Equipment and Processes: These MCC's provide power to the Existing Solids Building Equipment and Existing Digesters 1, 2 and 3.
 - c. Procedure: Coordinate and submit a plan of the work as specified in this section. This work will only proceed after approval by the Owner.
 - d. Dates: Shutdown shall be accomplished between 12:00 AM and 6:00 AM.
 - e. Time: Shutdown shall be performed prior to plant flows increasing due to diurnal flow patterns.

- B. Shutdown B: Anticipated power outages for Electrical Modifications
 1. General:
 - a. Affected Equipment Operating Prior to Shut down: Power Feeders from Existing SWBD-2 at Headworks Building.
 - b. Impact on Other Equipment and Processes: This shutdown affects the entire plant.
 - c. Procedure: Coordinate and submit a plan of the work as specified in this section. This work will only proceed after approval by the Owner.
 - d. Dates: Shutdown shall be accomplished between 12:00 AM and 6:00 AM.
 - e. Time: Shutdown shall be performed prior to plant flows increasing due to diurnal flow patterns.

- C. Shutdown C: Anticipated outages for Control Panel Modifications (see drawing 000Y-14)
 1. General:
 - a. Affected Equipment Operating Prior to Shut down: Existing Control Panels at Headworks Building, Administration Building, Solids Handling Facility, Screenings Building, UV Areas.
 - b. Impact on Other Equipment and Processes: The control panels impact the operation of the Headworks.
 - c. Procedure: Coordinate and submit a plan of the work as specified in this section. This work will only proceed after approval by the Owner.
 - d. Dates: Shutdown shall be accomplished between 12:00 AM and 6:00 AM.

3.5 ATTACHMENTS

- A. The following, bound after this Specifications Section's "End of Section" designation, are part of this Specifications Section:
 1. Table Listing Significant Tie-ins
 2. Removal From Service Request (RFS)

END OF SECTION

Tie-In No.	New Line Size and Service	Existing (Connecting) Line Size & Service	Tie-In Building/Location	Remarks
1	MCC 4	MCC 4 (Solids Bldg Electrical Room)	New Mechanical Building and Headworks	See Drawings for conduit and duct bank routing. All testing as specified must be completed prior to switch over to new MCC.
2	MCC 4A and MCC 4E	MCC 4A (Solids Bldg Electrical Room)	New Mechanical Building and Headworks	See Drawings for conduit and duct bank routing. All testing as specified must be completed prior to switch over to new MCC.
3	SWBD 2 Power Feed to new MCC 4 and MCC 4E	SWBD 2 Power Feeds	New Mechanical Building and Headworks	Coordinate with Owner's operations and Engineer prior to this work. Contractor shall submit a detailed plan for approval by the Owner prior to the work. Maximum duration of shutdown shall be one-hour.
4	Headworks Control Panel and Remote I/O Rack	Headworks Control Panel in MCC Room	New Mechanical Building MCC Room And Headworks Control Panel (Remote I/O Rack)	Coordinate with Owner's operations and software/control engineer prior to this work. Contractor shall submit a detailed plan for approval by the Owner prior to the work.
5	Administration Building POP Panel – Remote I/O Rack	Administration Building POP Panel	Administration Building POP Panel	Coordinate with Owner's operations and software/control engineer prior to this work. Contractor shall submit a detailed plan for approval by the Owner prior to the work.
6	Sludge (Solids) Handling Facility Control Panel – Remote I/O Rack	Sludge (Solids) Handling Facility Control Panel	New Mechanical Building Sludge Control Panel & Exst Sludge (Solids) Handling Facility Control Panel	Coordinate with Owner's operations and software/control engineer prior to this work. Contractor shall submit a detailed plan for approval by the Owner prior to the work.
7	NOT USED	NOT USED	NOT USED	NOT USED
8	NOT USED	NOT USED	NOT USED	NOT USED
9	UV ACP Panel Ethernet Switch	UV ACP Panel Ethernet Switch	ICP/ESP Panel Ethernet Switch	UV Disinfection must be maintained at all times. Contractor may provide an alternate disinfection means, approved by the Washington Department of Ecology, without increase in the lump sum price in the Agreement.
10	ICP/ESP Panel Ethernet Switch	ICP/ESP Panel Ethernet Switch	ICP/ESP Panel Ethernet Switch	Coordinate with Owner's operations and software/control engineer prior to this work. Contractor shall submit a detailed plan for approval by the Owner prior to the work.
11	Screenings Room Panel Ethernet Switch	Screenings Room Panel Ethernet Switch	Screenings Room Panel Ethernet Switch	Coordinate with Owner's operations and software/control engineer prior to this work. Contractor shall submit a detailed plan for approval by the Owner prior to the work.
12	PS Tie In	6-inch PS	South of Existing Solids Building	Coordinate this work with Owners operations. Shutdowns shall not exceed one 6 hour period.
13	WAS Tie In	6-inch WAS	South of Existing Solids Building	Coordinate this work with Owners operations. Shutdowns shall not exceed one 6 hour period.
14	Digester 4 DG Tie-In	4-inch DG	4-inch DG in Solids Building Compressor Room	Provide Owner prior notification as specified and follow specifications for line purging requirements in Specification Section 40 05 00

Tie-In No.	New Line Size and Service	Existing (Connecting) Line Size & Service	Tie-In Building/Location	Remarks
15	Polymer System Tie-In	2-inch Polymer Piping	Existing Solids Building, Ground Level, Existing Polymer Room	Coordinate this work with Owners operations. Shutdowns of the existing polymer system shall not exceed 6 hours in duration. At least one polymer pump must remain in operation.
16	Polymer Pump Replacement	Existing Polymer Pumps	Existing Solids Building, Ground Level, Existing Polymer Room	Coordinate this work with Owners operations. Shutdowns of the existing polymer system shall not exceed 6 hours in duration. At least one polymer pump must remain in operation.
17	W-1 System Tie In	4-inch Water Piping	Existing Solids Building, Lower Level, Ex. W-1 Header	Coordinate this work with Owners operations. Shutdowns of the existing W-1 system shall not exceed 2 hours in duration.
18	8-inch Odorous Air Connection	20-inch FRP Odorous Air	Existing Solids Building, Upper Level	Coordinate this work with Owners operations. Shutdowns of the existing Odorous Air system shall not exceed 2 hours in duration.
19	Transfer Pump No.1	Existing Solids Building	Existing Solids Building	(1) Digester 2 may only be taken out of service after Digester 3 and 4 Improvements have reached substantial completion (2) Complete HVAC improvements in Solids Building prior to Start-up of Transfer Pump
20	Transfer Pump No. 4	Existing Solids Building	Existing Solids Building	(1) Digester 1 may only be taken out of service after Digester 3 and 4 Improvements have reached substantial completion. (2) Complete HVAC improvements in Solids Building prior to Start-up of Transfer Pump
21	Replacement of Primary Hot Water Loop Pumps and Piping	Primary Hot Water Loop Pumps and Piping	Boiler Room of Existing Solids Building	Coordinate this work with Owners operations. Shutdowns shall not exceed 10 hours in duration. At least one of the two pumps must remain in operation.
22	New Waste Gas Burner and Control Panel	Existing WGB and Control Panel	South of Existing WGB and Control Panel as shown on the site drawings	Coordinate this work with Owners operations. Shutdowns shall not exceed 24 hours in duration. Digester 2 must be in operation during this tie-in for storage of digester gas.
23	AHU's	Existing ductwork in Solids Building	Existing Solids Building Lower, Ground and Upper Levels	Coordinate this work with Owners operations. Shut down of AHU's will require continuous operation of the foul air system. The AHU's may be out of operation no more than two weeks per unit. No more than one unit may be out of operation at a time. Contractor shall maintain as much airflow in the room as possible while the AHU is out of operation.
24	Odor Control	36-inch	Existing Solids Building, Rooftop, East of Digester 1	Coordinate this work with Owners operations. Shutdowns of the odor control system shall not exceed one continuous 24 hour period. No AHU's may be shut down at the same time the odor control system is shut down.

Tie-In No.	New Line Size and Service	Existing (Connecting) Line Size & Service	Tie-In Building/Location	Remarks
25	Digester 3 Level Element Installation (LE/LIT510-03)	Existing Solids Building Lower Level	Existing Solids Building Lower Level	<p>(1) Digester 3 may only be taken out of service after Digester 4 Improvements have reached substantial completion and prior to Digester 1 Improvements such that two digesters are on-line and operating at all times.</p> <p>(2) Complete HVAC improvements in Solids Building prior to Start-up of Level Element</p> <p>(3) Digester head space must be isolated and purged with nitrogen to bring the O₂ concentration level to below 7.2 ppm.</p> <p>(4) Also note, the Waste Gas Burner pilot will need to be fed by a clean fuel source while the nitrogen is purged from the Digester Gas system.</p>
26	Digester 1 Level Element Installation (LE/LIT510-01)	Existing Solids Building	Existing Solids Building	<p>(1) Digester 1 may only be taken out of service after Digester 3 and 4 Improvements have reached substantial completion such that two digesters are on-line and operating at all times.</p> <p>(2) Complete HVAC improvements in Solids Building prior to Start-up of Level Element</p> <p>(3) Digester head space must be isolated and purged with nitrogen to bring the O₂ concentration level to below 7.2 ppm.</p> <p>(4) Also note, the Waste Gas Burner pilot will need to be fed by a clean fuel source while the nitrogen is purged from the Digester Gas system.</p>
27	Digester 2 Level Element Installation (LE/LIT510-02)	Existing Solids Building	Existing Solids Building	<p>(1) Digester 2 may only be taken out of service after Digester 3 and 4 Improvements have reached substantial completion such that two digesters are on-line and operating at all times.</p> <p>(2) Complete HVAC improvements in Solids Building prior to Start-up of Level Element</p> <p>(3) Digester head space must be isolated and purged with nitrogen to bring the O₂ concentration level to below 7.2 ppm.</p> <p>(4) Also note, the Waste Gas Burner pilot will need to be fed by a clean fuel source while the nitrogen is purged from the Digester Gas system.</p>

VERIFY TEMPORARY PIPING/WIRING DOES NOT NEED TO BE INSTALLED TO MAINTAIN PROCESS FLOW. SCHEDULED DOWNTIME WILL NOT AFFECT TREATMENT AND THIS EQUIPMENT/PIPELINE/WIRING IS NOT CRITICAL TO TREATMENT PROCESS.

REQUEST APPROVED / DENIED _____
OWNER'S WASTEWATER SUPERINTENDENT / DATE

REQUEST APPROVED / DENIED _____
OWNER'S PROJECT REPRESENTATIVE / DATE

REQUEST APPROVED / DENIED _____
OWNER'S MAINTENANCE REPRESENTATIVE / DATE

REQUEST APPROVED / DENIED _____
CONTRACTOR'S ON-SITE SUPERINTENDENT / DATE

POST ON ELECTRONIC FILE FOLDER

END OF SECTION

SECTION 01 21 00
ALLOWANCE (LUMP SUM PROJECTS)

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
1. Provisions for handling Allowance.

1.2 ALLOWANCE

- A. Allowance(s) are established to provide the Owner with a method for compensating the Contractor for specific items of Work that are not completely defined in the Contract Documents prior to the award of contract and maybe required to complete the Work.
- B. Allowance(s) for minor changes are for the exclusive use of Owner as a result of changed conditions, design refinements, and unanticipated design issues.
1. The Owner will issue a field order or directive to proceed with the work as defined in the Allowance below.
 2. The Owner can compensate the Contractor for the work as defined below without issuing a change order as long as the costs are within the Allowance amount stated in the Contract.
 3. Owner approval is required prior to the start of the work and/or a authorization of progress payments for the Allowance(s).
 4. The Owner and Contractor can agree to compensate the Contractor for work covered by the Allowance(s) in one or more of the following methods;
 - a. Lump sum payment agreed to prior to beginning the work,
 - b. Agreed on unit prices measured against actual installed quantities, and/or
 - c. Contractor's actual costs as documented on force account sheets completed daily and approved by the Owner. Overhead and Profit will be compensated through the Contractor's Fee as defined in the Contract Documents.
- C. Include in the Bid an Allowance equal to the amount shown on the Bid Form.
1. Include Allowance sum on Bid Form on the line provided.
 2. The Total Contract Price shall be the sum of the Base Bid and the Allowance.
 3. At Project closeout and prior to Final Payment, adjust the final Contract Sum accordingly by Change Order.
 - a. Amount of the Change Order shall reflect difference between actual costs of all approved contingency adjustments and the Allowance.

PART 2 - PRODUCTS - (NOT USED)

PART 3 - EXECUTION - (NOT USED)

END OF SECTION

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SECTION 01 22 00
MEASUREMENT AND PAYMENT

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Defines how work items are measured and paid for on Lump Sum Contracts. These items include lump sum price, and allowance payment items.
 - 2. In the case of conflict between this Section and the measurement methods specified in the individual Technical Specification Sections, the measurement methods in Technical Specification Sections shall govern.
 - 3. Receive payment for work after it is installed. Payment for material on hand can only be paid for if allowed by the Agreement, the General and/or Special Conditions.
 - 4. Partial payment may be requested for items partially installed when agreed to by the Owner.
- B. Related Specification Sections include but are not necessarily limited to:
 - 1. Division 00 - Procurement and Contracting Requirements.
 - 2. Division 01 - General Requirements.
 - 3. Applications for Payment requirements are included in Specification Section 01 3000 - Special Conditions.

1.2 LUMP SUM ITEMS

- A. Progress payments for Lump Sum items in the Bid Schedule will be based on the breakdown prepared by the Contractor and approved by the Engineer and Owner before acceptance of the Application for Payment for the Lump Sum item.
- B. Lump Sum payment will be for the entire item as specified and as indicated in the Contract Documents. Payment for all bid items indicated as Lump Sums shall include the cost of all labor, materials, equipment and incidentals necessary to furnish, install, clean, test, and place each bid item into operation; including permitting, general conditions, overhead and profit.

1.3 ALLOWANCES

- A. Allowances indicated in the Bid Schedule are defined in the Contract Documents. No work may be performed under an allowance item without prior written approval of the Owner.
- B. Allowance is for exclusive use of Owner for changes as a result of changed conditions, design refinements, and unanticipated design issues. Not for use by Contractor as Contractor's construction contingency.
- C. Owner approval of an adjustment required prior to a authorization of progress payments from Contingency Allowance. Adjustments will include either:
 - 1. Contractor's lump sum or unit price measured quantity amount.
 - 2. Contractor's related costs, and reasonable overhead and profit as stipulated in Contract Documents when Work is performed on the Cost of the Work basis.
- D. Any unused balance of the allowances shall revert to the Owner upon completion of the project. Prior to final payment, the original amount provided for allowances shall be adjusted to actual costs by deductive Change Order, adjusting the contract price, accordingly.
- E. Make no claim, nor receive any compensation, for anticipated profits, loss of profit, damages, or any extra payment due to any unexpended portion of the allowances.
- F. The Contractor is to include time for allowance work in the construction schedule. No adjustment of Contract Time shall be allowed for any work performed under allowance items.

- G. The measurable and allowable costs for work performed under an allowance item(s) shall be limited to the actual costs associated with that allowance item unless otherwise stated in the specific measurement and payment provisions under allowance items.
- H. Allowance work shall be compensated as specified in Section 01 21 00.
 - 1. Time and materials sheets shall be signed daily by the Engineer or its representative to confirm labor hours worked, equipment hours worked, and materials incorporated into the Work.
 - 2. Labor hours worked shall be recorded daily for each person. The labor will be classified by craft. Actual labor rates will be supported by certified payroll or other payroll documentation agreed to by the Engineer.
 - 3. Equipment hours worked shall be recorded daily for each piece of equipment used to perform the work. Equipment rates shall be as defined in the General or Supplemental Conditions.
 - 4. Material shall be identified with the costs supported by invoice.
 - 5. Profit and overhead shall be compensated for in accordance with the Contractor's Fee as defined in the General Conditions.
 - 6. Labor and equipment rates used in pricing out the work shall be as defined in the General Conditions.

1.4 APPLICATION FOR PAYMENT

- A. Provide a Summary Sheets and breakdown sheets equivalent to those of EJCDC document C-620, Contractor's Application for Payment forms.

PART 2 - PRODUCTS - (NOT USED)

PART 3 - EXECUTION - (NOT USED)

END OF SECTION

SECTION 01 25 13
PRODUCT SUBSTITUTIONS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. The procedure for requesting the approval of substitution of a product that is not equivalent to a product which is specified by descriptive or performance criteria or defined by reference to one or more of the following:
 - a. Name of manufacturer.
 - b. Name of vendor.
 - c. Trade name.
 - d. Catalog number.
 - 2. Substitutions are not "or-equals."
 - 3. This Specification Section does not address substitutions for major equipment.
- B. Related Specification Sections include but are not necessarily limited to:
 - 1. Division 00 - Procurement and Contracting Requirements.
 - 2. Division 01 - General Requirements.
- C. Request for Substitution - General:
 - 1. Base all bids on materials, equipment, and procedures specified.
 - 2. Certain types of equipment and kinds of material are described in specifications by means of references to names of manufacturers and vendors, trade names, or catalog numbers.
 - a. When this method of specifying is used, it is not intended to exclude from consideration other products bearing other manufacturer's or vendor's names, trade names, or catalog numbers, provided said products are "or-equals," as determined by Engineer.
 - 3. Other types of equipment and kinds of material may be acceptable substitutions under the following conditions:
 - a. Or-equals are unavailable due to strike, discontinued production of products meeting specified requirements, or other factors beyond control of Contractor; or,
 - b. Contractor proposes a cost and/or time reduction incentive to the Owner.

1.2 QUALITY ASSURANCE

- A. In making request for substitution or in using an approved product, Contractor represents they:
 - 1. Have investigated proposed product, and have determined that it is a dequate or superior in all respects to that specified, and that it will perform function for which it is intended.
 - 2. Will provide same guarantee for substitute item as for product specified.
 - 3. Will coordinate installation of a accepted substitution into Work, to include building modifications if necessary, making such changes as may be required for Work to be complete in all respects.
 - 4. Waives all claims for additional costs related to substitution which subsequently arise.

1.3 DEFINITIONS

- A. Product: Manufactured material or equipment.

1.4 PROCEDURE FOR REQUESTING SUBSTITUTION DURING BIDDING PERIOD

- A. See Section 00 21 13 - Instructions to Bidders.

1.5 PROCEDURE FOR REQUESTING SUBSTITUTION AFTER AWARD OF CONTRACT

- A. Substitution will only be considered under the conditions stated herein.
- B. Written request through Contractor only.

- C. Transmittal Mechanics:
 - 1. Follow the transmittal mechanics prescribed for Shop Drawings in Specification Section 01 33 00.
 - a. Product substitution will be treated in a manner similar to "deviations," as described in Specification Section 01 33 00.
 - b. List the letter describing the deviation and justifications on the transmittal form in the space provided under the column with the heading DESCRIPTION.
 - 1) Include in the transmittal letter, either directly or as a clearly marked attachment, the items listed in Paragraph D below.
- D. Transmittal Contents:
 - 1. Product identification:
 - a. Manufacturer's name.
 - b. Telephone number and representative contact name.
 - c. Specification Section or Drawing reference of originally specified product, including discrete name or tag number assigned to original product in the Contract Documents.
 - 2. Manufacturer's literature clearly marked to show compliance of proposed product with Contract Documents.
 - 3. Itemized comparison of original and proposed product addressing product characteristics including but not necessarily limited to:
 - a. Size.
 - b. Composition or materials of construction.
 - c. Weight.
 - d. Electrical or mechanical requirements.
 - 4. Product experience:
 - a. Location of past projects utilizing product.
 - b. Name and telephone number of persons associated with referenced projects knowledgeable concerning proposed product.
 - c. Available field data and reports associated with proposed product.
 - 5. Data relating to changes in construction schedule.
 - 6. Data relating to changes in cost.
 - 7. Samples:
 - a. At request of Engineer.
 - b. Full size if requested by Engineer.
 - c. Held until substantial completion.
 - d. Engineer not responsible for loss or damage to samples.

1.6 APPROVAL OR REJECTION

- A. Written approval or rejection of substitution given by the Engineer.
- B. Engineer reserves the right to require proposed product to comply with color and pattern of specified product if necessary to secure design intent.
- C. In the event the substitution is approved, the resulting cost and/or time reduction will be documented by Change Order in accordance with the General Conditions.
- D. Substitution will be rejected if:
 - 1. Submittal is not through the Contractor with his stamp of approval.
 - 2. Request is not made in accordance with this Specification Section.
 - 3. In the Engineer's opinion, acceptance will require substantial revision of the original design.
 - 4. In the Engineer's opinion, substitution will not perform adequately the function consistent with the design intent.
- E. Reimburse Owner for the cost of Engineer's evaluation whether or not substitution is approved.

PART 2 - PRODUCTS - (NOT USED)

PART 3 - EXECUTION - (NOT USED)

END OF SECTION

SECTION 01 26 00
CONTRACT MODIFICATION PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

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

1.2 GENERAL – APPLICABLE TO ALL PROVISIONS OF THIS SECTION

- A. Submit Contract modification documents to Engineer, addressed to the contact person and contact information indicated in Section 01 33 00 - Submittal Procedures, and in accordance with Section 01 31 26 - Electronic Communication Protocols.
- B. Retain at Contractor's office and at the Site complete copy of each Contract modification document, all interpretations and clarifications, related documents, and Engineer's response.

1.3 REQUESTS FOR INTERPRETATION

- A. General.
1. Transmit written requests for interpretation to Engineer. Contractor and Owner may prepare and transmit requests for interpretation.
 2. Prepare and transmit request for interpretation to obtain clarifications or interpretations of the Contract Documents. Report conflicts, errors, ambiguities, and discrepancies in the Contract Documents by requesting an interpretation.
 3. Do not transmit request for interpretation when other form of communication is appropriate, such as Submittals, requests for approvals of substitutes, notices, ordinary correspondence, or other form of communication. Improperly prepared or inappropriate requests for interpretation will be returned without response or action by Engineer.
 4. Do not submit request for interpretation or clarification when:
 - a. answer may be obtained by observations at the Site; or.
 - b. required information is clearly indicated in the Contract Documents; or.
 - c. required information is included in industry standards referenced in the Contract Documents or Supplier's instructions that are consistent with the Contract Documents; or.
 - d. are reasonably inferable from any of foregoing.
 5. Engineer will return requests for interpretation without response for any of the following reasons:
 - a. Request is regarding one of the items addressed in Paragraphs 1.3.A.3 and 4 of this Specifications section.
 - b. Request is unclear or incomplete.
 - c. Request was answered in Engineer's response to a prior request for interpretation.
 - d. Request is related to construction means, methods, techniques, procedures, or sequences of construction that are not required by the Contract Documents.
 - e. Request is related to safety and protection matters that are solely Contractor's responsibility.

- f. Request resulted in whole or in part to lack of adequate coordination by Contractor, including coordination of Subcontractors and Suppliers.
 - g. Requests that are otherwise frivolous or unnecessary.
6. Should requests be categorized by Engineer as within the limits of Paragraphs 1.3.A.3, 4, or 5 of this Specifications Section, Engineer may recommend and Owner may withhold from payments due Contractor under the Contract set-off(s) sufficient to cover Owner's costs of Contractor's submittal of invalid, frivolous, unnecessary, or inappropriate requests for interpretation or clarification..
 7. Contractor shall have sole financial responsibility for Contractor's costs for requests for interpretation or clarification that are submitted late, out of sequence, or that are unnecessary.
- B. Procedure.
1. Transmit requests for interpretation in accordance with Section 01 31 26 - Electronic Communication Protocols, and requirements of this Specifications section. Include with each request for interpretation a separate letter of transmittal.
 2. If Engineer requests additional information to make an interpretation, entity requesting the interpretation shall transmit the information requested within 10 days, unless Engineer allows additional time, via correspondence referring to request for interpretation number.
 3. Engineer will review and respond to requests for interpretation with reasonable promptness. Allow sufficient time for review and response.
 4. Engineer will maintain log of requests for interpretation. Upon request, copy of log will be transmitted to requestor.
 5. Engineer's response to requests for interpretation will be transmitted in accordance with Section 01 31 26 - Electronic Communication Protocols, and requirements of this Specifications section. Each response to a request for interpretation will include a separate letter of transmittal.
 6. Engineer's response to each request for interpretation will be distributed to:
 - a. Contractor.
 - b. Owner.
 - c. Resident Project Representative (RPR).
 - d. Engineer.
 7. If Contractor desires to appeal Engineer's interpretation or clarification, comply with the appeals procedure set forth in the General Conditions, as may be modified by the Supplementary Conditions.
 8. Interpretations that One or Both Parties Believes Entails a Change to the Contract:
 - a. If Contractor or Owner believes that a change in the Contract Price or Contract Times or other change to the Contract is required as a result of Engineer's interpretation, so advise Engineer in writing before proceeding with the Work associated with the request for interpretation.
 - b. If, after this initial communication, either Owner or Contractor believes that change in Contract Price, Contract Times, both, or other relief with respect to the terms of the Contract is necessary, recourse shall be in accordance with the Contract Documents.
- C. Preparation of Requests for Interpretation:
1. Prepare each request for interpretation on the "Request for Interpretation" form included with this Specifications section, or other form acceptable to Engineer.
 2. Number each request for interpretation as follows: Numbering system shall be the Contract number and designation followed by a hyphen and three-digit sequential number. Example: First request for interpretation on the general contract for project titled, "Contract WWTP09" would be, "RFI No. WWTP09-GC-001".
 3. In space provided on form, describe the interpretation requested. Provide additional sheets as necessary. Include text and sketches as required in sufficient detail to describe the need for interpretation.
 4. When applicable, request for interpretation shall include Contractor's recommended resolution.

1.4 WRITTEN CLARIFICATIONS

- A. General:
 - 1. Written clarifications, when required, will be initiated and issued by Engineer.
 - 2. Written clarifications do not change the Contract Price or Contract Times, and do not alter the Contract Documents.
 - 3. Written clarifications will be issued as correspondence or using clarification notice form acceptable to Engineer, with additional information as required.
- B. Procedure:
 - 1. Engineer's written clarifications will be transmitted in accordance with Section 01 31 26 - Electronic Communication Protocols, and requirements of this Specifications section.
 - 2. Each written clarification will be distributed to:
 - a. Contractor.
 - b. Owner.
 - c. Resident Project Representative (RPR).
 - d. Engineer.
 - 3. If Contractor desires to appeal Engineer's interpretation or clarification, comply with the appeals procedure set forth in the General Conditions, as may be modified by the Supplementary Conditions.
 - 4. Written Clarifications that One or Both Parties Believes Entails a Change to the Contract:
 - a. If Contractor or Owner believe that a change in the Contract Price or Contract Times or other change to the Contract is required as a result of Engineer's written clarification, so advise Engineer in writing before proceeding with the Work associated with the written clarification.
 - b. If, after this initial communication, either Owner or Contractor believes that change in the Contract Price, Contract Times, both, or other relief with respect to the terms of the Contract is necessary, recourse shall be in accordance with the Contract Documents.
 - 5. If Engineer's written clarification is unclear, prepare and transmit a request for interpretation in accordance with the Contract Documents.

1.5 MINOR CHANGES IN THE WORK AND FIELD ORDERS

- A. General:
 - 1. Field Orders, when required, will be initiated and issued by Engineer.
 - 2. Field Orders authorize minor changes in the Work but do not change the Contract Price or Contract Times.
 - 3. Field Orders will be in the form of Engineers Joint Contract Documents Committee document EJCDC C-942, "Field Order".
 - 4. Engineer will maintain a log of Field Orders issued. Copy of Engineer's log of Field Orders will be transmitted to Contractor or Owner upon request.
- B. Procedure:
 - 1. Field Orders will be transmitted in accordance with Section 01 31 26 - Electronic Communication Protocols, and requirements of this Specifications section. Each Field Order will include a separate letter of transmittal.
 - 2. Each Field Order will be distributed to the following:
 - a. Contractor.
 - b. Owner.
 - c. Resident Project Representative (RPR).
 - d. Engineer.
 - 3. Field Orders that One or Both Parties Believes Entails a Change to the Contract Price or Contract Times:
 - a. If Contractor or Owner believes that a change in the Contract Price or Contract Times or other change to the Contract is required as a result of a Field Order, so advise Engineer in writing before proceeding with the Work associated with the Field Order.

- b. If, after this initial communication, Contractor believes that change in Contract Price, Contract Times, both, or other relief with respect to the terms of the Contract is necessary, recourse shall be in accordance with the Contract Documents.
- 4. If the Field Order is unclear, submit request for interpretation.
- 5. If Owner disagrees with the Field Order, Engineer may issue a revised or amended Field Order, or a Change Order or Work Change Directive may be issued.

1.6 WORK CHANGE DIRECTIVES

A. General:

- 1. Work Change Directives, when issued, order additions, deletions, or revisions to the Work. When issued, Contractor shall promptly implement the changes ordered in the associated work Change Directive.
- 2. Work Change Directives do not change the Contract Price or Contract Times but are evidence that the parties to the Contract expect that the change ordered or documented by the Work Change Directive will be incorporated in subsequently issued Change Order following an agreement by the parties as to the Work Change Directive's effect, if any, on the Contract Price, Contract Times, or both.
- 3. Work Change Directives will be in the form of EJCDCC-940, "Work Change Directive".

B. Procedure.

- 1. Work Change Directives signed by Owner and Engineer will be transmitted in accordance with Section 01 31 26 - Electronic Communication Protocols, and requirements of this Specifications section. Each Work Change Directive will include a separate letter of transmittal. Signed Work Change Directives will be transmitted to:
 - a. Contractor.
 - b. Owner.
 - c. Engineer.
 - d. Resident Project Representative.
 - e. Contractor: One original.
 - f. Owner: One original.
 - g. Engineer: One original.
 - h. Resident Project Representative (RPR): One copy.
- 2. Documentation of Costs:
 - a. Promptly following receipt of the Work Change Directive:
 - 1) Advise Engineer and Owner in writing of the anticipated quantity and types of construction equipment and machinery required or anticipated for the associated Work.
 - 2) Advise Engineer and Owner in writing of which construction equipment and machinery is owned by the Contractor or Subcontractor and which is, or will be, rented from an equipment rental firm.
 - 3) When construction equipment and machinery is rented from a rental firm, transmit to Engineer and Owner copy of the associated rental agreements(s) pertinent to the Work ordered by the Work Change Directive.
 - 4) For all construction equipment and machinery, indicate to Engineer and Owner whether each item is required only for the Work ordered by the Work Change Directive and whether each item is being, or will be, used for other Work on the Project or other projects for Owner.
 - 5) Advise Engineer and Owner in writing of information on anticipated temporary materials (including items such as temporary support of excavations, scaffolding, temporary barriers, temporary plates covering excavations, and other temporary materials) to the same extent as that required for construction equipment and machinery.
 - b. When basis of payment for Work ordered under a Work Change Directive will be paid as Cost of the Work plus a fee, or when otherwise required by Engineer, document for the Work performed under each separate Work Change Directive, for each day, the following:

- 1) Number and labor classifications of workers employed and hours worked each day on the Work ordered via the Work Change Directive.
 - 2) Construction equipment used, including manufacturer, model, and year of manufacture, and number of hours such equipment was onsite and used each day for the Work under the Work Change Directive. Indicate where the equipment was used for other Work under the Contract and idle time.
 - 3) Temporary materials; furnish the same information as required for construction equipment and machinery. Where rental costs of such items approaches the purchase cost of such item, or when otherwise requested by Engineer, furnish evidence, satisfactory to Engineer, of the purchase price of such temporary materials.
 - 4) Consumables and similar materials used.
 - 5) Suppliers' receipts, bills, or invoices for and descriptions of materials and equipment incorporated into the Work.
 - 6) Invoices and labor and equipment breakdowns for Subcontractors.
 - 7) Other information required by Owner or Engineer.
 - 8) Transmit such documentation as a Change Proposal promptly after such documentation is available to Contractor. Actively pursue Subcontractors and Suppliers for required documentation to promptly furnish required documentation to Engineer.
- c. Separately track and document Work performed in accordance with each Work Change Directive and Work performed under stipulated price methods of compensation (including lump sums and Unit Price Work).
- d. Submit such information in a format acceptable to Engineer.
3. Documentation of Time:
- a. General:
 - 1) Contractor will be entitled to change of Contract Times Work ordered by a Work Change Directive in accordance with the requirements of the General Conditions, as may be modified by the Supplementary Conditions.
 - 2) Contractor will be entitled to a change in Contract Times only when the Work ordered by the Work Change Directive is implemented promptly and affects the Contractor's ability to comply with the Contract Times.
 - b. Requirement Documentation: Submit the following as part of the Change Proposal documenting price-related impact of the Work ordered by the Work Change Directive:
 - 1) Statement on whether the subject Work affected Contractor's ability to comply with the Contract Times.
 - 2) If Contractor's ability to comply with the Contract Times was so affected, indicate the effect on each of the relevant Contract Times.
 - 3) Document that Contractor acted promptly and properly upon receipt of the Work Change Directive to promptly implement the Work ordered thereby.
 - 4) Time impact analysis for the affected Work, in accordance with Section 01 32 16- Construction Progress Schedule.
 - 5) Other time-related documentation required by Engineer.

1.7 PROPOSAL REQUESTS

- A. General:
1. Proposal Requests may be initiated by Contractor, Engineer or Owner.
 2. Proposal Requests are for requesting the effect on the Contract Price and the Contract Times and other information relative to contemplated changes in the Work. Proposal Requests do not authorize changes or variations in the Work, and do not change the Contract Price or Contract Times or terms of the Contract.
 3. Proposal Requests will be furnished using the "Proposal Request" form included with this Specifications section.

- B. Procedure:
1. Proposal Requests will be transmitted in accordance with Section 01 31 26 - Electronic Communication Protocols, and requirements of this Section. Each Proposal Requests will include a separate letter of transmittal.
 2. Each signed Proposal Request will be transmitted to the following:
 - a. Contractor.
 - b. Owner.
 - c. Resident Project Representative (RPR).
 - d. Engineer.
 3. Transmit request for interpretation to obtain clarification of conflicts, errors, ambiguities, and discrepancies in Proposal Request.
 4. Upon receipt of Proposal Request, Contractor shall prepare and transmit to Engineer a Change Proposal, in accordance with the Contract Documents, for the proposed Work described in the Proposal Request.

1.8 CHANGE PROPOSALS

- A. General:
1. Prepare and transmit written Change Proposal to Engineer in response to each Proposal Request; or when Contractor believes a change in the Contract Price, Contract Times, both, or other change to the terms of the Contract is required; or to appeal an initial decision by Engineer concerning the requirements of the Contract Documents or relating to the acceptability of the Work under the Contract Documents; contest a set-off against payment due; or seek other relief under the Contract.
- B. Procedure:
1. Prepare and transmit Change Proposals within time limits indicated in the General Conditions, as may be modified by the Supplementary Conditions.
 2. Submit only one Change Proposal for each change issue, unless Engineer requires additional information or clarification. Do not submit repeated Change Proposals for the same change issue. Rather, when Contractor is dissatisfied with Engineer's decision on a Change Proposal, recourse is set forth in the General Conditions, as may be modified by the Supplementary Conditions, and elsewhere in this Article.
 3. Transmit Change Proposals in accordance with Section 01 31 26 - Electronic Communication Protocols, and requirements of this Specifications section. Include with each Change Proposal all required supporting documentation and a separate letter of transmittal.
 4. Engineer's Review and Requests for Additional Information:
 - a. Engineer will review and act on each Change Proposal in accordance with, and within the time limits indicated in, the General Conditions, as may be modified by the Supplementary Conditions.
 - b. When, Engineer requests additional information to render a decision, submit required information within five days of receipt of Engineer's request, unless Engineer allows more time. Submit the required information via correspondence that refers to the specific Change Proposal number.
 - c. Owner shall transmit to Engineer such comments, if any, that Owner has on the Change Proposal, within 10 days of Owner's receipt of the Change Proposal.
 - d. Engineer will render a written decision on the Change Proposal or take other action in accordance with the General Conditions, as may be modified by the Supplementary Conditions.
 - e. Engineer's response to Change Proposals will be transmitted in accordance with Section 01 31 26 - Electronic Communication Protocols, and requirements of this Specifications section, the General Conditions, and the Supplementary Conditions.
 5. Engineer's response to each Change Proposal will be distributed to:
 - a. Contractor.
 - b. Owner.
 - c. Resident Project Representative (RPR).

- d. Engineer.
 - 6. If Change Proposal is recommended for approval by Engineer and is approved by Owner, a Change Order will be issued or, when applicable, an appropriate use of an allowance (already included in the Contract Price) will be authorized by Owner.
 - 7. If parties do not agree on terms for the change, Owner or Contractor may file a Claim against the other, in accordance with the General Conditions, as may be modified by the Supplementary Conditions.
- C. Preparation of Change Proposals:
- 1. Each Change Proposal shall be submitted on the “Change Proposal” form included with this Specifications section, or other form acceptable to Engineer.
 - 2. Number each Change Proposal as follows: Numbering system shall be the Contract number and designation followed by a hyphen and three-digit sequential number. Example: First Change Proposal for the general contract for project named “Contract No. 8” would be, “Change Proposal No. 8-GC-001”.
 - 3. In space provided on Change Proposal form:
 - a. Describe scope of each proposed change. Include text and sketches on additional sheets as required to provide detail sufficient for Engineer’s review and response. If a change item is submitted in response to Proposal Request, write in a scope, “In accordance with Proposal Request No.” followed by the Proposal Request number. Submit written clarifications, if any, to scope of change.
 - b. Submit justification for each proposed change. If change is in response to proposal request, write in a justification, “In accordance with Proposal Request No.” followed by the Proposal Request number.
 - c. Indicate the total change in the Contract Price and Contract Times for each separate change item included in the Change Proposal.
 - 4. Proposed Effect on Contract Price: Unless otherwise directed by Engineer, attach to the Change Proposal detailed breakdowns of pricing (Contractor’s cost and Contractor’s fee) including:
 - a. List of Work tasks to accomplish the change.
 - b. For each task, labor cost breakdown including labor classification, total hours per labor classification, and hourly cost rate for each labor classification. Where overtime is included, indicate the overtime hours, labor classifications, and associated overhead rates.
 - c. Construction equipment and machinery to be used, including manufacturer, model, and year of manufacture, and number of hours for each. Indicate whether the construction equipment or machinery is owned by Contractor, Subcontractor, or leased from a rental firm; if leased, include with the Change Proposal a copy of the rental agreement. Indicate whether the construction equipment and machinery is already onsite and used for other activities, or whether it is required solely for the Work in the contemplated change. Indicate overtime hours budgeted, if any, and the associated cost rate for overtime compared with the straight-time rate.
 - d. Indicate temporary materials required, including description of extent, scope, and quality, and associated cost. Temporary materials include items such as temporary sheeting for support of excavations, scaffolding, temporary plates to cover open excavations, temporary barriers, and other temporary items. Indicate ownership or source of such items. Include copy of rental agreement if rented from a third-party rental firm in which neither Contractor nor any Subcontractor has a financial interest. Indicate intended duration of use for such items and purchase cost of such items.
 - e. Detailed breakdown of cost of materials and equipment to be incorporated into the Work, including quantities, unit costs, and total cost, with Supplier’s written quotations. When requested by Engineer, submit quotes by multiple prospective Suppliers.
 - f. Breakdowns of each Subcontractors’ pricing, including labor, construction equipment and machinery, temporary materials, and materials and equipment incorporated into the Work, other costs, and Subcontractor fees (e.g., overhead and profit). Breakdown of Subcontractors’ pricing shall be the same level of detail as that for Contractor.

- g. Breakdown of other costs eligible, in accordance with the General Conditions and the Supplementary Conditions under “Cost of the Work” provisions.
 - h. Other information required by Engineer.
 - i. Contractor’s fees (overhead and profit) applied to eligible Contractor costs and eligible Subcontractor costs.
5. Proposed Effect on Contract Times: Unless otherwise directed by Engineer, attach to the Change Proposal detailed information substantiating the proposed change in Contract Times, including:
- a. Time impact analysis required by Section 01 32 16 - Construction Progress Schedule.
 - b. Indication of whether the Work associated with the contemplated change will affect Contractor’s ability to comply with the Contract Times.
 - c. Other time-related information requested by Engineer.

1.9 CHANGE ORDERS

A. General:

- 1. Change Orders will be recommended by Engineer (when required by the General Conditions) and will be signed by Owner and Contractor (subject to the General Conditions related to a party withholding its signature from a contractually-required Change Order), to authorize additions, deletions, or revisions to the Work, changes to the Contract Price, changes in the or Contract Times, changes to the terms of the Contract, or a combination thereof.
- 2. Change Orders will be in the form of EJCDC C-941, “Change Order”.

B. Procedure.

- 1. Change Orders for signature by Contractor will be transmitted in accordance with Section 01 31 26 - Electronic Communication Protocols, and requirements of this Specifications section. Each Change Order will include a separate letter of transmittal. Contractor shall print three originals of Change Order for Contractor’s signature.
- 2. Contractor shall promptly sign each original Change Order and, within five days of receipt, deliver all originals to Engineer.
- 3. Engineer will sign each original Change Order and forward them to Owner.
- 4. After approval and signature by Owner, original Change Orders will be distributed as indicated below.
- 5. Original, signed Change Orders will be distributed as follows:
 - a. Contractor: One original.
 - b. Owner: One original.
 - c. Engineer: One original.
 - d. Resident Project Representative (RPR): One copy.
- 6. Upon Contractor’s receipt of the fully-signed Change Order, promptly perform the Work ordered thereby in accordance with the Contract Documents and the Progress Schedule accepted by Engineer.

PART 2 - PRODUCTS - (NOT USED)

PART 3 - EXECUTION

3.1 ATTACHMENTS

- A. The forms listed below and bound following this Specifications section’s “End of Section” designation, are part of this Specifications section:
- 1. Request for Interpretation form (one page).
 - 2. Proposal Request form (one page).
 - 3. Change Proposal form (one page).
 - 4. EJCDC Change Order Form C-941

END OF SECTION

REQUEST FOR INTERPRETATION (RFI)

Owner: _____

Project Name: _____

Contractor: _____ RFI No. _____

Date Transmitted: _____ Date Received: _____

Date Response Requested: _____ Date Response Transmitted: _____

Subject: _____

Specification Section and Paragraph: _____

Drawing References: _____

INTERPRETATION REQUESTED:

Signature: _____ Date: _____

ENGINEER'S RESPONSE:

Signature: _____ Date: _____

PROPOSAL REQUEST

Owner: _____

Project Name: _____

Proposal Request No.: _____ Date: _____

Contract Name and No.: _____

Contractor: _____

Other Contracts Involved in Proposed Change: _____

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

SCOPE OF PROPOSED CHANGE(S) IN THE WORK:

1. [Title 1]:
2. [Title 2]:
3. [Title 3]:

Attachments to this Proposal Request:

1. [None].

Proposal requested by: _____
HDR (Engineer)

Signature of Requestor: _____

CHANGE PROPOSAL

Owner: _____

Project Name: _____

Change Proposal No.: _____ Date: _____

Submitted in Response to Proposal No.: _____

Contractor Name and No.: _____

Contractor: _____

Subject: _____

The following changes to the Contract are proposed:

SCOPE OF PROPOSED CHANGE TO CONTRACT: *(attach supporting information as required)*

1. [Title 1]:
2. [Title 2]:

JUSTIFICATION:

1. [Title 1]:
2. [Title 2]:

PROPOSED CHANGES IN CONTRACT PRICE AND CONTRACT TIMES:

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

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

For the Contract Times, state increase, decrease, or no change to Contract Times for Substantial Completion, readiness for final payment, and Milestones, if any. If increase or decrease, state specific number of days for changes to the Contract Times. Submit supporting data, including time impact analysis for the Progress Schedule.

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

Changes to Milestones, if any: _____

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

Change Proposal by: _____

Signature of Proposer: _____

This page intentionally left blank.

Change Order _____

Date of Issuance: Owner: Contractor: Engineer: Project:	Effective Date: Owner's Contract No.: Contractor's Project No.: Engineer's Project No.: Contract Name:
---	--

The Contract is modified as follows upon execution of this Change Order:

Description:

Attachments: *[List documents supporting change]*

CHANGE IN CONTRACT PRICE	CHANGE IN CONTRACT TIMES <i>[note changes in Milestones if applicable]</i>
Original Contract Price: \$ _____	Original Contract Times: Substantial Completion: _____ Ready for Final Payment: _____ <div style="text-align: right;">days or dates</div>
[Increase] [Decrease] from previously approved Change Orders No. ___ to No. ___: \$ _____	[Increase] [Decrease] from previously approved Change Orders No. ___ to No. ___: Substantial Completion: _____ Ready for Final Payment: _____ <div style="text-align: right;">days</div>
Contract Price prior to this Change Order: \$ _____	Contract Times prior to this Change Order: Substantial Completion: _____ Ready for Final Payment: _____ <div style="text-align: right;">days or dates</div>
[Increase] [Decrease] of this Change Order: \$ _____	[Increase] [Decrease] of this Change Order: Substantial Completion: _____ Ready for Final Payment: _____ <div style="text-align: right;">days or dates</div>
Contract Price incorporating this Change Order:	Contract Times with all approved Change Orders:

\$ _____	Substantial Completion: _____
	Ready for Final Payment: _____ _____ days or dates

RECOMMENDED:	ACCEPTED:	ACCEPTED:
By: _____ Engineer (if required)	By: _____ Owner (Authorized	By: _____ Contractor
Title: _____	Title _____	Title _____
Date: _____	Dat _____	Dat _____

Approved by Funding Agency (if applicable)

By: _____ Dat _____
Title: _____

SECTION 01 29 73
SCHEDULE OF VALUES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
1. Administrative and procedural requirements for the Schedule of values.
- B. Scope:
1. Contractor shall prepare and submit to Engineer for acceptance a Schedule of Values that allocates cost to each item of the Work, for which compensation is on a lump sum basis, Schedule of Value list of line items shall correspond to each aspect of the Work, establishing in detail the portion of the Contract Price allocated to each component of the Work.
 2. Upon request of Engineer, promptly furnish data and information that substantiates and supports the amounts indicated in the Schedule of Values.
 3. Submit preliminary Schedule of Values to Engineer for initial review. Contractor shall incorporate Engineer's comments into the Schedule of Values and resubmit to Engineer. Engineer may require corrections and re-submittals until Schedule of Values is acceptable.
 4. Schedule of Values may be used as a basis for negotiating price of changes, if any, in the Work.

1.2 SUBMITTALS

- A. Informational Submittals: Submit the following:
1. Submit to Engineer the Schedule of Values in the form and quantity required in Section 01 33 00 - Submittals, and in accordance with Section 01 31 26 - Electronic Communication Protocols.
 2. Content of Schedule of Values Submittals shall be in accordance with Article 1.3 of this Specifications section.
 3. Timing of Submittals:
 - a. Submit preliminary Schedule of Values within time limit indicated in the General Conditions.
 - c. Submittal of the Schedule of Values for acceptance by Engineer shall be in accordance with the General Conditions. Engineer will not accept Applications for Payment without an acceptable Schedule of Values.
 - d. When required by Engineer, promptly submit updated Schedule of Values to include cost breakdowns for changes in the Contract Price.

1.3 SCHEDULE OF VALUES FORMAT AND CONTENT

- A. Organization and Major Elements of Schedule of Values.
1. Prepare Schedule of Values on the "progress estimate" or "continuation sheets", as applicable, of the Application for Payment form indicated in Section 01 29 76 - Progress Payment Procedures.
 2. Include in Schedule of Values itemized list of Work for each major work area included in the Work, for each lump sum payment item included in the Contract
 3. Organization in Accordance with Specification Sections:
 - a. Within each work area, organize the Schedule of Values by the various Specifications section numbers and titles included in the Contract Documents.
 - b. Label each row in the Schedule of Values with the appropriate Specifications section number. Include an amount for each row in the Schedule of Values.
 - c. List sub-items of major materials, equipment, or systems, as appropriate or when requested by Engineer.

- B. Requirements for preliminary Schedule of Values Submittal and the Schedule of Values Submittal for acceptance by Engineer are:
1. Subcontracted Work:
 - a. Schedule of Values shall indicate division of Work between Contractor and each Subcontractor.
 - b. Line items for Work to be performed by each Subcontractor shall include the word, “(SUBCONTRACTED)” and the name of the Subcontractor once the associated subcontract is signed and effective.
 2. Apportionment between Materials and Equipment, and Installation: Schedule of Values shall include separate apportionment of costs for:
 - a. Cost of materials and equipment to be incorporated into the completed construction.
 - b. Cost of delivery, handling, and storage of materials and equipment to be incorporated into the completed construction.
 - c. Cost of temporary materials (such as excavation supports, scaffolding, and other temporary materials), and their associated delivery, handling, and storage costs, if any.
 - d. Cost of rentals of construction equipment and machinery, whether owned by Contractor or Subcontractor or leased from a third-party equipment rental entity.
 - e. Cost of installing materials and equipment.
 - f. Travel and subsistence costs, if any.
 - g. Other costs used in preparing the Bid by Contractor and each Subcontractor.
 3. Sum of individual line item amounts indicated on the Schedule of Values shall equal the total of associated bid/payment item. Sum of bid/payment item totals in the Schedule of Values shall equal the total lump sum component of the Contract Price.
 4. Overhead and Profit:
 - a. Include in each line item a directly proportional amount of Contractor’s overhead and profit in the Contract Price.
 - b. Do not include overhead and profit as separate line item(s).
 5. Allowances: Include separate line item for each allowance.
 6. Unit Price Work: Separately indicate items of Unit Price Work in the overall Schedule of Values. Where the required form (in accordance with Section 01 29 76 - Progress Payment Procedures) includes a separate worksheet or page for Unit Price Work, indicate all items of Unit Price Work on such worksheet or page of the form.
 7. Bonds and Insurance Costs:
 - a. Include line item for bonds and insurance in payment item in a amount not exceeding 2.0 PCT of the Contract Price.
 - b. When greater than the amount stipulated immediately above is proposed by Contractor in the Schedule of Values, submit to Engineer documentation substantiating the proposed amounts. Submit to Engineer such documentation when otherwise requested by Engineer.
 - c. When Contractor has furnished bonds and evidence of insurance acceptable to Owner and in accordance with the Contract Documents, entire amount for bonds and insurance may be applied for in the first Application for Payment.
 8. “Site Overhead” and Administrative Cost Elements:
 - a. Include in the Schedule of Values relevant line items and amounts for work and services required by the General Conditions and specific Division 01 Specifications sections, such as:
 - 1) Superintendence and supervision costs and other costs.
 - 2) Itemized list of Work by work area, as applicable, for costs associated with coordination with the Owner’s operations, including required sequencing, as set forth in the Contract Documents.
 - 3) Construction Progress Schedule and scheduling, schedule updates, time impact analyses, and preparation of recovery schedules.
 - 4) Construction photographic documentation.
 - 5) Permits (when applicable).
 - 6) Temporary utilities and temporary facilities.

- 7) Field offices (monthly rental and maintenance) and storage facilities (excluding costs of establishment and removal, which are part of mobilization and demobilization).
 - 8) Site maintenance, such as temporary controls (dust, air pollution, water pollution, solid waste control, pest and rodent control, temporary erosion and sediment controls, and others), snow and ice removal, and similar activities.
 - 9) Field engineering and surveying.
 - 10) Progress cleaning and cleaning for Substantial Completion.
 - 11) Record documents (preparation, maintenance, and submittal).
 - a) If adequate record documents are maintained, up to 50 PCT of the value of the record documents line item will be eligible for payment, spread evenly over those progress payments in which construction at the Site is performed.
 - b) Remainder of Project record documents line item will be eligible for payment when complete record documents are submitted in accordance with the Contract Documents. If record documents submitted are unsatisfactory to Engineer, a amount may be reduced via set-offs in accordance with the Contract Documents.
 - 12) Other items required by Engineer.
- b. Include such items in Applications for Payment on payment schedule acceptable to Engineer
 - c. Such line items in the Schedule of Values shall exclude any and all costs associated with Contractor's permanent place(s) of business, personnel stationed at permanent office(s), salaries and bonuses of executive and administrative personnel not directly performing work on the Project, and general business expenses, all of which are part of Contractor's overhead costs.
9. Mobilization and Demobilization: In accordance with Section 01 71 14 - Mobilization and Demobilization.
 10. Mobilization and Demobilization:
 - a. Include separate line items under each appropriate lump sum bid/payment item for mobilization and demobilization.
 - b. Document for Engineer the activities included in mobilization and demobilization line items.
 - c. Mobilization includes: obtaining permits; negotiating, preparing, and signing subcontracts and purchase orders, attending preconstruction conference(s) and initial scheduling conference(s); establishing temporary utilities and temporary facilities; establishing field offices, storage sheds, and staging and laydown areas; establishing major temporary equipment and machinery at the Site; establishing temporary access roads and parking; preparing and initial implementation of spill prevention control and countermeasures plans; initial establishment of temporary environmental controls, including initial temporary erosion and sediment controls; and similar work required for Contractor to mobilize for Work at the Site, not included under other line items of the Schedule of Values. Obtain Engineer's concurrence for other costs included under mobilization.
 - d. Mobilization will be limited to 5 PCT of the Contract Price, and will be paid in two payments, each of 50 PCT of total amount for mobilization. Should Contractor propose mobilization in an amount greater than the limit indicate in this paragraph or on an alternative schedule from that indicated in this paragraph, submit to Engineer for acceptance information and documentation sufficient to support and substantiate the proposed amount and payment schedule for mobilization.
 - e. Demobilization includes: closing out permits obtained by Contractor; final closeout of remaining subcontracts and purchase orders, attending the final inspection; terminating temporary utilities; removing remaining temporary facilities; removing field offices, storage sheds, and staging and laydown areas and performing final restoration of such areas; removing major temporary equipment and machinery from the Site; removing

- temporary access roads and parking; and similar work required for Contractor to fully demobilize from the Site, not included under other line items of the Schedule of Values.
- f. Demobilization shall be not less than 1/2 PCT of the Contract Price and shall be included with the Application for Payment following Substantial Completion, or other schedule acceptable to Engineer.
11. Costs for Submittals, field quality control activities, and training of operations and maintenance personnel shall be as follows, unless otherwise accepted by Engineer:
- a. Submittals: Up to 8.0 PCT of cost (including all associated overhead and profit) of each equipment item, exclusive of transportation and installation costs associated therewith, may be allocated to preparation of Shop Drawings, Samples, and other Submittals required for release for purchase, fabrication, or delivery (as applicable) and may be included in the Application for Payment following Engineer's approval of Shop Drawings (and acceptance of other Submittals, as applicable) required for fabricating or purchasing for that item for the Work.
 - b. Field Quality Control: Up to 3.0 PCT of total cost of each item (including all associated overhead and profit), including materials and equipment, and installation, may be apportioned to specified or required field quality control activities (including required testing and inspections) and included in the Application for Payment following Engineer's acceptance of the associated written field quality control report Submittal(s).
 - c. O&M Manual Submittals and Training: Up to a total of 4.0 PCT of equipment cost (including all associated overhead and profit), exclusive of transportation and installation costs, may be apportioned to operations and maintenance manuals and training of operations and maintenance personnel, which may be included in the Application for Payment following completion of training for the associated item.

PART 2 - PRODUCTS - (NOT USED)

PART 3 - EXECUTION - (NOT USED)

END OF SECTION

SECTION 01 29 76
PROGRESS PAYMENT PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Administrative and procedural requirements for Contractor's progress payments.
- B. Scope:
 - 1. Contractor's requests for payment shall be in accordance with the Agreement, General Conditions and Supplementary Conditions, and the Specifications.
 - 2. Form: Applications for Payment shall be the Engineers Joint Contract Documents Committee (EJCDC) document EJCDC C-620, "Contractor's Application for Payment" (2018 edition or later) or other form acceptable to the Owner and Engineer.

1.2 CONTENT AND PROCEDURE FOR REQUESTING PROGRESS FOR PAYMENTS

- A. Procedure:
 - 1. Review with Resident Project Representative (RPR) quantities and the Work proposed for inclusion in each progress payment request. Application for Payment shall cover only the Work and quantities recommended by the RPR.
 - 2. Contractor will review with Engineer or RPR the status of Project record documents, in connection with Engineer's review of each Application for Payment. Failure to maintain record document current will be cause for Engineer to recommend a reduction in payment for record documents [in accordance with Section 01 29 73 - Schedule of Values,] and will entitle Owner to set-offs in accordance with the Contract Documents.
 - 3. Submit to Engineer three printed originals, each with Contractor's signature, of each complete Application for Payment and other documents to accompany the Application for Payment.
 - 4. Engineer will act on request for payment in accordance with the General Conditions and Supplementary Conditions.
- B. Content: Each request for payment shall include:
 - 1. Completed Application for Payment form, including summary/signature page, progress estimate sheets, and stored materials summary. Progress estimate sheets shall have the same level of detail as the Schedule of Values.
 - 2. Documentation for Stored Materials and Equipment:
 - a. For materials and equipment not incorporated in the Work but suitably stored, submit documentation in accordance with the General Conditions and Supplementary Conditions.
 - b. UCC-1 Financial Statement:
 - 1) For each lot or delivery of stored materials and equipment for which payment is requested prior to installation of the item(s) at the Site, complete UCC-1, "Financial Statement" form. On UCC-1 form, indicate Owner as "security party"; indicate Supplier as "debtor" when stored item(s) are in Supplier's custody, and indicate Contractor as "debtor" when stored item(s) are in Contractor's custody; and clearly indicate in detail all stored item(s) included in the filing as "collateral" on the form. Include attachments to the form when necessary to clearly and fully indicate in detail the associated "collateral".
 - 2) File completed UCC-1 form with the secretary of state in the state where the subject item(s) are stored.
 - 3) Include with Application for Payment the completed UCC-1 form together with evidence of filing with the required state(s). Submit UCC-1 form and related documentation once for each lot or delivery of stored items.

- c. Photographs of the stored items at the storage location, in accordance with requirements for progress photographs in Section 01 30 00 - Special Conditions. Submit photographs sufficient to clearly indicate each stored item, clearly showing marking of Owner's property in accordance with Paragraph 1.2.C.1 of this section. Such photographs do not count as photographs required under Section 01 30 00 - Special Conditions. For each month that such item(s) are stored, take and submit monthly new photographs of each stored item, with date-stamp on each photograph.
 - d. Legibly indicate on invoice or bill of sale the specific stored materials or equipment included in the payment request and corresponding bid/payment item number for each and the Supplier price for each item.
3. For Payment on the Basis of Cost of the Work plus a Fee:
- a. When Work included in an Application for Payment will be compensated on the basis of Cost of the Work plus a fee, whether when the entire Contract is compensated on the basis of Cost of the Work plus a fee or when the Application for Payment includes Change Order Work to be compensated on the basis of Cost of the Work plus a fee, the Application for Payment shall include documentation of the costs, including not less than the following:
 - 1) Number of and labor classifications of workers employed and hours worked. Separately indicate overtime and holiday hours, when applicable.
 - 2) Construction equipment used including manufacturer, model, and year of manufacture, and number of hours such equipment was onsite and used for the Work compensated on the basis of Cost of the Work. Where such equipment was used on overtime, separately indicate overtime hours.
 - 3) Consumables and similar materials used.
 - 4) Receipts, bills, or invoices for, and descriptions of, materials and equipment incorporated into the Work.
 - 5) Invoices and breakdowns of labor, construction equipment, and materials and equipment incorporated into the Work by Subcontractors, and Suppliers' onsite time, if any.
 - 6) Invoices or receipts for other expenses included in the Application for Payment, such as travel and subsistence expenses, costs for bonds and insurance, and all other eligible costs and expenses for which compensation is sought in the subject Application for Payment on the basis of Cost of the Work.
 - 7) Other information and documents required by Owner or Engineer,
 - b. Costs for which progress payment is requested on the basis of Cost of the Work plus a fee and for which documentation acceptable to Engineer is not submitted will not be eligible for payment.
4. Listing of Subcontractors and Suppliers:
- a. In accordance with the General Conditions, submit not less than monthly updated listing of all Subcontractors and Suppliers known to Contractor, whether or not such entities have a contract directly with Contractor.
 - b. Submit complete information using the form attached to this Specifications section.
5. Allowance Work:
- a. For payment requests that include payment for Work under an allowance, include with the progress payment request copy of Owner's authorization of the associated allowance Work, in accordance with Section 01 21 00 - Allowances.
6. Partial Release or Reduction of Retainage:
- a. For each Application for Payment where Contractor requests partial release or reduction of retainage in any amount (other than request for final payment), submit with associated progress payment request consent of surety to partial release or reduction of retainage, duly completed by Contractor and surety.
 - b. Acceptable form includes AIA G707A, "Consent of Surety to Reduction in or Partial Release of Retainage" (1994 or later edition), or other form acceptable to Owner.
 - c. For payment requests that include reduction in or payment of retainage in an amount greater than that required by the Contract Documents, obtain Owner's concurrence for

partial release or reduction in retainage prior to submitting such Application for Payment.

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

1.3 ADDITIONAL PROCEDURES FOR PAYMENT FOR STORED MATERIALS AND EQUIPMENT

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

PART 2 - PRODUCTS - (NOT USED)

PART 3 - EXECUTION

3.1 ATTACHMENTS

- A. The forms listed below, following this Specifications section's "End of Section" designation, are part of this Specifications section:
 - 1. List of Subcontractors and Suppliers form (two pages).
 - 2. Applications for Payment shall be the Engineers Joint Contract Documents Committee (EJCDC) document EJCDC C-620, "Contractor's Application for Payment"
 - 3. UCC-1 Form

END OF SECTION

LIST OF SUBCONTRACTORS AND SUPPLIERS

Owner: _____
Project Name: _____

Contractor: _____ Date: _____
Contract Designation: _____

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

SUBCONTRACTORS

1. **Subcontractor Name:**

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

2. **Subcontractor Name:**

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

3. **Subcontractor Name:**

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

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

SUPPLIERS

1. **Supplier Name:**

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

2. **Supplier Name:**

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

3. **Supplier Name:**

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

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Contractor's Application for Payment

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

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

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UCC FINANCING STATEMENT

FOLLOW INSTRUCTIONS

A. NAME & PHONE OF CONTACT AT FILER (optional)
B. E-MAIL CONTACT AT FILER (optional)
C. SEND ACKNOWLEDGMENT TO: (Name and Address)
<div style="border: 1px solid black; width: 100%; height: 100%; position: relative;"> </div>

Print

Reset

THE ABOVE SPACE IS FOR FILING OFFICE USE ONLY

1. DEBTOR'S NAME: Provide only one Debtor name (1a or 1b) (use exact, full name; do not omit, modify, or abbreviate any part of the Debtor's name); if any part of the Individual Debtor's name will not fit in line 1b, leave all of item 1 blank, check here and provide the Individual Debtor information in item 10 of the Financing Statement Addendum (Form UCC1Ad)

1a. ORGANIZATION'S NAME				
OR				
1b. INDIVIDUAL'S SURNAME	FIRST PERSONAL NAME	ADDITIONAL NAME(S)/INITIAL(S)	SUFFIX	
1c. MAILING ADDRESS	CITY	STATE	POSTAL CODE	COUNTRY

2. DEBTOR'S NAME: Provide only one Debtor name (2a or 2b) (use exact, full name; do not omit, modify, or abbreviate any part of the Debtor's name); if any part of the Individual Debtor's name will not fit in line 2b, leave all of item 2 blank, check here and provide the Individual Debtor information in item 10 of the Financing Statement Addendum (Form UCC1Ad)

2a. ORGANIZATION'S NAME				
OR				
2b. INDIVIDUAL'S SURNAME	FIRST PERSONAL NAME	ADDITIONAL NAME(S)/INITIAL(S)	SUFFIX	
2c. MAILING ADDRESS	CITY	STATE	POSTAL CODE	COUNTRY

3. SECURED PARTY'S NAME (or NAME of ASSIGNEE of ASSIGNOR SECURED PARTY): Provide only one Secured Party name (3a or 3b)

3a. ORGANIZATION'S NAME				
OR				
3b. INDIVIDUAL'S SURNAME	FIRST PERSONAL NAME	ADDITIONAL NAME(S)/INITIAL(S)	SUFFIX	
3c. MAILING ADDRESS	CITY	STATE	POSTAL CODE	COUNTRY

4. COLLATERAL: This financing statement covers the following collateral:

5. Check only if applicable and check only one box: Collateral is held in a Trust (see UCC1Ad, item 17 and Instructions) being administered by a Decedent's Personal Representative

6a. Check <u>only</u> if applicable and check <u>only</u> one box: <input type="checkbox"/> Public-Finance Transaction <input type="checkbox"/> Manufactured-Home Transaction <input type="checkbox"/> A Debtor is a Transmitting Utility	6b. Check <u>only</u> if applicable and check <u>only</u> one box: <input type="checkbox"/> Agricultural Lien <input type="checkbox"/> Non-UCC Filing
--	--

7. ALTERNATIVE DESIGNATION (if applicable): Lessee/Lessor Consignee/Consignor Seller/Buyer Bailee/Bailor Licensee/Licenser

8. OPTIONAL FILER REFERENCE DATA:

Instructions for UCC Financing Statement (Form UCC1)

Please type or laser-print this form. Be sure it is completely legible. Read and follow all Instructions, especially Instruction 1; use of the correct name for the Debtor is crucial.

Fill in form very carefully; mistakes may have important legal consequences. If you have questions, consult your attorney. The filing office cannot give legal advice.

Send completed form and any attachments to the filing office, with the required fee.

ITEM INSTRUCTIONS

A and B. To assist filing offices that might wish to communicate with filer, filer may provide information in item A and item B. These items are optional.

C. Complete item C if filer desires an acknowledgment sent to them. If filing in a filing office that returns an acknowledgment copy furnished by filer, present simultaneously with this form the Acknowledgment Copy or a carbon or other copy of this form for use as an acknowledgment copy.

1. **Debtor's name.** Carefully review applicable statutory guidance about providing the debtor's name. Enter only one Debtor name in item 1 -- either an organization's name (1a) or an individual's name (1b). If any part of the Individual Debtor's name will not fit in line 1b, check the box in item 1, leave all of item 1 blank, check the box in item 9 of the Financing Statement Addendum (Form UCC1Ad) and enter the Individual Debtor name in item 10 of the Financing Statement Addendum (Form UCC1Ad). Enter Debtor's correct name. Do not abbreviate words that are not already abbreviated in the Debtor's name. If a portion of the Debtor's name consists of only an initial or an abbreviation rather than a full word, enter only the abbreviation or the initial. If the collateral is held in a trust and the Debtor name is the name of the trust, enter trust name in the Organization's Name box in item 1a.

1a. **Organization Debtor Name.** "Organization Name" means the name of an entity that is not a natural person. A sole proprietorship is **not** an organization, even if the individual proprietor does business under a trade name. If Debtor is a registered organization (e.g., corporation, limited partnership, limited liability company), it is advisable to examine Debtor's current filed public organic records to determine Debtor's correct name. Trade name is insufficient. If a corporate ending (e.g., corporation, limited partnership, limited liability company) is part of the Debtor's name, it must be included. Do not use words that are not part of the Debtor's name.

1b. **Individual Debtor Name.** "Individual Name" means the name of a natural person; this includes the name of an individual doing business as a sole proprietorship, whether or not operating under a trade name. The term includes the name of a decedent where collateral is being administered by a personal representative of the decedent. The term does not include the name of an entity, even if it contains, as part of the entity's name, the name of an individual. Prefixes (e.g., Mr., Mrs., Ms.) and titles (e.g., M.D.) are generally not part of an individual name. Indications of lineage (e.g., Jr., Sr., III) generally are not part of the individual's name, but may be entered in the Suffix box. Enter individual Debtor's surname (family name) in Individual's Surname box, first personal name in First Personal Name box, and all additional names in Additional Name(s)/Initial(s) box.

If a Debtor's name consists of only a single word, enter that word in Individual's Surname box and leave other boxes blank.

For both organization and individual Debtors. Do not use Debtor's trade name, DBA, AKA, FKA, division name, etc. in place of or combined with Debtor's correct name; filer may add such other names as additional Debtors if desired (but this is neither required nor recommended).

1c. Enter a mailing address for the Debtor named in item 1a or 1b.

2. **Additional Debtor's name.** If an additional Debtor is included, complete item 2, determined and formatted per Instruction 1. For additional Debtors, attach either Addendum (Form UCC1Ad) or Additional Party (Form UCC1AP) and follow Instruction 1 for determining and formatting additional names.

3. **Secured Party's name.** Enter name and mailing address for Secured Party or Assignee who will be the Secured Party of record. For additional Secured Parties, attach either Addendum (Form UCC1Ad) or Additional Party (Form UCC1AP). If there has been a full assignment of the initial Secured Party's right to be Secured Party of record before filing this form, either (1) enter Assignor Secured Party's name and mailing address in item 3 of this form and file an Amendment (Form UCC3) [see item 5 of that form]; or (2) enter Assignee's name and mailing address in item 3 of this form and, if desired, also attach Addendum (Form UCC1Ad) giving Assignor Secured Party's name and mailing address in item 11.

4. **Collateral.** Use item 4 to indicate the collateral covered by this financing statement. If space in item 4 is insufficient, continue the collateral description in item 12 of the Addendum (Form UCC1Ad) or attach additional page(s) and incorporate by reference in item 12 (e.g., See Exhibit A). Do not include social security numbers or other personally identifiable information.

Note: If this financing statement covers timber to be cut, covers as-extracted collateral, and/or is filed as a fixture filing, attach Addendum (Form UCC1Ad) and complete the required information in items 13, 14, 15, and 16.

5. If collateral is held in a trust or being administered by a decedent's personal representative, check the appropriate box in item 5. If more than one Debtor has an interest in the described collateral and the check box does not apply to the interest of all Debtors, the filer should consider filing a separate Financing Statement (Form UCC1) for each Debtor.

6a. If this financing statement relates to a Public-Finance Transaction, Manufactured-Home Transaction, or a Debtor is a Transmitting Utility, check the appropriate box in item 6a. If a Debtor is a Transmitting Utility and the initial financing statement is filed in connection with a Public-Finance Transaction or Manufactured-Home Transaction, check only that a Debtor is a Transmitting Utility.

6b. If this is an Agricultural Lien (as defined in applicable state's enactment of the Uniform Commercial Code) or if this is not a UCC security interest filing (e.g., a tax lien, judgment lien, etc.), check the appropriate box in item 6b and attach any other items required under other law.

7. **Alternative Designation.** If filer desires (at filer's option) to use the designations lessee and lessor, consignee and consignor, seller and buyer (such as in the case of the sale of a payment intangible, promissory note, account or chattel paper), bailee and bailor, or licensee and licensor instead of Debtor and Secured Party, check the appropriate box in item 7.

8. **Optional Filer Reference Data.** This item is optional and is for filer's use only. For filer's convenience of reference, filer may enter in item 8 any identifying information that filer may find useful. Do not include social security numbers or other personally identifiable information.

SECTION 01 30 00
SPECIAL CONDITIONS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Administrative and procedural requirements for:
 - a. Indication of applicable building codes and related codes.
 - b. Project signs.
 - c. Contractor's field office.
 - d. Engineer's field office.
 - e. Project photographic documentation.
 - f. Adjacent properties and facilities.

1.2 QUALITY ASSURANCE

- A. Regulatory Requirements:
 - 1. References in the Contract Documents to local code(s) means the following:
 - a. National Electric Code in effect at the location of the Project.
 - b. NFPA 101 – Life Safety Code.

1.3 SUBMITTALS

- A. Action Submittals: Submit the following:
 - 1. Shop Drawings:
 - a. Project Signage: Location, materials, mounting hardware or mounting method, layout, and colors of required Project signage.
 - b. Engineer's Field Office: Proposed location, type of construction, size, and layout of Engineer's field office.
 - 2. Project Data:
 - a. Manufacturer's published literature and product data for Engineer's field offices:
 - 1) Furniture and furnishings.
 - 2) Office equipment.
 - 3) Safety items and first-aid kit.
 - 4) Proposed communications service(s).
- B. Informational Submittals: Submit the following:
 - 1. Project Photographic Documentation:
 - a. Preconstruction photographic documentation.
 - b. Progress photographic documentation, submitted at the frequency indicate in this Specifications section.
 - c. Final photographic documentation.

1.4 PROJECT SIGNS

- A. Within 10 days after date the Contract Times start to run provide and maintain a Project sign in accordance with this Specifications section. Signage other than the required Project sign and traffic/site access control signage is not allowed without Owner's written approval.
- B. Project Sign Materials:
 - 1. Project sign shall be:
 - a. Furnished by an experienced professional sign company.
 - b. Structurally adequate and suitable for exterior application.
 - c. Sign panels shall be constructed using a 4 FT and 8 FT, 3/4 IN new A-B Grade, exterior type, APA MDO plywood both sides.
 - d. Materials shall be new and of good quality.

2. Paint shall be exterior quality, as specified in the Specifications of Division 09 or as a minimum, primer and finish coat: exterior, semi-gloss, enamel. Colors for the sign and structure, framing, sign surfaces, and graphics shall be as shown [on the Drawings] [as shown and indicated in the attachments to this Specifications section].
 3. Prior to furnishing the sign, submit the Project sign layout Submittal required in this section. Sign layout Submittal shall indicate sign text, font, arrangement, logo(s) (if any), and colors of text, logos, and sign background.
- C. Information to be indicated on the Project sign includes:
1. Site name.
 2. Project name (including Owner's project number or contract designation).
 3. Owner's name.
 4. Engineer's company name.
 5. Contractor's company name.
 6. Project Cost: TBD
 7. Washington Department of Ecology logo
 8. EPA logo
- D. Installation of Project Sign:
1. Install sign as shown in the Drawings or as requested by the Owner.
 - a. Coordinate Project Sign location(s) and mounting with the Owner prior to installation.
 2. Mount sign to resist wind loads as required by authorities having jurisdiction and other loads reasonably imposed on the sign, but not less than sustained wind velocity of 50 MPH with gusts of 75 MPH.
 3. Prior to installing sign, submit mounting design to Engineer.
 4. Install sign level and plumb. Unless otherwise required by the Contract Documents, all angles shall be at 90 DEG.
- E. Maintenance and Removal:
1. Keep Project sign clean and legible until the sign is removed from the Site.
 2. Repair sign when necessary.
 3. Remove Project sign entirely from the Site following Substantial Completion and prior to requesting final inspection.
 4. Use 4 IN x 4 IN treated lumber posts for mounting the sign. Sink posts 3 to 4 FT below grade and stabilize posts to minimize lateral motion. Leave a minimum of 8 FT of post above existing grade for mounting of sign.
 5. Remove signs, framing, supports, and foundations to a depth of at least 2 FT below finished grade at the sign.
 6. Restore area of sign to condition as required by the Contract Documents. If not expressly required otherwise, restore landscaping and pavement and site improvements to condition equal to or exceeding that at the time the Contract Times started to run.

1.5 CONTRACTOR'S FIELD OFFICE

- A. Establish at the Site the Contractor's field office, structurally sound and in accordance with Laws and Regulations, sufficient for Contractor's needs at the Site. Equipment: Telephone, copier/scanner, and (as deemed necessary by Contractor) appropriate computer equipment.
- B. Contractor's personnel will be reasonably present at Contractor's office during working days.
- C. At Contractor's field office, maintain complete file of the Contract Documents, Submittals approved or accepted (as applicable) by Engineer, interpretations and clarifications issued by Engineer, copies of Contractor's daily field reports necessary and required safety data sheets, copies of documents comprising Contractor's safety program, record documents required by the Contract Documents including the General Conditions, and other files of field operations deemed appropriate by Contractor and as required by the Contract Documents.
- D. Remove field office from Site following Substantial Completion of all the Work and prior to final inspection of the completed Work.

1.6 ADJACENT PROPERTIES AND FACILITIES

- A. Contractor shall obtain and pay for any and all waivers or alternate arrangements necessary for transporting materials and equipment to the Site.
- B. Access, Traffic Control, and Parking:
 - 1. Maintain conditions of access road to site such that access is not hindered as the result of construction related deterioration.
 - 2. Do not permit driving across or transporting materials or equipment across areas outside the construction limits shown on the Drawings.
 - 3. Provide traffic control devices and personnel necessary to ensure a safe interface of construction traffic with business traffic to and from adjacent sites.
 - 4. Provide access routes for emergency vehicles at all times.
 - 5. Provide daily sweeping of hard-surface roadways to remove soils tracked onto roadway.
 - 6. Provide on-site parking for all staff to limit interference with adjacent properties and businesses.

PART 2 - PRODUCTS - (NOT USED)

PART 3 - EXECUTION - (NOT USED)

END OF SECTION

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SECTION 01 31 26
ELECTRONIC COMMUNICATION PROTOCOLS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Procedures with which Users will comply regarding transmission or exchange of Electronic Documents for the Project.
- B. Related Requirements:
 - 1. Refer to the General Conditions, as may be modified by the Supplementary Conditions, regarding transmitting Electronic Documents by Electronic Means.
 - 2. In addition to the requirements of this Specifications Section, comply with the requirements for Electronic Documents in the following Specifications:
 - a. Section 01 30 00 - Special Conditions.
 - b. Section 01 32 16 - Construction Progress Schedule.
 - c. Section 01 33 00 - Submittals.

1.2 DEFINITIONS

- A. The following terms are defined for use in this Specifications Section and are indicated herein using initial capital letters. The terms have the associated meaning regardless of whether indicated in singular or plural.
 - 1. Electronic Documents Protocol (abbreviated as “EDP”): Procedures and requirements set forth in this Specifications Section for the exchange of Electronic Documents by Electronic Means.
 - 2. Project Website: An internet-based software platform, such as a website or other project management information system (PMIS) designated by Contract or mutual consent of Users as the means of exchanging Electronic Documents during the Project.
 - 3. System Infrastructure: Hardware, operating system(s) software, internet access, e-mail service and software, security software, and large-file transfer functions.
 - 4. Users: Owner, Contractor, Engineer, and others exchanging Electronic Documents on the Project in accordance with the EDP.

1.3 ADMINISTRATIVE REQUIREMENTS.

- A. Coordination:
 - 1. Contractor shall require all Subcontractors and Suppliers to comply with the EDP established in the Contract Documents.

1.4 GENERAL PROVISIONS OF ELECTRONIC DOCUMENT PROTOCOL

- A. EDP – General:
 - 1. To the fullest extent practical, Users agree to and will transmit and accept Electronic Documents transmitted by Electronic Means in accordance with the requirements of this Specifications Section. Use of the Electronic Documents and any information contained therein is subject to requirements of this Specifications Section and other provisions of the Contract Documents governing transmittal of Electronic Documents.
 - 2. Content of Electronic Documents will be the responsibility of transmitting User.
 - 3. Unless otherwise provided in: (1) the EDP, (2) elsewhere in the Contract Documents, or (3) or other agreement between two or more Users governing use of Electronic Documents, Electronic Documents exchanged in accordance with the Contract Documents may be used in the same manner as paper or other printed versions of the same documents exchanged using other than Electronic Means, subject to the same governing requirements, limitations, and restrictions set forth in the Contract Documents.

4. Except as otherwise explicitly indicated in the EDP, the terms of this EDP will be incorporated into any other agreement or subcontract between a party and a third party for a portion of the Work or Project-related services, where such third party is, either directly or indirectly, required to exchange Electronic Documents with Owner, Contractor, or Engineer. Nothing in this EDP modifies the requirements of the Contract Documents regarding communications between and among Owner, Contractor, and Engineer Subcontractors, Suppliers, consultants, and others for which each is responsible.
 5. When transmitting Electronic Documents, transmitting User makes no representations regarding long-term compatibility, usability, or readability of the items resulting from the receiving User's use of software applications or System Infrastructure differing from those established in this EDP.
 6. This EDP does not negate or mitigate any obligation: (1) in the Contract Documents to create, provide, or maintain an original paper record version of Drawings and Specifications, signed and sealed in accordance with Laws or Regulations; (2) to comply with Laws and Regulations governing signing and sealing of design documents or signing and electronic transmission of other documents; or (3) to comply with notice requirements of the General Conditions (as May be modified by the Supplementary Conditions).
 7. Modifications to EDP:
 - a. When modifications to the EDP are necessary to address issues affecting System Infrastructure, Users shall cooperatively resolve the issues.
 - b. If resolution within a reasonable time is not achieved, Owner is empowered to require reasonable and necessary changes to the EDP consistent with the original intent of the EDP.
 - c. If such changes result in additional cost or delay to Contractor, not reasonably anticipated under the original EDP, Contractor may seek an adjustment in the Contract Price, Contract Times, or both in accordance with the Contract Documents.
- B. System Infrastructure and Systems for Exchanging Electronic Document:
1. Each User will provide System Infrastructure (as defined in this EDP) at its own cost and sufficient for complying with EDP requirements. Except for minimum standards set forth in this EDP [and explicit system requirements specified by attachment to this EDP], it is the obligation of each User to determine, for itself, such User's own System Infrastructure.
 - a. Maximum size of e-mail file attachment for under this EDP is 10 megabytes (MB). Attachments larger than the maximum size indicated in this paragraph may be exchanged using large-file transfer functions (such as file exchange websites or FTP sites mutually acceptable to the Users) or physical media such as USB flash drive/thumb drive or other physical media mutually acceptable to the Users.
 - b. Each entity transmitting or receiving Electronic Documents has full responsibility for its own costs, delays, deficiencies, and errors associated with converting, translating, updating, verifying, licensing, and otherwise enabling its System Infrastructure for use in accordance with this EDP.
 - c. Each User will provide its own printing facilities and will be responsible for its own costs of printing Electronic Documents.
 2. Each User is responsible for its own system operations, security, back-up, archiving, audits, and other technology and resources for operations of its System Infrastructure during the Project, including coordination with the User's individual(s) or subcontractor(s) responsible for managing its System Infrastructure and capable of addressing communications and other technology issues affecting exchange of Electronic Documents.
 3. Security:
 - a. Each User will operate and maintain industry-standard, industry-accepted, ISO standard, commercial-grade security software and systems to protect against threats including software viruses and other malicious software including worms, trojans, adware; data breaches; loss of confidentiality; and other threats in transmission to, or storage of, Electronic Documents from other Users, including transmission of Electronic Documents by physical media including flash drives/thumb drives, hard

- drives, compact discs (CD), digital video discs (DVD), and other portable devices, whether connected physically or wirelessly.
- b. To the extent that a User maintains and operates such security software and a appropriate System Infrastructure, such User will not be liable to other Users participating in the Project for breach of system security.
4. Archiving and Electronic Document Backup:
 - a. Each User is responsible for its own back-up and archive of Electronic Documents and data transmitted and received during the Project, unless this EDP establishes a Project Electronic Document archive, either as a mandatory Project Website or other communications protocol, upon which Users may rely for Electronic Document archiving for the duration of the Project Website or archiving system established in this EDP.
 - b. Each User is solely responsible for its own post-Project back-up and archive of Electronic Documents after the Project is complete or after termination of the Project Website or other Project archive (as applicable), for the longer of: (1) required by the Contract Documents, (2) required by Laws and Regulations, and (3) as each User deems necessary for its purposes.
 5. Receipt of Damaged, Incomplete, or Corrupt Electronic Documents: When a receiving User receives an obviously corrupted, damaged, or unreadable Electronic Document, the receiving User will advise the transmitting User of the incomplete transmission and transmitting User will retransmit the Electronic Document.
 6. Completion of Transmittals: Users will bring non-conforming Electronic Documents into compliance with the EDP. Users will attempt to complete a successful transmission of the Electronic Document or use an alternative delivery method to complete the transfer of the Electronic Documents.
 7. Principal means of exchanging Electronic Documents will be e-mail and files attached to e-mail, in accordance with the EDP.
- C. General Requirements and Limitations for Software for Electronic Document Exchange:
1. Software and file formats for exchange of Electronic Documents shall be as indicated in Article 1.5 of this Specifications Section.
 2. Software Versions:
 - a. Each User will acquire the software and associated licenses necessary to create, transmit, receive, read, and use Electronic Documents for the Project, using the software and file formats indicate in Article 1.5 of this Specifications Section.
 - b. Prior to using any updated version of the software required in the EDP for Electronic Document(s) transmitted to other User(s), the originating User will first notify and either (1) receive concurrence from receiving User(s) for use of the updated version, or (2) adjust its transmission to comply with the EDP.
 3. Preservation of Intellectual Property and Confidentiality of Electronic Documents:
 - a. Users agree to not intentionally edit, reverse-engineer, decrypt, remove security or encryption features, or convert to another format for modification purposes Electronic Documents, and information and data contained therein, transmitted in a file format, including portable document format (PDF), intended by transmitting User to not be modified, unless the receiving User (1) obtains permission from owner of the Electronic Document and intellectual property contained therein, or (2) is expressly allowed by the EDP to edit or modify the Electronic Document.
 - b. Where modifying, editing, decryption, or reverse-engineering is allowed by the EDP, such use is conferred only for the Project.
 - c. The EDP does not transfer any ownership or rights of any sort regarding use outside of the Project of Electronic Documents.
 - d. Users shall not cite or quote excerpts of Electronic Documents for purposes outside of the Project unless required to do so by Laws and Regulations.

- D. Contractor's Requests for Electronic Documents in Other Formats:
1. Release of Electronic Documents in format(s) other than those indicated in Article 1.5 of this Specifications Section and elsewhere in the Contract Documents will be at the discretion of Owner and subject to terms and conditions required by the owner of such files and documents, and the provisions indicated below.
 2. To extent determined by Owner, in its sole discretion, to be appropriate, release of Electronic Documents in alternative format(s) requested by Contractor ("Request") are subject to provisions of Owner's response to the Request and to the following:
 - a. Contractor's Request shall be in writing. Owner and others, as appropriate, will consider and respond to Request promptly, but neither Owner nor Engineer will be responsible for any time or cost impacts on Contractor associated with timing of the Request, or with Owner's decision associated therewith.
 - b. When Engineer is the owner of the Electronic Documents requested by Contractor in native format, prior to Engineer transmitting such Electronic Documents to Contractor, Contractor shall sign and deliver to Engineer, without modifying or amending, Engineer's "Electronic Media Release" agreement.
 - c. Content included in Electronic Documents created by Engineer and furnished in response to the Request was prepared by Engineer as an internal working document for Engineer's purposes solely and, when provided to Contractor, is on an "as-is" basis without warranties of any kind, including, but not limited to any implied warranties of fitness for purpose. Contractor acknowledges that content of Electronic Documents furnished in response to the Request may not be suitable for Contractor's purpose(s), or may require substantial modification and independent verification by Contractor. Content may include limited resolution of models, not-to-scale schematic representations and symbols, use of notes to convey design concepts in lieu of accurate graphics, approximations, graphical simplifications, undocumented intermediate revisions, and other shown or indicated information that may affect subsequent use by Contractor or others for whom Contractor is responsible.
 - d. Electronic Documents containing text, graphics, metadata, or other types of data furnished by Engineer in response to the Request are only for Contractor's convenience and any and all conclusions or information obtained or derived from such Electronic Documents will be at Contractor's sole risk and expense. Contractor waives any and all claims against Engineer, Owner, or both arising from Contractor's use of Electronic Documents furnished in response to the Request.
 - e. Contractor shall indemnify and hold harmless Owner, Engineer, and their respective consultants and subconsultants from any and all claims, damages, losses, and expenses, including attorneys' fees and defense costs, fees and costs of engineers, architects, geologists, accountants, and other professionals, and any and all other costs, direct and indirect, resulting from Contractor's use, adaptation, or distribution of Electronic Document(s) furnished in response to the Request.
 - f. Contractor shall not sell, copy, transfer, forward, give away or otherwise distribute the Electronic Documents (in source format or modified file format) to any third party without direct written authorization of Engineer or other entity that owns the Electronic document(s), unless such distribution is specifically indicated in the Request and is limited to Subcontractors and Suppliers. Contractor warrants that subsequent use by Subcontractors and Suppliers complies with terms and conditions of the Contract Documents, Owner's response to the Request, and release agreement(s) (if any) by owner of the Electronic Documents (including Engineer, where applicable).
 3. When the Request is for Electronic Documents in a format not other than that indicated in the Contract Documents, and Owner (and others, as applicable) decide to comply with the Request, and when the requested Electronic Documents are not easily available in the format(s) requested, Contractor shall reimburse Owner for costs incurred by Owner, either directly or indirectly, to furnish Electronic Documents in accordance with the Request at a rate of \$150 per labor-hour to furnish the requested format(s). In compensation, Owner may retain such amount(s) as set-off(s) under the Contract Documents.

1.5 EXCHANGE OF ELECTRONIC DOCUMENTS

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

TABLE 01 31 26-A – EXCHANGE OF ELECTRONIC DOCUMENTS

Electronic Document Type	Format	Transmitting User	Transmission Method	Receiving User	Allowed Uses	Notes
1.5.A.1. Project communications						
General communications & correspondence	EM, PDF	O, E, C	EM, EMA	O, E, C	R	
Meeting notices and agendas	EM, PDF	E	EM, EMA	O, C	R	
Meeting minutes	PDF	E	EM, EMA	O, C	R	
1.5.A.2. Contractor's Submittals to Engineer						
Shop Drawings	PDF	C	EMA	E	M (1)	(1)
Product data Submittals, delegated design Submittals, and other action Submittals (except Samples)	PDF	C	EMA	E	M (1)	(1)
Informational and closeout Submittals:	PDF	C	EMA	E	M (1)	(1) (6)
Documentation of delivery of maintenance materials submittals	PDF	C	EMA	E	M (1)	
1.5.A.3. Engineer's return of reviewed Submittals to Contractor						
Shop Drawings	PDF	E	EMA	O., C	R	
Product data Submittals, delegated design Submittals, and other action Submittals	PDF	E	EMA	O., C	R	
Informational and closeout Submittals:	PDF	E	EMA	O., C	R	(6)
Documentation of delivery of maintenance materials submittals	PDF	E	EMA	O. C	R	
1.5.A.4. Contract Modifications Documents						
Requests for interpretation to Engineer	PDF	C., O	EMA	E	M (1)	(1)
Engineer's interpretations (RFI responses)	PDF	E	EMA	C, O	R	
Engineer's clarifications to Contractor	EM, PDF	E	EM, EMA	C, O	R	
Engineer's issuance of Field Orders	PDF	E	EMA	C, O	R	
Proposal Requests	PDF	E, O	EMA	C	R	
Change Proposals – submitted to Engineer	PDF	C	EMA	O, E	S	
Change Proposals – Engineer's response	PDF	E	EMA	C. O		

Electronic Document Type	Format	Transmitting User	Transmission Method	Receiving User	Allowed Uses	Notes
Work Change Directives (for Contractor signature)	PDF	E	EMA	C	R	(2)
Change Orders (for Contractor signature)	PDF	E	EMA	C	R	(2)
1.5.A.5. Applications for Payment						(3)
1.5.A.6. Claims and other notices						(4)
1.5.A.7. Closeout Documents						
Record drawings	DWG and PDF	C	EMA	E, O	M (5)	(5)
Other record documents	PDF	C	EMA	E, O	M (5)	(5)
Contract closeout documents						

1. Key to Table 01 31 26-A:

- a. Data Format:
 - 1) EM: .msg, .htm, .txt, .rtf, e-mail text.
 - 2) W: .docx, Microsoft Word 2013 or later.
 - 3) EX: .xlsx, Microsoft Excel 2013 or later.
 - 4) PDF: .pdf, portable document format.
 - 5) DWG: .dwg, Autodesk AutoCAD 2014 drawing.
- b. Transmitting User:
 - 1) O: Owner.
 - 2) C: Contractor.
 - 3) E: Engineer.
- c. Transmission Method:
 - 1) EM: Via e-mail.
 - 2) EMA: Attachment to e-mail transmission.
 - 3) PORT: Delivered via portable media such as flash drive/thumb drive, CD, or DVD
 - 4) PW: Posted to Project Website.
 - 5) FTP: FTP transfer to receiving FTP server.
- d. Receiving User:
 - 1) O: Owner.
 - 2) C: Contractor.
 - 3) E: Engineer.
- e. Permitted Uses:
 - 1) S: Store and view only.
 - 2) R: Reproduce and distribute.
 - 3) I: Integrate (incorporate additional electronic data without modifying data received)
 - 4) M: Modify as required to fulfill obligations for the Project.
- f. Notes:
 - 1) Modifications by Engineer to Contractor's Submittals and requests for interpretations are limited to printing, marking-up, and adding comment sheets.
 - 2) May be distributed only to affected Subcontractors and Suppliers. Print, sign document, and return signed paper originals to Engineer.
 - 3) Submit printed Applications for Payment with original ("wet") signatures.
 - 4) Submit notices, including Claims, in accordance with the notice provisions of the General Conditions, as may be modified by the Supplementary Conditions.

- 5) Submit record drawings in native CAD format indicated when Contractor has signed Engineer's standard agreement for release of electronic media. In addition, always submit record drawings as PDF files. Comply with Contract Documents requirements for Project record documents.
- 6) For operation and maintenance data, also submit paper copies as required by Section 01 33 04- Operations and Maintenance Manuals.

PART 2 - PRODUCTS - (NOT USED)

PART 3 - EXECUTION - (NOT USED)

END OF SECTION

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SECTION 01 32 16 CONSTRUCTION PROGRESS SCHEDULE

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Specific requirements for the preparation, submittal, updating, and status reporting of the construction Progress Schedule.
- B. Related Specification Sections include, but are not necessarily limited to:
 - 1. Division 00 - Procurement and Contracting Requirements.
 - 2. Division 01 - General Requirements.
- C. Review of the Critical Path Method (CPM) Schedule:
 - 1. In so far as the Contractor is solely responsible for its means and methods and the CPM schedule represents in part its means and methods, the review of the CPM schedules (baseline, updates, revisions, etc.) is for compliance with the requirements as defined in the contract documents.
 - 2. The review of the CPM schedule is not intended to be complete or exhaustive or check every activity and its relation to the work.
 - 3. The Engineer will provide comments on the CPM schedule compliance with those contract requirements and anomalies that might appear to the Engineer.
 - 4. If the Contractor fails to include contract requirements (e.g. specified cure times, commissioning periods) in the CPM schedule, or the Engineer fails to notify the Contractor of anomalies the Contractor is not relieved of the contract requirements.
 - 5. Acceptance of the CPM schedule does not imply that the Owner has approved or accepted the Contractor's means and methods or sequence for performing the work to construct the project.
 - 6. If the Contractor has questions or concerns about comments, the Contractor and Engineer shall meet to resolve those issues prior to issuance of future updates or revisions.

1.2 QUALITY ASSURANCE

- A. The person preparing, updating and revising the construction Progress Schedule shall be experienced in the preparation of schedules of similar complexity.
- B. Project Scheduler Qualifications:
 - 1. Minimum of five years experience working in some capacity as a scheduler and with the use of Microsoft Project or Oracle's Primavera P6 Software for the purpose of developing, monitoring, updating and maintaining the Contractor's detailed schedule.
 - 2. Minimum five years of relevant experience in construction, planning, scheduling, expediting and tracking the progress of the work for projects of a similar nature, size, and complexity.
 - 3. Adhere to all requirements of this schedule specification, participate in all job progress review/update meetings, and other requested meetings regarding the project schedules.
 - 4. If the Engineer notifies the Contractor that the scheduler does not meet the minimum requirements, provide the qualifications of another scheduler that meets the requirements.
 - 5. If the Contractor changes schedulers after the Engineer determines the scheduler meets these requirements, follow this same process outlined above to substitute schedulers.
 - 6. Qualifications necessary:
 - a. Produced, updated, and maintained for at least five years complex construction schedules for projects of similar type, size and complexity.
 - b. Proficient in the use of the scheduling program selected for this project.
 - c. If the Contractor changes the person responsible for developing and maintaining the schedule, the Contractor will provide documentation verifying the new person meets the minimum qualifications.

1.3 DEFINITIONS

- A. The following definitions shall apply to this Specification Section:
1. **Baseline Schedule:** Establishes the Contractor's plans to execute the project. The Baseline Schedule shall include preconstruction activities, submittals, Engineer's reviews, fabrication, and delivery; construction activities with durations not to exceed 20 days and whose progress can be reasonably measured; Milestones, and constraints defined in the Contract Documents; post construction activities, O&M Manual production, testing, commissioning, and project closeout.
 2. **Schedule Update:** The initially accepted Baseline Schedule, or subsequently a approved Revised Baseline Schedules, updated each month to reflect actual start and finish dates of each schedule activity and the remaining duration of activities that began during the period.
 3. **Current Schedule:** The current schedule is either the Baseline Schedule or Revised Baseline Schedule including and incorporating Schedule Updates.
 4. **Revised Schedule:** Updated schedule that include changes agreed on by the Engineer and the Contractor. The Revised Schedule shall be developed after the Schedule Update is completed. The Revised Schedule will become the Current Schedule that will subsequently be utilized for Schedule Updates.
 5. **Recovery Schedule:** A Recovery Schedule shall be prepared when the Current Schedule forecasts the Work completing at least 10 working days or more in meeting a contract milestone or the contract completion date. The Recovery Schedule shall show how the Contractor intends to complete the Work within the Contract Time. Do not incorporate unapproved changes in the Recovery Schedule.
 6. **Three Week Look Ahead Schedule:** A schedule prepared by the Contractor reflecting the work planned for the current and subsequent three weeks and the work completed in the week prior to the current week. This is also known as a Look-Ahead Schedule.
 7. **Resources:** Hours for each worker on the project, materials, and permanent equipment incorporated into the work, construction equipment, or budgeted dollars.
 8. **Time Impact Analysis (TIA):** A schedule used to quantify the effects of an unplanned event which can have an impact on the work scope and Contract Time.

1.4 SUBMITTALS

- A. Project Schedule Preparation:
1. Within five days from Execution of the Contract, Submit a statement of qualifications for the person responsible for the preparation, maintenance, updating and revision of all schedules. The statement of qualifications shall demonstrate that the scheduler meets the minimum qualifications for a scheduler outlined herein.
- B. Baseline Schedule and Narrative Report:
1. Submittal and review:
 - a. Submit within ten days after Effective Date of the Contract or Notice to Proceed, whichever is earlier.
 - b. The Engineer shall review the Baseline Schedule and provide comments to the Contractor within ten working days after receipt of the schedule.
 - c. After receiving comments, the Contractor and Engineer shall meet to review the comments within five working days.
 - d. After the meeting, the Contractor will modify the schedule as agreed and resubmit the Baseline Schedule within five working days.
 - e. After the Engineer confirms that the Contractor has made the changes as agreed, the schedule will become the Baseline Schedule.
 2. Submittal package:
 - a. CPM time-scaled network diagram in PDF.
 - b. Tabular Report.
 - c. Baseline Schedule Report: Provide a written Narrative Report as defined in this specification.

- d. Electronic Data Files: The Contractor with provide the Engineer with the source or “raw” data/electronic files in “.MPP” or “.XER” format that can be viewed with the software used to develop the CPM schedule.
- C. Schedule Updates:
- 1. Submittal and Review:
 - a. Provide Schedule Updates five days after the last working day of the month as a greed to with the Engineer.
 - b. If the Engineer identifies anomalies the Engineer shall provide comments to the Contractor on the Schedule Update.
 - c. Unless directed by the Engineer to resubmit the schedule update within five working days, incorporate the Engineer comments into the next Schedule Update.
 - d. Do not include any changes to the existing logic, a activity durations, add new activities, or delete activities within the Monthly update during the monthly updating process. Should the Contractor wish to make any changes to the existing logic, activity durations, add new activities, or delete activities, the proposed changes to the schedule will be submitted to the Engineer for review. If the Engineer determines the change(s) are not consistence with the contract document, the Engineer shall notify the Contractor of its determination and maintain the current schedule. If the Engineer determines the changes are consistent with the contract document, the changes can be put into the current update following the procedures described below under Sections F below.
 - 2. Submittal Package:
 - a. CPM time-scaled network dia gram in PDF.
 - b. Tabular Report.
 - c. Schedule Update Progress Report: Provide a written progress report with each schedule update.
 - d. Electronic Data Files: The Contractor with provide the Engineer with the source or “raw” data/electronic files in “.MPP” or “.XER” format that can be viewed with the software used to develop the CPM schedule.
- D. Revised Schedule:
- 1. Submittal and Review:
 - a. Provide a Revised Baseline Schedule to reflect a approved Change Orders as requested by the Engineer.
 - b. Submit five working days after the Updated Schedule.
 - c. Activities will be added or the durations modified to reflect the work a approved in change orders.
 - d. The Engineer will review and provide comments to the Contractor on the Revised Baseline Schedule within five working days.
 - e. Incorporate the Engineer comments into the Revised Baseline Schedule.
 - f. After acceptance by the Engineer, the Revised Baseline Schedule, use for future Schedule Updates.
 - 2. Submittal Package:
 - a. CPM time-scaled network diagram in PDF.
 - b. Tabular Report.
 - c. Revised Schedule Report: Provide a Narrative Report with its CPM schedule.
 - d. Electronic Data Files: The Contractor with provide the Engineer with the source or “raw” data/electronic files in “.MPP” or “.XER” format that can be viewed with the software used to develop the CPM schedule.
- E. Recovery Schedule:
- 1. Unless otherwise directed in writing by the Engineer, when the activities on the critical path or the completion milestones appear to be beyond the contract time, provide a Recovery Schedule demonstrating how the Contractor will recover the lost time so that the Work will be completed within the Contract Time.
 - a. Do not incorporate unapproved changes in the Recovery Schedule.

- b. The Contractor's refusal, failure or neglect to take appropriate recovery action or to submit a written recovery statement shall constitute reasonable evidence that the Contractor is not prosecuting the Work, or separable part, with the diligence that will insure its completion within the applicable Contract Time and shall constitute sufficient basis for the Engineer to recommend to withhold any payment or portion thereof otherwise due, or identify and order alternate recovery actions on the basis of the information in the Contract Schedule.
2. Submittal and Review.
 - a. Provide the Recovery schedule within five working days after requested by the Engineer.
 - b. Activities will be added or the durations modified to reflect the changes to the work.
 - c. The Engineer will review and provide comments to the Contractor on the Recovery Schedule within five working days.
 - d. The Contractor will incorporate the Engineer comments into the Recovery Schedule.
 - e. The Recovery Schedule shall be used for subsequent Schedule Updates.
 3. Submittal Package:
 - a. CPM time-scaled network diagram in PDF.
 - b. Tabular Report.
 - c. Recovery Schedule Report: Provide a Recovery Schedule Report with its CPM schedule.
 - d. Electronic Data Files: The Contractor will provide the Engineer with the source or "raw" data/electronic files in ".MPP" or ".XER" format that can be viewed with the software used to develop the CPM schedule.
- F. Three Week Look Ahead Schedule:
1. Submittal and Review:
 - a. Provide a three week rolling look-ahead schedule each week during the Contract Time by Friday noon prior to the first working day of the schedule.
 - b. If the Engineer provides comments, the Contractor will revise and resubmit the schedule.

1.5 SCHEDULE REQUIREMENTS

- A. General:
1. The above listed project schedules shall be used for evaluating all issues related to time for this Contract. The Project Schedules shall be updated in accordance with the requirements of this Specification to reflect the actual progress of the Work and the Contractor's current plan for the timely completion of the Work. The Project Schedules shall be used by the Engineer and Contractor for the following purposes as well as any other purpose where the issue of time is relevant:
 - a. To communicate to the Engineer the Contractor's current plan for carrying out the Work.
 - b. To identify work paths that are critical to the timely completion of the Work.
 - c. To identify upcoming activities on the critical path(s).
 - d. To evaluate the best course of action for mitigating the impact of unforeseen events.
 - e. As the basis of progress payments to the Contractor.
 - f. As the basis for analyzing the time impact of changes in the Work.
 - g. As a reference in determining the cost associated with increases or decreases in the Work.
 - h. To prioritize the Engineer's review of submittals.
 - i. To document the actual progress of the Work.
 - j. To evaluate resource requirements of the Contractor and the Engineer.
 - k. To integrate the Work with the operational requirements of the Engineer's facilities.
 - l. To facilitate efforts to complete the Work in a timely manner.
 2. The Project Schedules provide a basis for Engineer decisions that may impact the Work under this Contract, as well as other concurrent or future Work. As such, the Contractor understands that time is of the essence in the performance of all Work under this Contract

including but not limited to providing the necessary schedule information required by this Specification.

- a. The project schedules shall at all times accurately reflect the Contractor's current plan for the Work and shall be updated as required by this Specification.
- b. This Specification requires the Contractor to submit the Project Schedules in a specific format. Failure to meet the full requirements of this Specification will adversely affect the Owner and Engineer's ability to administer this and other Contracts.
- c. Be responsible for all impacts to the Work on this Contract as well as the Work on other Contracts and any cost incurred resulting from the Contractor's failure to meet the requirements of this Specification.
- d. The monthly accepted Schedule Update, showing updated activities and status in accordance with the requirements of this Section shall be a condition precedent to the start of the progress payment cycle.

B. Schedule Detail:

1. The CPM Schedule shall contain sufficient pre-construction, construction, and testing & commissioning and closeout activities to represent the Work, with a means to monitor and follow progress of all phases of Work; comply with limits imposed by the scope of Work, with contractually specified interim milestones and completion dates; and with constraints, restraints, or sequences included in the Contract. The CPM Schedules shall include, but are not limited to the following:
 - a. Include a well-defined activity coding structure that allows Project activities to be sorted by type of Work, location of Work, work breakdown structure (WBS), or as mutually agreed to by the Contractor and the Engineer. Activity coding shall be assigned consistently and uniformly among all similar activity types.
 - b. Activities will be sorted by milestones, area, trades, and subcontractors as agreed on with the Engineer.
 - c. Construction start dates (Award date, Notice(s) to Proceed date).
 - d. Preparation of submittals, submittal reviews and approvals, manufacture, tests, delivery, installation activities, critical materials and equipment shall be represented in the CPM Schedule. Description of the activity shall include sufficient detail to identify the unique scope of that activity.
 - e. Materials and Equipment Procurement: Include the following activity sequence for critical and long lead materials and equipment procurement or any activity that may be requested by the Engineer:
 - 1) Submittal Preparation.
 - 2) Review and Approval.
 - 3) Fabricate and Deliver.
 - f. If the contract permits and the Contractor plans to request payment for materials and/or equipment prior to installation, a separate activity shall be included in the CPM schedule for each item for which the Contractor plans to request payment. This section does not supersede or take precedence over any other contract provision regarding such payment.
 - g. The CPM schedule shall include required review times for any Submittals and Approvals by regulatory agencies or other Parties as defined in the contract.
 - h. Milestones or access restraints for completion of certain portions of the Work or access and availability to Work areas.
 - i. Identification of interfaces and dependencies with preceding, concurrent, and follow-on Contractors, other agencies and utilities, typically shown as milestone type of activities.
 - j. Other activities can include shutdowns, utility tie-ins, plant tie-ins, traffic changes and closings, inspections and hold points, receipt of operations and maintenance (O&M) manuals, start-up of equipment, testing of equipment and systems, and commissioning.
 - k. Water curing of concrete after placement for all structures.
 - l. Planning for phased or total handover to the Owner.

- m. Cost Loading: Allocation of the monetary value for each activity in the CPM Schedule. The sum of all values shall match the total Contract value. The Engineer reserves the right to accept or reject any value and allocation to the activity.
 - n. Identification of manpower by trade, material, or equipment restrictions, as well as any activity requiring unusual shift work, such as two shifts, six day weeks, specified overtime, or work at times other than regular days or hours.
 - o. Resource Loading: Resource allocation for each activity in the CPM Schedule identifying the hours by trade, the physical quantity of material to be installed (Cubic yards of concrete, linear feet of pipe, etc.). The Engineer reserves the right to accept or reject any value and allocation of the man-hours and/or the materials. The unit of measure shall be reviewed and approved by the Engineer.
2. Calendars:
 - a. Develop activity calendars commensurate with the Contractor's workweek plan. Calendars shall include all non-working days, such as weekends, holidays, or other periods when the Contractor plans not to work. Calendar(s) shall be reviewed and accepted by the Engineer as part of the CPM schedule submittal and will be monitored using the most updated schedule.
 - b. The planning unit for the Contract shall be days;
 - c. Calendars shall contain all Owner holidays;
 - d. Every activity shall be assigned a calendar that takes into account when the activity is planned to occur and/or when it is contractually permitted to occur.
 - e. Contract times are expressed in calendar days, the CPM Schedule shall be calculated in working days.
 3. Logic and Durations:
 - a. Logic and activity durations shall be established by the Contractor consistent with the Contract requirements and shall reflect coordination between trades, definitive resource planning and on-site work conditions.
 - b. Logic shall show how the start of a given activity is dependent on the completion of preceding activities, and its completion restricts the start of following activities. Except for fabrication activities shall not have duration greater than 20 working days.
 - c. Except the first activity and completion milestone(s), each activity on the CPM schedule shall have a predecessor and successor activity.
 - d. Preferential Logic sequencing shall not be allowed in the schedule.
 4. Restraints, Constraints and Milestones:
 - a. The start date of the CPM Schedule shall be the Contract Notice to Proceed.
 - b. The completion date of the CPM Schedule shall be the Contract Final Completion date.
 - c. All intermediate restraints and milestones required in the Contract shall be shown in proper logical sequence and properly constrained.
 - d. The CPM Schedule shall include all Work constraints indicated in the Contract or as added with a Contract modification. Other activity Constraints shall not be used unless approved by the Engineer.
 5. Schedule Dates: Whenever the term "schedule" or "scheduled date" is used, it shall mean the "early start" and "early finish" dates in the CPM Schedule. The "late" dates are for purposes of calculating float and do not represent the schedule dates.
 6. Activity Descriptions:
 - a. Activities shall be described such that the Work is readily identifiable for a assessment of start and completion, as well as intermediate status.
 - b. Descriptions shall utilize identifiers for physical locations such as column lines, stations, and elevations where possible to define the Work.
 - c. The activity description shall identify the scope of the activity.
 - d. There shall not be any two activities with the same activity description. If the Contractor wants to change the description of an activity, it will delete the activity and then add a new one with the new activity description.

C. Float:

1. The total float of an activity is the maximum time that its actual completion date can extend beyond its early finish date and not affect the Contract Time.
2. Float is not for exclusive use or benefit of either the Owner, Engineer, or the Contractor but is an expiring resource available to both parties. Float is used by any party, as needed, to meet the contract milestones and the contract completion dates, or to cover changes to the Contract. However the Contractor is expected to execute the work according to the Early Dates of the schedule.
3. Float Suppression: Pursuant to float sharing requirements of this Section, use of float suppression techniques such as preferential sequencing or logic, special lead/lag logic restraints, and extended activity durations are prohibited. Approval of any Schedule Submission by the Engineer shall not preclude later correction of float suppression techniques or of any other deficiency by the Engineer.
4. Early Completion Schedule: Recognizing that the Owner developed the project duration based on its needs and resources, if the Contractor proposes an early completion schedule, such schedule shall be subject to the acceptance of the Engineer. Any time between the early completion of a contract milestone, including substantial completion, schedule proposed by the Contractor and that contract milestone will be considered float.

D. CPM Time-Scaled Network Diagram:

1. A printed logic diagram and PDF that include the following information:
 - a. Unique activity number/identifier; numeric, alpha or combination of numeric/alpha.
 - b. Activity description.
 - c. Activity duration.
 - d. Early start and early finish for each activity.
 - e. Late start and late finish for each activity.
 - f. Total float (TF) for each activity.
 - g. Bar showing the early start and completion dates of each activity.
 - h. The activities will be sorted by area, trades, and subcontractors as agreed on with the Engineer.
 - i. Print the CPM time-scaled network diagram on minimum sheet size of 11 IN x 17 IN.
 - j. Provide electronic data in accordance with the Early Completion paragraph in the GENERAL REQUIREMENTS Article.

E. Tabular Reports:

1. Provide a Tabular Report with each schedule submittal that includes the following information;
 - a. Activity number/identifier.
 - b. Activity description.
 - c. Activity duration.
 - d. Early start and early finish for each activity.
 - e. Late start and late finish for each activity.
 - f. Total float (TF) for each activity.
 - g. Predecessor activities.
 - h. Successor activities.
 - i. Cost/budget to perform the work in the activity.
 - j. Resources needed to perform the activity.

F. Schedule Reports: Provide reports with each of the schedule submittals. As a minimum, the reports shall contain the following information:

1. Baseline Schedule Report.
 - a. Executive Summary explaining how the Contractor plans to execute its plan to construct the project.
 - b. Assumptions used to develop the schedule.
 - c. Constraints included in the schedule as defined by the Contract Documents.
 - d. The critical path and near critical path activities with an explanation of why those activities are included on those paths.
 - e. Number of planned working days per week including shifts per day.

- f. Manpower plan including craft on site per day.
 - g. Production rates assumptions.
 - h. Major equipment planned for the project and durations for their use.
 - i. Resource constraints.
 - j. Identification of unusual conditions or restrictions regarding labor, equipment or material.
 - k. Calendar(s) used in the contract and how the multiple calendars are used.
 - l. Holidays observed during construction.
2. Schedule Updates Progress Reports:
 - a. Provide a report with each Schedule Update detailing the work completed during the month, any changes to the schedule logic, any changes to activity durations, any changes to the critical path, and any changes to its assumptions for constructing the Work, including assumed constraints included in the schedule as defined by the Contract Documents, permits, or the Contractor.
 - b. Identify the current critical path activities.
 - c. Indicate reasons the Contractor made the changes to logic, durations, activities, and/or the critical path.
 3. Revised Schedule Report:
 - a. Provide a report with each Revised Schedule detailing the work completed during the month, any changes to the schedule logic, any changes to activity durations, any changes to the critical path, and any changes to its assumptions for constructing the Work, including assumed constraints included in the schedule as defined by the Contract Documents, permits, or the Contractor.
 - b. Identify the current critical path activities.
 - c. Indicate reasons the Contractor made the changes to logic, durations, activities, and/or the critical path.
 4. Recovery Schedule Report:
 - a. Provide a report with an explanation of the changes in logic and/or activity durations.
 - b. Identify the current critical path activities.
 - c. Indicate reasons the Contractor made the changes to logic, durations, activities, and/or the critical path.
- G. Electronic Data Files:
1. The Contractor will provide the Engineer with the source or “raw” data/electronic files in “.MPP” or “.XER” format that can be viewed with the software used to develop the CPM schedule.
- H. Weather delays:
1. Include an activity on the critical path of the schedule with a duration of five working days per year for delays due to adverse weather on the project. When the Engineer and Contractor agree that a weather day affects the work, it will reduce the remaining duration of the weather day activity by the agreed on weather days.
 - a. Adverse weather is considered when the temperature and/or precipitation exceeds the average temperature, precipitation and/or other weather event by 15 PCT as measured by the National Oceanic and Atmospheric Administration (NOAA) at the closest weather station to the project site and the adverse weather impacts the Contractor’s delivery of material, availability of labor, or production of work. If the adverse weather does not affect delivery of material, availability of labor, or production of work, then it will not be considered adverse weather.
 - b. The adverse weather must affect the work on the critical path at the time the adverse weather occurs.
 - c. Any time not used in a calendar year may be carried over to the next year or considered float.
- I. CPM Scheduling Software:
1. Unless otherwise agreed to with the Engineer, use the latest version of Microsoft Project or Oracle’s Primavera P6 to develop and maintain the schedules listed above for this project.

- 1) Provide data files that can be read using the latest version of Microsoft Project or Oracle's Primavera P6. Do not employ any methods for locking data or preventing the Engineer from reading the data using the latest version of Microsoft Project or Oracle's Primavera P6.
2. If the Contractor proposes to use a different scheduling software package for this project, provide up to three licenses for the software to the Owner Engineer and provide on-going training on the use of that software.

1.6 START-UP, DEMONSTRATION, TRAINING, AND FINAL COMPLETION

- A. The Baseline Schedule must include broad-based activities for start-up, operator training, and final completion.
 1. The Baseline Schedule may not necessarily contain sufficient detail on all activities listed in Specification Section 01 75 00 for start-up and demonstration.
 2. At least 30 days prior to any activities, submit a detailed schedule in conformance with the requirements of Specification Section 01 75 00:
 - a. Identify task for the substantial completion notification.
 - b. Pre-demonstration period:
 - 1) Identify equipment start-up for all major equipment.
 - c. Identify all operator trainings required by individual Specification Sections.
 - d. Complete submission of all required submittals.
 - e. Demonstration period: Identify for each project classified system.

1.7 CONSTRUCTION SCHEDULING MEETINGS

- A. Preconstruction Scheduling Conference:
 1. The Engineer and Contractor shall conduct a pre-construction scheduling conference within 15 calendar days of Notice of Award. At a minimum, the Contractor's Project Manager and qualified Scheduler shall attend this meeting. The Engineer will review the schedule requirements defined in the contract documents with the Contractor. Submit and provide an overview of the Preliminary Baseline Schedule.
- B. Baseline Schedule Conference:
 1. After the Engineer reviews the Baseline Schedule submittal, the Engineer and Contractor shall meet to review the Baseline Schedule. Any comments or concerns will be addressed and re-submit the schedule with any agreed on changes.
- C. Schedule Review Conferences:
 1. Within five days after the Engineer reviews the Schedule Updates, Revised Schedule, and Recovery schedule submittals, the Engineer and Contractor shall meet to review the schedule submittal. Any comments or concerns will be addressed and modify the schedule with any agreed on changes.

1.8 TIME IMPACT ANALYSIS (TIA)

- A. Provide a TIA to support all requests for increases to the Contract Time.
- B. Use the Current Schedule to develop the TIA.
 1. The TIA must be attached to any change order proposal prior to approval of any change to time or cost when requesting additional time.
 2. Submit a written narrative report to the Engineer with each request for adjustment to the Contract Time, or when Contractor or Engineer consider that an approved or anticipated change may impact the critical path or progress of the work.
 - a. Include a description of delaying factors and their impact with an explanation of corrective actions taken or proposed.
 - b. The TIA shall illustrate the impacts of each change or delay on the current scheduled completion date or internal milestone, as appropriate.
 - c. The analysis shall start by using the schedule that has a date closest to and prior to the event or change.

- d. The analysis shall identify the activities on the critical path prior to the event or change, the activities added or extended as a result of the event or change, and the impact of those changes on the critical path activities.
 - e. The analysis shall identify the impacts that the Contractor attributed to the change or Owner, those impacts that are the result of the Contractor's actions and those impacts that are considered concurrent.
 - f. If the impact schedule shows that incorporating the event modifies the critical path and scheduled completion date of the accepted CPM Schedule, the difference between scheduled completion dates of the two schedules shall be equal to the adjustment of Contract Time.
- C. Submit a TIA within ten working days of receiving a written request for a TIA from the Engineer or after the event.
- 1. Allow the Engineer twenty days after receipt to approve or reject the submitted TIA.
 - 2. All approved TIA schedule changes shall be shown on the next Schedule Update.
- D. Rejections of a TIA:
- 1. If a TIA submitted by the Contractor is rejected by the Engineer, meet with the Engineer to discuss and resolve issues related to the TIA.
 - 2. If a agreement is not reached, the Contractor will be allowed ten working days from the meeting with the Engineer to give notice.
 - 3. The Engineer will withhold a portion of the progress payment if a TIA is requested by Engineer and not submitted by Contractor within 15 working days.
 - 4. The payment will resume on the next estimate after the requested TIA is submitted and accepted by the Engineer.
- E. Any delay by the Contractor that is in parallel with another delay not caused by the Contractor shall be considered a concurrent delay for which the Contractor will not be entitled to impactable/compensable time regardless if on the critical path or not.

PART 2 - PRODUCTS - (NOT APPLICABLE TO THIS SPECIFICATION SECTION)

PART 3 - EXECUTION - (NOT APPLICABLE TO THIS SPECIFICATION SECTION)

END OF SECTION

SECTION 01 33 00 SUBMITTALS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Mechanics and administration of the submittal process for:
 - a. Shop Drawings.
 - b. Samples.
 - c. Informational submittals.
 - 2. General content requirements for Shop Drawings.
- B. Related Specification Sections include but are not necessarily limited to:
 - 1. Division 00 - Procurement and Contracting Requirements.
 - 2. Division 01 - General Requirements.
 - 3. Construction Progress Schedule submittal requirements are specified in Specification Section 01 32 16.
 - 4. Operations and Maintenance Manual submittal requirements are specified in Specification Section 01 33 04.
 - 5. Technical Specification Sections identifying required submittals.

1.2 DEFINITIONS

- A. Action Submittals:
 - 1. Action Submittals require an explicit, written approval or other appropriate action by Engineer before Contractor may release the associated item(s) for raw materials procurement, fabrication, production, and shipment.
 - 2. Unless otherwise indicated in the Contract Documents, Action Submittals include the following:
 - a. Shop Drawings.
 - b. Product data.
 - c. Samples.
 - d. Testing plans for quality control activities required by the Contract Documents.
 - e. Delegated Designs: Design drawings, design specifications, calculations, reports, and other instruments of service sealed and signed by design professional retained by Contractor, Subcontractor, or Supplier for a portion of the completed Work as part of the completed Project. Engineer's approval or other appropriate action on such delegated design Submittals will be only for the limited purposes set forth in the General Conditions.
- B. Informational Submittals:
 - 1. Informational Submittals are Submittals, other than Action Submittals, required by the Contract Documents. Explicit response from Engineer is not required when such Submittal is acceptable and Engineer's acceptance thereof will be indicated in the Engineer's Submittals log. When Informational Submittal does not indicate full compliance with the Contract Documents, Engineer will indicate the non-compliance in a written response to Contractor.
 - 2. Representative types of informational submittal items include but are not limited to:
 - a. HVAC test and balance reports.
 - b. Installed equipment and systems performance test reports.
 - c. Manufacturer's installation certification letters.
 - d. Instrumentation and control commissioning reports.
 - e. Warranties.
 - f. Service agreements.

- g. Construction photographs.
 - h. Survey data.
 - i. Work plans.
 - j. Shop Drawings, product data, Samples, and testing plans, submitted as a requirement of for delegated designs, bearing the Submittal approval stamp of associated design professional retained by Contractor, Subcontractor, or Supplier.
3. For-Information-Only submittals upon which the Engineer is not expected to conduct review or take responsive action may be so identified in the Contract Documents.

1.3 SUBMITTAL SCHEDULE

- A. Schedule of Shop Drawings:
 - 1. Submitted and approved within 20 days of receipt of Notice to Proceed.
 - 2. Account for multiple transmittals under any specification section where partial submittals will be transmitted.
- B. Shop Drawings: Submittal and approval prior to 30 PCT completion of project.
- C. Informational Submittals:
 - 1. Reports and installation certifications submitted within seven days of conducting testing, installation, or examination.
 - 2. Submittals showing compliance with required qualifications submitted 20 days prior to any work beginning using the subject qualifications.
- D. The submittal schedule shall include the following columns as a minimum:

Submittal Section	Submittal Description	Planned Submittal Date	Submittal Need Date	Actual Submittal Date	Actual Return Date	Disposition

1.4 PREPARATION OF SUBMITTALS

- A. General:
 - 1. All submittals and all pages of all copies of a submittal shall be completely legible.
 - 2. Submittals which, in the Engineer’s sole opinion, are illegible will be returned without review.
 - 3. Minimize extraneous information for equipment and products not relevant to the submittal.
 - 4. Contractors or vendors written comments on the submittal drawings shall be in green
- B. Shop Drawings, Product Data, and Samples:
 - 1. Scope of any submittal and letter of transmittal:
 - a. Limited to one Specification Section.
 - b. Submittals with more than one Specification section included will be rejected.
 - c. Do not submit under any Specification Section entitled (in part) "Basic Requirements" unless the product or material submitted is specified, in total, in a "Basic Requirements" Specification Section.
 - 2. Numbering letter of transmittal:
 - a. Include as prefix the Specification Section number followed by a series number, "-xx", beginning with "01" and increasing sequentially with each additional transmittal for that Specification Section.
 - b. If more than one submittal under any Specification Section, assign consecutive series numbers to subsequent transmittal letters.

3. Describing transmittal contents:
 - a. Provide listing of each component or item in submittal capable of receiving an independent review action.
 - b. Identify for each item:
 - 1) Manufacturer and Manufacturer's Drawing or data number.
 - 2) Contract Document tag number(s).
 - 3) Unique page numbers for each page of each separate item.
 - c. When submitting "or-equal" items that are not the products of named manufacturers, include the words "or-equal" in the item description.
4. Contractor certification of review and approval:
 - a. Contractor's review and approval certification stamp shall be applied either to the letter of transmittal or a separate sheet preceding each independent item in the submittal.
 - 1) Stamp may be either a wet ink stamp or electronically embedded.
 - 2) Clearly identify the person who reviewed the submittal and the date it was reviewed.
 - 3) Shop Drawing submittal stamp shall read "(Contractor's Name) has satisfied Contractor's obligations under the Contract Documents with respect to Contractor's review and approval as stipulated in the General Conditions."
 - b. Execute Exhibit AA, Contractor's Submittal Certification form, to indicate Contractor has reviewed and approved the submittal contents.
 - 1) Clearly identify the person who reviewed the submittal and the date it was reviewed.
 - c. Submittals containing multiple independent items shall be prepared with each item listed on the letter of transmittal or on an index sheet for all items listing the discrete page numbers for each page of each item, which shall be stamped with the Contractor's review and approval stamp.
 - 1) Each independent item shall have a cover sheet with the transmittal number and item number recorded.
 - a) Provide clear space of 3 IN SQ for Engineer stamping.
 - 2) Individual pages or sheets of independent items shall be numbered in a manner that permits the entire contents of a particular item to be readily recognized and associated with Contractor's certification.
5. Resubmittals:
 - a. Number with original Specification Section and series number with a suffix letter starting with "A" on a (new) duplicate transmittal form.
 - b. Do not increase the scope of any prior transmittal.
 - c. Provide cover letter indicating how each "B", "C", or "D" Action from previous submittal was addressed and where the correction is found in the resubmittal.
 - d. Account for all components of prior transmittal.
 - 1) If items in prior transmittal received "A" or "B" Action code, list them and indicate "A" or "B" as appropriate.
 - a) Do not include submittal information for items listed with prior "A" or "B" Action in resubmittal.
 - 2) Indicate "Outstanding-To Be Resubmitted At a Later Date" for any prior "C" or "D" Action item not included in resubmittal.
 - a) Obtain Engineer's approval to exclude items.
6. For 8-1/2 x 11 IN, 8-1/2 x 14 IN, and 11 x 17 IN size sheets, provide five copies of each submittal for Engineer plus the number required by the Contractor.
 - a. The number of copies required by the Contractor will be defined at the Preconstruction Conference, but shall not exceed three.
 - b. All other size sheets:
 - 1) Submit one reproducible transparency or high resolution print and one additional print of each Drawing until approval is obtained.
 - 2) Utilize mailing tube; do not fold.

- 3) The Engineer will mark and return the reproducible to the Contractor for reproduction and distribution.
7. Do not use red color for marks on transmittals.
 - a. Duplicate all marks on all copies transmitted, and ensure marks are photocopy reproducible.
 - b. Engineer will use red marks or enclose marks in a cloud.
8. Transmittal contents:
 - a. Coordinate and identify Shop Drawing contents so that all items can be easily verified by the Engineer.
 - b. Provide submittal information or marks defining specific equipment or materials utilized on the Project.
 - 1) Generalized product information, not clearly defining specific equipment or materials to be provided, will be rejected.
 - c. Identify equipment or material project use, tag number, Drawing detail reference, weight, and other Project specific information.
 - d. Provide sufficient information together with technical cuts and technical data to allow an evaluation to be made to determine that the item submitted is in compliance with the Contract Documents.
 - e. Do not modify the manufacturer's documentation or data except as specified herein.
 - f. Submit items such as equipment brochures, cuts of fixtures, product data sheets or catalog sheets not exceeding 11 x 17 IN pages.
 - 1) Indicate exact item or model and all options proposed by a row and leader.
 - g. When a Shop Drawing submittal is called for in any Specification Section, include as appropriate, scaled details, sizes, dimensions, performance characteristics, capacities, test data, anchoring details, installation instructions, storage and handling instructions, color charts, layout Drawings, rough-in diagrams, wiring diagrams, controls, weights and other pertinent data in addition to information specifically stipulated in the Specification Section.
 - 1) Arrange data and performance information in format similar to that provided in Contract Documents.
 - 2) Provide, at minimum, the detail specified in the Contract Documents.
 - h. If proposed equipment or materials deviate from the Contract Drawings or Specifications in any way, clearly note the deviation and justify the said deviation in detail in a separate letter immediately following transmittal sheet. Any deviation from plans or specifications not depicted in the submittal or included but not clearly noted by the Contractor may not have been reviewed. Review by the Engineer shall not serve to relieve the Contractor of the contractual responsibility for any error or deviation from contract requirements.
9. Samples:
 - a. Identification:
 - 1) Identify sample as to transmittal number, manufacturer, item, use, type, project designation, tag number, Specification Section or Drawing detail reference, color, range, texture, finish and other pertinent data.
 - 2) If identifying information cannot be marked directly on sample without defacing or adversely altering samples, provide a durable tag with identifying information securely attached to the sample.
 - b. Include application specific brochures, and installation instructions.
 - c. Provide Contractor's review and approval certification stamp or Contractor's Submittal Certification form as indication of Contractor's checking and verification of dimensions and coordination with interrelated work.
 - d. Resubmit revised samples of rejected items.

C. Informational Submittals:

1. Prepare in the format and detail specified in Specification requiring the informational submittal.

1.5 TRANSMITTAL OF SUBMITTALS

A. Shop Drawings and Samples:

1. Transmit all submittals to:

HDR
835 N Post Street, Suite 101
Spokane, WA 99201-2126
Attn: Andrew Staples:

2. Utilize two copies of attached Exhibit A to transmit all Shop Drawings and samples.
3. All submittals must be from Contractor.
 - a. Submittals will not be received from or returned to subcontractors.

B. Informational Submittals:

1. Transmit under Contractor's standard letter of transmittal or letterhead.
2. Submit in triplicate or as specified in individual Specification Section.
3. Transmit to:

HDR
835 N Post Street, Suite 101
Spokane, WA 99201-2126
Attn: Andrew Staples

C. Electronic Transmission of Submittals:

1. Transmittals shall be made electronically.
 - a. Use HDR's Project Tracker Collaboration System (PTCS).
 - b. Protocols and processes will be determined at the Pre-Construction Conference.
2. Provide documents in Adobe Acrobat Portable Document Format (PDF), latest version.
3. Do not password protect or lock the PDF document.
4. Drawings or other graphics must be converted to PDF file format from the original drawing file format and made part of the PDF document.
 - a. Scanning of drawings is to be used only where actual file conversion is not possible and drawings must be scanned at a resolution of 300 DPI or greater.
 - b. Required signatures may be applied prior to scanning for transmittal.
5. Electronic drawings shall be formatted to be at full-scale (or half-scale when printed to 11x17).
 - a. Do not reduce drawings by more than 50 PCT in size.
 - b. Reduced drawings shall be clearly marked "HALF-SIZE" and shall scale accurately at that size.
6. Rotate sheets that are normally viewed in landscape mode so that when the PDF file is opened the sheet is in the appropriate position for viewing.
7. Create bookmarks in the bookmarks panel for the cover, the Table of Contents, and each major section of the document.
8. Using Adobe Acrobat Standard or Adobe Acrobat Professional, set the PDF document properties, initial view as follows:
 - a. Select File → Properties → Initial View.
 - b. Select the Navigation tab: Bookmarks Panel and Page.
 - c. Select the Page layout: Single Page.
 - d. Select the Magnification: Fit Page.
 - e. Select Open to page: 1.
 - f. Set the file to open to the cover page with bookmarks to the left, and the first bookmark linked to the cover page.
9. Set the PDF file "Fast Web View" option to open the first several pages of the document while the rest of the document continues to load.
 - a. To do this:
 - 1) Select Edit → Preferences → Documents → Save Settings.

- 2) Check the Save As optimizes for Fast Web View box.
- 10. File naming conventions:
 - a. File names shall use the convention (XXXXXX-YY-Z.PDF) where XXXXXX is the Specification Section number, YY is the Shop Drawing Root number and Z is an ID number used to designate the associated volume.
- 11. Labeling:
 - a. As a minimum, include the following labeling on all electronic media:
 - 1) Project Name.
 - 2) Equipment Name and Project Tag Number.
 - 3) Project Specification Section.
 - 4) Manufacturer Name.
 - 5) Vendor Name.
- 12. Binding:
 - a. Include labeled electronic media in a protective case.
 - 1) Bind protective case in three-ring binder, inserted at the front of the Final paper copy submittal.
 - 2) Protective case(s) to have means for securing electronic media to prevent loss (e.g., zip case, flap and strap, or equivalent).

1.6 ENGINEER'S REVIEW ACTION

- A. Shop Drawings and Samples:
 - 1. Items within transmittals will be reviewed for overall design intent and will receive one of the following actions:
 - a. A - FURNISH AS SUBMITTED.
 - b. B - FURNISH AS NOTED (BY ENGINEER).
 - c. C - REVISE AND RESUBMIT.
 - d. D - REJECTED.
 - e. E - ENGINEER'S REVIEW NOT REQUIRED.
 - 2. Submittals received will be initially reviewed to ascertain inclusion of Contractor's approval stamp.
 - a. Submittals not stamped by the Contractor or stamped with a stamp containing language other than that specified herein will not be reviewed for technical content and will be returned rejected.
 - 3. In relying on the representation on the Contractor's review and approval stamp, Owner and Engineer reserve the right to review and process poorly organized and poorly described submittals as follows:
 - a. Submittals transmitted with a description identifying a single item and found to contain multiple independent items:
 - 1) Review and approval will be limited to the single item described on the transmittal letter.
 - 2) Other items identified in the submittal will:
 - a) Not be logged as received by the Engineer.
 - b) Be removed from the submittal package and returned without review and comment to the Contractor for coordination, description and stamping.
 - c) Be submitted by the Contractor as a new series number, not as a re-submittal number.
 - b. Engineer, at Engineer's discretion, may revise the transmittal letter item list and descriptions, and conduct review.
 - 1) Unless Contractor notifies Engineer in writing that the Engineer's revision of the transmittal letter item list and descriptions was in error, Contractor's review and approval stamp will be deemed to have applied to the entire contents of the submittal package.
 - 4. Submittals returned with Action "A" or "B" are considered ready for fabrication and installation.

- a. If for any reason a submittal that has an "A" or "B" Action is resubmitted, it must be accompanied by a letter defining the changes that have been made and the reason for the resubmittal.
- b. Destroy or conspicuously mark "SUPERSEDED" all documents having previously received "A" or "B" Action that are superseded by a resubmittal.
5. Submittals with Action "A" or "B" combined with Action "C" (Revise and Resubmit) or "D" (Rejected) will be individually analyzed giving consideration as follows:
 - a. The portion of the submittal given "C" or "D" will not be distributed (unless previously agreed to otherwise at the Preconstruction Conference).
 - 1) One copy or the one transparency of the "C" or "D" Drawings will be marked up and returned to the Contractor.
 - a) Correct and resubmit items so marked.
 - b. Items marked "A" or "B" will be fully distributed.
 - c. If a portion of the items or system proposed are acceptable, however, the major part of the individual Drawings or documents are incomplete or require revision, the entire submittal may be given "C" or "D" Action.
 - 1) This is at the sole discretion of the Engineer.
 - 2) In this case, some Drawings may contain relatively few or no comments or the statement, "Resubmit to maintain a complete package."
 - 3) Distribution to the Owner and field will not be made (unless previously agreed to otherwise).
6. Failure to include any specific information specified under the submittal paragraphs of the Specifications will result in the submittal being returned to the Contractor with "C" or "D" Action.
7. Calculations required in individual Specification Sections will be received for information purposes only, as evidence calculations have been stamped by the professional as defined in the specifications and for limited purpose of checking conformance with given performance and design criteria. The Engineer is not responsible for checking the accuracy of the calculations and the calculations will be returned stamped "E. Engineer's Review Not Required" to acknowledge receipt.
8. Furnish required submittals with sufficient information and accuracy to obtain required approval of an item with no more than three submittals. Engineer will record Engineer's time for reviewing a fourth or subsequent submittal of a Shop Drawings, sample, or other item requiring approval, and Contractor shall be responsible for Engineer's charges to Owner for such time. Owner may impose a set-off against payments due to Contractor to secure reimbursement for such charges.
9. Transmittals of submittals which the Engineer considers as "Not Required" submittal information, which is supplemental to but not essential to prior submitted information, or items of information in a transmittal which have been reviewed and received "A" or "B" action in a prior submittal, will be returned with action "E. Engineer's Review Not Required."
10. Samples may be retained for comparison purposes.
 - a. Remove samples when directed.
 - b. Include in bid all costs of furnishing and removing samples.
11. Approved samples submitted or constructed, constitute criteria for judging completed work.
 - a. Finished work or items not equal to samples will be rejected.

PART 2 - PRODUCTS - (NOT USED)

PART 3 - EXECUTION - (NOT USED)

END OF SECTION

EXHIBIT A Shop Drawing Transmittal No.

(Spec Section) (Series)

Project Name:		Date Received:	
Project Owner:		Checked By:	
Contractor:	HDR Engineering, Inc.	Log Page:	
Address:	Address:	HDR No.:	
		Spec Section:	
		Drawing/Detail No.:	
Attn:	Attn:	1st. Sub	ReSub.
Date Transmitted:		Previous Transmittal Date:	

Remarks:

* The Action designated above is in accordance with the following legend:

<p>A - Furnish as Submitted</p> <p>B - Furnish as Noted</p> <p>C - Revise and Submit</p> <ol style="list-style-type: none"> 1. Not enough information for review. 2. No reproducibles submitted. 3. Copies illegible. 4. Not enough copies submitted. 5. Wrong sequence number. 6. Wrong resubmittal number. 7. Wrong spec. section. 8. Wrong form used. 9. See comments. <p>D - Rejected</p>	<p>E - Engineer's review not required</p> <ol style="list-style-type: none"> 1. Submittal not required. 2. Supplemental Information. Submittal retained for informational purposes only. 3. Information reviewed and approved on prior submittal. 4. See comments. <p>Engineer's review and approval will be only to determine if the items covered by the submittals will, after installation or incorporation in the Work, conform to the information given in the Contract Documents and be compatible with the design concept of the completed Project as a functioning whole as indicated by the Contract Documents. Any deviation from plans or specifications not depicted in the submittal or included but not clearly noted by the Contractor may not have been reviewed. Review by the Engineer shall not serve to relieve the Contractor of the contractual responsibility for any error or deviation from contract requirements.</p>
--	--

Comments:

By _____ Date _____

Distribution: Contractor | File | Field | Owner | Other |

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Contractor's Submittal Certification

Shop Drawing Transmittal No.: _____

Contract/Project Name: _____

Company Name: _____

has

1. reviewed and coordinated this Shop Drawing or Sample with other Shop Drawings and Samples and with the requirements of the Work and the Contract Documents;
2. determined and verified all field measurements, quantities, dimensions, specified performance and design criteria, installation requirements, materials, catalog numbers, and similar information with respect thereto;
3. determined and verified the suitability of all materials offered with respect to the indicated application, fabrication, shipping, handling, storage, assembly, and installation pertaining to the performance of the Work; and
4. determined and verified all information relative to Contractor's responsibilities for means, methods, techniques, sequences, and procedures of construction, and safety precautions and programs incident thereto.

This Submittal **does not** contain any variations from the requirements of the Contract Documents.

This Submittal **does** contain variations from the requirements of the Contract Documents. A separate description of said variations and a justification for them is provided in an attachment hereto identified as:

"Shop Drawing Transmittal No. _____ Variation and Justification Documentation"

Insert picture file or electronic signature of Authorized Representative

Authorized Representative

Date

SECTION 01 33 04
OPERATION AND MAINTENANCE MANUALS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Administration of the submittal process for Operation and Maintenance Manuals.
 - 2. Content requirements for Operation and Maintenance Manuals.
- B. Related Specification Sections include but are not necessarily limited to:
 - 1. Division 00 - Procurement and Contracting Requirements.
 - 2. Division 01 - General Requirements.
 - 3. General submittal requirements are specified in Specification Section 01 33 00 - Submittals.
 - 4. Technical Specification Sections identifying required Operation and Maintenance Manual submittals.

1.2 DEFINITIONS

- A. Equipment Operation and Maintenance Manuals:
 - 1. Contain the technical information required for proper installation, operation and maintenance of process, electrical and mechanical equipment and systems.
- B. Building Materials and Finishes Operation and Maintenance Manuals:
 - 1. Contain the information required for proper installation and maintenance of building materials and finishes.

1.3 SUBMITTALS

- A. List of all the Operation and Maintenance Manuals required by the Contract as identified in the Technical Specification Sections. These may be referred to as "Operation and Maintenance Data" submittals.
- B. Operation and Maintenance Manuals:
 - 1. Draft and final electronic copies.
 - 2. Final paper copies: One.

1.4 SUBMITTAL SCHEDULE

- A. List of Required Operation and Maintenance Manuals:
 - 1. Submit list with Specification Section number and title within 90 days after Notice to Proceed.
- B. Draft Operation and Maintenance Manuals:
 - 1. Submit approvable draft manuals in electronic format (PDF) within 30 days following approval of the respective Shop Drawing.
 - a. Include placeholders or fly sheet pages where information is not final or is missing from the draft manual.
 - 2. All Draft Operation and Maintenance Manuals shall be received by no later than 50 PCT project completion.
- C. Final Operation and Maintenance Manuals:
 - 1. Final approval of Operation and Maintenance Manuals in electronic format (PDF) must be obtained 45 days prior to equipment start-up.
 - 2. Provide paper copies and electronic PDF copies of approved final Operation and Maintenance Manuals, a minimum of 30 days prior to equipment start-up.

3. Issue addenda to Final Approved Operation and Maintenance Manual to include:
 - a. Equipment data that requires collection after start-up, for example but not limited to HVAC balancing reports, electrical switchgear, automatic transfer switch and circuit breaker settings.
 - b. Equipment field testing data.
 - c. Equipment start-up reports.

1.5 PREPARATION OF SUBMITTALS

A. General:

1. All pages of the Operation and Maintenance Manual submittal shall be legible.
 - a. Submittals which, in the Engineer's sole opinion, are illegible will be rejected without review.
2. Identify each equipment item in a manner consistent with names and identification numbers used in the Contract Documents, not the manufacturer's catalog numbers.
3. Neatly type any data not furnished in printed form.
4. Operation and Maintenance Manuals are provided for Owner's use, to be reproduced and distributed as training and reference materials within Owner's organization.
 - a. This requirement is:
 - 1) Applicable to both paper copy and electronic files.
 - 2) Applicable to materials containing copyright notice as well as those with no copyright notice.
5. Notify supplier and/or manufacturer of the intended use of Operations and Maintenance Manuals provided under the Contract.

B. Operation and Maintenance Manual Format and Delivery:

1. Draft electronic submittals:
 - a. Provide manual in Adobe Acrobat Portable Document Format (PDF), latest version.
 - b. Create one (1) PDF file for each equipment Operation and Maintenance Manual.
 - c. Do not password protect or lock the PDF document.
 - d. Scanned images of paper documents are not acceptable. Create the Operation and Maintenance Manual PDF file from the original source document.
 - e. Drawings or other graphics must be converted to PDF file format from the original drawing file format and made part of the PDF document.
 - f. Scanning of drawings is to be used only where actual file conversion is not possible and drawings must be scanned at a resolution of 300 DPI or greater.
 - g. Rotate sheets that are normally viewed in landscape mode so that when the PDF file is opened the sheet is in the appropriate position for viewing.
 - h. Create bookmarks in the bookmarks panel for the Operation and Maintenance Manual cover, the Table of Contents and each major section of the Table of Contents.
 - i. Using Adobe Acrobat Standard or Adobe Acrobat Professional, set the PDF document properties, initial view as follows:
 - 1) Select File → Properties → Initial View.
 - 2) Select the Navigation tab: Bookmarks Panel and Page.
 - 3) Select the Page layout: Single Page Continuous.
 - 4) Select the Magnification: Fit Page.
 - 5) Select Open to page: 1.
 - 6) Set the file to open to the cover page of the manual with bookmarks to the left, and the first bookmark linked to the cover page.
 - 7) Window Options: Check the "Resize window to initial page" box.
 - j. Set the PDF file "Fast Web View" option to open the first several pages of the document while the rest of the document continues to load.
 - 1) To do this:
 - a) Select Edit → Preferences → Documents → Save Settings.
 - b) Check the "Save As optimizes for Fast Web View" box.

- k. PDF file naming convention:
 - 1) Use the Specification Section number, the manufacturer's name and the equipment description, separated by underscores.
 - 2) Example: 46 51 21_Sanitaire_Coarse_Bubble_Diffusers.pdf.
 - 3) Do not put spaces in the file name.
 - 2. Final electronic submittals:
 - a. Submit two copies in PDF file format on two USB flash drives or on two CD-ROM discs (one copy per electronic media), each secured in a protective case.
 - b. Labeling:
 - 1) Provide the following printed labeling on all electronic media:
 - a) Project name.
 - b) Specification Section.
 - c) Equipment names and summary of tag(s) covered.
 - d) Manufacturer name.
 - e) Date (month, year).
 - c. Binding:
 - 1) Include labeled electronic media in a protective case.
 - a) Bind protective case in three-ring binder, inserted at the front of the Final paper copy submittal.
 - b) Protective case(s) to have means for securing electronic media to prevent loss (e.g., zip case, flap and strap, or equivalent).
 - 3. Final paper copy submittals:
 - a. Quantity: Provide two copies.
 - b. Paper: 8.5 x 11 IN or 11 x 17 IN bright white, 20 LB paper with standard three-hole punching.
 - c. 3-Ring Binder:
 - 1) Provide D-ring binder with clear vinyl sleeves (i.e. view binder) on front and spine.
 - 2) Insert binder title sheet with the following information under the front and spine sleeves:
 - a) Project name.
 - b) Specification Section.
 - c) Equipment names and summary of tag(s) covered.
 - d) Manufacturer name.
 - e) Date (month, year).
 - 3) Provide plastic sheet lifters prior to first page and following last page.
 - d. Drawings:
 - 1) Provide all drawings at 11 x 17 IN size, triple folded and three-hole punched for insertion into manual.
 - 2) Where reduction is not practical to ensure readability, fold larger drawings separately and place in three-hole punched vinyl envelopes inserted into the binder.
 - 3) Identify vinyl envelopes with drawing numbers.
 - e. Use plastic coated dividers to tab each section of each manual in accordance with the Table of Contents.
- C. Equipment Operation and Maintenance Manual Content:
- 1. Provide a cover page as the first page of each manual with the following information:
 - a. Manufacturer(s) Name and Contact Information.
 - b. Vendor's Name and Contact Information.
 - c. Date (month, year).
 - d. Project Owner and Project Name.
 - e. Specification Section.
 - f. Project Equipment Tag Numbers.
 - g. Model Numbers.
 - h. Engineer's Name.
 - i. Contractor's Name.
 - 2. Provide a Table of Contents for each manual.

3. Provide Equipment Record sheets as follows:
 - a. Printed copies of the Equipment Record (Exhibits B 1, B2 and B3), as the first tab following the Table of Contents.
 - 1) For Instrumentation and Control equipment, International Society of Automation (ISA) Data Sheets will be acceptable in lieu of the Equipment Record sheets.
 - b. Exhibits B 1-B3 are available as Ffillable PDF Form documents from the Engineer.
 - c. Each section of the Equipment Record must be completed in detail; simply referencing the related equipment Operation and Maintenance Manual sections for nameplate, maintenance, spare parts or lubricant information is not acceptable.
 - d. For equipment involving separate components (for example, a motor and gearbox), a fully completed Equipment Record is required for each component.
 - e. Submittals that do not include the Equipment Record(s) will be rejected without further content review.
 4. Provide a printed copy of the Manufacturer's Field Services report as required by Specification Section 01 75 00 following the Equipment Record sheets.
 5. Provide the following detailed information, as applicable:
 - a. Use equipment tag numbers from the Contract Documents to identify equipment and system components.
 - b. Equipment function, normal and limiting operating characteristics.
 - c. Instructions for assembly, disassembly, installation, alignment, adjustment, and inspection.
 - d. Operating instructions for start-up, normal operation, control, shutdown, and emergency conditions.
 - e. Maintenance instructions, including lubrication instructions if applicable
 - f. Troubleshooting guide.
 - g. Mark each sheet to clearly identify specific products and component parts and data applicable to the installation for the Project; delete or cross out information that does not specifically apply to the Project.
 - h. Parts lists:
 - 1) A parts list and identification number of each component part of the equipment.
 - 2) Exploded view or plan and section views of the equipment with a detailed parts callout matching the parts list.
 - 3) A list of recommended spare parts.
 - 4) List of spare parts provided as specified in the associated Specification Section.
 - 5) A list of any special storage precautions which may be required for all spare parts.
 - i. General arrangement, cross-section, and assembly drawings.
 - j. Electrical diagrams, including elementary diagrams, wiring diagrams, connection diagrams, and interconnection diagrams.
 - k. Factory and field test data and performance curves (if applicable).
 - l. As-constructed fabrication or layout drawings and wiring diagrams.
 - m. Copy of the equipment manufacturer's warranty meeting the requirements of the Contract.
 - n. Copy of any service contracts provided for the specific piece of equipment as part of the Contract.
 6. Additional information as required in the associated equipment or system Specification Section.
 7. Include in Submittal the final, configured control setpoints and similar configurable parameters provided in the equipment.
- D. Building Materials and Finishes Operation and Maintenance Manual Content:
1. Provide a cover page as the first page of each manual with the following information:
 - a. Manufacturer(s) Name and Contact Information.
 - b. Vendor's Name and Contact Information.
 - c. Date (month, year).
 - d. Project Owner and Project Name.
 - e. Specification Section.

- f. Model Numbers.
- g. Engineer's Name.
- h. Contractor's Name.
- 2. Provide a Table of Contents for each manual.
- 3. Building products, applied materials and finishes:
 - a. Include product data, with catalog number, size, composition and color and texture designations.
 - b. Provide information for ordering custom manufactured products.
- 4. Necessary precautions:
 - a. Include product MSDS for each approved product.
 - b. Include any precautionary application and storage guidelines.
- 5. Instructions for care and maintenance:
 - a. Include manufacturer's recommendations for cleaning agents and methods, precautions against detrimental agents and methods and recommended schedule for cleaning and maintenance.
- 6. Moisture protection and weather exposed products:
 - a. Include product data listing, applicable reference standards, chemical composition, and details of installation.
 - b. Provide recommendations for inspections, maintenance and repair.
- 7. Additional requirements as specified in individual product specifications.
- E. National Fire Protection Association 70 (National Electrical Code) Documentation:
 - 1. Assemble documented calculations of Arc-Fault Current, Equipment Available Fault Current and Short Circuit Current Rating (SCCR) provided as part of equipment submittals into one O&M manual volume.

1.6 TRANSMITTAL OF SUBMITTALS

- A. Operation and Maintenance Manuals.
 - 1. Transmit all submittals to:
 - a. The address specified in Specification Section 01 33 00 - SUBMITTALS.
 - 2. Transmittal form: Use Operation and Maintenance Manual Transmittal, Exhibit A.
 - 3. Transmittal numbering:
 - a. Number each submittal with the Specification Section number followed by a series number beginning with "-01" and increasing sequentially with each additional transmittal, followed by "-OM" (for example: 43 23 14-01-OM).
 - 4. Submit draft and final Operation and Maintenance Manual in electronic format (PDF) to Engineer, until manual is approved.

1.7 ENGINEER'S REVIEW ACTION

- A. Draft Electronic (PDF) Submittals:
 - 1. Engineer will review and indicate one of the following review actions:
 - a. A - ACCEPTABLE
 - b. B - FURNISH AS NOTED
 - c. C - REVISE AND RESUBMIT
 - d. D - REJECTED
 - 2. Submittals marked as Acceptable or Furnish As Noted will be retained; however, the transmittal form will be returned with a request for the final paper and electronic documents to be submitted.
 - 3. Copies of submittals marked as Revise and Resubmit or Rejected will be returned with the transmittal form marked to indicate deficient areas.
 - 4. Resubmit until approved.
- B. Final Paper Copy Submittals:
 - 1. Engineer will review and indicate one of the following review actions:
 - a. A - ACCEPTABLE
 - b. D - REJECTED

2. Submittals marked as Acceptable will be retained with the transmittal form returned as noted.
3. Submittals marked as Rejected will be returned with the transmittal form marked to indicate deficient areas.
4. Resubmit until approved.

PART 2 - PRODUCTS - (NOT USED)

PART 3 - EXECUTION - (NOT USED)

END OF SECTION



**EXHIBIT A Operation and Maintenance Manual
Transmittal _____ - _____ - OM
(Spec Section) (Series) _____**

Project Name: _____		Date Received: _____
Project Owner: _____		Checked By: _____
Contractor: _____	Owner: _____	Log Page: _____
Address: _____	Address: _____	HDR No.: _____
Attn: _____	Attn: _____	_____
		1st. Sub. ReSub.

Date Transmitted: _____	Previous Transmittal Date: _____
-------------------------	----------------------------------

No. Copies	Description of Item	Manufacturer	Dwg. or Data No.	Action Taken*

Remarks: _____

To: _____	From: _____ <i>HDR Engineering, Inc.</i>
	Date: _____

- * The Action designated above is in accordance with the following legend:
- | | |
|---|--|
| <p>A - Acceptable, provide one (1) additional paper copy and two (2) electronic copies on CD-ROM for final review.</p> <p>B - Furnish as Noted</p> <p>C - Revise and Resubmit
This Operation and Maintenance Manual Submittal is deficient in the following area:</p> <ol style="list-style-type: none"> 1. Equipment Records. 2. Functional description. 3. Assembly, disassembly, installation, alignment, adjustment & checkout instructions. 4. Operating instructions. | <ol style="list-style-type: none"> 5. Lubrication & maintenance instructions. 6. Troubleshooting guide. 7. Parts list and ordering instructions. 8. Organization (binder, binder titles, index & tabbing). 9. Wiring diagrams & schematics specific to installation. 10. Outline, cross section & assembly diagrams. 11. Test data & performance curves. 12. Tag or equipment identification numbers. 13. Inclusion of all components & subcomponents. 14. Other - see comments. <p>D - Rejected</p> |
|---|--|

Comments: _____

By _____	Date _____
Distribution: Contractor File Field Owner Other	

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Equipment Data and Spare Parts Summary

Project Name	Specification Section:
Equipment Name	Year Installed:

Project Equipment Tag No(s).

Equipment Manufacturer	Project/Order No.
Address	Phone
Fax	Web Site
	E-mail

Local Vendor/Service Center	
Address	Phone
Fax	Web Site
	E-mail

MECHANICAL NAMEPLATE DATA

Equip.					Serial No.
Make					Model No.
ID No.	Frame No.	HP	RPM	Cap.	
Size	TDH	Imp. Sz.	CFM	PSI	
Other:					

ELECTRICAL NAMEPLATE DATA

Equip.								Serial No.
Make								Model No.
ID No.	Frame No.	HP	V.	Amp.	HZ	PH	RPM	SF
Duty	Code	Ins. Cl.	Type	NEMA	C Amb.	Temp. Rise	Rating	
Other:								

SPARE PARTS PROVIDED PER CONTRACT

Part No.	Part Name	Quantity

RECOMMENDED SPARE PARTS

Part No.	Part Name	Quantity

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Lubrication Summary

Equipment Description	Project Equip. Tag No(s).
-----------------------	---------------------------

Lubricant Point						
Lubricant Type	Manufacturer		Product	AGMA #	SAE #	ISO
	1					
	2					
	3					
	4					
	5					

Lubricant Point						
Lubricant Type	Manufacturer		Product	AGMA #	SAE #	ISO
	1					
	2					
	3					
	4					
	5					

Lubricant Point						
Lubricant Type	Manufacturer		Product	AGMA #	SAE #	ISO
	1					
	2					
	3					
	4					
	5					

Lubricant Point						
Lubricant Type	Manufacturer		Product	AGMA #	SAE #	ISO
	1					
	2					
	3					
	4					
	5					

Lubricant Point						
Lubricant Type	Manufacturer		Product	AGMA #	SAE #	ISO
	1					
	2					
	3					
	4					
	5					

Lubricant Point						
Lubricant Type	Manufacturer		Product	AGMA #	SAE #	ISO
	1					
	2					
	3					
	4					
	5					

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SECTION 01 35 05
ENVIRONMENTAL PROTECTION AND SPECIAL CONTROLS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Minimizing the pollution of air, water, or land; control of noise, the disposal of solid waste materials, and protection of deposits of historical or archaeological interest.
- B. Related Specification Sections include but are not necessarily limited to:
 - 1. Division 00 - Procurement and Contracting Requirements.
 - 2. Division 01 - General Requirements.

1.2 SUBMITTALS

- A. Shop Drawings:
 - 1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
 - 2. Prior to the start of any construction activities submit:
 - a. A detailed proposal of all methods of control and preventive measures to be utilized for environmental protection.
 - b. A drawing of the work area, haul routes, storage areas, access routes and current land conditions including trees and vegetation.
 - c. A copy of the NPDES permit for storm water discharges from construction activities.
 - d. A copy of the approved pollution prevention plan.

PART 2 - PRODUCTS - (NOT USED)

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Employ and utilize environmental protection methods, obtain all necessary permits, and fully observe all local, state, and federal regulations.
- B. Land Protection:
 - 1. Except for any work or storage area and access routes specifically assigned for the use of the Contractor, the land areas outside the limits of construction shall be preserved in their present condition.
 - a. Confine construction activities to areas defined for work within the Contract Documents.
 - 2. Manage and control all borrow areas, work or storage areas, access routes and embankments to prevent sediment from entering nearby water or land adjacent to the work site.
 - 3. Restore all disturbed areas including borrow and haul areas and establish permanent type of locally adaptable vegetative cover.
 - 4. Unless earthwork is immediately paved or surfaced, protect all side slopes and back slopes immediately upon completion of final grading.
 - 5. Plan and execute earthwork in a manner to minimize duration of exposure of unprotected soils.
 - 6. Except for areas designated by the Contract Documents to be cleared and grubbed, do not deface, injure or destroy trees and vegetation, nor remove, cut, or disturb them without approval of the Engineer.
 - a. Any damage caused by the Contractor's equipment or operations shall be restored as nearly as possible to its original condition at no additional cost to the Owner.

C. Surface Water Protection:

1. Utilize, as necessary, erosion control methods to protect side and backslopes, minimize and the discharge of sediment to the surface water leaving the construction site as soon as rough grading is complete.
 - a. These controls shall be maintained until the site is ready for final grading and landscaping or until they are no longer warranted and concurrence is received from the Engineer.
 - b. Physically retard the rate and volume of run-on and runoff by:
 - 1) Implementing structural practices such as diversion swales, terraces, straw bales, silt fences, berms, storm drain inlet protection, rock outlet protection, sediment traps and temporary basins.
 - 2) Implementing vegetative practices such as temporary seeding, permanent seeding, mulching, sod stabilization, vegetative buffers, hydroseeding, anchored erosion control blankets, sodding, vegetated swales or a combination of these methods.
 - 3) Providing Construction sites with graded or rock access entrance and exit drives and parking areas to reduce the tracking of sediment onto public or private roads.
2. Discharges from the construction site shall not contain pollutants at concentrations that produce objectionable films, colors, turbidity, deposits or noxious odors in the receiving stream or waterway.

D. Solid Waste Disposal:

1. Collect solid waste on a daily basis.
2. Provide disposal of degradable solid waste to an approved solid waste disposal site.
3. Provide disposal of nondegradable solid waste to an approved solid waste disposal site or in an alternate manner approved by Engineer and regulatory agencies.
4. No building materials wastes or unused building materials shall be buried, dumped, or disposed of on the site.

E. Fuel and Chemical Handling:

1. Store and dispose of chemical wastes in a manner approved by regulatory agencies.
2. Take special measures to prevent chemicals, fuels, oils, greases, herbicides, and insecticides from entering drainage ways.
3. Do not allow water used in onsite material processing, concrete curing, cleanup, and other waste waters to enter a drainage way(s) or stream.
4. Provide containment around fueling and chemical storage areas to ensure that spills in these areas do not reach waters of the state.

F. Control of Dust:

1. The control of dust shall mean that no construction activity shall take place without applying all such reasonable measures as may be required to prevent particulate matter from becoming airborne so that it remains visible beyond the limits of construction.
 - a. Reasonable measures may include paving, frequent road cleaning, planting vegetative groundcover, application of water or application of chemical dust suppressants.
 - b. The use of chemical agents, such as calcium chloride, must be approved by the State of Washington.
2. Utilize methods and practices of construction to eliminate dust in full observance of a agency regulations.
3. The Engineer will determine the effectiveness of the dust control program and may request the Contractor to provide additional measures, at no additional cost to Owner.

G. Burning:

1. Do not burn material on the site.
2. If the Contractor elects to dispose of waste materials by burning, make arrangements for an off-site burning area and conform to all agency regulations.

H. Control of Noise:

1. Control noise by fitting equipment with appropriate mufflers.

- I. Completion of Work:
 1. Upon completion of work, leave area in a clean, natural looking condition.
 2. Ensure all signs of temporary construction and activities incidental to construction of required permanent work are removed.

END OF SECTION

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SECTION 01 42 13
STANDARD ABBREVIATIONS AND SYMBOLS

PART 1 - GENERAL

1.1 UNITS OF MEASUREMENT

A. Units of measurement abbreviations are defined on the drawings.

1.2 TERMINOLOGY

- A. Abbreviations associated with terminology are defined in the Drawings, with the following exceptions:
1. Typical equipment abbreviations are listed in 01 61 03 - Equipment - Basic Requirements.
 2. Piping system abbreviations are listed in 40 05 00 - Pipe and Pipe Fittings - Basic Requirements.

1.3 ORGANIZATIONS AND STANDARDS

A. Organizations associated with industry reference standards are defined in each Specification Section.

END OF SECTION

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SECTION 01 45 00
QUALITY CONTROL

PART 1 - GENERAL

1.1 SUMMARY

- A. Provisions followed by an asterisk (*) include some or all provision as obtained from AIA Document A201- General Conditions of the Contract for Construction.

1.2 SECTION INCLUDES

- A. Quality assurance and control.
- B. Regulatory requirements.
- C. Tolerances.
- D. Mock-ups.
- E. Manufacturer's field services.

1.3 QUALITY ASSURANCE AND CONTROL

- A. Monitor quality assurance and control over suppliers, manufacturers, products, services, site conditions, and workmanship, to produce Work of specified quality.
- B. Comply with manufacturers' instructions, including each step in sequence.
- C. Should manufacturer's instructions conflict with Contract Documents, request clarification from Architect before proceeding.
- D. Comply with specified standards as minimum quality for Work except when more stringent tolerances, codes, or specified requirements indicate higher standards or more precise workmanship.
- E. Have Work performed by persons qualified and experienced to produce required or specified quality.
- F. Verify that field measurements are as indicated on approved shop drawings or as instructed by manufacturer of product.
- G. Secure products in place with positive anchorage devices designed and sized to withstand stresses, vibration, physical distortion or disfigurement.
- H. Materials shall be compatible with one another and with other materials with which they may come in contact.

1.4 SUPERVISION AND CONSTRUCTION PROCEDURES

- A. Contractor shall supervise and direct Work, using Contractor's best skill and attention. *
- B. Contractor shall be solely responsible for, and have control over, construction means, methods, techniques, sequences and procedures and for coordinating all portions of Work under the Contract, unless Contract Documents give other specific instructions concerning these matters. *
- C. Whether or not Contract Documents give specific instructions concerning construction means, methods, techniques, sequences or procedures, the Contractor shall review, substantiate, and comply with current industry execution standards and manufacturer's current execution instructions and evaluate jobsite safety thereof and shall be fully and solely responsible for jobsite safety of such means, methods, techniques, sequences or procedures. *
 - 1. If Contractor determines that such means, methods, techniques, sequences or procedures may not be safe, the Contractor shall give timely written notice to Owner and Architect and

shall not proceed with that portion of Work without further written instructions from Architect. *

2. If Contractor is then instructed to proceed with the required means, methods, techniques, sequences or procedures without acceptance of changes proposed by Contractor, the Owner shall be solely responsible for any loss or damage arising solely from those Owner-required means, methods, techniques, sequences or procedures. *
- D. Contractor shall be responsible to Owner for acts and omissions of Contractor's employees, Subcontractors and their agents and employees, and other persons or entities performing portions of Work for, or on behalf of Contractor or any of its Subcontractors. *
- E. Contractor shall be responsible for inspection of portions of Work already performed to determine that such portions are in proper condition to receive subsequent Work. *
- F. Contractor is solely responsible for coordination of scope of Work for its own forces, and of Subcontractors and suppliers, and to complete all Work, whether performed by the Contractor or a Subcontractor.
- G. Contractor shall employ Licensed Surveyor to locate and stake out Work and establish necessary reference and benchmarks.
 1. Work from established benchmarks and reference points, layout and correctly establish lines, levels, grades, and locations of all parts of their own Work and be responsible for their accuracy and proper correlation with Work and established data.

1.5 REGULATORY REQUIREMENTS

- A. When Contract Documents require Contractor, Subcontractor, Vendor or other supplier to provide selection or design of parts of Work, such selection or design shall meet requirements of Municipal, State or other governmental authorities having jurisdiction.

1.6 TOLERANCES

- A. Monitor fabrication and installation tolerance control of Products to produce approved Work.
 1. Do not permit tolerances to accumulate.
- B. Comply with manufacturers' tolerances.
 1. Should manufacturers' tolerances conflict with Contract Documents, request clarification from Architect before proceeding.
- C. Adjust Products to appropriate dimensions; position before securing Products in place.

1.7 MANUFACTURER'S FIELD SERVICES AND REPORTS

- A. When field services are specified, have material or product suppliers, or manufacturers, provide technically competent staff personnel to observe site conditions, conditions of surfaces and installation, quality of workmanship, start-up of equipment, test, adjust and balance of equipment and supervise installation where specified, as applicable and to initiate instructions when necessary.
- B. Report observations, and site decisions or instructions given to applicators or installers which are supplemental or contrary to manufacturer's written instructions.
- C. Submit report in duplicate within 30 days of observation.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify existing site conditions and substrate surfaces are acceptable for subsequent work. Beginning new work means acceptance of existing conditions.

- B. Verify existing substrate is capable of structural support or attachment of new work being applied or attached.
- C. Examine and verify specific conditions described in individual Specification Sections.
- D. Verify that utility services are available, of correct characteristics, and in correct locations.

3.2 PREPARATION

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

END OF SECTION

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SECTION 01 45 25

TESTING CONCRETE STRUCTURES FOR WATERTIGHTNESS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Requirements for furnishing all labor, materials, tools, equipment, and services, for all testing of concrete structures for watertightness, in accord with provisions of the Contract Documents.
 - 2. Completely coordinate with work of all other trades.
 - 3. Although such work is not specifically indicated, furnish and install all supplementary or miscellaneous items, appurtenances and devices incidental to or necessary for a sound, secure and complete leak test.
- B. Related Specification Sections include but are not necessarily limited to:
 - 1. Division 00 - Procurement and Contracting Requirements.
 - 2. Division 01 - General Requirements.
- C. Payment:
 - 1. Contractor to pay all costs required for testing, , retesting, patching, repair and work required to provide access for repair as required to meet watertightness requirements specified or indicated.

1.2 QUALITY ASSURANCE

- A. Reference Standards:
 - 1. American Concrete Institute (ACI):
 - a. 350.1, Specification for Tightness Testing of Environmental Engineering Concrete Containment Structures and Commentary.
 - 2. NSF International (NSF).
 - 3. Underwriters Laboratories, Inc. (UL).
 - 4. United States Department of Agriculture (USDA).
 - 5. Water Quality Association (WQA).

1.3 SUBMITTALS

- A. Shop Drawings:
 - 1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
 - 2. Watertightness testing plan:
 - a. Plan shall include:
 - 1) Scheduling for testing.
 - 2) Description of testing apparatus for measuring water level in structure and evaporation pan.
 - a) Include Drawings (plans, sections and details) as appropriate to fully describe apparatus.
 - 3) Location plan showing measurement location and evaporation pan location.
 - 4) Procedures for isolation of tank or compartments to assure a constant volume during testing.
 - 5) Narrative describing testing procedure.
 - 6) Calculations showing:
 - a) Total structure volume at water elevation for commencement of test period.
 - b) Maximum water leakage allowed.
 - c) Test period: See ACI 350.1.
 - 7) Plan shall be in accordance with ACI 350.1, Chapters 1 and 2.

3. If structure has running water leaks or fails watertightness test, submit repairing and patching plan.
 - a. Include with plan:
 - 1) Location and areas of leaks.
 - 2) Repair material and procedures proposed for repair.
 - 3) Photographs of all visible leaks and damp areas.
 - a) Include distant photos and close-ups to document conditions.
- B. Informational Submittals:
 1. Results of watertightness testing indicating the following:
 - a. Level of water in structure and in evaporation pan and water temperature at commencement of test period.
 - b. Level of water in structure and in evaporation pan and water temperature at end of test period.
 - c. Net leakage in percent of total volume during test period (gross leakage minus that due to evaporation).
 - d. Results of retesting required due to leakage exceeding percentages allowed.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Water for Testing:
 1. See ACI 350.1.
 2. Wastewater plant: Treated effluent water.
 3. Coordinate delivery of water for testing with Owner.
- B. Any patching or repair materials that may come into contact with potable water in tanks shall be approved for drinking water per NSF, UL, USDA, or WQA.

PART 3 - EXECUTION

3.1 PREPARATION BEFORE TESTING

- A. General:
 1. Verify the specified 28-day concrete strength has been achieved prior to testing.
 2. Testing to be performed prior to placement of exterior backfill soil.
 - a. Contractor is responsible for phasing construction to minimize the impact of and to leak testing.
 3. Contractor to furnish all necessary materials (such as gaskets and flange cover plates).
 4. Testing to be performed prior to application of specified waterproofing cementitious finishing product.
 5. Test the following tanks prior to backfilling:
 - a. Digester #4
 - b. Below Grade Basement
- B. Source of water for watertightness testing:
 1. Coordinate use of water for filling tanks with Owner.
 2. The source of water will be nonpotable water from the WWTP.
 3. The cost of providing water will be paid by the Owner if it is nonpotable water from the WWTP.
 - a. The cost of additional water due to retesting will be paid by the Contractor.
 4. Contractor shall provide the means of transporting the water to the structure being tested.
- C. Cleaning:
 1. Thoroughly clean interior of structure to be tested of all debris and dirt and hose down surfaces of all walls and slabs.

2. Cleaning may be required after satisfactory test completion.
 3. See Specification Section 01 74 00.
- D. Patching and Finishing:
1. Prepare concrete surfaces in accordance with ACI 350.1 and Sections 03 35 00 and 03 31 30.
 - a. Fill all holes, voids and honeycombed areas per Section 03 35 00. Cracks suspected to cause leakage to be filled and sealed.
 - b. Review tank for areas of potential leakage before filling.

3.2 WATERTIGHTNESS TESTING

- A. Provide watertightness testing for the following structures in accordance with the indicated criteria:
1. Where no elevation is given for WATER ELEVATION AT COMMENCEMENT OF TEST PERIOD in the following table, use the normal operating water elevation for the indicated structure.

STRUCTURE NAME or TYPE	WATER ELEVATION AT COMMENCEMENT OF TEST PERIOD	MAXIMUM WATER LEAKAGE ALLOWED IN TEST PERIOD (PERCENT OF TOTAL VOLUME)
Digester #4		
Below Grade Basement		

- B. Perform a watertightness test as required by Engineer on any additional structure when in the opinion of the Engineer the structure contains sufficient concrete defects that could impair the watertightness of the structure.
1. Digester No.4 shall be leak tested and approved by the Engineer or Owner prior to coating the inside of the digesters as specified.
 2. Testing to conform to requirements of this Specification Section with allowable leakage and other criteria as established by Engineer.
- C. Test for leakage in accordance with ACI 350.1, latest edition, Chapters 1 and 2, and this Specification Section.
1. Isolate sections of structures that can be isolated during operation.
 - a. Test each section separately.
 2. Allow Engineer and/or Owner's Representative to witness testing for watertightness and review accompanying results.
- D. Place evaporation pan in an easily accessible location.
- E. Record level of water in structure and evaporation pan and water temperature at commencement of the test period.
- F. During testing period, inspect structure for areas indicating leakage.
1. Any areas evidencing running water, weeping or damp to the touch to be repaired..
 2. Repair of leaks as defined above shall be completed independent of the watertightness test.
 - a. Passing watertightness test does not relieve Contractor from repairing running water leaks.
- G. Record level of water surface in the structure and evaporation pan and temperature every 24 HRS until end of test period.
1. Test periods defined per ACI 350.1.
- H. If leakage is greater than that allowed, repair and patch areas suspected of causing the leakage.
1. Re-test structure using the same procedure until leakage is equal to or less than that allowed.
 2. Provide repair plan to Engineer for approval prior to repair of tank.

3. Cracks suspected to cause leakage to be filled and sealed to prevent leakage.
 - a. Patching to be performed after defective concrete area is cleaned of all loose material to surface of sound concrete.
 4. Prior to patching activities, Contractor to submit patching materials and procedures for review and approval by Engineer.
- I. Dispose of water used for testing.
1. Dispose of water used for testing to an area which will not damage new or existing construction and will not interfere with construction operations or plant operations.
 2. Provide hoses, temporary connections, temporary fittings and other conduits as necessary to dispose of test water without damage to structure or terrain.
 3. Point of disposal to be approved by Owner.

END OF SECTION

SECTION 01 45 33
SPECIAL INSPECTIONS AND TESTING PROGRAM

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
1. Contractor responsibilities for special inspection and testing.
 2. Special Inspection program and reporting requirements.
 3. Attachment A to this Specification Section includes the Submittal of Special Inspections.
 4. Attachment B to this Specification Section includes Special Inspector qualifications, reporting requirements, and material specific inspections and tests.
 - a. This information is for the Contractor reference only and is not part of the Contract Documents.
 - b. It is included to assist the Contractor in understanding the Owner-provided Services so that those services may be factored into the Contractor's pricing and schedule.
 - c. The Service Provider(s) responsible for the Owner-provided Services will be selected after Contract award.
- B. Purpose:
1. This Document was developed to address the requirements of the 2015 International Building Code, including:
 - a. One or more special inspectors will be hired by the Owner or the Owner's Agent to provide inspections during constructions on the types of work listed under Section 1704.
 2. A Statement of Special Inspections will be submitted to the Building Code Official as a condition for permit issuance. This statement is included as Attachment A to this Specification. Attachment B includes a complete list of materials and work requiring special inspections, the inspections to be performed and a list of the minimum qualifications of the individuals, approved agencies or firms intended to be retained for conducting such inspections.
- C. Related Specification Sections include but are not necessarily limited to:
1. Division 00 - Procurement and Contracting Requirements.
 2. Division 01 - General Requirements.

1.2 DEFINITIONS

- A. Special Inspector: Representative of the Owner approved inspection agency designated for that portion of the work.
- B. Testing Agency: Approved agency, not affiliated or hired by the Contractor, which is responsible for the materials testing requirements of the project including but not limited to concrete cylinder breaks, soils testing, and masonry materials testing.
- C. Statement of Special Inspections: Document provided to the Building Code Official outlining special inspections and tests to be done on the project and frequency of required test.
- D. Soils Engineer or Geotechnical Engineer: For the purposes of Special Inspection "Soils Engineer," "Geotechnical Engineering," and "Special Inspector" shall be interchangeable as pertains to the Division 31 specifications.
- E. NICET: National Institute for Certification in Engineering Technologies.

1.3 CONTRACTOR'S RESPONSIBILITIES

- A. Cooperate with testing agency personnel, special inspector, and agents of the Building Code Official and provide access to the work.
 - 1. Providing access to the work shall include all labor and facilities to perform inspections and tests as listed in the specifications for the duration of the inspections or tests involved.
 - 2. Provide means to obtain and handle samples taken on site.
- B. Attend a pre-construction meeting to coordinate and clarify inspection and testing procedures, requirements.
- C. Notify special inspector and/or testing agency of work to be inspected/tested minimum of 24 HRS prior.
- D. Work for which special inspections are required shall remain accessible and exposed for the purposes of special inspections until completion of required special inspections.
- E. Any portion of work that is not in conformance shall be corrected and re-inspected. Such portions of the work shall not be covered or concealed until authorized by Owner's Representative.
- F. Work to be inspected should be complete at time of inspector's arrival on-site.
- G. Payment for Special Inspection services will be in accordance with the following:
 - 1. Payment described below is for the Testing Agency and Special Inspector costs and does not include the Contractor's costs listed in Paragraph 1.3 A.
 - 2. After Contractor notification, inspector arrives at site and performs inspection within the timeframe defined in Item 4 below.
 - a. Inspection reveals work is satisfactory.
 - b. Owner pays all costs associated with this inspection.
 - 3. After Contractor notification, inspector arrives at site and performs inspection within the timeframe defined in Item 4 below.
 - a. Inspection reveals work is deficient.
 - b. Contractor corrects deficiencies within timeframe defined in Item 4) below.
 - c. Work is re-inspected and work is satisfactory.
 - d. Owner pays all costs associated with this inspection.
 - 4. After Contractor notification, inspector arrives at site and work is not ready for inspection when inspector arrives.
 - a. Inspector will remain on-site for a maximum of 2 HRS awaiting the completion of the work.
 - b. If work is not ready for inspection at the end of this period, inspector will be dismissed until Contractor requests re-inspection.
 - c. All costs associated with this inspection trip will be charged to the Contractor.
 - 5. After Contractor notification, inspector arrives at site and performs inspection within the timeframe defined above.
 - a. Inspection reveals work is deficient.
 - b. Contractor attempts to correct deficiencies within 2 HR timeframe and calls for re-inspection.
 - c. Work is re-inspected and found to still be deficient.
 - d. Inspector will be dismissed.
 - e. All costs associated with this inspection trip will be charged to the Contractor.
 - 6. Owner will pay for "passing" soils on the Project. Costs of corrective actions and cost of failed test areas requiring retesting are the sole responsibility of the Contractor. For additional specific payment requirements for soils see the respective Division 31 Section.
- H. Special Inspection is intended to be an independent quality assurance. Special Inspections shall not relieve the Contractor of any quality assurance, quality control, workmanship, or warranty responsibilities. Contractor's own personnel shall review all work to be inspected for conformance with Contract Documents prior to calling for inspection.

1.4 REPORTING DUTIES AND AUTHORITY

- A. A pre-construction meeting to coordinate and clarify inspection, testing, and procedural requirements will be held per Section 01 3000.
 - 1. The meeting is to be attended by:
 - a. Owner.
 - b. Engineer.
 - c. Building Code Official or designee.
 - d. Testing Agency and Special Inspectors.
 - e. General Contractor.
 - f. Appropriate Sub-contractor(s).
- B. Special Inspector shall report all deficient work to the Contractor as soon as possible.
 - 1. Deficient work that has been covered up or concealed prior to re-inspection shall be reported to the Engineer and the Building Code Official.
- C. Special Inspector does not have authority to stop work or modify the requirements of the Contract Documents.

PART 2 - PRODUCTS - (NOT USED)

PART 3 - EXECUTION - (NOT USED)

END OF SECTION

**ATTACHMENT A TO SECTION 01 45 33
SUBMITTAL OF SPECIAL INSPECTIONS**

Statement Date: [_____]

Project Name: [_____]

Project Address: [_____]

Owner: [_____]

Registered Design Professional in Responsible Charge (DPRC): [_____]

The Statement of Special Inspections (Statement) is submitted as a condition for permit issuance in accordance with the Special Inspection requirements of the Building Code. The Special Inspection program is outlined in Specification Section 01 45 33 and Attachments A and B. A detailed explanation of the requirements for Special Inspections and Testing can be found in specification Section 01 45 33 of the Project Manual in conjunction with the Technical Specifications for each material.

[Bi-weekly] [Monthly] Special Inspection reports will be submitted to the DPRC and the Building Official. Discovered discrepancies will be brought to the immediate attention of the Contractor for correction. If the discrepancies are not corrected, the discrepancies will be brought to the attention of the DPRC and the Building Official. Only documents that are prepared and signed or sealed by the Special Inspectors (SI) are valid.

The SI is responsible for verifying all information on each document prior to signing or sealing and directly forwarding it to the DPRC and Building Official. The SI is responsible for verifying all inspectors under his supervision maintain current certifications during the course of the project. At the conclusion of each individual Special Inspection type, the SI will complete a Final Report.

The Special Inspection program does not relieve the Contractor or any other entity of any contractual duties, including quality control, quality assurance, or safety. The Contractor is solely responsible for construction means, methods, and job site safety. Failure to adhere to the SI program as outlined herein may result in a stop work notice being issued by the Building Official.

Respectfully submitted,
Design Professional in Responsible Charge,

Type or Print Name

[_____] License # [_____]

Expires: [_____]

Signature

Date

END OF ATTACHMENT A

ATTACHMENT B TO SECTION 01 45 33
SPECIAL INSPECTIONS, INSPECTOR QUALIFICATIONS AND REPORTING
REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

- A. Related Specification Sections include but are not necessarily limited to:
 - 1. Division 00 - Procurement and Contracting Requirements.
 - 2. Division 01 - General Requirements.
 - 3. Section 03 05 05 - Concrete Testing and Inspection.
 - 4. Section 05 12 00 - Structural Steel.
 - 5. Section 05 50 00 - Metal Fabrications.
 - 6. Section 07 24 13 - Exterior Insulation and Finish System (EIFS)
 - 7. Section 31 23 00 - Earthwork.

1.2 QUALIFICATIONS

- A. Qualifications stated here are the minimum recommended by the Engineer. If the Building Code Official has more stringent qualifications, the more stringent qualifications will take precedence.
- B. All Special Inspections and Testing to be done under the direction of a Professional Engineer or Registered Architect registered in the State of Washington herein referred to as Registered Professional for Special Inspections (RPSI).
- C. Soil, concrete, masonry, mortar, grout, steel and aluminum related testing.
 - 1. The Testing Agency shall have a minimum of 10 years' experience in the testing of these materials.
 - 2. The Testing Agency's technician(s) conducting this testing:
 - a. Shall have a minimum of five years' experience in the testing of soil, concrete, mortar, grout, steel and aluminum as appropriate.
 - 3. Concrete related work:
 - a. International Code Council certification for Reinforced Concrete and American Concrete Institute Concrete Field Testing Technician – Grade 1.
- D. Special Structural Inspections:
 - 1. Professional Engineers or Architects, licensed in the State of Washington, may perform special inspections in accordance with their license qualifications.
 - 2. Other individuals, working under the direct supervision of a licensed engineer and meeting the following qualifications, may perform special inspections.
 - 3. Soils related work:
 - a. NICET Level II Certification in geotechnical engineering technology/construction; or
 - b. Registered Geologist; or
 - c. Engineer Intern under the direct supervision of a Licensed Professional Engineer.
 - 4. Concrete related work:
 - a. International Code Council certification for Reinforced Concrete Special Inspector or American Concrete Institute Concrete Construction Special Inspector.
 - b. Alternatively, may be an Engineer Intern under the direct supervision of a Licensed Professional Engineer.
 - 5. Precast concrete erection related work:
 - a. Engineer Intern under the direct supervision of a Licensed Professional Engineer.
 - 6. Precast concrete erection welding:
 - 1) American Welding Society as a Certified Welding Inspector; or
 - 2) International Code Council Structural Steel and Welding Certification and American Welding Society Qualified and one year of related experience; or

- 3) NDT Level II or II Certificate (for non-destructive testing only).
7. Masonry related work:
 - a. Shall be certified by the International Code Council or American Concrete Institute for structural masonry and one year of related experience.
 - b. Alternatively, may be an Engineer Intern with a minimum of two years appropriate training.
8. Steel and aluminum related work:
 - a. Frame and material verification [IBC Table 1704.3, Items 3 and 6]:
 - 1)
 - b. Welding:
 - 1) American Welding Society as a Certified Welding Inspector; or
 - 2) International Code Council Structural Steel and Welding Certification and American Welding Society Qualified and one year of related experience; or
 - 3) NDT Level II or II Certificate (for non-destructive testing only).
 - c. High strength bolting:
 - 1) International Code Council Structural Steel and Welding Certification and one year related experience.
 - 2) Alternatively, may be an Engineer Intern with appropriate training.
9. Fire resistive coating (intumescent paint) related work:
 - a. International Code Council Spray-Applied Fireproofing Certification and three years of related experience; or
 - b. International Code Council Fire Inspector 1 Certification and three years of related experience.
10. Other equivalent certifications will not be acceptable unless approved by the Engineer.

1.3 REPORTING DUTIES AND AUTHORITY

- A. Reporting requirements for special inspector per IBC 2015 for Building System Related Work.
 1. Comply with requirements of IBC Section 1704.1.2.
 2. Provide written documentation of all inspections and testing.
 - a. Include exact location of work.
 - b. If testing of specimens is included, include detailed information on storage and curing of specimens prior to testing.
 3. Furnish inspection and test reports to the Contractor, the Engineer's Project Manager and the Owner's on-site representative.
 - a. Indicate that work inspected was done in conformance with approved construction documents.
 - b. Immediately report any discrepancies to the Contractor for correction.
 - c. If the discrepancies are not corrected in a timely fashion, notify the Engineer's Project Manager and Owner's on-site representative.
 4. Issue an electronic report summarizing all inspections, corrective action notifications and resolution of discrepancies and non-conforming work every two weeks (14 calendar days).
 - a. Copy will be available to:
 - 1) Engineer's Project Manager.
 - 2) Owner.
 - 3) The Building Code Official.
 - 4) General Contractor.
 5. At the end of the Project, the RPSI shall compile all test reports for each inspected material and for each Special Inspector and summarize into a single PDF and submit to the Engineer and Building Code Official.
 - a. Final summary report to be signed and sealed by a Registered Professional for Special Inspections stating:
 - 1) The required Special Inspections have been performed.
 - 2) All discrepancies have been resolved except as specifically stated in the summary report.
- B. Special Inspector shall report all deficient work to the Contractor as soon as possible.

1. Deficient work that has been covered up or concealed prior to re-inspection shall be reported to the Engineer and the Building Code Official.
- C. Special Inspector does not have authority to stop work or modify the requirements of the Contract Documents.

1.4 MATERIAL SPECIFIC SPECIAL INSPECTIONS AND TESTS

- A. Material specific requirements for special inspection and testing are listed in the technical specifications listed below. Special inspection and testing requirements will be located in each appropriate technical specification under "SOURCE QUALITY CONTROL", "FIELD QUALITY CONTROL" and/or "QUALITY ASSURANCE" as appropriate for each material.

1.5 SOILS

- A. Special Inspection/testing will be provided per IBC Section 1704.7 and Table 1704.7 as required to determine that the site has been prepared in accordance with the approved soils report, and to verify the allowable soil bearing pressure, materials, compaction densities, trenching and backfill and conformance to the project Specifications.
- B. Inspection/testing requirements are listed separately in Specification Division 31 and are indicated as the work to be done by the Geotechnical Engineer, Testing Agency, or Special Inspections and Testing Provider.

1.6 CONCRETE

- A. Special Inspection and testing will be provided per IBC Table 1704.4. Inspection is required for material verification, reinforcing steel, embedded bolts, mechanical splices, concrete tests, welding of reinforcing, concrete placement and curing, and waterstop placement.
- B. Inspection and testing requirements are listed separately in Specification Section 03 05 05 and are indicated as the work to be done by the Special Inspector or Testing Agency.

1.7 PRECAST CONCRETE

- A. Special Inspection and testing will be provided per IBC Table 1704.4 Item 10. Inspection and testing is required for connection embed number and placement, connection welding, and proper panel detailing prior to placement.
- B. Inspection requirements are listed separately and are indicated as the work to be done by the Special Inspector.

1.8 MASONRY

- A. Special Inspection and testing will be provided per IBC Table 1704.5.3 (Level 1). Inspection is required for material tests and verification, reinforcing steel, embedded bolts and anchorage, grout placement, and welding of reinforcing.
- B. Inspection/testing requirements are listed separately and are indicated as the work to be done by the Special Inspector.

1.9 STEEL, STAINLESS STEEL, AND ALUMINUM

- A. Special Inspection will be provided for structural steel and aluminum per IBC Section 1704.2, 1704.3 and Table 1704.3. Inspection is required for material verification, high-strength bolting, welding and other work noted on the Contract Documents.
- B. Inspection/testing requirements are listed separately in Section 05 12 00 and Section 05 50 00 and are indicated as the work to be done by the Special Inspector. Inspection requirements listed are applicable to aluminum, stainless steel, and structural steel.

1.10 EXTERIOR FINISH AND INSULATION SYSTEM (EIFS)

- A. Special Inspection will be provided per IBC.
- B. Inspection requirements are listed separately in Specification Section 07 24 13 and are indicated as the work to be done by the Special Inspector

1.11 MASTIC AND INTUMESCENT FIRE-RESISTANT COATINGS

- A. Special Inspection will be provided per IBC [Section 1704.13] as required to determine that the mastic and intumescent fire-resistant coatings have been installed in conformance with the Contract Documents.
- B. Inspection requirements are listed separately and are indicated as the work to be done by the Special Inspector.

PART 2 - PRODUCTS - (NOT USED)

PART 3 - EXECUTION - (NOT USED)

END OF ATTACHMENT B

SECTION 01 61 03
EQUIPMENT - BASIC REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
1. Requirements of this Specification Section apply to all equipment provided on the Project including those found in other Divisions even if not specifically referenced in individual "Equipment" Articles of those Specification Sections.
- B. Related Sections include but are not necessarily limited to:
1. Division 00 - Procurement and Contracting Requirements.
 2. Division 01 - General Requirements.
 3. Section 01 81 10 - Wind and Seismic Design Criteria.
 4. Section 03 15 19 - Anchorage to Concrete.
 5. Section 03 31 30 - Concrete, Materials and Proportioning.
 6. Section 05 50 00 - Metal Fabrications.
 7. Section 07 92 00 - Joint Sealants.
 8. Section 09 96 00 - High Performance Industrial Coatings.
 9. Section 10 14 00 - Identification Devices.
 10. Section 26 08 13 - Acceptance Testing.
 11. Section 26 29 23 - Variable Frequency Drives - Low Voltage.
 12. Section 40 05 00 - Pipe and Pipe Fittings - Basic Requirements.
 13. Section 40 91 10 - Primary Elements and Transmitters.
 14. Section 40 67 00 - Control System Equipment Panels and Racks.

1.2 QUALITY ASSURANCE

- A. Referenced Standards:
1. American Bearing Manufacturers Association (ABMA).
 2. American Gear Manufacturers Association (AGMA).
 3. ASTM International (ASTM):
 - a. E1934, Standard Guide for Examining Electrical and Mechanical Equipment with Infrared Thermography.
 - b. F593, Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs.
 4. Hydraulic Institute (HI):
 - a. 9.6.4, Centrifugal and Vertical Pumps for Vibration Measurements and Allowable Valves.
 5. International Electrotechnical Commission (IEC).
 6. Institute of Electrical and Electronics Engineers, Inc. (IEEE).
 7. International Organization for Standardization (ISO):
 - a. 1940, Mechanical Vibration - Balance Quality Requirements for Rotors in a Constant (Rigid) State - Part 1: Specification and Verification of Balance Tolerances.
 - b. 21940-11, Mechanical Vibration - Rotor Balancing - Part 11: Procedures and Tolerances for Rotors with Rigid Behavior.
 8. National Electrical Manufacturers Association (NEMA):
 - a. 250, Enclosures for Electrical Equipment (1000 Volts Maximum).
 - b. ICS 6, Enclosures for Industrial Control and System.
 - c. MG 1, Motors and Generators.
 9. International Electrical Testing Association (NETA):
 - a. ATS, Acceptance Testing Specification for Electrical Power Distribution Equipment and Systems.
 10. National Fire Protection Association (NFPA):
 - a. 70, National Electrical Code (NEC):

11. National Institute for Certification in Engineering Technologies (NICET).
 12. National Institute of Standards and Technology (NIST).
 13. Occupational Safety and Health Administration (OSHA):
 - a. 29 CFR 1910, Occupational Safety and Health Standards, referred to herein as OSHA Standards.
 14. Underwriters Laboratories, Inc. (UL).
 - a. 508, Standard for Safety Industrial Control Equipment.
 - b. 508A, Standard for Safety Industrial Control Panels.
 - c. 698A, Standard for Industrial Control Panels Relating to Hazardous (Classified) Locations.
 15. Vibration Institute.
- B. Natural frequency analysis firm:
1. An independent firm, whose sole or principal part of its business is the calculation of and analysis of natural frequencies of rotating equipment.
 2. Minimum of 10 years experience.
 3. Employs a registered professional engineer who has experience in finite element analysis, rotordynamic analysis and experimental modal analysis.
 - a. Minimum five years combined field testing and data analysis experience.
 - b. Qualified Vibration Category III certification from the Vibration Institute.
- C. Vibration Testing Program:
1. Testing firm:
 - a. An independent firm performing, as the sole or principal part of its business for a minimum of 10 years, the inspection, testing, calibration, and adjusting of systems.
 - b. Must have an established monitoring and testing equipment calibration program with an accuracy traceable in an unbroken chain, according to NIST.
 2. Field personnel:
 - a. Minimum of three years field experience covering all phases of field vibration testing and data gathering.
 - b. Qualified Vibration Category II certification from the Vibration Institute.
 3. Analysis personnel:
 - a. Minimum five years combined field testing and data analysis experience.
 - b. Qualified Vibration Category III certification from the Vibration Institute.
- D. Infrared Thermography Testing Program:
1. Testing firm:
 - a. An independent firm performing, as the sole or principal part of its business for a minimum of 10 years, the inspection, testing, calibration, and adjusting of systems.
 - b. Must have an established monitoring and testing equipment calibration program with an accuracy traceable in an unbroken chain, according to NIST.
 2. Field personnel:
 - a. Minimum of one year field experience covering all phases of field thermography testing and data gathering.
 - b. Supervisor certified by NETA or NICET.
 3. Analysis personnel:
 - a. Minimum three years combined field testing and data analysis experience.
 - b. Supervisor certified by NETA or NICET.
- E. Electrical Equipment and Connections Testing Program:
1. Testing firm:
 - a. An independent firm performing, as the sole or principal part of its business for a minimum of 10 years, the inspection, testing, calibration, and adjusting of systems.
 - b. Must have an established monitoring and testing equipment calibration program with an accuracy traceable in an unbroken chain, according to NIST.

2. Field personnel:
 - a. Minimum of one year field experience covering all phases of electrical equipment inspection, testing, and calibration.
 - b. Relay test technician having previous experience with testing and calibration of relays of the same manufacturer and type used on project and proficient in setting and testing the types of protection elements used.
 - c. Supervisor certified by NETA or NICET.
 3. Analysis personnel:
 - a. Minimum three years combined field testing and data analysis experience.
 - b. Supervisor certified by NETA or NICET.
- F. Miscellaneous:
1. A single manufacturer of a "product" shall be selected and utilized uniformly throughout Project even if:
 - a. More than one manufacturer is listed for a given "product" in Specifications.
 - b. No manufacturer is listed.
 2. Equipment, electrical assemblies, related electrical wiring, instrumentation, controls, and system components shall fully comply with specific NEC requirements related to area classification and to NEMA 250 and NEMA ICS 6 designations shown on Electrical Power Drawings and defined in the Electrical specifications.
 3. Variable speed equipment applications:
 - a. The VFDs shall be supplied by Contractor's VFD supplier and in accordance with Section 16265. All VFDs shall be supplied from a single supplier. The VFD supplier shall be responsible for the coordination with driven equipment manufacturer and verify the compatibility of the selected VFD.
 - 1) VFD submittals will not be reviewed by the Engineer until the driven equipment manufacturer's submittals have been approved.
 - b. The driven equipment manufacturer shall respond to, and supply, all information requests by the VFD supplier which may be in addition to the submittal data.

1.3 DEFINITIONS

- A. Product: Manufactured materials and equipment.
- B. Major Equipment Supports - Supports for Equipment:
 1. Located on or suspended from elevated slabs with supported equipment weighing 2000 LBS or greater, or;
 2. Located on or suspended from roofs with supported equipment weighing 500 LBS or greater, or;
 3. Located on slab-on-grade or earth with supported equipment weighing 5000 LBS or more.
- C. Equipment:
 1. One or more assemblies capable of performing a complete function.
 2. Mechanical, electrical, instrumentation or other devices requiring an electrical, pneumatic, electronic or hydraulic connection.
 3. Not limited to items specifically referenced in "Equipment" articles within individual Specifications.
- D. Installer or Applicator:
 1. Installer or applicator is the person actually installing or applying the product in the field at the Project site.
 2. Installer and applicator are synonymous.

1.4 SUBMITTALS

- A. Shop Drawings:
 1. General for all equipment:
 - a. See Section 01 33 00 for requirements for the mechanics and administration of the submittal process.

- b. Data sheets that include manufacturer's name and complete product model number.
 - 1) Clearly identify all optional accessories that are included.
- c. Acknowledgement that products submitted comply with the requirements of the standards referenced.
- d. Manufacturer's delivery, storage, handling, and installation instructions.
- e. Equipment identification utilizing numbering system and name utilized in Drawings.
- f. Equipment installation details:
 - 1) Location of anchorage.
 - 2) Type, size, and materials of construction of anchorage.
 - 3) Anchorage setting templates.
 - 4) Manufacturer's installation instructions.
- g. Equipment area classification rating.
- h. Shipping and operating weight.
- i. Equipment physical characteristics:
 - 1) Dimensions (both horizontal and vertical).
 - 2) Materials of construction and construction details.
- j. Equipment factory primer and paint data.
- k. Manufacturer's recommended spare parts list.
- l. Equipment lining and coatings.
- m. Equipment utility requirements include air, natural gas, electricity, and water.
- n. Ladders and platforms provided with equipment:
 - 1) Certification that all components comply fully with OSHA requirements.
 - 2) Full details of construction/fabrication.
 - 3) Scaled plan and sections showing relationship to equipment.
- 2. Mechanical and process equipment:
 - a. Operating characteristics:
 - 1) Technical information including applicable performance curves showing specified equipment capacity, rangeability, and efficiencies.
 - 2) Brake horsepower requirements.
 - 3) Copies of equipment data plates.
 - b. Piping and duct connection size, type and location.
 - c. Equipment bearing life certification.
 - d. Equipment foundation data:
 - 1) Equipment center of gravity.
 - 2) Criteria for designing vibration, special or unbalanced forces resulting from equipment operation.
- 3. Electric motor:
 - a. Motor manufacturer and model number.
 - b. Complete motor nameplate data.
 - c. Insulation class and rated ambient temperature or rated temperature rise.
 - d. Weight.
 - e. NEMA design type.
 - f. Enclosure type.
 - g. Frame size.
 - h. Winding insulation class and temperature rise.
 - i. Motor conduit box data.
 - j. Marked "Thermally Protected" where applicable.
 - k. Starts per hour.
 - l. Performance data:
 - 1) Motor speed-torque curve superimposed over driven machine speed-torque curve during start-up acceleration and at rated terminal voltage a minimum permissible or specified terminal voltage for all motors over 100 HP.
 - 2) Time-current plots with acceleration versus current and thermal damage curves at the operating and ambient temperatures and at rated terminal voltage and minimum permissible or specified terminal voltage for all motors over 100 HP.

- 3) Guaranteed minimum efficiencies at 100 PCT, 75 PCT, and 50 PCT of full load.
 - 4) Guaranteed minimum power factor at 100 PCT, 75 PCT, and 50 PCT of full load.
 - 5) Locked rotor and full load current at rated terminal voltage and minimum permissible or specified terminal voltage.
 - 6) Starting, full load, and breakdown torque at rated terminal voltage and minimum permissible or specified terminal voltage.
- m. Bearing data and lubrication system.
 - n. Natural frequency calculations for:
 - 1) Completed assembly including but not limited to the equipment base, rotating piece of equipment, and the rotating piece of equipment driver.
 - 2) Individual piece of rotating equipment.
 - 3) Equipment driver and connected gear reducer, if applicable.
 - o. Thermal protection system including recommended alarm and trip settings for winding and bearing RTD's.
 - p. Space heater data, where applicable.
 - q. Motor test reports, where applicable.
 - r. Fabrication and/or layout drawings:
 - 1) Dimensioned outlined drawing.
 - 2) Connection diagrams including accessories (strip heaters, thermal protection, etc.).
 - s. Certifications:
 - 1) When utilized with a reduced voltage starter, certify that motor and driven equipment are compatible.
 - 2) When utilized with a variable frequency controller, certify motor is inverter duty and the controller and motor are compatible.
 - a) Include minimum speed at which the motor may be operated for the driven machinery.
 - t. Electrical gear:
 - 1) Unless specified in a narrow-scope Specification Section, provide the following:
 - a) Equipment ratings: Voltage, continuous current, kVa, watts, short circuit with stand, etc., as applicable.
 - 2) Control panels:
 - a) Panel construction.
 - b) Point-to-point ladder diagrams.
 - c) Scaled panel face and subpanel layout.
 - d) Technical product data on panel components.
 - e) Panel and subpanel dimensions and weights.
 - f) Panel access openings.
 - g) Nameplate schedule.
 - h) Panel anchorage.
 - i) Short Circuit Current Rating (SCCR) nameplate marking per NFPA 70. Include any required calculations.
4. Systems schematics and data:
 - a. Provide system schematics where required in system specifications.
 - 1) Acknowledge all system components being supplied as part of the system.
 - 2) Utilize equipment, instrument and valving tag numbers defined in the Contract Documents for all components.
 - 3) Provide technical data for each system component showing compliance with the Contract Document requirements.
 - 4) For piping components, identify all utility connections, vents and drains which will be included as part of the system.
 5. For factory painted equipment, provide paint submittals in accordance with Section 09 96 00.
 6. Qualifications for:
 - a. Natural frequency analysis firm and personnel.
 - b. Vibration testing firm and personnel.

- c. Infrared thermography testing firm and personnel.
 - d. Electrical equipment and connections testing firm and personnel.
7. Equipment Monitoring and Testing plans, in accordance with PART 3 of this Specification Section:
- a. Natural frequency analysis and calculations.
 - b. Vibration testing.
 - c. Thermography testing.
 - d. Electrical equipment and connection testing.
- B. Factory Test Reports:
- 1. Natural frequency bump test reports where required for rotating equipment.
 - a. Minimum characteristics of impact hammer.
 - 1) Frequency Range 1 kHz.
 - 2) Range (5v output) 5,000LBF (22,200N).
 - 3) Hammer Sensitivity (7pprox.) 1 mV/lbf (0.23 mV/N).
 - 4) Resonant Frequency 12 kHz
 - 2. Motor, equipment and final assembled equipment including motor.
 - a. Determine natural frequency of a assembled motor prior to shipping to OEM or job site.
 - 1) Individual motor fastened to an “infinitely rigid” mass at the same bolt circle as the final assembled equipment.
 - b. Determine natural frequency of the pump.
 - 1) Pump fastened to an “infinitely rigid” mass at the same bolt circle as the final assembled equipment.
 - c. Determine natural frequency of the pump/motor assembly.
 - 1) Pump/motor assembly fastened to an “infinitely rigid” mass at the same bolt circle as the final field assembled equipment.
 - d. For this use, the "infinitely rigid" mass shall be at least 10 times the weight of the equipment being tested.
 - 3. Submit natural frequency report(s) for a approval prior to shipment.
 - 4. Equipment performance tests.
 - a. As listed in individual equipment specifications.
- C. Contract Closeout Information:
- 1. Operation and Maintenance Data:
 - a. See Section 01 33 04 for requirements for the mechanics, administration, and the content of Operation and Maintenance Manual submittals.
- D. Informational Submittals:
- 1. Notification, at least one week in advance, that testing will be conducted at factory.
 - 2. Certification from equipment manufacturer that all manufacturer-supplied control panels that interface in any way with other controls or panels have been submitted to and coordinated with the supplier/installer of those interfacing systems.
 - 3. Submit sample Manufacturer's Field Service Report (MFSR). Report shall use manufacturer's standard report or use the form in the Exhibits and have at least the following information:
 - a. Certification that equipment has been installed properly, has been initially started up, has been calibrated and/or adjusted as required, and is ready for operation.
 - b. Certification for major equipment supports that equipment foundation design loads shown on the Drawings or specified have been compared to actual loads exhibited by equipment provided for this Project and that said design loadings are equal to or greater than the loads produced by the equipment provided.
 - c. Motor test reports.
 - d. Field noise testing reports if such testing is specified.
 - e. Preliminary field quality control testing format to be used as a basis for final field quality control reporting.

- f. Provide three bound final written reports documenting natural frequency testing, vibration monitoring and testing for specified equipment.
 - 1) Include the acceptance criteria of all equipment tested.
 - 2) Provide individual tabbed sections for information associated with each piece of tested equipment.
 - g. Certification prior to Project closeout that electrical panel drawings for manufacturer-supplied control panels truly represent panel wiring including any field-made modifications.
 - h. Testing and monitoring reports in accordance with PART 3 of this Specification Section.
 - i. Certification that driven equipment and VFD are compatible.
4. Submit completed Manufacturer's Field Service Report (MFSR) for each piece of equipment supplied.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
 1. Motors:
 - a. General Electric.
 - b. Marathon Electric.
 - c. Rockwell - Reliance.
 - d. TECO-Westinghouse.
 - e. U.S. Motors, Nidec Motor Corporation.
- B. Submit request for substitution in accordance with Section 01 25 13.

2.2 MANUFACTURED UNITS

- A. Electric Motors:
 1. Where used in conjunction with adjustable speed AC or DC drives, provide motors that are fully compatible with the speed controllers.
 2. Design for frequent starting duty equivalent to duty service required by driven equipment.
 3. Design for full voltage starting.
 4. Design bearing life based upon actual operating load conditions imposed by driven equipment.
 5. Size for altitude of Project.
 6. Furnish with stainless steel nameplates which include all data required by NEC Article 430.
 7. Use of manufacturer's standard motor will be permitted on integrally constructed motor driven equipment specified by model number in which a redesign of the complete unit would be required in order to provide a motor with features specified.
 8. AC electric motors less than 1/3 HP:
 - a. Single phase, 60 Hz, designed for the supply voltage shown on the Drawings.
 - b. Permanently lubricated sealed bearings conforming to ABMA standards.
 - c. Built-in manual reset thermal protector or integrally mounted manual motor starter with thermal overload element with stainless steel enclosure.
 9. AC electric motors 1/3 to 1 HP:
 - a. Single or 3 PH, 60 Hz, designed for the supply voltage shown on the Drawings.
 - b. Permanently lubricated sealed bearings conforming to ABMA standards.
 - 1) For single phase motors, provide built-in manual reset thermal protector or integrally mounted manual motor starter with thermal overload element.
 10. AC electric motors 1-1/2 to 10HP:
 - a. Single or 3 PH, 60 Hz, designed for the supply voltage shown on the Drawings.
 - b. Permanently lubricated sealed bearings conforming to ABMA standards.

- c. For vertical motors provide 15 year, average-life thrust bearings conforming to ABMA standards.
- 11. AC electric motors greater than 10HP:
 - a. Single or 3 PH, 60 Hz, designed for the supply voltage shown on the Drawings.
 - b. Oil or grease lubricated antifriction bearings conforming to ABMA standards.
 - 1) Design bearing life for 90 PCT survival rating at 50,000 HRS of operation for motors up to and including 100 HP.
 - 2) For motors greater than 100 HP, design bearing life for 90 PCT survival rating at 100,000 HRS of operation.
 - c. For vertical motors provide 15 year, average-life thrust bearings conforming to ABMA standards.
 - d. Thermal protection:
 - 1) For motors 50 HP and above controlled from a variable frequency drive and for all other motors 100 HP and above, provide integral thermal detectors with normally closed contacts that will open on overtemperature or resistance type temperature detector (RTD) complete with monitor and a lam panel having a normally closed contact that will open on overtemperature.
 - a) Two thermal sensing devices per phase in each phase hot-spot location.
 - b) RTD:
 - (1) Provide a motor protection relay in the associated starter.
 - c) Monitor and alarm panel:
 - (1) For constant speed motors, install panel in and energize from the motor starter equipment.
 - (2) For variable speed motors, install panel in and energize from the variable speed drive equipment.
- 12. Severe duty motor to have the following minimum features:
 - a. All cast iron construction.
 - b. Gasketed conduit box.
 - c. Epoxy finish for corrosion protection.
 - d. Hydroscopic varnish on windings for corrosion protection.
 - e. Drain plug and breather.
- B. NEMA Design Squirrel Cage Induction Motors:
 - 1. Provide motors designed and applied in compliance with NEMA and IEEE for the specific duty imposed by the driven equipment.
 - 2. Motors to meet NEMA MG 1 (NEMA Premium) efficiencies.
 - 3. Do not provide motors having a locked rotor kVA per HP exceeding the NEMA standard for the assigned NEMA code letter.
 - 4. For use on variable frequency type adjustable speed drives, provide:
 - a. Induction motors that are in compliance with NEMA MG 1, Part 31.
 - b. Nameplate identification meeting NEMA MG 1 Part 31 requirements.
 - c. Insulated drive end bearing on all motors.
 - d. Insulated non-drive end bearings, at a minimum, on all motors with horizontal shaft 100 HP and larger.
 - e. An insulated bearing carrier on the non-drive end for vertical shaft motors 100HP and larger.
 - f. Shaft grounding ring on all motors 10 HP and greater:
 - 1) Factory installed, maintenance free, circumferential, bearing protection ring with conductive microfiber shaft contacting material.
 - 2) Electro Static Technology AEGIS SGR Bearing Protection Ring or approved equal.
 - g. Have the following minimum turndown ratio without the use of additional cooling, such as a blower, to provide continuous supply of cooling air over the motor.
 - 1) Variable torque: 10:1.
 - 2) Constant torque: 6:1.

5. Design motor insulation in accordance with NEMA standards for Class F insulation with Class B temperature rise above a 40 DEGC ambient.
6. Design motors for continuous duty.
7. Size motors having a 1.0 service factor so that nameplate HP is a minimum of 1.5 PCT greater than the maximum HP requirements of the driven equipment over its entire operating range.
 - a. As an alternative, furnish motors with a 1.15 service factor and size so that nameplate HP is at least equal to the maximum HP requirements of the driven equipment over its entire operating range.
8. Motor enclosure and winding insulation application:
 - a. The following shall apply unless modified by specific Specification Sections:

MOTOR LOCATION	MOTOR ENCLOSURE / WINDING INSULATION
Unclassified Indoor Areas	DPFG (for horizontal motors), TEFC, Standard Insulation
Wet indoor Areas	TEFC, Standard Insulation WP-II (for vertical motors)
Wet outdoor Areas	TEFC, Extra Dip and Bake for Moisture, WP-II (for vertical motors when TEFC (Extra Dip and Bake for Moisture) is not available)
Corrosive Areas	TEFC, Severe/ Chemical Duty
Class I, Division 1 Areas	Explosion Proof, Approved for Class I Division 1 Locations
Class II, Division 1 Areas	Explosion Proof, Approved for Class II Division 1 Locations
Class I or Class II, Division 2 Areas	Explosion Proof, Approved for Division 1 Locations or TEFC with maximum external frame temperature compatible with the gas or dust in the area, (Extra Dip and Bake for moisture)

NOTE: Provide TENV motors in the smaller horsepower ratings where TEFC is not available.

For VFD applications provide auxiliary cooling fan where needed for operating in the lower speed range. Provide additional conduit, wiring and controls when auxiliary cooling fans are provided.

9. Provide oversize conduit box complete with clamp type grounding terminals inside the conduit box.
 10. Balance motors to ISO G2.5 level.
 - a. Submit prior to shipping to OEM or job site.
- C. Submersible Motors: Refer to individual narrow-scope Specification Sections for submersible motor requirements.
- D. V-Belt Drive:
1. Provide each V-belt drive with sliding base or other suitable tension adjustment.
 2. Provide V-belt drives with a service factor of at least 1.6 at maximum speed.
 3. Provide staticproof belts.
- E. Vibration Isolators:
1. Provide all equipment subject to vibration with restrained spring type vibration isolators or pads according to the manufacturer's written recommendation.
- F. Space Heaters:
1. Silicone rubber strip type, 120 V rated.
 2. Contractor shall coordinate the starter control power transformer capacity rating to accommodate the space heater rating.
 3. Provided on:
 - a. All motors 10 HP and larger mounted outdoors.
 - b. Indoor motors in humid environments as indicated.

2.3 COMPONENTS

- A. Gear Drives and Drive Components:
1. Size drive equipment capable of supporting full load including losses in speed reducers and power transmission.
 2. Provide nominal input horsepower rating of each gear or speed reducer at least equal to nameplate horsepower of drive motor.
 3. Design drive units for 24 HR continuous service, constructed so oil leakage around shafts is precluded.
 4. Utilize gears, gear lubrication systems, gear drives, speed reducers, speed increasers and flexible couplings meeting applicable standards of AGMA.
 5. Gear reducers:
 - a. Provide gear reducer totally enclosed and oil lubricated.
 - b. Utilize antifriction bearings throughout.
 - c. Provide worm gear reducers having a service factor of at least 1.20.
 - d. Furnish other helical, spiral bevel, and combination bevel-helical gear reducers with a service factor of at least 1.50.

2.4 ACCESSORIES

- A. Guards:
1. Provide each piece of equipment having exposed moving parts with full length, easily removable guards, meeting OSHA requirements.
 2. Interior applications:
 - a. Construct from expanded galvanized steel rolled to conform to shaft or coupling surface.
 - b. Utilize non-flattened type 16 GA galvanized steel with nominal 1/2 IN spacing.
 - c. Connect to equipment frame with hot-dip galvanized bolts and wing nuts.
 3. Exterior applications:
 - a. Construct from 16 GA stainless steel or aluminum.
 - b. Construct to preclude entrance of rain, snow, or moisture.
 - c. Roll to conform to shaft or coupling surface.
 - d. Connect to equipment frame with stainless steel bolts and wing nuts.
- B. Anchorage:
1. Cast-in-place anchorage:
 - a. Provide ASTM F593, Type 316 stainless steel anchorage for all equipment.
 - b. Configuration and number of anchor bolts shall be per manufacturer's recommendations.
 - c. Provide two nuts for each bolt.
 2. Drilled anchorage:
 - a. Adhesive anchors per Section 03 15 19.
 - b. Epoxy grout per Section 03 31 30.
 - c. Threaded rods same as cast-in-place.
- C. Data Plate:
1. Attach a stainless steel data plate to each piece of rotary or reciprocating equipment.
 2. Permanently stamp information on data plate including manufacturer's name, equipment operating parameters, serial number and speed.
- D. Gages:
1. Provide gages in accordance with Section 40 91 10.
 2. Provide at the following locations:
 - a. Inlet and outlet of all reciprocating, centrifugal and positive displacement mechanical and process equipment.
 - b. At locations identified on Drawings.
 3. Utilize tapping sleeves for mounting per Section 40 05 00.

- E. Lifting Eye Bolts or Lugs:
 1. Provide on all equipment 50 LBS or greater.
 2. Provide on other equipment or products as specified in the narrow-scope Specification Sections.
- F. Platforms and Ladders:
 1. Design and fabricate in accordance with OSHA Standards.
 2. Fabricate components from stainless steel grade 304 or aluminum.
 3. Provide platform surface: Non-skid grating, unless specified in narrow-scope Specification Sections.

2.5 FABRICATION

- A. Design, fabricate, and assemble equipment in accordance with modern engineering and shop practices.
- B. Manufacture individual parts to standard sizes and gages so that repair parts, furnished at any time, can be installed in field.
- C. Furnish like parts of duplicate units to be interchangeable.
- D. Ensure that equipment has not been in service at any time prior to delivery, except as required by tests.
- E. Furnish equipment which requires periodic internal inspection or adjustment with access panels which will not require disassembly of guards, dismantling of piping or equipment or similar major efforts.
 1. Quick opening but sound, securable access ports or windows shall be provided for inspection of chains, belts, or similar items.
- F. Provide common, lipped base plate mounting for equipment and equipment motor where said mounting is a manufacturer's standard option.
 1. Provide drain connection for 3/4 IN PVC tubing.
- G. Machine the mounting feet of rotating equipment.
- H. Fabricate equipment which will be subject to Corrosive Environment in such a way as to avoid back to back placement of surfaces that cannot be properly prepared and painted.
 1. When such back to back fabrication cannot be avoided, provide continuous welds to seal such surfaces from contact with corrosive environment.
 2. Where continuous welds are not practical, after painting seal the back to back surfaces from the environment in accordance with Section 0792 00.
- I. Natural frequency/critical Speed:
 1. All rotating parts accurately machined and in as near perfect rotational balance as practicable.
 2. Excessive vibration is sufficient cause for equipment rejection.
 3. Ratio of all rotative speeds to natural frequency/critical speed of a unit or components: Greater than 1.2.
- J. Control Panels Engineered and Provided with the Equipment by the Manufacturer:
 1. Manufacturer's standard design for components and control logic unless specific requirements are specified in the specific equipment Specification Section.
 2. NEMA rated components are acceptable unless specific requirements are required in the specific equipment Specification Section. IEC rated components are not permitted.
 3. Affix entire assembly with a UL 508A or UL 698A label "Listed Enclosed Industrial Control Panel" prior to delivery.
 - a. Control panels without an affixed UL 508A or UL 698A label shall be rejected.
 4. Provide equipment or control panels with Short Circuit Current Rating (SCCR) labeling as required by NFPA 70 and other applicable codes.
 - a. Determine the SCCR rating by one of the following methods:

- 1) Method 1: SCCR rating meets or exceeds the available fault current of the source equipment when indicated on the Drawings.
 - 2) Method 2: SCCR rating meets or exceeds the source equipment's Amp Interrupting Current (AIC) rating as indicated on the Drawings.
 - 3) Method 3: SCCR rating meets or exceeds the calculated available short circuit current at the control panel.
- b. The source equipment is the switchboard, panelboard, motor control center or similar equipment where the control panel circuit originates.
 - c. For Method 3, provide calculations justifying the SCCR rating. Utilize source equipment available fault current or AIC rating as indicated on the Drawings.

2.6 SHOP OR FACTORY PAINT FINISHES

- A. Electrical Equipment:
 1. Provide factory-applied paint coating system(s) for all electrical equipment components except those specified in Section 09 96 00 to receive field painting.
 - a. Field painted equipment: See Section 09 96 00 for factory applied primer/field paint compatibility requirements.
- B. Field paint other equipment in accordance with Section 09 96 00.
 1. See Section 09 96 00 for factory applied primer/field paint compatibility requirements.

2.7 SOURCE QUALITY CONTROL

- A. Motor Tests:
 1. Test motors in accordance with NEMA and IEEE standards.
 2. Provide an un-witnessed short commercial test for all motors which shall include:
 - a. Running no-load current.
 - b. Locked rotor current.
 - c. Winding resistance.
 - d. High-potential.
 - e. Bearing inspection.
 3. Submit test report in accordance with the submittals section.
 4. The Owner reserves the right to select and have tested, either routine or complete, any motor included in the project.
 - a. The Owner will pay all costs, including shipping and handling, for all motors successfully passing the tests.
 - b. Pay all costs, including shipping and handling, for all motors failing the tests.
 - c. If two successive motors of the same manufacturer fail testing, the Owner has the right to reject all motors from that manufacturer.
- B. Balance:
 1. Unless specified otherwise, for all equipment 10 HP or greater, all rotating elements in motors, pumps, blowers, and centrifugal compressors shall be fully assembled, including coupling hubs, before being statically and dynamically balanced. Balance all rotating elements to the following criteria, per ISO 21940-11:

$$U_{per} = \frac{G \times 6.015 \times W/2}{N}$$

Where:

U_{per} = Permissible residual unbalance for each correction plane in ounce-inches (OZ-IN). See ISO 21940-11 for acceptable values.

G = ISO Balance Quality Grade Number, per ISO 21940-11

W = Rotor weight in pounds

N = Maximum continuous operating RPM

- a. Where specified, balancing reports, demonstrating compliance with this requirement, shall be submitted as product data.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install equipment as shown on Drawings and in accordance with manufacturer's directions.
- B. Utilize templates for anchorage placement for slab-mounted equipment.
- C. For equipment having drainage requirements such as seal water, provide 3/4 IN PVC or clear plastic tubing from equipment base to nearest floor or equipment drain.
 1. Route clear of major traffic areas and as approved by Engineer.
- D. DO NOT construct foundations until major equipment supports are approved.
- E. Extend all non-accessible grease fittings using stainless steel tubing to a location which allows easy access of fittings from closest operating floor level.
- F. Equipment Base:
 1. Construct level in both directions.
 2. Take particular care at anchor bolt locations so these areas are flat and level.
- G. Machine Base:
 1. Mount machine base of rotating equipment on equipment base.
 - a. Level in both directions, using a machinist level, according to machined surfaces on base.
 2. Level machine base on equipment base and align couplings between driver and driven unit using stainless steel blocks and shims.
 - a. Blocks and shims milled flat and coplanar of both faces.
 - b. Maximum of 3 shims under each foot.
 - c. Size blocks and shims to provide solid support at each mounting bolt location.
 - 1) Provide area size of blocks and shims approximately 1-1/2 times area support surface at each mounting bolt point.
 - d. Provide blocks and shims at each mounting bolt.
 - 1) Furnish blocks and shims that are square shape with "U" cut out to allow blocks and shims to be centered on mounting bolts.
 - e. After all leveling and alignment has been completed and before grouting, tighten mounting bolts to proper torque value.
- H. Rotating equipment Couplings:
 1. Align in the annular and parallel positions.
 - a. For equipment rotating at 1200 RPM or less, align both annular and parallel within 0.001 IN tolerance for couplings 4 IN size and smaller.
 - b. Couplings larger than 4 IN size: Increase tolerance 0.0005 IN per inches of coupling diameter, i.e., allow 6 IN coupling 0.002 IN tolerance, and allow a 10 IN coupling 0.004 IN tolerance.
 - c. For equipment rotating at speeds greater than 1200 RPM allow both annular and parallel positions within a tolerance rate of 0.00025 IN per inch coupling diameter.
 2. If equipment is delivered as a mounted unit from factory, verify factory alignment on site after installation and realigned if necessary.
 3. Check surfaces for runout before attempting to trim or align units.
- I. Grouting:
 1. After machine base has been shimmed, leveled onto equipment base, couplings aligned and mounting bolts tightened to correct torque value, place a dam or formwork around base to contain grouting between equipment base and equipment support pad.
 - a. Extend dam or formwork to cover leveling shims and blocks.
 - b. Do not use nuts below the machine base to level the unit.

2. Saturate top of roughened concrete subbase with water before grouting.
 - a. Add grout until entire space under machine base is filled to the top of the base underside.
 - b. Puddle grout by working a stiff wire through the grout and vent holes to work grout in place and release any entrained air in the grout or base cavity.
3. When the grout has sufficiently hardened, remove dam or formwork and finish the exposed grout surface to fine, smooth surface.
 - a. Cover exposed grout surfaces with wet burlap and keep covering sufficiently wet to prevent too rapid evaporation of water from the grout.
 - b. When the grout has fully hardened (after a minimum of seven days) tighten all anchor bolts to engage equipment base to grout, shims, and equipment support pad.
 - c. Recheck driver-driven unit for proper alignment.

3.2 INSTALLATION CHECKS

- A. For all equipment specifically required in detailed specifications, secure services of experienced, competent, and authorized representative(s) of equipment manufacturer to visit site of work and inspect, check, adjust and approve equipment installation.
 1. In each case, representative(s) shall be present during placement and start-up of equipment and as often as necessary to resolve any operational issues which may arise.
- B. Secure from equipment manufacturer's representative(s) a written report certifying that equipment:
 1. Has been properly installed and lubricated.
 2. Is in accurate alignment.
 3. Is free from any undue stress imposed by connecting piping or anchor bolts.
 4. Has been operated under full load conditions and that it operated satisfactorily.
 - a. Secure and deliver a field written report to Owner immediately prior to leaving jobsite.
- C. No separate payment shall be made for installation checks.
 1. All or any time expended during installation check does not qualify as Operation and Maintenance training or instruction time when specified.

3.3 IDENTIFICATION OF EQUIPMENT AND HAZARD WARNING SIGNS

- A. Identify equipment and install hazard warning signs in accordance with Section 10 14 00.

3.4 FIELD PAINTING AND PROTECTIVE COATINGS

- A. For required field painting and protective coatings, comply with Section 09 96 00, High Performance Industrial Coatings.

3.5 WIRING CONNECTIONS AND TERMINATION

- A. Clean wires before installing lugs and connectors.
- B. Coat connection with oxidation eliminating compound for aluminum wire.
- C. Terminate motor circuit conductors with copper lugs bolted to motor leads.
- D. Tape stripped ends of conductors and associated connectors with electrical tape.
 1. Wrapping thickness shall be 150 PCT of the conductor insulation thickness.
- E. Connections to carry full ampacity of conductors without temperature rise.
- F. Terminate spare conductors with electrical tape.

3.6 FIELD QUALITY CONTROL

- A. General:
 1. Furnish equipment manufacturer's field quality control services and testing as specified in the individual equipment Specification Sections.
 2. Execute pre-demonstration requirements in accordance with Section 01 75 00.

3. Perform and report on all tests required by the equipment manufacturer's Operation and Maintenance Manual.
 4. Provide testing of electrical equipment and connections in accordance with the Electrical specifications.
 5. Equip testing and analysis personnel with all appropriate project related reference material required to perform tests, analyze results, and provide documentation including, but not limited to:
 - a. Contract Drawings and Specifications.
 - b. Related construction change documentation.
 - c. Approved Shop Drawings.
 - d. Approved Operation and Maintenance Manuals.
 - e. Other pertinent information as required.
- B. Inspect wire and connections for physical damage and proper connection.
- C. After installation and prior to energizing the motor, provide insulation resistance test of all motors 50HP and above.
1. Conduct test with 500 or 1000 Vdc megger.
 2. Test each phase separately.
 3. Disconnect all extraneous leads to the motor.
 4. Comply with NEMA MG 1 safety requirements and test procedures.
- D. Equipment Monitoring and Testing Plans:
1. Approved in accordance with Shop Drawing submittal schedule.
 2. Included as a minimum:
 - a. Qualifications of firm, field personnel, and analysis personnel doing the Work.
 - b. List and description of testing and analysis equipment to be utilized.
 - c. List of all equipment to be testing, including:
 - 1) Name and tag numbers identified in the Contract Documents.
 - 2) Manufacturer's serial numbers.
 - 3) Other pertinent manufacturer identification,
- E. Instruments Used in Equipment and Connections Quality Control Testing:
1. Minimum calibration frequency:
 - a. Field analog instruments: Not more than 6 months.
 - b. Field digital instruments: Not more than 12 months.
 - c. Laboratory instruments: Not more than 12 months.
 - d. If instrument manufacturer's calibration requirements are more stringent, those requirements shall govern.
 2. Carry current calibration status and labels on all testing instruments.
 3. See individual testing programs for additional instrumentation compliance requirements.
- F. Testing and Monitoring Program Documentation:
1. Provide reports with tabbed sections for each piece of equipment tested.
 2. Include all testing results associated with each piece of equipment under that equipment's tabbed section.
 - a. Include legible copies of all forms used to record field test information.
 3. Prior to start of testing, submit one copy of preliminary report format for Engineer review and comment
 - a. Include data gathering and sample test report forms that will be utilized.
 4. In the final report, include as a minimum, the following information for all equipment tested:
 - a. Equipment identification, including:
 - 1) Name and tag numbers identified in the Contract Documents.
 - 2) Manufacturer's serial numbers.
 - 3) Other pertinent manufacturer identification,
 - b. Date and time of each test.
 - c. Ambient conditions including temperature, humidity, and precipitation.

- d. Visual inspection report.
 - e. Description of test and referenced standards, if any, followed while conducting tests.
 - f. Results of initial and all retesting.
 - g. Acceptance criteria.
 - h. "As found" and "as left" conditions.
 - i. Corrective action, if required, taken to meet acceptance.
 - j. Verification of corrective action signed by the Contractor, equipment supplier, and Owner's representative.
 - k. Instrument calibration dates of all instruments used in testing.
5. Provide three (3) bound final reports prior to Project final completion.
- G. Electrical Equipment and Connections Testing Program:
- 1. Perform testing on Electrical equipment and connections in accordance with the Electrical specification requirements.
 - 2. Testing of motors:
 - a. After installation and prior to energizing the motor, perform inspections and tests per NETA ATS 7.15 for all motors 25 HP or above.
 - b. Ensure motor has been lubricated.
 - c. Bump motor to check for correct rotation.
 - 3. Repair or replace equipment shown to be out of range of the acceptable tolerance until the equipment meets or exceeds acceptability standards.
- H. Other Testing:
- 1. Perform tests and inspections not specifically listed but required to assure equipment is safe to energize and operate.
 - 2. Subbase that supports the equipment base and that is made in the form of a cast iron or steel structure that has supporting beams, legs, and cross members that are cast, welded, or bolted shall be tested for a natural frequency of vibration after equipment is mounted.
 - a. The ratio of the natural frequency of the structure to the frequency of the disturbing force shall not be between 0.5 and 1.5.
- I. Infrared Thermography Testing Program:
- 1. Perform infrared thermography testing for equipment specified in other Divisions during the Equipment Demonstration Period.
 - a. Perform on all rotating and reciprocating equipment having drivers 25 HP or greater.
 - b. Perform on electrical equipment and connections: See Section 26 08 13.
 - 2. Additional requirements for infrared thermography monitoring and testing equipment:
 - a. Temperature range: -10 to 350 DEGC.
 - b. Accuracy: ± 2 PCT or 2 DEGC, whichever is greater.
 - c. Repeatability: ± 1 PCT or 1 DEGC, whichever is greater.
 - d. Temperature indication resolution: 0.1 DEGC.
 - e. Minimum focus distance: 0.3 meters.
 - f. Output in color palettes: JPEG, BMP, or other digital format compatible with Windows.
 - 3. Perform inspection per ASTM E1934.
 - a. Operate VFD driven equipment at 100 PCT speed during thermographic inspection.
 - 4. Acceptability of electrical connections and components based on temperature comparison between components and ambient air temperatures not greater than 10 DEGC per ASTM E1934.
 - 5. Acceptability of motors and equipment bearings based on temperature rise not greater than 5 DEGC above the equipment and/or bearing manufacturers published criteria.
 - 6. Repair or replace equipment shown to be out of range of the acceptable tolerance until the equipment meets or exceeds acceptability standards.
- J. Equipment Vibration Monitoring and Testing Program:
- 1. Perform vibration monitoring and testing for equipment specified in other Divisions during the Equipment Demonstration Period.

2. Provide vibration testing on all rotating and reciprocating equipment shown in the Equipment Vibration Testing Schedule.
3. Additional requirements for vibration monitoring and testing equipment at 25 DEGC:
 - a. Requirements for analyzer.
 - 1) Frequency range: 10 Hz to 20kHz.
 - 2) Frequency Accuracy: 0.02 PCT.
 - 3) Non-integrated spectral amplitude accuracy: 5 PCT, 3 Hz to 65kHz.
 - 4) Single integrated spectral amplitude accuracy: 5 PCT 10 Hz to 20kHz.
 - 5) Supports measurements of acceleration, velocity, displacement, envelope demodulation for bearing defect detection.
 - 6) Capable of two-place computer balancing.
 - b. Requirements for vibration sensor at 25 DEGC:
 - 1) Sensitivity: ± 5 PCT = 100 mV/g.
 - 2) Acceleration range: ± 50 g.
 - 3) Amplitude nonlinearity: ± 1 PCT.
 - 4) Frequency response: ± 10 Hz to 7 kHz (± 3 dB).
 - 5) Permanently attach vibration test and monitoring mounting pads to mechanical equipment at location recommended by the equipment manufacturer or as recommended by the testing firm.
4. Acceptability of equipment conditions, except pumps, based on ISO 1940-1 Balance Quality Grade G2.5 criteria.
5. Acceptability of pumping equipment to be based on current ANSI/HI criteria:
 - a. ANSI/HI 11.6-2012 for Submersible Pumps in a Wet-pit or Dry-pit configuration.
 - b. ANSI/HI 9.6.4-2009 for all other centrifugal pumps.
6. Repair or replace equipment shown to be out of range of the acceptable tolerance until the equipment meets or exceeds acceptability standards.
7. Utilize an Engineer approved testing agency to perform vibration monitoring and testing on equipment defined in the schedule at the end of this Section.
8. Permanently attach vibration test and monitoring mounting pads to the equipment at locations recommended by the equipment manufacturer or as recommended by the vibration testing agency.
9. Utilize mounting pads suitable for permanent installation and for incorporation into a predictable maintenance program.
10. For variable speed equipment provide vibration testing at 1 Hz increments of VFD speed throughout entire operating range.
11. Diagnosis to include, but is not limited to the following:
 - a. Unbalance.
 - b. Misalignment.
 - c. Bent shaft.
 - d. Journal bearing related problems.
 - e. Rolling contact bearing problems.
 - f. Mechanical looseness.
 - g. Resonance.
 - h. Foundation flexibility.
 - i. Electrically induced problems.
 - j. Pump problems.
 - k. Fan problems.
 - l. Coupling problems.
 - m. Drive belt problems.
 - n. Gear problems.
 - o. Centrifugal compressor problems.
 - p. Electric motor induced vibration from VFD or VFD carrier frequency.
 - q. Natural frequency of the installed equipment.

12. Provide machinery condition diagnosis based on an acceptable machinery vibration severity guide or machinery fault guide analysis provided by the testing agency, ISO 1940 Balance Quality Grade 6.3 as a minimum.
13. Tolerances for pumping equipment shall be per HI published standards.
14. Repair or replace equipment shown to be out of range of the specified tolerance until the equipment meets the specified normal operation range required in the machinery fault guide analysis.
15. Document testing with written report.
 - a. Report to include initial testing results, acceptance criteria, corrective action taken to meet acceptance, verification of corrective action and acceptance report and baseline.
 - b. Natural frequency of installed equipment utilizing an impact hammer.
 - c. Report to include graphical plots of vibration signature for each test point at a scale which illustrates all vibration levels greater than 0.025 ips RMS.

3.7 DEMONSTRATION

- A. Demonstrate equipment in accordance with Section 01 75 00.

3.8 ABBREVIATION TABLE

- A. As indicated on the Drawings.

END OF SECTION

EXHIBIT A

MANUFACTURER FIELD SERVICE REPORT

This field service report is generic in nature. An electronic copy of this form will be furnished upon request from the Engineer. This report is to reflect that all requirements of the Operations and Maintenance Manual and the individual equipment specification requirements have been performed for the installation and operation and also to provide a baseline for amperage draw for each phase, vibration readings, rotation, alignment and all other applicable tests required to insure that the equipment has been installed properly. A MFSR will be required for each individual piece of equipment requiring a MFSR.

Definitions of Reports:

Initial service report: Required for construction preparations. Equipment delivered to site is in good condition and conforms to specification requirements. Anchor bolts, hardware and ancillary items (piping, flanges, conduits, fuel/power supply) are compatible with equipment.

Interim service report: Required for equipment installation onto base or foundation. Piping connections, electrical and control connections or structural attachment are complete. For equipment stored on site over four weeks, interim service report will document that manufacturer's long-term storage procedures have been incorporated and equipment has not been damaged, nor coatings deteriorated.

Final service report is to be completed when equipment can be started, electrical amperage and voltage draw measured, cold and hot alignments performed, vibration testing and monitoring performed and the equipment is found to be in compliance with Manufacturer's operating parameters and the requirements of the individual equipment specifications.

PROJECT: _____

Report Status:

Initial Service Report completed and submitted on _____

Interim Service Report completed and submitted on _____

Final Service Report completed and submitted on _____

Commencement of Warranty _____

I Description

A. Equipment Name and Identification: _____

B. Serial Number: _____

C. Specification Section Number: _____

D. Manufacturer: _____

E. Representative: _____

F. Type of Service: Initial _____ Interim _____ Final _____

II General Review

A. The above referenced equipment/material/supplies have been inspected, checked, and adjusted. Yes _____ No _____

Summary: _____

B. The above referenced equipment/material/supplies were placed upon properly prepared or suitable substrate. N/A _____ Yes _____ No _____

Summary: _____

C. The above referenced equipment/material/supplies are free from any undue stress imposed by any connected piping, anchor bolts or any other load. N/A _____ Yes _____ No _____

Summary: _____

D. The above referenced equipment/material/supplies have operated under design conditions.
 N/A _____ Yes _____ No _____

Summary: _____

E. The above referenced equipment/material/supplies have been installed in accordance with the manufacturer's recommendations and the Procurement Documents, require no corrective work, and are hereby approved. Yes _____ No _____

Summary: _____

F. The above referenced equipment/material/supplies are acceptable to the manufacturer as installed providing the following corrective action(s) are performed:

1. _____
2. _____
3. _____
4. _____
5. _____

III Inspection Checklist

Item	Acceptable (Yes/No)	Readings/Comments
Bearings (1)		
Belts (tension reading)		
Lubrication Levels		
Vibration (1) (2) (MILS/SEC)		
Infrared Thermography (1) (2)		
Starting AMPS		
Full Load AMPS		
Volts		
Rotation		
Jacket Temperature (DEGF)		
Seal Water Flow Rate (GPH or GPM)		
Seal Water Pressure (PSI)		
O-rings/Packing		
Alignment (1)		
Anchor Bolts		
Grout		

Item	Acceptable (Yes/No)	Readings/Comments
Substrate Approval		
Sound level (4 FT from unit) (1) (dB)		
Other		

(1) Inspection or testing reports must be attached.
(2) Provide vibration testing and monitoring procedures for Engineer's review and approval prior to testing.

IV O&M Manuals

- A. The O&M manual as presented contains all information required for proper operation, maintenance, and instruction of this system. N/A _____ Yes _____ No _____

Summary: _____

V Preventive Maintenance

- A. The preventive maintenance summary outlined in the O&M manual is acceptable for operation of the system throughout the warranty period. N/A _____ Yes _____ No _____

Summary: _____

VI Operator Training/Classroom Instruction

- A. Training and instruction have been performed in accordance with the requirements of the Procurement Documents. N/A _____ Yes _____ No _____

B. Final Training/Classroom Instruction Completed on: _____

Summary: _____

VII Remarks

VIII Certification

I hereby certify, that I, _____, am a duly authorized representative of the manufacturer, that I am empowered by the manufacturer to inspect, approve, and operate his equipment, and that I am authorized to make recommendations required to assure that the equipment furnished by the manufacturer is complete and operational, except as modified herein. I also certify that all information contained herein is true and accurate.

By: _____
(Authorized Representative)

For: _____

Date: _____

IX Acknowledgments

By: _____

For: _____
(Contractor)

Date: _____

By: _____

For: _____
(Engineer)

Date: _____

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SECTION 01 65 50
PRODUCT DELIVERY, STORAGE, AND HANDLING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Scheduling of product delivery.
 - 2. Packaging of products for delivery.
 - 3. Protection of products against damage from:
 - a. Handling.
 - b. Exposure to elements or harsh environments.
- B. Related Specification Sections include but are not necessarily limited to:
 - 1. Division 00 - Procurement and Contracting Requirements.
 - 2. Division 01 - General Requirements.
- C. Payment:
 - 1. No payment will be made to Contractor for equipment or materials not properly stored and insured or without approved Shop Drawings.
 - a. Previous payments for items will be deducted from subsequent progress estimate(s) if proper storage procedures are not observed.

1.2 DELIVERY

- A. Scheduling: Schedule delivery of products or equipment as required to allow timely installation and to avoid prolonged storage.
- B. Packaging: Deliver products or equipment in manufacturer's original unbroken cartons or other containers designed and constructed to protect the contents from physical or environmental damage.
- C. Identification: Clearly and fully mark and identify as to manufacturer, item, and installation location.
- D. Protection and Handling: Provide manufacturer's instructions for storage and handling.

PART 2 - PRODUCTS - (NOT USED)

PART 3 - EXECUTION

3.1 PROTECTION, STORAGE AND HANDLING

- A. Manufacturer's Instruction:
 - 1. Protect all products or equipment in accordance with manufacturer's written directions.
 - a. Store products or equipment in location to avoid physical damage to items while in storage.
 - b. Handle products or equipment in accordance with manufacturer's recommendations and instructions.
 - 2. Protect equipment from exposure to elements and keep thoroughly dry.
 - 3. When space heaters are provided in equipment, connect and operate heaters during storage until equipment is placed in service.

3.2 STORAGE FACILITIES

- A. Temporary Storage Building:
 - 1. Provide a weatherproof temporary storage building specifically for the purpose of providing for protection of products and equipment.
 - a. Size building to accommodate anticipated storage items.
 - 2. Equip building with lockable doors and lighting, and provide electrical service for equipment space heaters and heating or ventilation as necessary to provide storage environments acceptable to specified manufacturers.
 - 3. Provide methods of storage of products and equipment off the ground.
 - 4. Provide this structure within 60 days after Notice to Proceed.
 - a. Locate building on-site where shown on the Drawings or in location approved by Engineer.
 - b. Remove building from site prior to startup and demonstration period.

3.3 FIELD QUALITY CONTROL

- A. Inspect Deliveries:
 - 1. Inspect all products or equipment delivered to the site prior to unloading.
 - a. Reject all products or equipment that are damaged, used, or in any other way unsatisfactory for use on Project.
- B. Monitor Storage Area: Monitor storage area to ensure suitable temperature and moisture conditions are maintained as required by manufacturer or as appropriate for particular items.

END OF SECTION

SECTION 01 71 14
MOBILIZATION AND DEMOBILIZATION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Project mobilization and demobilization.
- B. Related Sections include but are not necessarily limited to:
 - 1. Division 00 - Procurement and Contracting Requirements.
 - 2. Division 01 - General Requirements.

1.2 GENERAL

- A. Mobilization work shall consist of preparatory work and operations necessary to be ready to perform the Work required under the Contract, and for other work and operations which must be performed, or costs incurred prior to the beginning of the Work.
- B. Demobilization work shall consist of all activities and costs for transportation of personnel, equipment, and supplies necessary to demobilize the contractor from the site.
- C. Mobilization and Demobilization shall not include mobilization or demobilization for specific items of work for which payment is provided elsewhere in the Contract.
- D. When the Contract or proposed Schedule of Values includes a separate item for mobilization or demobilization, payment will include full compensation for the furnishings of all labor, materials, tools, equipment, administrative costs, and incidentals to mobilization or demobilization.
- E. If additional mobilization and demobilization activities and costs are required during the performance of the Contract as a result of the changed, deleted, or added items of work for which the Contractor is entitled to an adjustment in Contract price, compensation for such costs shall be included in the price adjustment for the item of Work changed or added.

1.3 ITEMS INCLUDED

- A. Mobilization costs shall be limited to the following items:
 - 1. Obtaining bonds and insurance.
 - 2. Obtaining required permits and licenses.
 - 3. Developing Project Work Schedule.
 - 4. Attending Preconstruction Conference.
 - 5. Processing Permits.
 - 6. Furnishing and installing signs.
 - 7. Any work that is necessary to provide access to the site, including, but not limited to, grading and clearing.
 - 8. Installing temporary construction power wiring.
 - 9. Necessary assembly and testing required prior to start of the Work.
 - 10. Establishment of all and other facilities necessary for the Work, including utilities and specified field offices.
 - 11. Providing for and establishing Contractor's work and storage yard.
 - 12. Movement of personnel, major equipment, supplies, and incidentals to the site.
 - 13. Cost incurred prior to the start of the Work which must be performed, such as a down payment on a long lead item.

- B. Demobilization costs shall be limited to the following items:
1. Disassembly, removal and site cleanup/repair of offices, buildings, and other facilities assembled on the site for the Contract.
 2. Costs for final site cleanup, packaging of miscellaneous items for return to the yard and other project closeout related expenses.
 3. Cost for final payment documents, and provision of Acknowledgement Certification Request, Bond, and Certificate of Completion.
- C. The Owner will pay all costs for the Mobilization and Demobilization of all of the Contractor's personnel, equipment, supplies, and incidentals at the contract lump sum price as follows:
1. The Owner will pay no greater than 5 PCT of the original Contract Amount as a separate pay item for mobilization.
 2. The Owner will pay no greater than 1/2 PCT of the original Contract Amount as a separate pay item for demobilization.
 3. Owner will pay 50 PCT of the Mobilization lump sum price when 5 PCT of the original Contract Amount is earned.
 4. Owner will pay the remaining 50 PCT of the Mobilization lump sum price when 10 PCT of the original Contract Amount is earned.
 5. Owner will pay 100 PCT of the Demobilization lump sum price when all closeout activities and documents are completed.
 6. Furnish cost data and documentation to justify this portion of the bid if Owner believes that the percentages in this paragraph do not bear a reasonable relation to the cost of the work in this contract.
 7. Failure to justify such price to the satisfaction of the Owner will result in payment as determined by the Owner, of:
 - a. Actual mobilization costs at completion of mobilization.
 - b. Actual demobilization costs at completion of demobilization; and
 - c. The remainder of this item in the final payment under this contract.
 8. The Owner's determination of the actual costs in this paragraph is not subject to appeal.
 9. This schedule of mobilization progress payments will not limit or preclude progress payments otherwise provided by the Contract.

PART 2 - PRODUCTS - (NOT USED)

PART 3 - EXECUTION - (NOT USED)

END OF SECTION

SECTION 01 73 20
OPENINGS AND PENETRATIONS IN CONSTRUCTION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Methods of installing and sealing openings and penetrations in construction.
- B. Related Specification Sections include but are not necessarily limited to:
 - 1. Division 00 - Procurement and Contracting Requirements.
 - 2. Division 01 - General Requirements.
 - 3. Section 05 50 00 - Miscellaneous Metals.
 - 4. Section 06 82 00 - Fiberglass Reinforced Plastic Fabrications.
 - 5. Section 07 62 00 - Flashing and Sheet Metal.
 - 6. Section 07 84 00 - Firestopping.
 - 7. Section 07 92 00 - Joint Sealants.
 - 8. Section 09 96 00 - High Performance Industrial Coatings.

1.2 QUALITY ASSURANCE

- A. Referenced Standards:
 - 1. ASTM International (ASTM):
 - a. A36, Standard Specification for Carbon Structural Steel.
 - b. A53, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
 - c. A269, Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service.
 - d. A312, Standard Specification for Seamless, Welded, and Heavily Cold Worked Austenitic Stainless Steel Pipes.
 - e. A351, Standard Specification for Castings, Austenitic, for Pressure-Containing Parts.
 - f. A554, Standard Specification for Welded Stainless Steel Mechanical Tubing.
 - g. A653, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
 - h. A666, Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.
 - i. A995, Castings, Austenitic-Ferritic (Duplex) Stainless Steel, for Pressure-Containing Parts.
 - 2. National Fire Protection Association (NFPA):
 - a. 70, National Electrical Code (NEC):
 - 1) Article 501, Class I Locations.
 - b. 90A, Standard for Installation of Air Conditioning and Ventilating Systems.
 - c. Sheet Metal and Air Conditioning Contractors' National Association (SMACNA).

1.3 DEFINITIONS

- A. Corrosive Areas: For the purpose of this specification section, refer to the Contract Drawings for locations of corrosive areas.
- B. Hazardous Areas: Areas shown in the Contract Documents as having Class I or Class II area classifications.
- C. Washdown Areas: Areas having floor drains or hose bibbs.

1.4 SUBMITTALS

- A. Shop Drawings:

1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
2. For each structure provide dimensioned or scaled (minimum 1/8 IN = 1 FT) plan view drawings containing the following information:
 - a. Vertical and horizontal location of all required openings and penetrations.
 - b. Size of all openings and penetrations.
 - c. Opening type.
 - d. Seal type.
3. Manufacturer's installation instructions for standard manufactured products.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Pipe Sleeves:
 1. Areas listed as Corrosive Areas in PART 1:
 - a. Stainless steel, Type 316L.
 - b. Penetrations 24 IN DIA or less: ASTM A269, ASTM A312 or ASTM A554, Schedule 40.
 - c. Penetrations larger than 24 IN DIA: Stainless steel, ASTM A666, Minimum 1/4 IN thickness.
 2. All other Areas:
 - a. Steel, Hot-dipped galvanized after fabrication.
 - b. Penetrations 24 IN DIA or less: ASTM A53, Schedule 40.
 - c. Penetrations larger than 24 IN DIA: ASTM A36, Minimum 1/4 IN thickness.
- B. Backing Rod and Sealant: See Specification Section 07 92 00.
- C. Modular Mechanical Seals:
 1. Acceptable manufacturers:
 - a. Link-Seal.
 2. 316 stainless steel bolts, nuts and washers.
- D. Firestopping Material: See Specification Section 07 84 00.
- E. Sheet Metal Sleeves:
 1. Areas listed as Corrosive Areas in PART 1: Stainless steel: ASTM A240, Type 316L.
 2. All other areas: Galvanized steel: ASTM A653, G90.
 3. Minimum 12 GA.
- F. Commercial Wall Castings:
 1. Ductile iron, ASTM A536.
 2. Grade equal to connecting piping system.

PART 3 - EXECUTION

3.1 FABRICATION

- A. Fabricate pipe sleeves in accordance with Specification Section 05 50 00.
- B. Fabricate sheet metal sleeves in accordance with Specification Section 07 62 00.
- C. Provide waterstop plate/anchor flange for piping, ducts, castings and sleeves cast-in-place in concrete.
 1. For fabricated units, weld plate to sleeve, pipe, or ductwork.
 2. For commercial castings, cast water stop/anchor with wall pipe.
 3. Plate is to be same thickness as sleeve, pipe, casting or ductwork.
 4. For fabricated units, diameter of plate or flange to be 4 IN larger than outside diameter of sleeve, pipe or ductwork.

5. For commercial castings, wa terstop/anchor size to be manufacturer standard.
 6. Provide continuous around entire circumference of sleeve, pipe, or ductwork.
- D. Factory or shop-coat painted components in accordance with Specification Section 09 96 00.

3.2 INSTALLATION AND APPLICATION

- A. Firestopping materials used in fire-resistance rated construction shall be in full compliance with Specification Section 07 84 00.
- B. Seal openings and penetrations in non-fire-resistance-rated construction in accordance with Specification Section 07 92 00.
- C. Obtain prior approval from Engineer when any opening larger than 100 SQIN must be made in existing or newly completed construction.
- D. Perform HVAC penetrations in accordance with NFPA 90A.
- E. Perform electrical penetrations in accordance with NFPA 70, Article 501.
- F. When mechanical or electrical work cannot be installed as structure is being erected, provide and arrange for building-in of boxes, sleeves, insets, fixtures or devices necessary to permit installation later.
 1. Lay out chases, holes or other openings which must be provided in masonry, concrete or other work.
- G. Where pipes, conduits or ducts pass through floors in washdown areas, install sleeves with top 3 IN above finish floors.
 1. In non-washdown areas, install sleeves with ends flush with finished surfaces.
- H. Size sleeves, blockouts and cutouts which will receive sealant seal such that free area to receive sealant is minimized and seal integrity may be obtained.
- I. For insulated piping and ducts, size sleeves, blockouts and cutouts large enough to accommodate full thickness of insulation.
- J. Where pipes, conduits or ducts pass through grating, provide banding at the entire perimeter of the opening.
 1. Metal grating: See Specification Section 05 50 00.
 2. FRP grating: See Specification Section 06 82 00.
- K. Where pipes, conduits or ducts are removed where passing through grating:
 1. Metal grating:
 - a. Provide banding at perimeter and cover opening with 1/4 IN plate of the same material of the grating.
 - b. See Specification Section 05 50 00.
 2. FRP grating:
 - a. Provide full depth cover meeting same loading requirement as existing material or replace grating section.
 - b. See Specification Section 06 82 00.
- L. Do not cut into or core drill any beams, joists, or columns.
- M. Do not install sleeves in beams, joists, or columns.
- N. Do not install recesses in beams, joists, columns, or slabs.
- O. Field Cutting and Coring:
 1. Saw or core drill with non-impact type equipment.
 2. Mark opening and drill small 3/4 IN or less holes through structure following opening outline.
 3. Sawcut opening outline on both surfaces.
 - a. Knock out within sawcuts using impact type equipment.
 - b. Do not chip or spall face of surface to remain intact.

- c. Do not allow any overcut with saw kerf.
- P. Precast-Prestressed Concrete Construction:
- 1. Do not cut openings or core drill vertically or horizontally through stems of members.
 - 2. Do not locate or install sleeves or recess sleeves vertically or horizontally through or in stems of members.
 - 3. Cast openings and sleeves into flanges of units.
 - 4. Cast openings larger than 6 IN in diameter or 6 IN maximum dimension in units at time of manufacture.
 - 5. Cast openings smaller than 6 IN in diameter or 6 IN maximum dimensions in flanges of units at time of manufacture or field cut.
- Q. Where alterations are necessary or where new and old work join, restore adjacent surfaces to their condition existing prior to start of work.
- R. Where area is blocked out to receive sheet metal sleeve at later date:
- 1. If blockout size is sufficient to allow placement, utilize dowels for interface of initially placed concrete and sleeve encasement concrete which is placed later.
 - a. Size blockout based on sleeve size required plus 4 to 6 IN each side of sleeve for concrete encasement.
 - b. Provide #4 dowels at 12 IN spacing along each side of blockout with minimum of two dowels required per side.
 - 2. If blockout size is not sufficient to allow placement of dowels, provide keyway along all sides of blockout.
 - a. Size blockout based on sleeve size required plus 2 to 4 IN each side of sleeve for concrete encasement.
- S. For interior wall applications where backer rod and sealant are specified, provide backer rod and sealant at each side of wall.
- T. Refer to Drawings for location of fire-rated walls, floors, and ceilings.
- 1. Utilize firestopping materials and procedures specified in Specification Section 07 84 00 IN conjunction with scheduled opening type to produce the required fire rating.
- U. Use full depth expanding foam sealant for seal applications where single or multiple pipes, conduits, etc., pass through a single sleeve.
- V. Do not make duct or conduit penetrations below high water levels when entering or leaving tankage, wet wells, or other water holding structures.
- W. Modular Mechanical Seals:
- 1. Utilize one seal for concrete thickness less than 8 IN and two seals for concrete, 8 IN thick or greater.
 - 2. Utilize two seals for piping 16 IN diameter and larger if concrete thickness permits.
 - 3. Install seals such that bolt heads are located on the most accessible side of the penetration.
- X. Backer Rod and Sealant:
- 1. Install in accordance with Specification Section 07 92 00.
 - 2. Provide backer rod and sealant for modular mechanical seal applications.
 - a. Apply on top side of slab penetrations and on interior, dry side wall penetrations.

3.3 SCHEDULES

- A. General Schedule of Penetrations through Floors, Roofs, Foundation Base Slabs, Foundation Walls, Foundation Footings, Partitions and Walls for Ductwork, Piping, and Conduit:
- 1. Provide the following opening and penetration types:
 - a. Type A - Block out 2 IN larger than outside dimensions of duct, pipe, or conduits.
 - b. Type B - Saw cut or line-drill opening. Place new concrete with integrally cast sheet metal or pipe sleeve.
 - c. Type C - Fabricated sheet metal sleeve or pipe sleeve cast-in-place. Provide pipe sleeve with water ring for wet and/or washdown areas.

- d. Type D - Commercial type casting or fabrication.
 - e. Type E - Saw cut or line-drill opening. Place new concrete with integrally cast pipe, duct or conduit spools.
 - f. Type F - Integrally cast pipe, duct or conduit.
 - g. Type G - Saw cut or line-drill and remove area 1 IN larger than outside dimensions of duct, pipe or conduit.
 - h. Type H - Core drill.
 - i. Type I - Block out area. At later date, place new concrete with integrally cast sheet metal or pipe sleeve.
 - j. Type J - Grating Banding for any field cut openings.
2. Provide seals of material and method described as follows.
 - a. Category 1 - Modular Mechanical Seal.
 - b. Category 2 - Roof curb and flashing according to SMACNA specifications unless otherwise noted on Drawings. Refer to Specification Section 07 62 00 and roofing Specification Sections for additional requirements.
 - c. Category 3 - 12 GA sheet metal drip sleeve set in bed of silicon sealant with backing rod and sealant used in sleeve annulus.
 - d. Category 4 - Backer rod and sealant.
 - e. Category 5 - Full depth compressible sealant with escutcheons on both sides of opening.
 - f. Category 6 - Full depth compressible sealant and flanges on both sides of opening. Flanges constructed of same material as duct, fastened to duct and minimum 1/2 IN larger than opening.
 - g. Category 7 - Full depth compressible sealant and finish sealant or full depth expanding foam sealant depending on application.
 - h. Category 8 - Banding for all grating openings and banding and cover plate of similar materials for abandoned openings.
 3. Furnish openings and sealing materials through new floors, roofs, grating, partitions and walls in accordance with Schedule A, Openings and Penetrations for New Construction.
 4. Furnish openings and sealing materials through existing floors, grating, roofs, partitions and walls in accordance with Schedule B, Openings and Penetrations for Existing Construction.

**SCHEDULE A. OPENINGS AND PENETRATIONS SCHEDULE
FOR NEW CONSTRUCTION**

APPLICATIONS	DUCTS		PIPING		CONDUIT	
	OPENING TYPE	SEAL CATEGORY	OPENING TYPE	SEAL CATEGORY	OPENING TYPE	SEAL CATEGORY
Through floors with bottom side a hazardous location	C F I	7 Not Req 7	D F I ⁽¹⁾	Not Req Not Req 7	C F	7 Not Req
Through floors on grade above water table	C F I	4 Not Req 4	C F I ⁽¹⁾	7 Not Req 7	C F I ⁽¹⁾	4 Not Req 7
Through slab on grade below water table	F	Not Req	F	Not Req	F	Not Req
Through floors in washdown areas	C I	4 4	C H ⁽²⁾ I ⁽¹⁾	4 3 4	F H ⁽²⁾ I ⁽¹⁾	Not Req 3 7
Through walls where one side is a hazardous area	C F I	7 Not Req 7	D F I ⁽¹⁾	Not Req Not Req 7	C F	7 Not Req
Through exterior wall below grade above water table	C F I	7 Not Req 7	C D F I ⁽¹⁾	1 Not Req Not Req 1	F I ⁽¹⁾	Not Req 7
Through wall from tankage or wet well (above high water level) to dry well or dry area	C F I	7 Not Req 7	C D F H ⁽²⁾	1 Not Req Not Req 1	C F H ⁽²⁾ I ⁽¹⁾	7 Not Req 7 7
Through wall from tankage or wet well (below high water level) to dry well or dry area	F	Not Req	F	Not Req	F	Not Req
Through exterior wall above grade	A B C	6 6 6	A B D H ⁽²⁾	5 5 Not Req 5	C H ⁽²⁾	5 4
Roof penetrations	A	2	A	2	A	2
Through interior walls and slabs not covered by the above applications	A C	4 4	A C	4 4	A C F	4 4 Not Req
Grating openings and penetrations	J	8	J	8	J	8

**SCHEDULE B. OPENINGS AND PENETRATIONS SCHEDULE
FOR EXISTING CONSTRUCTION**

APPLICATIONS	DUCTS		PIPING		CONDUIT	
	OPENING TYPE	SEAL CATEGORY	OPENING TYPE	SEAL CATEGORY	OPENING TYPE	SEAL CATEGORY
Through floors with bottom side a hazardous location	B E	7 Not Req	B ⁽¹⁾ E ⁽³⁾ H ⁽²⁾	7 Not Req 7	B ⁽¹⁾ E ⁽³⁾ H ⁽²⁾	7 Not Req 7
Through floors on grade above water table	B	7	B	7	B	7
Through slab on grade below water table	E	Not Req	E	Not Req	E	Not Req
Through floors in washdown areas	G	3	G H ⁽²⁾	3 3	G H ⁽²⁾	3 3
Through walls where one side is a hazardous area	B E	7 Not Req	B ⁽¹⁾ B ⁽³⁾ E H ⁽²⁾	7 1 Not Req 7	B ⁽¹⁾ ⁽³⁾ E H ⁽²⁾	7 Not Req 7
Through exterior wall below grade above water table	B	7	B ⁽¹⁾ B ⁽³⁾ H ⁽²⁾	7 1 7	B ⁽¹⁾ ⁽³⁾ H ⁽²⁾	7 7
Through wall from tankage or wet well (above high water level) to dry well or dry area	B E	7 Not Req	B E H ⁽²⁾	1 Not Req 1	B ⁽¹⁾ ⁽³⁾ E H ⁽²⁾	7 Not Req 7
Through wall from tankage or wet well (below high water level) to dry well or dry area	E	Not Req	E	Not Req	E	Not Req
Through exterior wall above grade	G	6	G ⁽¹⁾ ⁽³⁾ H ⁽²⁾	5 5	G ⁽¹⁾ ⁽³⁾ H ⁽²⁾	5 7
Roof penetrations	G	2	G ⁽¹⁾ ⁽³⁾ H ⁽²⁾	2	G	2
Through interior walls and slabs not covered by the above applications	G	4	G ⁽¹⁾ ⁽³⁾ H ⁽²⁾	4 4	G ⁽¹⁾ ⁽³⁾ H ⁽²⁾	4 4
Grating openings and penetrations	J	8	J	8	J	8

(1) Multiple piping 3 IN and smaller or multiple conduits.

(2) Single pipe 3 IN and smaller or single conduit.

(3) Single pipe or conduit larger than 3 IN.

END OF SECTION

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SECTION 01 73 29
CUTTING AND PATCHING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. General requirements for cutting and patching Work.
- B. Scope:
 - 1. Contractor shall perform cutting and coring, and rough and finish patching of holes and openings in existing construction.
 - 2. Provide cutting, coring, fitting, and patching, including attendant excavation and fill, required to complete the Work, and to:
 - a. remove and replace defective Work;
 - b. remove samples of installed Work as specified or required for testing;
 - c. remove construction required to perform required alterations or additions to existing construction;
 - d. uncover the Work for Engineer's observation of covered Work, testing, or inspection by testing entities, or observation by authorities having jurisdiction;
 - e. connect to completed Work not performed in proper sequence;
 - f. remove or relocate existing utilities and piping that obstruct the Work in locations where connections are to be made;
 - g. make connections or alterations to existing or new facilities.
- C. Related Requirements:
 - 1. Section 03 31 30 - Concrete, Materials and Proportioning.
 - 2. Section 03 35 00 - Concrete Finishing and Repair of Surface Defects.
 - 3. Section 09 96 00 - High Performance Industrial Coatings.

1.2 SUBMITTALS

- A. Action Submittals: Submit the following:
 - 1. Cutting and Patching Request:
 - a. Submit written request to Engineer, well in advance of executing cutting or alteration that affects one or more of the following:
 - 1) Design function or intent of Project.
 - 2) Work of Owner or other contractors retained by Owner.
 - 3) Structural capacity or integrity of an element of the Project, building, or structure.
 - 4) Integrity or effectiveness of weather-exposed or moisture-resistant elements or systems.
 - 5) Efficiency, operational life, maintenance, or safety of operational elements.
 - 6) Visual qualities of elements that will be exposed to view after completion of the Work.
 - b. Request shall include:
 - 1) Identification of Project and Contract designation.
 - 2) Description of affected Work of Contractor and work of others (if any) retained by Owner.
 - 3) Necessity for cutting.
 - 4) Effect on work or operations of Owner and other contractors (if any) retained by Owner, and on structural and weatherproof integrity of Project, building, or structure.
 - 5) Description of proposed Work, indicating: scope of cutting and patching; trades that will execute the cutting and patching Work; materials and equipment to be

- used; extent of refinishing; schedule of operations; alternatives (if any) to cutting and patching, and net effect on aesthetics following completion of finishing Work.
- 6) Indication of entity responsible for cost of cutting and patching, when applicable.
 - 7) Written permission of other prime contractors (if any) whose work will or may be affected.
2. Recommendation Regarding Cutting and Patching:
 - a. Should conditions of work or schedule indicate a change of materials or specified methods, furnish Submit written recommendation to Engineer including:
 - 1) Conditions indicating change.
 - 2) Recommendations for alternative materials or alternatives to specified methods.
 - 3) Material manufacturer's printed recommendations for the proposed product and recommendations of manufacturer's technical representative for the specific application(s). The latter shall be on technical representative's letterhead and shall explicitly indicate the Project and specific cutting and patching application(s) to which the recommendation(s) apply.
 - 4) Items required with request for approval of substitute, in accordance with the substitution request requirements of the Contract Documents.
 3. Product Data:
 - a. Submit manufacturer's published data for the protective compound to be applied to core-drilled surfaces and cut concrete surfaces.
 - b. When not required under other Specifications sections, submit manufacturer's published data on materials to be used for finishing around the cut or patched area(s), together with indication of the location(s) where each is proposed for use.
 - c. Furnish Submittals for patching materials under the associated Specifications section. Submittal to include letter of recommendation from product manufacturer's technical representative indicating on technical representative's letterhead, explicitly indicating:
 - 1) Project name and facility name;
 - 2) specific cutting and patching application(s) to which the recommendations apply;
 - 3) that product manufacturer's technical representative has personally observed and is familiar with conditions in the work area(s) of the subject cutting and patching;
 - 4) materials that are the subject of the Submittal are appropriate for the condition(s) of the proposed patch and will remain durable in the patch's final exposure upon Substantial Completion; and.
 - 5) patching material manufacturer's technical representative's recommendations for surface preparation, installation of patching material(s), and curing.
- B. Informational Submittals: Submit the following:
1. Written Notification of Cutting and Patching:
 - a. Furnish as a Submittal written indication designating the day and time that the construction associated with cutting and patching will be uncovered to allow for observation. Do not begin cutting or patching operations until submittal is accepted by Engineer.
 2. X-ray Investigations:
 - a. Proposed method of investigation. Submit and obtain Engineer's acceptance prior to performing x-ray inspections.
 - b. Report of x-ray evaluation of slabs, floors, and walls to be cut or core-drilled.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Materials – General:
1. Provide materials that comply with the Contract Documents.
 2. If not shown or indicated in the Contract Documents, use materials identical to existing materials affected by cutting and patching Work.

3. For exposed surfaces, use materials that visually match existing adjacent surfaces to fullest extent possible. If identical materials are unavailable or cannot be used, provide materials whose installed performance will equal or surpass that of existing materials.
 4. Replace, patch, and repair materials and surfaces cut or damaged during cutting and patching operations, using materials that do not void required or existing warranties.
- B. Compound Applied to Core-Drilled Surfaces and Cut Concrete Surfaces:
1. After core-drilling or sawcutting (as applicable) and before installing the utility or equipment through the penetration, coat exposed concrete and exposed steel with solvent-free, two-component, protective, epoxy resin coating.
 2. Color shall approximate the finish color of the existing surface to be coated.
 3. Product and Manufacturer: Subject to compliance with the Contract Documents, the following products and manufacturers are acceptable:
 - a. Sikagard 62, by Sika Corporation.
 - b. Or equal.
- C. Grout Materials:
1. Comply with Section 03 31 30 - Concrete, Materials and Proportioning.
- D. Epoxy Bonding Adhesive:
1. Provide two-component, moisture-insensitive adhesive manufactured for the purpose of bonding fresh concrete to hardened concrete.
 2. Comply with Section 03 31 30 - Concrete, Materials and Proportioning.
 3. Product and Manufacturer: Subject to compliance with the Contract Documents, the following products and manufacturers are acceptable:
 - a. Euco No.452 MV by Euclid Chemical Co.
 - b. Sikadur 32, Hi-Mod by Sika Corporation.
 - c. Or equal.
- E. Epoxy Patch Material:
1. Engage the manufacturer's representative to observe and recommend a suitable patching material of the actual construction conditions.
 2. Subject to compliance with the Contract Documents, the following products and manufacturers are acceptable:
 - a. Depth of patch greater than 3/4 IN:
 - 1) Five Star MP Epoxy Patch.
 - 2) Or equal.
 - b. Depth of patch between 1/8 IN and 3/4 IN:
 - 1) Five Star Fluid Epoxy.
 - 2) Or equal.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examination and Assessment – General:
1. Examine surfaces to be cut or patched, and conditions under which cutting or patching will be performed before starting cutting or patching Work.
 2. Report unsatisfactory or questionable conditions to Engineer in writing.
 3. Do not proceed with cutting or patching Work until unsatisfactory conditions are corrected.
- B. Non-Destructive Investigation:
1. In advance of cutting or coring through existing slabs or walls, use x-ray or other non-destructive methods accepted by Engineer to determine location of reinforcing steel, electrical conduits, and other items embedded in slabs and walls.
 2. Submit to Engineer written report of findings of evaluation.

3. Perform x-ray investigation and submit results to Engineer sufficiently in advance of cutting Work to allow time to identify and implement alternatives, if changes to the Work are necessary because of conduit or other features in floor or wall.

3.2 PREPARATION

- A. Provide temporary support required to maintain structural integrity of facilities, to protect adjacent work from damage during cutting, and to support the element(s) to be cut.
- B. Protection of Existing Construction during Cutting and Patching:
 1. Protect existing construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of the Project and facility that will be exposed during cutting and patching operations.
 2. Avoid interference with use of adjoining areas or interruption of free passage to adjoining areas.
 3. Do not cut existing pipe, conduit, ductwork, or other utilities serving facilities scheduled to be removed or relocated until provisions have been made to bypass them.

3.3 CUTTING AND PATCHING – GENERAL

- A. Perform cutting and coring in such manner that limits extent of patching required.
- B. Structural Elements:
 1. Do not cut or patch structural elements in manner that would change the element's structural load-carrying capacity as load deflection ratio.
- C. Operating Elements:
 1. Do not cut or patch operating elements in manner that would reduce their capacity to perform as intended.
 2. Do not cut or patch operating elements or related components in manner that would increase maintenance requirements or decrease operational life or safety.
- D. Replace, patch, and repair materials and surfaces cut or damaged during cutting and patching operations, using methods that do not void required or existing warranties.
- E. Provide adequate temporary covering over openings (whether cut or core-drilled) where not in use. Avoid creating tripping hazards for openings provided in floors and slabs.

3.4 CORING

- A. Use core-drilling to make penetrations through concrete and masonry walls, slabs, or arches, unless otherwise accepted by Engineer in writing.
- B. Coring:
 1. Perform coring with non-impact rotary tool using diamond core-drills. Size holes for pipe, conduit, sleeves, equipment or mechanical seals, as required, to be installed through the penetration.
 2. Do not core-drill through electrical conduit or other utilities embedded in walls or slabs without approval of Engineer. To extent possible, avoid cutting reinforcing steel in slabs and walls.
- C. Protection:
 1. Protect existing equipment, utilities, and adjacent areas from water and other damage caused by or resulting from core-drilling operations.
 2. After core-drilling and before installing the utility or equipment through the penetration, coat exposed concrete and steel with protective coating material indicated in Paragraph 2.1.B of this Specification Section. Apply protective coating in accordance with manufacturer's instructions.
- D. Cleaning:
 1. After core-drilling, vacuum or otherwise remove slurry and tailings from the work area.

3.5 CUTTING

A. Cutting – General:

1. Cut existing construction using methods least-likely to damage elements retained and adjoining construction and that provide proper surfaces to receive subsequent installation or repair.
2. In general, use hand tools or small power tools suitable for sawing or grinding. When possible, avoid using hammering and avoid chopping. Carefully chip out concrete where necessary and as indicated in the Contract Documents.
3. Cut holes and slots as small as possible, neatly to the size required, and with minimum disturbance of adjacent surfaces.
4. Prior to starting cutting, provide adequate bracing of area to be cut.
5. To avoid marring existing finished surfaces, cut or drill from exposed or finished side into concealed side.
6. Use equipment of adequate size to remove the cut panel or “coupon”.

B. Cutting – Concrete and Masonry:

1. Cut through concrete and masonry using concrete wall saw with diamond saw blades.
2. On both sides of the element being cut, provide for control of slurry generated during sawing.
3. Concrete Cutting:
 - a. Make openings by sawing through existing concrete. Core drill with 6 IN DIA core at the corners of openings to avoid overcutting at corners.
 - b. When the cut-out concrete or “coupon” cannot be removed in one piece, or where concrete is too thick for saw to penetrate fully, break out concrete after initial saw cuts.
 - c. Where saw cutting is not possible:
 - 1) Make openings by drilling holes around perimeter of required opening and subsequently carefully chip out concrete.
 - 2) Holes shall be sufficient in quantity to prevent damage to remaining concrete.
4. Sizing and Repair of Cut Concrete Surfaces:
 - a. Where reinforcing steel is cut, remove existing reinforcing back to 1.5 IN below finished surface of concrete. Provide bonding adhesive on surfaces of resulting hole and fill resulting hole with non-shrink grout.
 - b. Oversize required openings in existing concrete by one inch on all sides and build back to required opening size by providing epoxy grout bonded to existing concrete.
 - c. Where oversizing the cut opening by one inch is not possible, cut the opening to the required dimensions. After cutting concrete and before installing subsequent construction on or through the opening, coat exposed concrete and steel with protective coating material indicated in Paragraph 2.1.B of this Specifications Section. Apply protective coating in accordance with manufacturer’s instructions.
 - d. Where indicated, finish remaining surfaces as indicated in Section 03 35 00 - Concrete Finishing and Repair of Surface Defects.

3.6 PATCHING

A. Patching – General:

1. Patch large openings to be filled with concrete in accordance with the Contract Documents. Before installing new concrete, apply bonding adhesive in accordance with manufacturer’s recommendations.
2. Where large openings to be filled with concrete are indicated on the Drawings as requiring reinforcing steel, provide reinforcing steel as shown and indicated in the Contract Documents. Where openings in existing reinforced concrete are larger than 2 FT in diameter or 2 FT by 2 FT and the Drawings or elsewhere in the Contract Documents do not expressly require reinforcing steel for the opening, submit a request for interpretation to Engineer and obtain Engineer’s response before proceeding.

3. Where concrete infill or grout repair materials are not used, patch using epoxy patch material indicated in Paragraph 2.1.D of this section unless otherwise indicated on Drawings.
 4. Patch construction by filling, repairing, refinishing, closing-up, and similar operations following performance of other Work.
 5. Patch with durable seams that are as inconspicuous as possible. Provide materials and comply with installation requirements indicated in the Contract Documents and the published installation instructions of the material's manufacturer.
 6. Patch to provide airtight and watertight connections to pipes, sleeves, ducts, conduit, and other penetrations through surfaces.
 7. Where feasible, test patched areas to demonstrate integrity of installation.
- B. Restoration:
1. Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in manner that eliminates evidence of patching and refinishing.
 2. For continuous surfaces, refinish to nearest intersection.
 3. For an assembly, refinish the entire unit that was patched.
 4. Patch, repair, or rehang existing ceilings as necessary to provide an even-plane surface of uniform appearance.

3.7 CLEANING

- A. Cleaning and Restoration:
1. Perform cleaning promptly after associated cutting, coring, and patching.
 2. Clean areas and spaces where cutting, coring, or patching were performed.
 3. Clean piping, conduit, and similar constructions before applying paint or other finishing materials.
 4. Restore damaged coverings of pipe and other utilities to original condition.

END OF SECTION

SECTION 01 74 00
CLEANING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
1. Requirements for keeping the Site free of accumulations of waste materials during construction (“progress cleaning”).
 2. Cleaning for Substantial Completion and prior to final inspection (collectively, “closeout cleaning”).
- B. Scope:
1. Contractor shall perform cleaning during the Project, including progress cleaning, as a condition precedent to Substantial Completion, upon completion of the Work, and as required by the General Conditions, as may be modified by the Supplementary Conditions, this Specifications section, and elsewhere in the Contract Documents.
 2. Maintain in a clean manner the Site, the Work, and areas adjacent to or affected by the Work.

1.2 QUALITY ASSURANCE

- A. Referenced Standards:
1. National Fire Protection Association (NFPA):
 - a. 241, Safeguarding Construction, Alteration, and Demolition Operations.

PART 2 - PRODUCTS - (NOT USED)

PART 3 - EXECUTION

3.1 PROGRESS CLEANING

- A. Progress Cleaning – General:
1. Clean the Site, work areas, and other areas occupied by Contractor not less than weekly. Dispose of waste materials in accordance with the General Conditions, as may be modified by the Supplementary Conditions, and the following:
 - a. Comply with NFPA 241 for removing combustible waste materials and debris.
 - b. Do not hold non-combustible materials at the Site more than three days if the ambient air temperature is expected to rise above 80 DEGF. When ambient air temperature is less than 80 DEGF, dispose of non-combustible materials within seven days of their generation.
 - c. Provide suitable containers for storage of waste materials and debris. Avoid generation of odors and creation of nuisances.
 - d. Containerize hazardous and unsanitary waste materials separately from other waste. Mark containers appropriately.
- B. Progress Cleaning – Site:
1. Keep outdoor, dust-generating areas wetted down or otherwise control dust emissions.
 2. Not less than weekly, brush-sweep roadways and paved areas at the Site and adjacent areas used by construction vehicles or otherwise affected by construction activities.
 3. Comply with dust control requirements of Section 01 35 05 - Environmental Protection and Special Controls.

- C. Progress Cleaning – Work Areas:
1. Clean areas where the Work is in progress to maintain an extent of cleanliness necessary for proper execution of the Work and safety of personnel.
 2. Remove liquid spills promptly. Where spills may have harmful effects on health, safety, protection of facilities, or the environment, immediately report spills to Owner, Engineer, and authorities having jurisdiction, in accordance with the Contract Documents and Laws and Regulations.
 3. Where dust would impair proper execution of or quality of the Work, broom-clean or vacuum entire work area, as necessary.
 4. Concealed Spaces: Remove waste material and debris from concealed spaces before enclosing the space.
- D. Progress Cleaning – Installed Work:
1. Keep installed Work clean. Clean installed surfaces according to written instructions of manufacturer or fabricator of installed materials and equipment, using only cleaning agents and methods specifically recommended by material or equipment Supplier.
 2. If Supplier does not recommend specific cleaning agents or methods, use cleaning agents and methods that are not hazardous to health and property and that will not damage or mar exposed surfaces.
- E. Progress Cleaning – Exposed Surfaces:
1. Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration until Substantial Completion.
- F. Progress Cleaning – Cutting and Patching:
1. Clean areas and spaces where cutting and patching are performed. Completely remove paint, mortar, oils, putty, trailings and cuttings, and similar materials.
 2. Comply with Section 01 73 29 - Cutting and Patching, regarding cleaning during and after cutting and patching Work.
 3. Thoroughly clean piping, ductwork, conduits, and similar features before applying patching material, paint, or other finishing materials.
 4. Restore damaged insulation and coverings on piping, cutwork, and similar items to its pre-construction condition.
- G. Cleaning of Hydraulic Structures:
1. Clean hydraulic structures that will contain fluid, such as tanks and channels, in accordance with this Specifications section and Section 01 45 25 - Testing Concrete Structures.
 2. Do not perform field quality control activities such as testing tanks, channels, and other hydraulic structures for leakage or disinfecting (where applicable), and do not apply for inspection for Substantial Completion for hydraulic structures, until the associated hydraulic structures are clean and free of all waste materials, and ready for intended use.
- H. Waste Disposal:
1. Properly dispose of waste materials (including surplus materials, debris, rubbish, and other waste) off the Site.
 2. Do not burn or bury waste materials at the Site.
 3. Remove waste material and rubbish from excavations before backfilling.
 4. Do not discharge volatile or hazardous substances, such as mineral spirits, oil, or paint thinner, into storm sewers, gutters, sanitary sewers, or other location in the environment. Dispose of such materials in accordance with Laws and Regulations.
 5. Do not discharge wastes to surface waters, drainage routes, or groundwater.
 6. Contractor is solely responsible for complying with Laws and Regulations regarding storing, transporting, and disposing of waste generated by Contractor's operations or brought to the Site by Contractor.
- I. During handling and installation of materials and equipment, clean and protect construction in progress and adjoining materials and equipment already in place. Apply protective covering

where necessary or required for protection from damage or deterioration, until Substantial Completion.

J. Clean completed construction as frequently as necessary throughout the construction period.

3.2 CLOSEOUT CLEANING

- A. Complete the following prior to requesting inspection for Substantial Completion:
1. Clean and remove from the Site waste material (including rubbish and debris) and other foreign and undesirable items and substances.
 2. Sweep broom-clean paved areas suitable for access by vehicles.
 3. Remove spills and stains of petroleum, oils, solvents, other chemicals, and other foreign and undesirable deposits.
 4. Hose-clean sidewalks and loading areas.
 5. Rake grounds that are neither planted nor paved to a smooth, even-textured surface.
 6. Surface waterways and drainage routes (including storm sewers, gutters, and ditches) shall be open and clean.
 7. Repair pavement, roads, sod, and other areas affected by construction operations and restore to specified condition; if condition is not specified, restore to preconstruction condition.
 8. Clean exposed exterior and interior hard-surfaced finishes to dirt-free condition, free of spatter, grease, stains, fingerprints, films, and similar foreign and undesirable substances.
 9. Clean, wax, and polish wood, vinyl, and painted floors.
 10. Remove waste material and surface dust from limited-access spaces, including roofs, plenums, shafts, trenchway, equipment vaults, manholes, and similar spaces.
 11. In unoccupied spaces, sweep concrete floors broom-clean.
 12. Clean transparent materials, including mirrors and glazing in doors and windows. Remove glazing compounds and other noticeable, vision-obscuring materials. Replace chipped or broken glass and other damaged transparent materials.
 13. Remove non-permanent tags and labels.
 14. Surface Finishes:
 - a. Touch-up and otherwise repair and restore chipped, scratched, dented or otherwise marred surfaces to specified finish and match adjacent surfaces.
 - b. Do not paint over "UL" or similar labels, including mechanical and electrical nameplates.
 15. Wipe surfaces of mechanical and electrical equipment, and similar equipment. Remove excess lubrication, paint, and mortar droppings, and other foreign or undesirable substances.
 16. Clean plumbing fixtures to sanitary condition, free of stains, including stains resulting from water exposure.
 17. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.
 18. Clean lighting fixtures, lamps, globes, and reflectors to function with full efficiency. Replace temporary lamps provided in permanent fixtures. Replace existing lighting fixture components that are burned out or noticeably dimmed from use during construction. Replace defective and noisy starters in fluorescent and mercury vapor fixtures to comply with requirements for new fixtures.
 19. Leave the Site clean, and in neat, orderly condition, satisfactory to Owner and Engineer.
- B. Complete the following prior to requesting final inspection:
1. After Substantial Completion of all the Work, following completion of items of incomplete or damaged Work ("punch list Work"), clean "punch list Work areas in accordance with Paragraph 3.2.A of this Specifications Section.
 2. Remove field offices, Contractor's storage sheds, and remaining stockpiles and clean all such areas in accordance with Paragraph 3.2.B of this Specifications Section, and in accordance with Contract Documents for landscaping and restoration.

END OF SECTION

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SECTION 01 75 00
CHECKOUT AND START-UP PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
1. Administrative and procedural requirements for checkout and startup of equipment, systems, and facilities.
- B. Scope:
1. Contractor shall initially check out, start up, and place equipment and systems installed under the Contract into successful operation, in accordance with the material and equipment manufacturers' written instructions, Suppliers' recommendations at the Site, and the Contract Documents.
 2. Provide the following:
 - a. All labor, tools, materials, and equipment required to complete equipment and system checkout and startup.
 - b. Chemicals, lubricants, and other required operating fluids necessary for checkout, startup, and initial operation of the Work.
 - c. Filters and other temporary or consumable items necessary for checkout, startup, and initial operation of the Work.
 - d. Fuel, electricity, water, and other temporary utilities and temporary facilities necessary for checkout and startup of equipment and systems, unless otherwise specified.
 3. The General Conditions, as may be modified by the Supplementary Conditions, and Section 01 77 19 - Closeout Requirements, address requirements for documenting Substantial Completion.
- C. Related Sections include but are not necessarily limited to:
1. Section 01 33 04 - Operation and Maintenance Manuals
 2. Section 01 61 03 - Equipment - Basic Requirements.
 3. Section 01 77 19 - Closeout Requirements.
 4. Section 40 61 13 - Process Control Systems - General Requirements.

1.2 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
1. Coordinate checkout and startup with other contractors, as necessary.
 2. Do not start up equipment or system(s) for continuous operation until all components of that equipment item or system, including instrumentation and controls, have been tested to the extent practicable and proven to be operable as intended by the Contract Documents.
 3. Subject to the constraints of this Specifications section, Owner will furnish sufficient personnel to assist Contractor in starting up equipment and system(s), but responsibility for proper operation of the Work is Contractor's.
 4. Supplier shall be present during checkout, startup, and initial operation, unless otherwise acceptable to Engineer or otherwise required by the Contract Documents.
 5. For startup of heating equipment, air conditioning equipment, and other equipment and systems that provide temperature control, that are dependent upon the time of year, return to the Site at beginning of next heating or cooling season (as applicable) to recheck and start the appropriate equipment and system(s).
 6. Do not start up equipment and system(s), without submitting acceptable preliminary operations and maintenance manuals by Contractor in accordance with the Contract Documents.

- B. Checkout and Startup Planning Meeting:
1. Contractor, with appropriate Subcontractors and Suppliers, shall attend and participate in a meeting with Owner, facility manager, and Engineer to discuss planning, scheduling, and coordination of checkout and startup activities.
 2. Upon mutual concurrence of Owner, facility manager, Engineer, and Contractor, meeting may be concurrent with training scheduling planning meetings.
 3. Meeting shall be held by the earlier of: (1) not less than 60 days prior to first scheduled training session for the equipment and system(s) to be checked out and started-up, and (2) not less than 60 days prior to the checkout and startup of the associated equipment and system(s).
 4. Attend meeting prepared to knowledgably and effectively discuss:
 - a. Status of the Work and schedule-to-complete for requirements prerequisite to checkout and startup.
 - b. Schedule for and status of training required for each equipment item and system.
 - c. Schedule for checkout, startup, and field quality control activities for the subject Work.
 - d. Status and quantities of required consumables, lubricants, and utility services necessary for checkout and startup.
 5. Meeting will be chaired by Engineer. Engineer will prepare and distribute a record of topics discussed and decisions made during the meeting. Contractor shall chair and prepare minutes of the training scheduling planning portion of the meeting and furnish its draft minutes to Engineer to incorporate into the overall minutes.
 6. Comply with decisions made at the meeting and the Contract Documents.
- C. Sequencing:
1. Comply with Section 01 14 16 - Coordination with Owner's Operations, regarding staging (phasing) of the Work and allowable shutdowns.
- D. Scheduling:
1. Progress Schedule:
 - a. Clearly indicate in the Progress Schedule planned and actual dates for checkout, startup, and field quality control activities, including all demonstration testing activities addressed in this Specifications section and elsewhere in the Contract Documents. Separately indicate checkout, startup, and field quality control activities for each equipment item and system.
 - b. Perform startup and field quality control activities on the associated, scheduled dates, unless otherwise acceptable to Owner, facility manager, and Engineer.
 2. Restrictions for Scheduling:
 - a. Checkout of materials, equipment, and systems by Contractor that do not involve or require Owner's or facility manager's personnel may be performed at any time during normal working hours. Where required by the Contract Documents or requested by Engineer, perform checkout in the presence of Engineer or Resident Project Representative (RPR).
 - b. Startup, including initial operation of materials, equipment, and systems, shall not be initiated on: Monday, Friday, Saturday, Sunday, Owner's holidays, the day immediately prior to a holiday, or the day immediately following a holiday, unless otherwise acceptable to Owner, facility manager, and Engineer.
 - c. Unless otherwise indicated in the Contract Documents or acceptable to Owner, facility manager, and Engineer, perform all startup during normal working hours of the day shift.
 - d. To the extent practicable, where extended-duration startup or field quality control activities are required by the Contract, avoid having such activities extend into evening, night, weekend, or holiday hours.
 - e. Owner reserves the right to require a minimum seven days' notice of rescheduled startup when Contractor cannot perform the associated activities as scheduled.

3. Operation and Maintenance Data:
 - a. Comply with Section 01 33 04 - Operation and Maintenance Manuals.
 - b. A preliminary copy of all operation and maintenance manuals shall be received by Engineer prior to the start of the demonstration period "OAT".
4. Spare Parts, Tools, and Extra Materials.
 - a. Deliver to Owner or facility manager (as applicable) all required spare parts, tools, and extra materials prior to commencing the demonstration period "OAT", unless earlier delivery is required elsewhere in the Contract Documents.

1.3 QUALITY ASSURANCE

- A. Regulatory Requirements:
 1. Do not start up equipment or systems or place into initial operation until required operating permits are obtained from authorities having jurisdiction.
 2. Where Owner (with or without assistance of Engineer) has applied for and obtained initial approvals or permits necessary for operation, Contractor shall furnish information and assistance to Owner or Engineer for Owner to secure final approvals from authorities having jurisdiction for required operating permits.
- B. Qualifications:
 1. Operations and maintenance specialist for liaison:
 - a. Licensed in the State of Washington at a level equivalent to a grade IV operator's license.
 - b. Alternate to licensed operator:
 - 1) Registered Professional Engineer with Master of Sciences degree in sanitary or environmental engineering.

1.4 DEFINITIONS

- A. The following defined terms are used in this Specifications Section:
 1. Project Classified System (PCS): An established, distinct part of the Project, consisting of an arrangement of items, such as equipment, structures, components, piping, cabling, materials, and incidentals, so related or connected to form an identifiable, unified, functional, operational, safe, and independent system. PCSs may be specifically indicated in this Specifications section or elsewhere in the Contract Documents, such as Section 01 14 16 - Coordination with Owner's Operations, and others.
 2. Pre-Demonstration Period: The period of time, of unspecified duration after initial construction and installation activities during which Contractor, with assistance from manufacturer's representatives, performs in the following sequence:
 - a. Finishing type construction work to ensure the Project has reached a state of Substantial Completion.
 - b. Equipment start-up.
 - c. Personnel training.
 3. Demonstration Period: A period of time, of specified duration, following the Pre-Demonstration Period, during which the Contractor initiates process flow through the facility and starts up and operates the facility, without exceeding specified downtime limitations, to prove the functional integrity of the mechanical and electrical equipment and components and the control interfaces of the respective equipment and components comprising the facility as evidence of Substantial Completion.

1.5 SUBMITTALS

- A. Action Submittals: Submit the following:
 1. Data collection and reporting log for each required Demonstration Period.
- B. Informational Submittals: Submit the following:
 1. Progress Schedules indicating dates for checkout, startup, and field quality control activities.
 2. Completed checkout and startup log required in Paragraph 3.2.A of this Specifications section.

3. Manufacturer's installation check letters (also known as Manufacturer's Field Services Report) required in Paragraph 3.2.A of this Specifications section.
4. Instrumentation Supplier's Instrumentation Installation Certificate, required in Paragraph 3.2.A of this Specifications section.
5. Letter verifying completion of all pre-demonstration startup activities, required in Paragraph 3.2.A of this Specifications section.
6. Report of data collected during each required Demonstration Period.
7. Qualifications Statements:
 - a. Qualifications, including resume' and copy of license, of Contractor-retained licensed operator.

PART 2 - PRODUCTS - (NOT USED)

PART 3 - EXECUTION

3.1 CHECKOUT AND STARTUP – GENERAL

- A. Facility Startup Divided into Two Periods:
 1. Pre-Demonstration Period including:
 - a. Obtain Engineer's approval or acceptance (as applicable) of Submittals required prior to checkout and startup, including all Shop Drawings, Samples, source quality control (shop testing) Submittals, preliminary operation and maintenance manuals, and other Submittals required by the Contract Documents, other than Submittals that cannot be furnished until after startup.
 - b. Complete the Work to a point ready for checkout and startup, including operation available in all manual, automatic, and other modes.
 - c. Checkout and initial field quality control activities that can be performed prior to startup of the equipment or system.
 - d. Startup of the associated Work.
 - e. Field quality control activities for the subject Work as indicated elsewhere in the Specifications and other Contract Documents, other than this section.
 - f. Training of operations and maintenance personnel.
 2. Demonstration Period, including:
 - a. Demonstration of functional integrity of equipment, system, or PCS.

3.2 PRE-DEMONSTRATION PERIOD

- A. Prior to the Pre-Demonstration Period, complete the Work to the point where it is ready for checkout and startup.
- B. Checkout.
 1. Comply with Section 01 61 03 - Equipment - Basic Requirements, including provisions concerning installation checks
- C. Startup:
 1. Comply with requirements for startup of materials, equipment, and systems indicated in the associated Specification sections and elsewhere in the Contract Documents.
 2. Prepare the Work so it will operate properly and safely and be ready to demonstrate functional integrity during the Demonstration Period.
 3. Perform startup without introducing process flow.
 4. Introduce process flow to complete startup for the following:
 - a. [Indicate equipment and systems].
 5. Procedures include but are not necessarily limited to the following:
 - a. Test or check and correct deficiencies of:
 - 1) Power, control, and monitoring circuits for continuity prior to connection to power source.
 - 2) Voltage of all circuits.

- 3) Phase sequence.
- 4) Cleanliness of connecting piping systems.
- 5) Alignment of connected machinery.
- 6) Vacuum and pressure of all closed systems.
- 7) Lubrication.
- 8) Valve orientation and position status for manual operating mode.
- 9) Tankage for integrity using [clean water] [process flow].
- 10) Pumping equipment using [clean water] [process flow].
- 11) Instrumentation and control signal generation, transmission, reception, and response.
 - a) Comply with Section 40 61 13 - Process Control System General Requirements.
- 12) Tagging and identification systems.
- 13) Proper connections, alignment, calibration and adjustment.
- b. Calibrate safety equipment.
- c. Manually rotate or move moving parts to assure freedom of movement.
- d. "Bump-start" electric motors to verify proper rotation.
- e. Perform other tests, checks, and activities required to make the Work ready for Demonstration Period.
- f. Checkout and Startup Plan:
 - 1) Prepare a log showing each equipment item and system requiring checkout and startup. Indicate in the log activities to be accomplished during checkout and startup.
 - 2) Provide a place for Contractor to record date and person performing required checkout and startup. Indicate a associated date(s), personnel, and employer of each.
 - 3) Submit completed checkout and startup log to Engineer and obtain Engineer's acceptance.
6. Obtain Suppliers' certifications of the installed and operational Work, without restrictions or conditions, and submit to Engineer:
 - a. Manufacturer's installation check letters (sometimes referred to as Manufacturer's Field Services Report).
 - b. Instrumentation Supplier's Instrumentation Installation Certificate.
7. Letter verifying completion of all pre-demonstration startup activities including receipt of all specified items from Suppliers as final item prior to initiation of Demonstration Period.
8. Personnel Training:

3.3 DEMONSTRATION PERIOD

- A. Demonstration Period – General:
 1. Demonstrate the operation and performance of mechanical, electrical, instrumentation, and control interfaces of the Work undergoing the Demonstration Period, in accordance with the Contract Documents.
 2. Duration of Demonstration Period: 120 consecutive hours.
 3. If, during the Demonstration Period, the aggregate time used for repair, alteration, or unscheduled adjustments to any part of the Work that renders the affected Work inoperative or operation outside of recommended ranges exceeds 10 PCT of the Demonstration Period, the demonstration of operation and performance will be deemed unacceptable and Contractor shall provide appropriate adjustments and remedies and re-perform the Demonstration Test, at no additional cost to Owner or facility manager, until acceptable results are obtained. Re-performance of the Demonstration Period shall comply with the same requirements as the original Demonstration Period.
 4. Perform the demonstration of operation and performance of the Work under full operational conditions.

5. Owner's or Facility Manager's Personnel:
 - a. Owner or facility manager (as applicable) will make available operations personnel to make process decisions affecting facility performance and compliance with applicable operating permits.
 - b. Owner's or facility manager's assistance will be available only for process decisions.
 - c. Contractor will perform all other functions associated with the Demonstration Period including but not limited to equipment operation and maintenance until successful completion of the Demonstration Period in accordance with the Contract Documents.
 6. Owner or facility manager reserves the right to simulate operational variables, equipment failures, routine maintenance scenarios, and similar actions and events during the Demonstration Period to verify the operation and performance of the Work in automatic, manual, and other types of operating modes, backup systems, and alternate operating modes.
 7. Prior to Starting Demonstration Period:
 - a. Prepare data collection and reporting log for sampling, analytical data, and data to be obtained by manually recording data from field or panel indicators. Not less than 30 days prior to the start of the Demonstration Period, submit the data collection and reporting log to Engineer for acceptance.
 8. Timing of Start and End of Demonstration Period:
 - a. Schedule the end of the Demonstration Period at a convenient time such as midnight, so the Owner or facility manager can assume operational responsibility on a new day beginning immediately after completion of the Demonstration Period.
 - b. Time of beginning and ending Demonstration Period shall be agreed upon by Contractor, Owner (and facility manager, if other than Owner), and Engineer in advance of initiating Demonstration Period.
- B. Demonstration Period, Evaluation, and Acceptance:
1. Throughout the Demonstration Period, provide knowledgeable personnel to answer Owner's or facility manager's questions, provide final field instruction on select systems (where appropriate) and to respond to problems or failures of the Work.
 2. Responsibilities for Sampling and Data Collection:
 - a. Use the data collection and reporting log format accepted by Engineer. Indicate data clearly and legibly.
 3. Responsibilities for Data Reporting:
 - a. Submit data collected to Engineer for evaluation of acceptability of results.
 4. Data Evaluation:
 - a. Engineer, in consultation with Owner and facility manager (as applicable) as necessary, will evaluate the data collected during the Demonstration Period and other information obtained during the Demonstration Period for compliance with the Contract Documents.
 - b. Engineer will advise Contractor in writing of whether the data and information obtained indicate that the Demonstration Period was successfully completed.

END OF SECTION

SECTION 01 77 19
CLOSEOUT REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: Administrative and procedural requirements for:
1. Substantial Completion.
 2. Final inspection.
 3. Request for final payment and acceptance of the Work.

1.2 SUBSTANTIAL COMPLETION

- A. Substantial Completion – General:
1. Prior to requesting inspection for Substantial Completion, perform the following for the substantially completed Work:
 - a. Materials and equipment for which Substantial Completion is requested shall be fully ready for their intended use, including full operating and monitoring capability in automatic, manual, and other operating modes set forth in the Contract Documents.
 - b. Permanent provisions for safety and protection, shown and indicated in the Contract Documents and associated with the substantially completed Work or for personnel accessing and using the substantially completed Work, shall be in place and ready for their intended use.
 - c. Complete field quality control Work, including inspections and testing at the Site, indicated in Specifications sections for individual materials and equipment items and related Contract Documents. Submit results of, and obtain Engineer's acceptance of, field quality control tests and inspections required by the Contract Documents.
 - d. Complete checkout and startup in accordance with Section 01 75 00 - Checkout and Startup Procedures, requirements of the Specifications for the various materials and equipment in the substantially completed Work, and related Contract Documents.
 - e. Cleaning for Substantial Completion shall be completed in accordance with Section 01 74 00 - Cleaning.
 - f. Spare parts, tools, and extra materials shall be delivered and accepted in accordance with the Contract Documents and documentation of Owner's acceptance thereof has been submitted to Engineer in acceptable.
 - g. Training of the facility's operations and maintenance personnel shall be completed in accordance with the Contract Documents.
 - h. Submit and obtain Engineer's acceptance of final operations and maintenance manuals in accordance with Section 01 33 04 - Operation and Maintenance Manuals.
 - i. Obtain and submit to Engineer all required permits, inspections, and approvals of authorities having jurisdiction for the substantially completed Work to be occupied and used by Owner.
 - j. Complete other tasks that the Contract requires be completed prior to Substantial Completion.
 2. Procedures for requesting and documenting Substantial Completion are in the General Conditions, as may be modified by the Supplementary Conditions.
 3. Sample letter for Contractor's request for inspection for Substantial Completion is attached to this Specifications section. Use the model language of the sample letter, modified to suit the Project and the needs of Contractor's request.
 4. Unless decided otherwise by Owner and Engineer, form of certificate of Substantial Completion will be EJCDC C-625, "Certificate of Substantial Completion" (2018 edition or later), prepared by Engineer.
 5. Refer to the Agreement and Section 01 29 76 - Progress Payment Procedures, for requirements regarding consent of surety to partial release of or reduction in retainerage.

1.3 FINAL INSPECTION

- A. Final Inspection – General:
1. Prior to requesting final inspection, verify that all the Work is fully complete and ready for final payment. Partial checklist for this purpose is attached to this Specifications section.
 2. Sample letter for Contractor to request final inspection is attached to this Specifications section. Use the model language of the sample letter, modified to suit the Project.
 3. Procedures for requesting and documenting the final inspection are in the General Conditions, as may be modified by the Supplementary Conditions, and as augmented in this Specifications section.

1.4 REQUEST FOR FINAL PAYMENT AND ACCEPTANCE OF THE WORK

- A. Procedure:
1. After successful completion of the final inspection, submit request for final payment in accordance with the Agreement and General Conditions, as may be modified by the Supplementary Conditions, and using procedure specified in Section 01 29 76 - Progress Payment Procedures, and this Specifications section.
 2. Acceptance of the Work:
 - a. Upon Engineer's concurrence that the Work is complete and ready for final payment (as a result of the final inspection and other communications between the parties and Engineer) and receipt of the final Application for Payment, accompanied by other required Contract closeout documentation, all in accordance with the Contract Documents, Engineer will issue to Owner and Contractor a notice of acceptability of the Work, in accordance with the General Conditions, as may be modified by the Supplementary Conditions.
 - b. Unless decided otherwise by Owner and Engineer, form of acceptance will be EJCDC C-626, "Notice of Acceptability of Work", (2018 edition or later).
 - c. Nothing other than receipt of such notice of acceptability from Engineer constitutes acceptance of the Work.
 - d. Receipt of Engineer's notice of acceptability of the Work does not relieve Contractor of Contractor's continuing obligations under the Contract, including correction period obligations, warranty obligations, indemnification obligations, insurance requirements, and Contractor's other obligations following acceptance of the Work by Engineer and final payment. Such obligations shall commence and remain in effect as indicated elsewhere in the Contract Documents.
- B. Request for final payment shall include:
1. Documents required for progress payments in Section 01 29 76 - Progress Payment Procedures.
 2. Documents required in the General Conditions, as may be modified by the Supplementary Conditions.
 3. List, on Contractor's letterhead, of all Change Proposals, Claims, and disputes that Contractor believes are unsettled. If there are no such Change Proposals, Claims, or disputes, so indicate in writing.
 4. Consent of Surety to Final Payment:
 - a. Acceptable form includes AIA G707, "Consent of Surety to Final Payment" (1994 or later edition), or other form acceptable to Owner.
 5. Releases of Liens:
 - a. Submit complete and legally effective releases (satisfactory to Owner) of all Liens filed in connection with the Work, regardless of whether such Lien was filed by Contractor, Subcontractor, or Supplier.
 - b. Each release of Lien shall be signed by an authorized representative of the entity submitting the release of Lien, and shall include Contractor's, Subcontractor's, or Supplier's (as applicable) corporate seal, when applicable.
 6. Waivers of Lien Rights:

- a. Submit legally-binding waivers of rights to file Liens, acceptable to Owner, as required in the General Conditions (as may be modified by the Supplementary Conditions) from Contractor and each Subcontractor and Supplier that furnished or provided labor, material, or equipment totaling \$1,000 or more for the Work.
- b. Furnish final list of Subcontractors and Suppliers indicating final amount of the associated subcontract or purchase order for each. Include on the list all lower-tier Subcontractors and Suppliers retained by higher-tier Subcontractors and Suppliers. Prepare the list using the form included in Section 01 29 76 - Progress Payment Procedures.
- c. Each waiver of Lien rights shall be signed by an authorized representative of the entity submitting waiver of Lien rights, and shall include Contractor's, Subcontractor's, or Supplier's (as applicable) corporate seal, when applicable.
- d. Waiver of Lien rights may be conditional upon receipt of final payment.
- e. Required Affidavits: Submit the following:
 - 1) Affidavit of payment of debts and claims, submitted by Contractor. Acceptable form includes AIA G706, "Contractor's Affidavit of Payment of Debts and Claims" (1994 or later edition), or other form acceptable to Owner, and;
 - 2) Affidavit of release of Liens, submitted by Contractor. Acceptable form includes AIA G706A, "Affidavit of Release of Liens" (1994 or later edition).
 - 3) Each affidavit shall be signed by an authorized representative of Contractor and shall bear Contractor's corporate seal, as applicable.
- f. In the event Contractor is unable to obtain one or more required waivers of Lien rights, recourse is set forth in the General Conditions, as may be modified by the Supplementary Conditions.

PART 2 - PRODUCTS - (NOT USED)

PART 3 - EXECUTION

3.1 ATTACHMENTS

- A. The documents listed below, following this Specification section's "End of Section" designation, are part of this Specifications section:
 1. Sample letter for Contractor's use in requesting inspection for Substantial Completion (two pages).
 2. Sample partial checklist to identify readiness for final inspection (four pages).
 3. Sample letter for Contractor's use in requesting final inspection (one page).
- B. In the model language of the attached sample letters for Contractor to request inspection for Substantial Completion and the final inspection, italicized language in brackets, e.g., "[insert date]" indicates instructions to the drafter of the letter and often indicates specific information to be inserted by Contractor; do not include bracketed, italicized text in the final version of the letter(s) prepared for the Project. Non-italicized language in brackets is optional language; use the appropriate language to complete the actual letter for the Project and edit where required to suit the specific circumstances.

END OF SECTION

**SAMPLE LETTER FOR CONTRACTOR'S USE IN
REQUESTING INSPECTION FOR SUBSTANTIAL COMPLETION**

SENT VIA E-MAIL AND U.S. CERTIFIED MAIL/RETURN RECEIPT REQUESTED

[Date]

[Name of Engineer's contact person]

HDR

[Street address]

[City, state, postal code]

Subject:

[Project name, Contract designation]

Request for Inspection for Substantial Completion

Dear [addressee]:

In our opinion, [all of] [or] [a portion of] the Work under the above-referenced Contract is substantially complete as of [insert month, day, year on which Substantial Completion was achieved]. [The specific portion of the Work that we believe is substantially complete is [insert identification of that portion of the Work that is substantially complete].]

Enclosed is our listing of uncompleted Work items ("punch list"). In accordance with Paragraph 15.03.A of the General Conditions, we hereby request: (1) That the Engineer schedule and perform the inspection for Substantial Completion as soon as possible, and (2) Issuance of the certificate of Substantial Completion.

In accordance with Paragraph 15.03.D of the General Conditions, upon Substantial Completion, we propose the following relative to a apportionment of responsibilities between the Owner and the Contractor:

1. Security, Protection, Insurance:
 - a. Site Security: [insert proposal; address whether Owner or Contractor will be responsible for security of the Site].
 - b. Protection of the Substantially Completed Work: [insert proposal; address whether Owner or Contractor will be responsible for protection].
 - c. Property Insurance: [insert proposal; typically Owner assumes responsibility for property insurance upon Substantial Completion]
2. Operation and Maintenance:
 - a. Operation: [insert proposal; address whether Owner or Contractor will be responsible for operating the substantially completed Work].
 - b. Maintenance: [insert proposal; address whether Owner or Contractor will be responsible for maintaining the substantially completed Work].
3. Utilities: [for each of the following, indicate whether Owner or Contractor will be responsible for utilities and services, or whether responsibility will be shared; if shared, indicate proposed cost-sharing]
 - a. Electricity: [insert proposal].
 - b. Natural Gas/Fuel/Heating: [insert proposal].
 - c. Water Supply: [insert proposal].

- d. Wastewater: [insert proposal].
- e. Communications (Telephone, Internet, Video): [insert proposal].

In accordance with Paragraph 15.08.A of the General Conditions, we understand that the Contract's correction period for the Work covered by the certificate of Substantial Completion commences on the Substantial Completion date documented in said certificate. [Drafter: Also see Paragraph 15.04 ("Partial Utilization") of the General Conditions and, where necessary, edit this paragraph of the letter accordingly.]

Should you have questions or comments regarding this notice, please contact [the undersigned] [or] [insert other contact person's name], at [insert telephone number and e-mail address].

Sincerely,

[Contractor's company name]

[Signatory name]

[Signatory's title]

Attachments:

Preliminary list of uncompleted Work items ("punch list"; [##] pages)

Copies:

[Owner's project manager]

SAMPLE PARTIAL CHECKLIST TO IDENTIFY READINESS FOR FINAL INSPECTION

Project: _____

Contract: _____

Contractor: _____

Item No./Description	Completed/Date	In Progress	Not Started	Not Applicable	Target Date	Responsible Entity/Person
1. All Submittals, including all Shop Drawings and Samples, approved or accepted by Engineer	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
<i>Remarks:</i>						
1. Final services completed by Suppliers, including submittal of "Manufacturer Field Service Report" in Section 01 61 03 Equipment - Basic Requirements	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
<i>Remarks:</i>						
2. Final Work completed by Subcontractors	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
<i>Remarks:</i>						
3. Permits closed out and regulatory compliance transitioned from construction to operations	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
<i>Remarks:</i>						
4. All outstanding change issues are addressed and all Change Proposals submitted	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
<i>Remarks:</i>						
5. All Change Proposals and Claims are resolved	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		

Item No./Description	Completed/Date	In Progress	Not Started	Not Applicable	Target Date	Responsible Entity/Person
<i>Remarks:</i>						
6. All defective Work of which Contractor is aware has been corrected in accordance with the Contract Documents	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
<i>Remarks:</i>						
7. Issues related to Constituents of Concern and potential Hazardous Environmental Condition have been fully addressed	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
<i>Remarks:</i>						
8. All spare parts, tools, and extra materials have been furnished in accordance with the Contract Documents, and documentation thereof submitted to Engineer	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
<i>Remarks:</i>						
9. All final operations & maintenance manuals have been submitted and accepted by Engineer	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
<i>Remarks:</i>						
10. Manufacturer warranties and software license(s) furnished	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
<i>Remarks:</i>						
11. Instruction and training of operations and maintenance personnel is complete and records of training submitted	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		

Item No./Description	Completed/Date	In Progress	Not Started	Not Applicable	Target Date	Responsible Entity/Person
<i>Remarks:</i>						
12. MBE/WBE/DBE/VBE compliance report(s) submitted (when applicable)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
<i>Remarks:</i>						
13. All field engineering Submittals, including survey data, furnished	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
<i>Remarks:</i>						
14. All Work on "punch list" is complete in accordance with the Contract Documents	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
<i>Remarks:</i>						
15. All record documents submitted to and accepted by Engineer	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
<i>Remarks:</i>						
16. Contractor is fully demobilized from the Site	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
<i>Remarks:</i>						
17. All Site restoration is complete	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
<i>Remarks:</i>						
18. Final cleaning of all work areas is complete	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
<i>Remarks:</i>						
19. Releases of Liens and waivers of Lien rights (or acceptable	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		

Item No./Description	Completed/Date	In Progress	Not Started	Not Applicable	Target Date	Responsible Entity/Person
a lternative) obtained from Subcontractors and Suppliers						
<i>Remarks:</i>						
20. Evidence of Contractor liability insurance furnished for correction period	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
<i>Remarks:</i>						
21. All other required Contract closeout documents obtained	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
<i>Remarks:</i>						
<i>Remarks:</i>						
22. All other Work and documentation required prior to final payment is complete and provided in accordance with the Contract Documents	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>		
<i>Remarks:</i>						
<i>Remarks:</i>						

**SAMPLE LETTER FOR CONTRACTOR'S USE IN
REQUESTING FINAL INSPECTION**

SENT VIA E-MAIL AND U.S. CERTIFIED MAIL/RETURN RECEIPT REQUESTED

[Date]

[Name of Engineer's contact person]

HDR

[Street address]

[City, state, postal code]

Subject:

[Project name, Contract designation]

Request for Final Inspection

Dear [addressee]:

The Work under the above-referenced Contract is complete and ready for final payment as of [insert month, day, year on which final completion was achieved]. In accordance with Paragraph 15.05 of the General Conditions, we hereby request that the Engineer schedule and perform the final inspection as soon as possible. Upon successful completion of the final inspection, we will submit our final Application for Payment accompanied by the required Contract closeout documentation in accordance with the Contract Documents.

Should you have questions or comments regarding this notice, please contact [the undersigned] [or] [insert other contact person's name], at [insert telephone number and e-mail address].

Sincerely,

[Contractor's company name]

[Signatory name]

[Signatory's title]

Attachments:

None

Copies:

[Owner's project manager]

SECTION 01 78 36
WARRANTIES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
1. General requirements for warranties required in the various Specifications.
 2. Provisions addressing:
 - a. Suppliers' standard warranties.
 - b. Suppliers' special or extended warranties.
 - c. Implied warranties.
 - d. Commencement and duration of warranties.

1.2 SUBMITTALS

- A. General:
1. For each item of equipment furnished under the Contract, submit Supplier's standard warranty, regardless of whether such warranty or Submittal thereof is required by the associated Specifications for that item. Submit such warranties for materials where such Submittal is required in the Specifications for the material.
 2. For each item of material or equipment where Supplier's special (or extended) warranty is required by the Contract Documents, submit appropriate special warranty that complies with the Contract Documents.
 3. Supplier's warranties shall be specifically endorsed to Owner, Contractor, and the entity purchasing the item (if other than Contractor) by the entity issuing such warranty.
 4. Submit Suppliers' standard warranties and special warranties as Submittals in accordance with the Schedule of Submittals accepted by Engineer.

1.3 CONTRACTOR'S GENERAL WARRANTY AND CORRECTION PERIOD OBLIGATIONS

- A. Contractor's General Warranty and Guarantee: Comply with requirements of the General Conditions, as may be modified by the Supplementary Conditions.
- B. Contractor's Warranty of Title: Comply with requirements of the General Conditions, as may be modified by the Supplementary Conditions.
- C. Correction Period: Comply with requirements of the General Conditions, as may be modified by the Supplementary Conditions.

1.4 SUPPLIERS' WARRANTIES FOR MATERIALS AND EQUIPMENT

- A. Warranty Types:
1. Required by the General Conditions:
 - a. Warranties specified for materials and equipment shall be in addition to, and run concurrent with, Contractor's general warranty and guarantee and requirements for the Contract's correction period.
 - b. Disclaimers and limitations in specific materials and equipment warranties do not limit Contractor's general warranty and guarantee, nor does such affect or limit Contractor's performance obligations under the correction period.
 2. Material or equipment manufacturer's standard warranty is pre-printed, written warranty published by item's manufacturer and specifically endorsed by manufacturer to the entities indicated in this Specifications Section's Article 1.2.
 3. Special warranty is written warranty that either extends the duration of material or equipment manufacturer's standard warranty or provides other, increased rights to Owner and other beneficiaries (if any) of such warranty. Where the Contract Documents indicate

specific requirements for warranties that differ from the manufacturer's standard warranty for that item, special warranty is implied.

- B. Requirements for Special Warranties:
 - 1. Submit written special warranty document that contains appropriate provisions and identification, ready for signature by material or equipment manufacturer, Owner, and other beneficiaries indicated in Article 1.2 of this Specifications Section. Submit draft warranty with Submittals required prior to fabrication and shipment of the item from the Supplier's facility.
 - 2. Manufacturer's Standard Form: Modified to include Project-specific information and properly signed by product manufacturer and other entities as appropriate.
 - 3. Specified Form: When specified forms for special warranties are included in the Contract Documents, prepare written document, properly signed by item manufacturer, Owner, and other beneficiaries indicated in Article 1.2 of this Specifications Section, using the required form.
 - 4. Refer to the Specifications for content and requirements for submitting special warranties.

1.5 IMPLIED WARRANTIES

- A. Warranty of Title and Intellectual Property Rights:
 - 1. Except as may be otherwise indicated in the Contract Documents, implied warranty of title required by Laws and Regulations is applicable to the Work and to materials and equipment incorporated therein.
 - 2. Provisions on intellectual property rights, including patent fees and royalties, are in the General Conditions, as may be modified by the Supplementary Conditions.
- B. Warranty of Merchantability:
 - 1. Notwithstanding any other provision of the Contract to the contrary, implied warranties of merchantability required by Laws and Regulations apply to the materials and equipment incorporated into the Work.
- C. Warranty of Fitness-for-Purpose:
 - 1. Implied warranty of fitness-for-purpose for materials and equipment to be incorporated into the Work, for which specific material or features are indicated in the Contract Documents, is hereby disclaimed by Owner and Contractor.
 - 2. Implied warranty of fitness-for-use for materials and equipment to be incorporated into the Work, as indicated in Laws and Regulations, remains in full force and effect.
 - 3. When Supplier is aware of, or has reason to be aware of, specified materials or features of the Work that are contrary to the intended use, purpose, service, application, or environment in which the material or item will be used, submit request for interpretation in accordance with Section 01 26 00 - Contract Modification Procedures. Where appropriate, such request for interpretation shall indicate the apparent discrepancy and propose appropriate, alternative materials or equipment.

1.6 COMMENCEMENT AND DURATION OF WARRANTIES

- A. Commencement of Warranties:
 - 1. Contract correction period and Contractor's general warranty commence as indicated in the General Conditions, as may be modified by the Supplementary Conditions.
 - 2. Suppliers' standard warranties and special warranties commence running on the date that the associated item is certified by Engineer as substantially complete in accordance with the Contract Documents. In no event shall special warranties commence running prior to Engineer's review and acceptance of special warranty Submittal for the item.
 - 3. Implied warranties commence in accordance with Laws and Regulations.
- B. Duration of Warranties:
 - 1. Duration of correction period is set forth in the General Conditions, as may be modified by the Supplementary Conditions.

2. Duration of Contractor's general warranty and guarantee is in accordance with Laws and Regulations.
3. Duration of Suppliers' standard warranties is in accordance with the applicable standard warranty document accepted for the Project by Engineer.
4. Duration of required Suppliers' special warranties shall be in accordance with the requirements of the Contract Documents for the subject item.
5. Duration of implied warranties shall be in accordance with Laws and Regulations.

PART 2 - PRODUCTS - (NOT USED)

PART 3 - EXECUTION - (NOT USED)

END OF SECTION

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SECTION 01 81 10
WIND AND SEISMIC DESIGN CRITERIA

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section is intended to be used for all aspects of this project. When there are conflicts between this Section and other wind and seismic design criteria given in the Contract Documents, the more stringent loading shall control unless clarified in writing during the Bid phase. Obtain clarification of all conflicts in writing prior to construction.
- B. Section Includes:
 - 1. The wind and seismic design criteria for this project including all items directly specified in the Contract Documents as well as all items that are specified to be designed by the Contractor and submitted for approval. Items include but are not necessarily limited to the following:
 - a. Anchorage of mechanical and electrical equipment.
 - b. Anchorage of pipe support structures.
 - c. Design and anchorage of tanks and vessels fabricated off site and shipped to Project site.
 - d. Precast and Prestressed Concrete Building.
 - e. Other structures or items as specified or indicated in the Contract Documents.
- C. Related Specification Sections include but are not necessarily limited to:
 - 1. Division 00 - Procurement and Contracting Requirements.
 - 2. Division 01 - General Requirements.

1.2 QUALITY ASSURANCE

- A. Referenced Standards:
 - 1. American Society of Civil Engineers (ASCE):
 - a. 7-10, Minimum Design Loads for Buildings and Other Structures.
 - 2. When referenced standards conflict the most stringent shall apply unless specifically indicated otherwise in the Contract Documents or unless approved otherwise in writing by the Engineer.
- B. Qualifications:
 - 1. Engineer for Contractor designed items: Professional Engineer licensed in the State of Washington.

1.3 GENERAL DESIGN CRITERIA

- A. This paragraph is applicable to both wind and seismic design criteria.
- B. Design in accordance with the requirements of the Building Code and all applicable referenced standards.
- C. Risk Category: IV.
- D. Design in accordance with the Building Code load combinations for service level or factored level at Contractor's option.
 - 1. Mechanical and electrical equipment loads will be considered dead loads.

1.4 SEISMIC DESIGN CRITERIA

- A. Seismic Design Load Criteria:
 - 1. Design spectral acceleration at short period: $S_{DS} = 0.47g$.
 - 2. Design spectral acceleration at 1-second period: $S_{D1} = 0.19g$.
 - 3. Importance Factor: $I_e = 1.50$.

4. Seismic Design Category: D.
 5. Component or system amplification factor, (a_p) and Component response modification factor, (R_p): In accordance with ASCE 7-10, Tables 13.5-1 and 13.6-1.
 6. Component importance factor:
 - a. All tagged equipment: $I_p = 1.50$.
 - b. All other components: $I_p = 1.00$.
- B. Seismic forces must be resisted by direct load transfer through fasteners to all seismic resisting elements. Do not use connections that use friction to transfer seismic forces.

1.5 WIND DESIGN CRITERIA

- A. Wind design load criteria:
1. Basic wind speed: 111 MPH.
 2. Exposure category: C.
 3. Topographic factor: $K_{zt} = 1.00$.
 4. Wind importance factor: $I_w = 1.00$.
 5. Building Description for wind design is Closed.
- B. Wind forces must be resisted by direct load transfer through fasteners to wind resisting elements. Do not use connections that use friction to transfer wind forces.

1.6 SUBMITTALS

- A. Informational Submittals:
1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
 2. Structural Calculations:
 - a. Submit calculations for each Contractor designed item under the Specification Section number for that item.
 - b. Indicate compliance with specific referenced documents of the Building Code.
 - c. Provide basis of design and lateral analysis as required to derive all loads and to show system stability including compatibility of deflections and compatibility with allowable soil parameters as applicable.
 - d. Indicate design load to each connection.
 - e. Provide a complete lateral load resisting system that transfers all wind and seismic loads through a load path to ground.
 - f. Sealed by a professional engineer licensed in the State the project is located in.

PART 2 - PRODUCTS - (NOT USED)

PART 3 - EXECUTION - (NOT USED)

END OF SECTION



DIVISION 02

EXISTING CONDITIONS



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SECTION 02 41 00
DEMOLITION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. General provisions applicable to all demolition and removals.
 - 2. Civil/site demolition and removals.
 - 3. Architectural and structural demolition and removals.
 - 4. Mechanical demolition and removals
 - 5. Electrical demolition and removals.
 - 6. Disposal of demolition debris, materials, and equipment.
- B. Scope:
 - 1. Contractor shall provide all labor, materials, equipment, tools, and incidentals as shown, specified and required for demolition, removals, and disposal Work.
 - 2. The Work under this Specifications section includes, but is not necessarily limited to:
 - a. Demolition and removal of existing materials and equipment as shown or indicated in the Contract Documents. The Work includes demolition of [structural concrete, foundations, walls, doors, windows, structural steel, metals, roofs, masonry, attachments, appurtenances, piping, electrical and mechanical systems and equipment, pavement, curbs, sidewalks, gutters, fencing,] and similar existing materials, equipment, and items.
 - 3. Demolitions and removals indicated in other Specifications sections shall comply with requirements of this Specifications section.
 - 4. Perform demolition Work within areas shown or indicated.
 - 5. Pay all costs associated with transporting and, as applicable, disposing of materials and equipment resulting from demolition and removals Work.
- C. Related Requirements:
 - 1. Section 31 10 00 - Site Clearing.

1.2 QUALITY ASSURANCE

- A. Referenced Standards:
 - 1. National Fire Protection Association (NFPA):
 - a. 241, Safeguarding Construction, Alteration, and Demolition Operations.
- B. Regulatory Requirements:
 - 1. Demolition, removals, and disposal Work shall be in accordance with 29 CFR 1926.850 through 29 CFR 1926.860 (Subpart T – Demolition), and all other Laws and Regulations.
 - 2. Comply with requirements of authorities having jurisdiction.
- C. Qualifications:
 - 1. Electrical Removals: Entity and personnel performing electrical removals shall be electrician(s) legally qualified to perform electrical construction and electrical work in the jurisdiction where the Site is located.
 - 2. Plumbing Removals: Entity and personnel performing plumbing removals shall be plumber(s) legally qualified to perform plumbing construction and plumbing work in the jurisdiction where the Site is located.

1.3 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Review procedures under this and other Specifications sections and coordinate the Work that will be performed with or before demolition and removals.

1.4 SUBMITTALS

- A. Informational Submittals: Submit the following:
1. Procedure Submittals:
 - a. Demolition and Removal Plan: Not less than ten days prior to starting demolition Work, submit acceptable plan for demolition and removal Work, including:
 - 1) Plan for coordinating shut-offs, capping, temporary services, and continuing utility services.
 - 2) Other proposed procedures as applicable.
 - 3) Equipment proposed for use in demolition operations.
 - 4) Recycling/disposal facility(ies) proposed, including facility owner, facility name, location, and processes. Include copy of appropriate permits and licenses, and compliance status.
 - 5) Planned demolition operating sequences.
 - 6) Detailed schedule of demolition Work in accordance with the Schedule accepted by Engineer.
 2. Notification of Intended Demolition Start: Submit in accordance with Paragraph 3.1.A of this Specifications Section.
 3. Field Quality Control Test Results:
 - a. Results of megger-testing of existing motors to remain Owner's property.
 4. Qualifications Statements:
 - a. Name and qualifications of entity performing electrical removals, including copy of licenses required by authorities having jurisdiction.
 - b. Name and qualifications of entity performing plumbing removals,

1.5 SITE CONDITIONS

- A. Owner makes no representation of condition or structural integrity of area(s) to be demolished or where removals are required by the Contract Documents.

PART 2 - PRODUCTS - (NOT USED)

PART 3 - EXECUTION

3.1 PREPARATION

- A. Notification:
1. Not less than 48 HRS prior to commencing demolition or removal, advise Engineer in writing of planned start of demolition Work. Do not start removals without permission of Engineer.
 2. Where demolition or removals has potential to affect adjacent properties, occupants, streets, or other public thoroughfare, transportation facilities, and utilities, furnish required notices to owners and occupants of properties, buildings, and structures that may be affected by the demolition or removal.
 3. In accordance with Laws and Regulations, furnish to authorities having jurisdiction, including emergency services as necessary, appropriate notices of planned demolition and removals.
 4. Submit to Engineer copies of notices furnished to adjacent property owners, occupants, and authorities having jurisdiction.
- B. Protection of Adjacent Areas and Facilities:
1. Perform demolition and removal Work in manner that prevents damage and injury to property, structures, occupants, the public, and facilities. Do not interfere with use of, and free and safe access to and from, structures and properties unless allowed by the Contract Documents otherwise allowed in writing by Owner.

2. Closing or obstructing of roads, drives, sidewalks, and passageways adjacent to the Work is not allowed unless indicated otherwise in the Contract Documents. Conduct the Work with minimum interference to vehicular and pedestrian traffic.
 3. Provide temporary partitions between demolition work areas and (a) areas that will be occupied during demolition and removals, and (b) areas accessible to the public or visitors. Temporary partitions shall be sturdy, braced plywood in good condition, of dimensions sufficient to adequately screen demolition work from view of occupants, public, and visitors. Maintain temporary partitions in place until demolition and removals work in the subject area is complete or until other Work requires removal of temporary partitions.
 4. Provide appropriate temporary barriers, lighting, sidewalk sheds, and other necessary protection.
 5. Repair damage to facilities that are to remain which such damages results from Contractor's operations.
- C. Existing Utilities: In addition to requirements of the General Conditions, Supplementary Conditions, and Division 01 Specifications, perform the following:
1. Should unforeseen, unknown, or incorrectly shown or indicated Underground Facilities be encountered, Contractor responsibilities shall be in accordance with the General Conditions as may be modified by the Supplementary Conditions. Cooperate with utility owners in keeping adjacent services and facilities in operation.
 2. Sanitary Sewerage: Before proceeding with demolition, locate and cap all sewer lines and service laterals discharging from the building or structure being demolished.
 3. Storm Water Sewerage: Existing storm water system shall remain in place until demolition of existing building or structure is complete. Upon completing demolition, cut and cap storm sewerage at locations shown on the Drawings. Remove existing storm water piping and related structures between points of cutting, and backfill, restore to grade, and stabilize the area over the removed facilities in accordance with the Contract Documents.
 4. Water Piping and Related Facilities: Before proceeding with demolition, locate and cap all potable and non-potable waterlines and service laterals serving the building or structure being demolished. Ensure compliance with Laws and Regulations regarding water quality.
 5. Other Utilities: Before proceeding with demolition, locate and cap as required all other utilities, such as fuel and gas; compressed air; heating, ventilating, and air conditioning; electric; and communications; and service laterals serving the building or structure being demolished.
 6. Shutdown of utility services shall be coordinated by Contractor, assisted by Owner as required relative to contacting utility owners.
- D. Remediation:
1. If unanticipated Hazardous Environmental Condition is believed to be encountered during demolition and removals, comply with requirements of the General Conditions, as may be modified by the Supplementary Conditions.

3.2 DEMOLITION - GENERAL

- A. Locate construction equipment used for demolition Work and remove demolished materials and equipment to avoid imposing excessive loading on supporting and adjacent walls, floors, framing, facilities, and Underground Facilities.
- B. Pollution Controls:
1. Use water sprinkling, temporary enclosures, and other suitable methods to limit emissions of dust and dirt to lowest practical level. Comply with Section 01 35 05 - Environmental Protection and Special Controls, and Laws and Regulations.
 2. Do not use water when water may create hazardous or objectionable conditions such as icing, flooding, or pollution.
 3. Clean adjacent structures, facilities, properties, and improvements of dust, dirt, and debris caused by demolition Work, in accordance with the General Conditions and Section 01 74 00 - Cleaning.

- C. Explosives:
 - 1. Explosives are not allowed at the Site. Do not use explosives for demolition and removal Work.
- D. Comply with Section 01 73 29 - Cutting and Patching and NFPA 241.
- E. Building or Structure Demolition and Removals:
 - 1. Unless otherwise approved by Engineer, proceed with demolition from top of building or structure to the ground. Complete demolition Work above each floor or tier before disturbing supporting members of lower levels.
 - 2. Demolish concrete and masonry in small sections.
 - 3. Remove structural framing members and lower to ground using hoists, cranes, or other suitable methods. Do not throw or drop to the ground.
 - 4. Break up and remove foundations, mats, and slabs-on-grade unless otherwise shown or indicated as remaining in place.
 - 5. Temporary Bracing and Supports:
 - a. Provide temporary bracing and supports sufficient to maintain safety, stability, and resist all loads to which the structure may be subject during demolition and removals, until entirety is permanently removed or permanently stabilized.
 - b. Temporary bracing and supports shall be sufficient for a associated dead load, live load, transient loading, and dynamic loads such as wind, seismic, and other loads to which the temporary bracing or support may be subject.
 - c. Where appropriate, retain a professional structural engineer, duly licensed and registered in the same jurisdiction as the Site, to design temporary bracing and supports.
- F. Salvage and Ownership:
 - 1. Materials and equipment to remain Owner's property shall be:
 - a. Carefully removed and appropriately handled by Contractor to avoid damage and in validation of warranties in effect. Brace motors attached to flexible mountings until reinstallation or delivery to Owner's storage location. Fully remedy to pre-construction condition or replace items damaged during removal or handling by Contractor.
 - b. Removed as functional units, together with all appurtenances required for operation.
 - c. Cleaned, listed, and tagged for storage.
 - d. Protected from damage.
 - e. Delivered to designated storage location at the Site or other site indicated in the Contract Documents, at place designated by Engineer or Owner.
 - 2. Items to be and delivered to Owner are as indicated in Table 02 41 00-A.

Table 02 41 00-A – Items to be Salvaged

Equipment Name/ Designation	Equipment Location	Deliver to Owner's Location
Polymer Pumps (total of 3)	Solids Building Polymer Room	At WWTF Site
W-1 System	Solids Building Lower Level	At WWTF Site
Valves	Solids Building Lower Level	At WWTF Site

- 3. Preparation of Owner's existing equipment for storage:
 - a. Where appropriate, identify each component with markings or tags to indicate its position in the assembly and the assembly of which it is part.
 - b. Place small parts in appropriate, durable boxes and clearly mark contents on the outside of box or container.
 - c. Remove oil from oil-lubricated bearings and gear boxes and replace with storage oil.
 - d. Grease grease-lubricated bearings.
 - e. Replace breather plugs with solid plugs.
 - f. Megger-test motor windings: Attach report of the test results to the associated motor and submit copy to Engineer.

- g. Attach unit to suitable crate bottom.
 - h. Enclose unit in polyethylene film and seal all seams and the film to the base of the unit with tape.
 - i. Construct crate of wood slats around top and sides of unit.
 - j. Attach permanent instruction tag to outside of crate stating "This unit has been prepared for storage. Replace oil, vent plugs, and lubricant in accordance with manufacturer's instructions before start-up."
- G. Finishing of Surfaces Exposed by Removals: Unless otherwise shown or indicated in the Contract Documents, surfaces of walls, floors, ceilings, and other areas exposed by removals, and that will remain as finished surfaces, shall be repaired and re-finished with materials that match existing adjacent surface, or as otherwise approved by Engineer.

3.3 STRUCTURAL REMOVALS

- A. Remove structures to lines and grades shown or indicated, unless otherwise directed by Engineer. Where limits are not shown or indicated, limits shall be four inches outside item to be installed. Removals beyond limits shown or indicated shall be at Contractor's risk and expense and such excess removals shall be reconstructed to satisfaction of Engineer without additional cost to Owner.
- B. Recycling and Reuse of Demolition Materials:
- 1. All concrete, brick, tile, masonry, roofing materials, reinforcing steel, structural metals, miscellaneous metals, plaster, wire mesh, and other items contained in or upon building or structure to be demolished shall be removed, transported, and disposed of away from the Site, unless otherwise approved by Engineer.
 - 2. Do not use demolished materials as fill or backfill adjacent to structures, in pipeline trenches, or as subbase under structures or pavement.
- C. After removing concrete and masonry walls or portions thereof, mats, slabs, and similar construction that ties in to the Work or to existing construction, neatly repair the junction point to leave exposed only finished edges and finished surfaces.
- D. Where parts of existing structures are to remain in service following demolition, remove the portions shown or indicated for removal, repair damage, and leave the building or structure in proper condition for the intended use.
- 1. Remove concrete and masonry to the lines shown or indicated by sawing, drilling, chipping, and other suitable methods. Leave the resulting surfaces true and even, with sharp, straight corners that will result in neat joints with new construction and be satisfactory for the purpose intended.
 - 2. Do not damage reinforcing bars beyond the area of concrete and masonry removal. Do not saw-cut beyond the area to be removed.
 - 3. Reinforcing bars that are exposed at surfaces of removed concrete and masonry that will not be covered with new concrete or masonry shall be removed to 1.5 IN below the final surface. Repair the resulting hole, with repair mortar for concrete and grout for masonry, to be flush with the surface.
 - 4. Where existing reinforcing bars are shown or indicated to extend into new construction, remove existing concrete so that reinforcing bars are clean and undamaged.
- E. Removal of Anchorages and Protruding Metals:
- 1. Where equipment or material anchored to concrete or masonry are removed and anchors are not to be re-used, and where existing metals (and to be removed) protrude from concrete, remove the anchors and other metal to not less than 1.5 IN beneath surface of concrete or masonry member. Repair the resulting hole, using repair mortar for concrete and grout for masonry, to be flush with the surface.
 - 2. Alternately, when the anchor is stainless steel, the anchor may be cut flush with the surface of the concrete or masonry, when so approved by Engineer.

- F. Jambes, sills and heads of windows, passageways, doors, or other openings (as applicable) cut-in to the Work or to existing construction shall be dressed with masonry, concrete, or metal to provide smooth, finished appearance.
- G. Where anchoring materials, including bolts, nuts, hangers, welds, and reinforcing steel, are required to attach the Work to existing construction, provide such materials under this Specifications section, unless specified elsewhere in the Contract Documents.

3.4 MECHANICAL REMOVALS

- A. Mechanical demolition and removal Work includes dismantling and removing existing:
 - 1. Piping systems and ductwork systems.
 - 2. Mechanical equipment and appurtenances.
 - 3. Mechanical elements of instrumentation and control systems, such as sensors and transmitters and similar items.
 - 4. Mechanical removals include cutting and capping as required, except that cutting of existing piping and ductwork to make connections is included under Section 01 73 29 - Cutting and Patching; Specifications sections in which requirements for coordination with Owner's operations are indicated; and applicable Specifications of Division 21 - Fire Suppression, Division 22 - Plumbing, Division 23 - Heating, Ventilating, and Air Conditioning, Division 40 - Process Interconnections, and others as applicable.
 - 5. Mechanical removals as required herein apply to systems exposed to view, hidden from view, and Underground Facilities. Mechanical removals may require work in spaces that may be classified confined spaces.
- B. Life-Safety Systems:
 - 1. Retain existing life-safety systems, including but not limited to fire suppression systems, in place for as long as possible prior to performing a associated demolition and removals.
 - 2. Where demolishing buildings or structures equipped with life-safety systems, remove or deactivate life-safety systems only in the area where active demolition operations are in progress.
- C. Demolition and Removals of Piping, Ductwork, and Similar Items:
 - 1. Scope:
 - a. Safety purge piping and tanks (as applicable) of chemicals, fuel, solids, liquids, and gases (as applicable) and make safe for removal and capping. Discharge contents of existing piping appropriately while avoiding damaging property; restricting access to or use of property; and creating unsafe, unsanitary, nuisances, and noisome conditions.
 - b. To the extent shown or indicated, remove existing piping conveying water (potable and non-potable), waste and vent, fuel (liquids and gases), heating fluids (such as water-glycol solutions), chemicals, solids and slurries, sludge, wastewater, other fluids, and processes gases, and other piping.
 - c. Remove piping to the nearest structurally sound (or "solid") piping support, and provide caps on ends of remaining piping.
 - d. Where piping to be demolished passes through existing walls to remain, cut off and cap pipe on each side of the wall.
 - 2. Caps, Closures, Blind Flanges, and Plugs – General (All Piping and Ducts):
 - a. Provide closure pieces, such as blind flanges and caps, where shown or required to complete the Work.
 - b. Where used in this Specifications section, the term "cap" means the appropriate type closure for the piping or ductwork being closed, including caps, blind flanges, and other closures.
 - c. Caps shall be compatible with the piping or ductwork on which the cap is installed, fluid-tight and gastight, and appropriate for the fluid or gas conveyed in the pipe or duct.
 - d. Unless otherwise shown or indicated, caps shall be mechanically fastened, fused, or welded to pipe or duct. Plug piping with means other than specified in this

Specifications section only when expressly so shown or indicated in the Contractor Documents or when allowed by Engineer.

3. Underground Facilities:
 - a. When Underground Facilities are altered or removed, properly cut and cap piping left in place, unless otherwise shown or indicated.
 4. Waste and Vent Piping; Ductwork:
 - a. Remove waste and vent piping, and ductwork to extent shown and cap as required.
 - b. Where demolished vent piping, stacks, and ductwork passes through existing roofing, patch the roof with the same or similar materials as existing, and fully compatible with existing materials. Completed patch shall be watertight and comply with roofing manufacturer's recommendations.
 5. Potable Water Piping; Plumbing; Fire Suppression Piping and Systems; Heating Piping:
 - a. Modifications to potable water piping, fire suppression systems, other plumbing piping, and heating system piping shall comply with Laws and Regulations.
 - b. All portions of potable water systems that have been modified or opened shall be hydrostatically tested and disinfected in accordance with the Contract Documents, and Laws and Regulations. Hydrostatically test other, normally -pressurized, plumbing and fire suppression piping and heating piping systems.
- D. Equipment Demolition and Removals:
1. To the extent shown or indicated and as required for the Work, remove existing mechanical equipment, including (but not limited to):
 - a. Facility equipment, such as food service equipment, laundry equipment, dumbwaiters, and similar facility items.
 - b. Conveying equipment such as elevators, escalators, and similar general-use conveying systems.
 - c. Fire suppression and plumbing equipment.
 - d. Heating, ventilating, and air conditioning equipment.
 - e. Standby power generators.
 - f. Security systems equipment.
 - g. Transportation-related equipment.
 - h. Flow control gates and valves.
 - i. Hoisting equipment.
 - j. Bulk materials conveying equipment.
 - k. Process heating and cooling equipment.
 - l. Blowers, compressors, air filters, air dryers, and similar equipment.
 - m. Pumps.
 - n. Tanks.
 - o. Process equipment, including purification equipment, pollution control and solid waste equipment, and treatment process equipment.
 - p. Turbines.
 - q. Appurtenances (including motors, drive systems, controls, cooling water and seal water systems) as shown, indicated, and required for completion of the Work.
 2. Where required, disassemble equipment to avoid imposing excessive loading on supporting walls, floors, framing, facilities, and Underground Facilities. Disassemble equipment as required for access through and egress from building or structure. Disassembly and removal shall comply with Laws and Regulations. Provide required means to remove equipment from building or structure.
 3. Remove control panels, operator stations, and instruments associated with equipment being removed, unless shown or indicated otherwise.
 4. Tanks and Equipment Containing Process Material:
 - a. Purge contents in accordance with Paragraph 3.5.A of this Specifications Section and other requirements of the Contract Documents, as applicable.
 - b. When removing generators, remove associated fuel storage tanks unless otherwise indicated to remain.

- c. Where contents of tank or equipment item may pose a potential hazard, such as hydrocarbon fuels or chemicals, properly dispose of contents in accordance with Laws and Regulations and the Contract Documents.
- d. Where tank or equipment contains wastewater or liquid sludge, and the Site is a wastewater treatment facility, transport and dispose of stored contents onsite at location acceptable to Owner and facility manager (if other than Owner) unless otherwise indicated in the Contract Documents. If Site is other than a wastewater treatment facility, dispose of contents appropriately in accordance with Laws and Regulations.
- e. Where tank or equipment contains solid or slurry-type material, remove, handle, and transport the contents and appropriately dispose of the materials offsite in accordance with Laws and Regulations, unless otherwise indicated in the Contract Documents.
- 5. Remove equipment supports as applicable, anchorages, base, grout, and piping. Remove anchorage systems in accordance with the "Structural Removals" Article in this Specifications section.
- 6. Remove small-diameter piping back to header unless otherwise indicated.
- 7. Remove access platforms, ladders, and stairs related to equipment being removed, unless otherwise shown or indicated.
- 8. Instrumentation and Control Systems Removal:
 - a. Remove instrumentation and controls equipment in accordance with this Specifications section's requirements for mechanical removals and electrical removals.
- 9. Reuse and Sale of Removed Equipment:
 - a. Entities indicated below may be interested in acquiring removed equipment:
 - 1) D.H. Griffin Companies Used Equipment Sales division, Greensboro, North Carolina.
 - 2) EcReCon, Inc., Penn's Grove, New Jersey.
 - 3) Federal Equipment Company, Cleveland, Ohio.
 - 4) Phoenix Equipment Corporation, Red Bank, New Jersey.
 - 5) [_____].
 - b. Comply with this Specifications section's "Disposal of Demolition Debris" Article for restrictions on sales of removed items.

3.5 ELECTRICAL REMOVALS

- A. Electrical demolition Work includes removing existing:
 - 1. Disconnecting cabling from motors, electrical sources, control panels, control stations, instrumentation and control items, and similar devices and equipment.
 - 2. Conduits, raceways, cable trays, hangers and supports, cabling, and related items.
 - 3. Switches, panelboards, control stations, and similar items.
 - 4. Transformers, distribution switchboards, control panels, motors, starters, variable speed controllers, and similar items.
 - 5. Lighting fixtures and related items.
 - 6. Utility poles, site lighting standards, and overhead cabling.
 - 7. Appurtenances and miscellaneous electrical equipment, as shown, specified, or required.
- B. Electrical Removals – General:
 - 1. Comply with Laws and Regulations, including the National Electric Code.
 - 2. Lock Out and Tagging:
 - a. Contractor shall lock out and tag circuit breakers and switches operated by Owner and shall verify that affected cabling are de-energized to ground potential before commencing electrical removals Work.
 - b. Upon completion of electrical removals Work, remove the locks and tags and promptly advise Resident Project Representative (RPR) or Engineer and [Owner] [facility manager] that existing facilities are available for use.
 - 3. Remove existing electrical equipment, fixtures, and systems to avoid damaging systems to remain, to keep existing systems in operation, and to maintain integrity of grounding systems.

4. Disconnect and remove motors, control panels, and other electrical gear where shown or indicated.
 5. Store removed motors, microprocessors and electronics, and other electrical gear to be reused in accordance with its manufacturer's recommendations and requirements of the Contract Documents.
- C. Motor Control Centers and Switchgear:
1. Remove or modify motor control centers and switchgear as shown or indicated.
 2. Modified openings shall be cut square and dressed smooth to dimensions required for installation of equipment.
- D. Removal of Cabling, Conduits, Raceways and Similar Items:
1. Verify the function of each cable before disconnecting and removing.
 2. Remove cabling, conduits, hangers and supports, and similar items back to the power source or control panel, unless otherwise shown or indicated.
 3. Remove cabling, conduits, and similar items where shown or indicated for removal. Abandoned conduits concealed in floor, ceiling slabs, or in walls shall be cut flush with the slab or wall (as applicable) at point of entrance, suitably capped, and the area repaired in a flush, smooth manner acceptable to Engineer.
 4. Disassemble and remove exposed conduits, junction boxes, other electrical appurtenances, and their supports.
 5. Repair all areas of the Work to prevent rusting on exposed surfaces.
 6. Underground Electric:
 - a. Conduits in Underground Facilities not scheduled for reuse shall be suitably capped watertight where each enters building or structure to remain.
 - b. Where shown or indicated, remove direct-burial cabling. Openings in buildings for entrance of direct-burial cabling shall be patched with repair mortar or other material approved by Engineer for such purpose, and made watertight.
- E. Electrical Service Entrances and Outdoor, Overhead Electrical Utilities:
1. Existing poles and overhead cabling shall be removed or abandoned as shown and specified.
 2. Completely remove from the Site poles not owned by electric utility, including site lighting standards and appurtenances, shown or indicated for removal.
 3. Existing substation(s) and poles owned by electric utility will be removed by the electric utility.
 4. Make necessary arrangements with electric utility owner for removal of utility owner's transformers and metering equipment after new electrical system has been installed and energized.
- F. Lighting fixtures, wall switches, receptacles, starters, and other miscellaneous electrical equipment, not designated as remaining as Owner's property, shall be removed and properly disposed off-Site as required in accordance with Laws and Regulations.

3.6 DEMOLITION OF SITE IMPROVEMENTS

- A. Pavement, Sidewalks, Curbs, and Gutters:
1. Demolition of asphalt or concrete pavement, sidewalks, curbs, and gutters, as applicable, shall terminate at cut edges. Edges shall be linear and have a vertical cut face.
 2. To cut pavement, sidewalks, curbs, and gutters, use machinery or tools that provides a smooth-cut edge, appropriate for the required. Where cut edges are not smooth, repair the cut edge to remain to provide a smooth, even appearance.
- B. Fencing, Guardrails, and Bollards:
1. Remove to the limits shown or indicated on the Drawings.
 2. Completely remove below-grade posts and concrete.

- C. Manholes, Vaults, Chambers, and Handholes:
 - 1. Remove to the limits shown or indicated on the Drawings.
 - 2. If not shown or indicated on the Drawings, remove to not less than three feet below finished grade indicated on the Drawings.
- D. Underground Facilities Other than Manholes, Vaults, Chambers, and Handholes:
 - 1. Remove to the extent shown or indicated on the Drawings.
 - 2. Unless otherwise shown or indicated, cap ends of piping to remain in place in accordance with the “Mechanical Removals” Article in this Specifications section.
- E. Landscaping: Comply with Section 31 1000 - Site Clearing.
- F. Other Site Improvements: When the Contract Documents require removal of other site improvements not addressed above, copy with Contract requirements for removal of buildings or structures.

3.7 DISPOSAL OF DEMOLITION DEBRIS

- A. Disposal – General:
 - 1. Promptly remove from the Site all debris, waste, rubbish, material, and equipment resulting from demolition and removal operations. Promptly upon completion of demolition and removal operations, remove from the Site construction equipment used in demolition Work.
 - 2. Do not sell at the Site demolition materials or removed equipment. If materials, equipment or debris will be sold by Contractor, remove the items from the Site and perform the sale or transaction elsewhere, in accordance with Laws and Regulations.
 - 3. Cleaning and Removal of Debris: Comply with the General Conditions, Supplementary Conditions, and Section 01 74 00 - Cleaning.
- B. Transportation and Disposal:
 - 1. Non-Hazardous Materials, Equipment, and Debris: Properly transport and dispose of non-hazardous demolition materials, equipment, and debris at a appropriate landfill or other suitable location, in accordance with Laws and Regulations. Non-hazardous material does not contain Constituents of Concern such as (but not limited to) asbestos, PCBs, petroleum, hazardous waste, radioactive material, or other material designated as hazardous in Laws or Regulations.
 - 2. Hazardous Materials, Equipment, and Debris: When handling and disposal of items containing Constituents of Concern is included in the Work, properly transport and dispose of such items in accordance with the Contract Documents and Laws and Regulations.
- C. Submit to Engineer information required in this Specification Section on proposed facility(ies) where demolition materials, equipment, and debris will be recycled. Upon request, Engineer or Owner, shall be allowed to visit recycling facility(ies) to verify adequacy and compliance status. During such visits, recycling facility operator shall cooperate and assist Engineer and Owner.

END OF SECTION



DIVISION 03

CONCRETE



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SECTION 03 05 05
CONCRETE TESTING AND INSPECTION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Contractor requirements for testing of concrete and grout.
 - 2. Definition of Owner provided testing.
 - 3. Acceptance criteria for concrete.
- B. Related Specification Sections include but are not necessarily limited to:
 - 1. Division 00 - Procurement and Contracting Requirements.
 - 2. Division 01 - General Requirements.
 - 3. Section 03 21 00 - Reinforcement.
 - 4. Section 03 31 30 - Concrete, Materials and Proportioning.
 - 5. Section 03 31 31 - Concrete Mixing, Placing, Jointing and Curing.
 - 6. Section 03 41 33 - Precast and Prestressed Concrete.

1.2 RESPONSIBILITY AND PAYMENT

- A. Owner will hire an independent Testing Agency/Service Provider to perform the following testing and inspection and provide test results to the Engineer and Contractor.
 - 1. Testing and inspection of concrete and grout produced for incorporation into the work during the construction of the Project for compliance with the Contract Documents.
 - 2. Additional testing or retesting of materials occasioned by their failure, by test or inspection, to meet requirements of the Contract Documents.
 - 3. Strength testing on concrete required by the Engineer or Special Inspector when the water-cement ratio exceeds the water-cement ratio of the typical test cylinders.
 - 4. In-place testing of concrete as may be required by Engineer when strength of structure is considered potentially deficient.
 - 5. Other testing services needed or required by Contractor such as field curing of test specimens and testing of additional specimens for determining when forms, form shoring or reshoring may re-removed.
 - 6. Owner will pay for services defined in Paragraph 1.2A.1.
 - 7. See Specification Section 01 30 00.
- B. Hire a qualified testing agency to perform the following testing and provide test results to the Engineer.
 - 1. Testing of materials and mixes proposed by the Contractor for compliance with the Contract Documents and retesting in the event of changes.
 - 2. Additional testing and inspection required because of changes in materials or proportions requested by Contractor.
 - 3. Pay for services defined in Paragraphs 1.2B.1. and 1.2B.2.
 - 4. Reimburse Owner for testing services defined in Paragraphs 1.2A.2., 1.2A.3., 1.2A.4. and 1.2A.5.
 - 5. See Specification Section 01 30 00.

1.3 QUALITY ASSURANCE

- A. Referenced Standards:
 - 1. American Concrete Institute (ACI):
 - a. 318, Building Code Requirements for Structural Concrete.
 - b. 350, Code Requirements for Environmental Engineering Concrete Structures and Commentary.

2. ASTM International (ASTM):
 - a. ASTM Cement and Concrete Reference Laboratory (CCRL).
 - b. C31, Standard Practice for Making and Curing Concrete Test Specimens in the Field.
 - c. C39, Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.
 - d. C42, Standard Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete.
 - e. C94, Standard Specification for Ready-Mixed Concrete.
 - f. C143, Standard Test Method for Slump of Hydraulic-Cement Concrete.
 - g. C172, Standard Practice for Sampling Freshly Mixed Concrete.
 - h. C1019, Standard Test Method for Sampling and Testing Grout.
 - i. C1218, Standard Test Method for Water-Soluble Chloride in Mortar and Concrete.
 - j. E329, Standard Specification for Agencies Engaged in Construction Inspection, Testing, or Special Inspection.
- B. Qualifications:
 1. Contractor's Testing Agency:
 - a. Meeting requirements of ASTM E329 and ASTM C94.
 - b. Provide evidence of recent inspection by CCRL of NBS, and correction of deficiencies noted.
- C. Use of Testing Agency and approval by Engineer of proposed concrete mix design shall in no way relieve Contractor of responsibility to furnish materials and construction in full compliance with Contract Documents.

1.4 DEFINITIONS

- A. Testing Agency/Service Provider: An independent professional testing/inspection firm or service hired by Contractor or by Owner to perform testing, inspection or analysis services as directed, and as provided in the Contract Documents.

1.5 SUBMITTALS

- A. Shop Drawings:
 1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
 2. Product technical data including:
 - a. Concrete materials and concrete mix designs proposed for use.
 - 1) Include results of all testing performed to qualify materials and to establish mix designs.
 - 2) Place no concrete until approval of mix designs has been received in writing.
 - 3) Submittal for each concrete mix design to include:
 - a) Sieve analysis and source of fine and coarse aggregates.
 - b) Test for aggregate organic impurities.
 - c) Proportioning of all materials.
 - d) Type of cement with mill certificate for the cement.
 - e) Brand, quantity and class of fly ash proposed for use along with other submittal data as required for fly ash by Specification Section 03 31 30.
 - f) Slump.
 - g) Brand, type and quantity of air entrainment and any other proposed admixtures.
 - h) Shrinkage test results.
 - i) Total water soluble chloride ion concentration in hardened concrete from all ingredients determined per ASTM C1218.
 - j) 28-day compression test results and any other data required by Specification Section 03 31 30 to establish concrete mix design.
 3. Certifications:
 - a. Testing Agency qualifications.

PART 2 - PRODUCTS - (NOT USED)

PART 3 - EXECUTION

3.1 TESTING SERVICES TO BE PERFORMED SERVICE PROVIDER/TESTING AGENCY

- A. The following concrete testing will be performed by the Service Provider/Testing Agency:
 - 1. Concrete strength testing
 - 2. Slump testing
 - 3. Air content
 - 4. In-place concrete testing (if required).

3.2 SPECIAL INSPECTIONS

- A. See Section 01 45 33.
 - 1. Special Inspections listed are for the Contractor reference only and is not part of the Contract Documents.
 - 2. It is included to assist the Contractor in understanding the Owner-provided Services so that those services may be factored into the Contractor's pricing and schedule.
- B. Formwork Special Inspections:
 - 1. Shape, location, and dimensions.
 - a. Inspect in accordance with dimensions and details on Drawings.
 - b. Frequency: Inspect prior to each concrete placement.
- C. Reinforcing Special Inspections:
 - 1. Reinforcing size, spacing, lap length and concrete cover.
 - a. Inspect in accordance with Drawings and Specification.
 - b. Frequency: Inspect prior to each concrete placement.
 - 2. Reinforcing adhesive anchoring system:
 - a. Inspect in accordance with ICC-ES report.
 - b. Frequency:
 - 1) Inspect all adhesive anchors for the first 4 HRS of installation.
 - 2) Inspect approximately 25 PCT of adhesive anchors thereafter.
 - 3) Additional inspection will be required for different installer or if the quality of installation appears to vary.
 - 3. Mechanical splices:
 - a. Inspect in accordance with ICC-ES report.
 - b. Frequency:
 - 1) Inspect all mechanical splices for the first 4 HRS of installation.
 - 2) Inspect approximately 25 PCT of mechanical splices thereafter.
 - 3) Additional inspection will be required for different installer or if the quality of installation appears to vary.
- D. Mixing, Placing, Jointing, and Curing Special Inspections:
 - 1. Perform concrete tests per the requirements of this Specification Section.
 - 2. Verification of proper mix design.
 - a. Frequency: Periodically, prior to each concrete placement.
 - 3. Proper concrete placement techniques.
 - a. Inspect per requirements of Section 03 31 31.
 - b. Frequency: During each concrete placement.
 - 4. Proper curing temperature and techniques.
 - a. Inspect per requirements of Section 03 31 31.
 - b. Frequency: Periodically.
 - 5. Joints:
 - a. Inspect joints for proper joint type, dimensions, reinforcing, dowel alignment, surface preparation and location.
 - b. Frequency: Prior to each concrete placement.

6. Waterstops:
 - a. Visually inspect waterstops for proper location, continuity, installation to prevent displacement, cleanliness, and damage to waterstop.
 - b. Frequency:
 - 1) Prior to each concrete placement.
- E. Anchorage to Concrete Special Inspection:
 1. Post installed anchors as required by the building code, ICC-ES Evaluation Reports, and as specified by the Engineer.
 - a. Frequency: Per ICC-ES Report.
 2. Cast-in-place concrete anchors, including anchor size, embedment, material, and location.
 - a. Frequency: Prior to each concrete placement.

3.3 SAMPLING ASSISTANCE AND NOTIFICATION FOR OWNER

- A. To facilitate testing and inspection, perform the following:
 1. Furnish any necessary labor to assist Testing Agency in obtaining and handling samples at site.
 2. Provide and maintain for sole use of Testing Agency adequate facilities for safe storage and proper curing of test specimens on site for first 24 HRS as required by ASTM C31.
 3. Take samples at point of placement into concrete member.
- B. Notify Engineer and Owner's Testing Agency sufficiently in advance of operations (minimum of 24 HRS) to allow for assignment of personnel and for scheduled completion of quality tests.

3.4 ACCEPTANCE

- A. Completed concrete work which meets applicable requirements will be accepted without qualification.
- B. Completed concrete work which fails to meet one or more requirements but which has been repaired to bring it into compliance will be accepted without qualification.
- C. Completed concrete work which fails to meet one or more requirements and which cannot be brought into compliance may be accepted or rejected as provided in these Contract Documents.
 1. In this event, modifications may be required to assure that concrete work complies with requirements.
 2. Modifications, as directed by Engineer, to be made at no additional cost to Owner.
- D. Dimensional Tolerances:
 1. Formed surfaces resulting in concrete outlines smaller than permitted by tolerances shall be considered potentially deficient in strength and subject to modifications required by Engineer.
 2. Formed surfaces resulting in concrete outlines larger than permitted by tolerances may be rejected and excess material subject to removal.
 - a. If removal of excess material is permitted, accomplish in such a manner as to maintain strength of section and to meet all other applicable requirements of function and appearance.
 3. Concrete members cast in wrong location may be rejected if strength, appearance or function of structure is adversely affected or misplaced items interfere with other construction.
 4. Inaccurately formed concrete surfaces exceeding limits of tolerances and which are exposed to view, may be rejected.
 - a. Repair or remove and replace if required.
 5. Finished slabs exceeding tolerances may be required to be repaired provided that strength or appearance is not adversely affected.
 - a. High spots may be removed with a grinder, low spots filled with a patching compound, or other remedial measures performed as permitted or required.

- E. Appearance:
1. Concrete surfaces exposed to view with defects which, in opinion of Engineer, adversely affect appearance as required by specified finish shall be repaired by approved methods.
 2. Concrete not exposed to view is not subject to rejection for defective appearance unless, in the opinion of the Engineer, the defects impair the long-term strength or function of the member.
- F. High Water-Cement Ratio:
1. Concrete with water in excess of the specified maximum water-cement ratio will be rejected.
 2. Remove and replace concrete with high water-cement ratio or make other corrections as directed by Engineer.
- G. Strength of Structure:
1. Strength of structure in place will be considered potentially deficient if it fails to comply with any requirements which control strength of structure, including but not necessarily limited to following:
 - a. Low concrete strength:
 - 1) Test results for standard molded and cured test cylinders to be evaluated separately for each mix design.
 - a) Such evaluation shall be valid only if tests have been conducted in accordance with specified quality standards.
 - b) For evaluation of potential strength and uniformity, each mix design shall be represented by at least three strength tests.
 - c) A strength test shall be the average of two, 6 IN diameter cylinders or three, 4 IN diameter cylinders from the same sample tested at 28 days.
 - 2) Acceptance:
 - a) Strength level of each specified compressive strength shall be considered satisfactory if both of the following requirements are met:
 - (1) Average of all sets of three consecutive strength tests equal or exceed the required specified 28 day compressive strength.
 - (2) No individual strength test falls below the required specified 28 day compressive strength by more than 500 PSI.
 - b. Reinforcing steel size, configuration, quantity, strength, position, or arrangement at variance with requirements in Specification Section 032100 or requirements of the Contract Drawings or approved Shop Drawings.
 - c. Concrete which differs from required dimensions or location in such a manner as to reduce strength.
 - d. Curing time and procedure not meeting requirements of this Specification Section.
 - e. Inadequate protection of concrete from extremes of temperature during early stages of hardening and strength development.
 - f. Mechanical injury, construction fires, accidents or premature removal of formwork likely to result in deficient strength.
 - g. Concrete defects such as voids, honeycomb, cold joints, spalling, cracking, etc., likely to result in deficient strength or durability.
 2. Structural analysis and/or additional testing may be required when strength of structure is considered potentially deficient.
 3. In-place testing of concrete may be required when strength of concrete in place is considered potentially deficient.
 - a. Testing by impact hammer, sonoscope, or other nondestructive device may be permitted by Engineer to determine relative strengths at various locations in the structure or for selecting areas to be cored.
 - 1) Such tests shall not be used as a basis for acceptance or rejection.

- b. Core tests:
 - 1) Where required, test cores will be obtained in accordance with ASTM C42.
 - a) If concrete in structure will be dry under service conditions, air dry cores (temperature 60 to 80 DEGF, relative humidity less than 60 PCT) for seven days before test then test dry.
 - b) If concrete in structure will be wet or subjected to high moisture atmosphere under service conditions, test cores after immersion in water for at least 40 HRS and test wet.
 - c) Testing wet or dry to be determined by Engineer.
 - 2) Three representative cores may be taken from each member or area of concrete in place that is considered potentially deficient.
 - a) Location of cores shall be determined by Engineer so as least to impair strength of structure.
 - b) If, before testing, one or more of cores shows evidence of having been damaged subsequent to or during removal from structure, damaged core shall be replaced.
 - 3) Concrete in area represented by a core test will be considered adequate if average strength of three cores is equal to at least 85 PCT of specified strength and no single core is less than 75 PCT of specified strength.
 - 4) Fill core holes with non-shrink grout and finish to match surrounding surface when exposed in a finished area.
- 4. If core tests are inconclusive or impractical to obtain or if structural analysis does not confirm safety of structure, load tests may be required and their results evaluated in accordance with ACI 318, Chapter 20.
- 5. Correct or replace concrete work judged inadequate by structural analysis or by results of core tests or load tests with additional construction, as directed by Engineer, at Contractor's expense.
- 6. Contractor to pay all costs incurred in providing additional testing and/or structural analysis required.

END OF SECTION

SECTION 03 11 13 FORMWORK

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Form work requirements for concrete construction.
- B. Related Specification Sections include but are not necessarily limited to:
 - 1. Division 00 - Procurement and Contracting Requirements.
 - 2. Division 01 - General Requirements.
 - 3. Section 03 05 05 - Concrete Testing and Inspection.
 - 4. Section 03 31 31 - Concrete Mixing, Placing, Jointing, and Curing.
 - 5. Section 03 35 00 - Concrete Finishing and Repair of Surface Defects.

1.2 QUALITY ASSURANCE

- A. Referenced Standards:
 - 1. American Concrete Institute (ACI):
 - a. CT-13, Concrete Terminology.
 - b. 117, Specification for Tolerances for Concrete Construction and Materials.
 - c. 347R, Guide to Formwork for Concrete.
- B. Qualifications:
 - 1. Form work, shoring and reshoring to be designed by a licensed professional engineer currently registered in the State of Washington or having a minimum of three years of experience in this type of design work.
 - a. Above qualifications apply to slabs and beams not cast on the ground.
- C. Miscellaneous:
 - 1. Design and engineering of formwork, shoring and reshoring as well as its construction is the responsibility of the Contractor.
 - 2. Design requirements:
 - a. Design form work for loads, lateral pressures and allowable stresses outlined in ACI 347R and for design considerations, wind loads, allowable stresses and other applicable requirements of the controlling local building code.
 - 1) Where conflicts occur between the above two standards, the more stringent requirements shall govern.
 - b. Design form work to limit maximum deflection of form facing materials reflected in concrete surfaces exposed to view to 1/240 of span between structural members.
 - 3. For slabs and beams not cast on the ground, develop a procedure and schedule for removal of shores and installation of reshores and for calculating the loads transferred to the structure during this process in accordance with ACI 347R.
 - a. Perform structural calculations as required to prove that all portions of the structure in combination with remaining forming and shoring system has sufficient strength to safely support its own weight plus the loads placed thereon. Calculations shall be performed by a licensed professional engineer licensed in the State of Washington.
 - b. When developing procedure, schedule and structural calculations, consider the following at each stage of construction:
 - 1) The structural system that exists.
 - 2) Effects of all loads during construction.
 - 3) Strength of concrete.
 - 4) The influence of deformations of the structure and shoring system on the distribution of dead loads and construction loads.

- 5) The strength and spacing of shores or shoring systems used, as well as the method of shoring, bracing, shore removal, and reshoring including the minimum time intervals between the various operations.
- 6) Any other loading or condition that affects the safety or serviceability of the structure during construction.

1.3 DEFINITIONS

- A. Words and terms used in these Specifications are defined in ACI CT-13.

1.4 SUBMITTALS

- A. Shop Drawings:
 1. See Specification Section 01 33 00 for the requirements for the mechanics and administration of the submittal process.
 2. Product technical data including:
 - a. Manufacturer and type of proposed form ties.
- B. Samples:
 1. A 12 IN SQ sample of each of the form finishes.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Forms for Surfaces Exposed to View:
 1. Wood forms:
 - a. 5/8 or 3/4 IN 5-ply structural plywood of concrete form grade.
 - b. Built-in-place or prefabricated type panel.
 2. Metal forms:
 - a. Metal forms may be used except for a luminum in contact with concrete.
 - b. Forms to be tight to prevent leakage, free of rust and straight without dents to provide members of uniform thickness.
- B. Forms for Surfaces Not Exposed to View:
 1. Wood or metal sufficiently tight to prevent leakage.
 2. Do not use a luminum foms.

2.2 ACCESSORIES

- A. Form Ties:
 1. Commercially fabricated for use in form construction.
 - a. Field fabricated ties are unacceptable.
 2. Constructed so that ends or end fasteners can be removed without causing spalling at surfaces of the concrete.
 3. Embedded portion of ties to be not less than 1-1/2 IN from face of concrete after ends have been removed.
 4. Cone size:
 - a. 3/4 IN minimum diameter cones on both ends.
 - b. Depth of cone not to exceed the concrete reinforcing cover.
 5. Provide ties with built-in waterstops in all walls that will be in contact with process liquid during plant operation.
 6. Through-wall ties that are designed to be entirely removed are not allowed in all walls that will be in contact with process liquid during plant operation.
- B. Void Forms:
 1. Constructed from double faced corrugated cardboard or fiberboard which is wax impregnated and laminated with moisture-resistant adhesive.
 2. Capable of resisting moisture with no loss of load carrying strength or change in depth or configuration.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Form Surface Treatment:
 - 1. Before placing of reinforcing steel or concrete, cover surfaces of forms with an approved release material that will effectively prevent absorption of moisture and prevent bond with concrete, will not stain concrete or prevent bonding of future finishes.
 - a. A field applied form release agent or sealer of approved type or a factory applied nonabsorptive liner may be used.
 - 2. Do not allow excess form release material to stand in puddles in forms nor in contact with hardened concrete against which fresh concrete is to be placed.
- B. Provide temporary openings at base of column and wall forms and at other points where necessary to facilitate cleaning and observation immediately before concrete is placed, and to limit height of free fall of concrete to prevent aggregate segregation.
 - 1. Temporary openings to limit height of free fall of concrete shall be spaced no more than 8 FT apart.
- C. Clean surfaces of forms, reinforcing steel and other embedded materials of any accumulated mortar or grout from previous concreting and of all other foreign material before concrete is placed.

3.2 ERECTION

- A. Install products in accordance with manufacturer's instructions.
- B. Tolerances:
 - 1. Conform to ACI 117.
 - 2. Variation from plumb:
 - a. In lines and surfaces of columns, piers, walls, and in risers.
 - 1) Maximum in any 10 FT of height: 1/4 IN.
 - 2) Maximum for entire height: 1/2 IN.
 - b. For exposed corner columns, control-joint grooves, and other exposed to view lines:
 - 1) Maximum in any 20 FT length: 1/4 IN.
 - 2) Maximum for entire length: 1/2 IN.
 - 3. Variation from level or from grades specified:
 - a. In slab soffits, ceilings, beam soffits and in rises, measured before removal of supporting shores.
 - 1) Maximum in any 10 FT of length: 1/4 IN.
 - 2) Maximum in any bay or in any 20 FT length: 3/8 IN.
 - 3) Maximum for entire length: 3/4 IN.
 - b. In exposed lintels, sills, parapets, horizontal grooves, and other exposed to view lines:
 - 1) Maximum in any bay or in 20 FT length: 1/4 IN.
 - 2) Maximum for entire length: 1/2 IN.
 - 4. Variation of linear structure lines from established position in plan and related position of columns, walls, and partitions:
 - a. Maximum in any bay: 1/2 IN.
 - b. Maximum in any 20 FT of length: 1/2 IN.
 - c. Maximum for entire length: 1 IN.
 - 5. Variation in sizes and location of sleeves, floor openings, and wall openings: Maximum of +1/2 IN.
 - 6. Variation in horizontal plan location of beam, column and wall centerlines from required location: Maximum of +1/2 IN.
 - 7. Variation in cross sectional dimensions of columns and beams and in thickness of slabs and walls: Maximum of -1/4 IN, +1/2 IN.

8. Footings and foundations:
 - a. Variations in concrete dimensions in plan: -1/2 IN, +2 IN.
 - b. Misplacement or eccentricity:
 - 1) 2 PCT of footing width in direction of misplacement but not more than 2 IN.
 - c. Thickness:
 - 1) Decrease in specified thickness: 5 PCT.
 - 2) Increase in specified thickness: No limit except that which may interfere with other construction.
 9. Variation in steps:
 - a. In a flight of stairs:
 - 1) Rise: +1/8 IN.
 - 2) Tread: +1/4 IN.
 - b. In consecutive steps:
 - 1) Rise: +1/16 IN.
 - 2) Tread: +1/8 IN.
 10. Establish and maintain in an undisturbed condition and until final completion and acceptance of Project, sufficient control points and bench marks to be used for reference purposes to check tolerances.
 11. Regardless of tolerances listed allow no portion of structure to extend beyond legal boundary of Project.
 12. To maintain specified tolerances, camber formwork to compensate for anticipated deflections in formwork prior to hardening of concrete.
- C. Make forms sufficiently tight to prevent loss of mortar from concrete.
 - D. Place 3/4 IN chamfer strips in exposed to view corners of forms to produce 3/4 IN wide beveled edges.
 - E. At construction joints, overlap contact surface of form sheathing for flush surfaces exposed to view over hardened concrete in previous placement by at least 1 IN.
 1. Hold forms against hardened concrete to prevent offsets or loss of mortar at construction joint and to maintain a true surface.
 2. Where possible, locate juncture of built-in-place wood or metal forms at architectural lines, control joints or at construction joints.
 - F. Where circular walls are to be formed and forms made up of straight sections are proposed for use, provide straight lengths not exceeding 2 FT wide.
 1. Brace and tie formwork to maintain correct position and shape of members.
 - G. Construct wood forms for wall openings to facilitate loosening, if necessary, to counteract swelling.
 - H. Anchor formwork to shores or other supporting surfaces or members so that movement of any part of formwork system is prevented during concrete placement.
 - I. Provide runways for moving equipment with struts or legs, supported directly on formwork or structural member without resting on reinforcing steel.
 - J. Provide positive means of adjustment (wedges or jacks) of shores and struts and take up all settlement during concrete placing operation.
 1. Securely brace forms against lateral deflection.
 2. Fasten wedges used for final adjustment of forms prior to concrete placement in position after final check.

3.3 REMOVAL OF FORMS

- A. No construction loads shall be supported on, nor any shoring removed from, any part of the structure under construction except when that portion of the structure in combination with remaining forming and shoring system has sufficient strength to safely support its weight and loads placed thereon.

- B. When required for concrete curing in hot weather, required for repair of surface defects or when finishing is required at an early age, remove forms as soon as concrete has hardened sufficiently to resist damage from removal operations or lack of support.
- C. Remove top forms on sloping surfaces of concrete as soon as concrete has attained sufficient stiffness to prevent sagging.
 - 1. Perform any needed repairs or treatment required on such sloping surfaces at once, followed by curing specified in Specification Section 03 31 31.
- D. Loosen wood forms for wall openings as soon as this can be accomplished without damage to concrete.
- E. Formwork for columns, walls, sides of beams, and other parts not supporting weight of concrete may be removed as soon as concrete has hardened sufficiently to resist damage from removal.
- F. Where no reshoring is planned, leave forms and shoring used to support weight of concrete in place until concrete has attained its specified 28 day compressive strength.
 - 1. Where a reshoring procedure is planned, supporting formwork may be removed when concrete has reached the concrete strength required by the formwork designer's structural calculations.
- G. When shores and other vertical supports are so arranged that non-load-carrying form facing material may be removed without loosening or disturbing shores and supports, facing material may be removed when concrete has sufficiently hardened to resist damage from removal.

3.4 RESHORING

- A. No construction loads shall be supported on, nor any shoring removed from, any part of the structure under construction except when that portion of the structure in combination with remaining forming and shoring system has sufficient strength to safely support its weight and loads placed thereon.
- B. While reshoring is underway, no superimposed dead or live loads shall be permitted on the new construction.
- C. During reshoring do not subject concrete in structural members to combined dead and construction loads in excess of loads that structural members can adequately support.
- D. Place reshores as soon as practicable after stripping operations are complete but in no case later than end of working day on which stripping occurs.
- E. Tighten reshores to carry their required loads without overstressing.
- F. Shoring, reshoring and supporting formwork may be removed when concrete has reached the concrete strength required by the formwork designer's structural calculations.
- G. For floors supporting shores under newly placed concrete leave original supporting shores in place or reshore.
 - 1. Reshoring system shall have a capacity sufficient to resist anticipated loads.
 - 2. Locate reshores directly under a shore position above.
- H. In multi-story buildings, extend reshoring over a sufficient number of stories to distribute weight of newly placed concrete, forms, and construction live loads in such a manner that design superimposed loads of floors supporting shores are not exceeded.

3.5 FIELD QUALITY CONTROL

- A. Special Inspection:
 - 1. See Section 01 45 33.
 - 2. See Section 03 05 05.

END OF SECTION

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SECTION 03 15 19
ANCHORAGE TO CONCRETE

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
1. Requirements for all cast-in-place anchor bolts, anchor rods, reinforcing adhesive anchorage, and post-installed concrete anchors required for the Project but not specified elsewhere in the Contract Documents.
 2. Design of all concrete anchors not indicated on the Drawings including, but not limited to, installation of anchors into concrete for the following structural and nonstructural components:
 - a. Structural members and accessories.
 - b. Metal, wood, and plastic fabrications.
 - c. Architectural components.
 - d. Mechanical and electrical equipment and components.
 - e. Plumbing, piping, and HVAC work.
 - f. All other components requiring attachment to concrete.
- B. Related Specification Sections include but are not necessarily limited to:
1. Division 00 - Procurement and Contracting Requirements.
 2. Division 01 - General Requirements.
 3. Section 03 05 05 - Concrete Testing and Inspection.
 4. Section 40 05 07 - Pipe Support Systems.

1.2 QUALITY ASSURANCE

- A. Referenced Standards:
1. American Concrete Institute (ACI):
 - a. 318, Building Code Requirements for Structural Concrete and Commentary.
 2. American Concrete Institute/Concrete Reinforcing Steel Institute (ACI-CRSI):
 - a. Adhesive Anchor Installation Certification Program: Adhesive Anchor Installer.
 3. American Institute of Steel Construction (AISC):
 - a. 303, Code of Standard Practice for Steel Buildings and Bridges.
 4. ASTM International (ASTM):
 - a. A36, Standard Specification for Carbon Structural Steel.
 - b. A108, Standard Specification for Steel Bar, Carbon and Alloy, Cold-Finished.
 - c. A123, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
 - d. A153, Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
 - e. A307, Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
 - f. A496, Standard Specification for Steel Wire, Deformed, for Concrete Reinforcement.
 - g. A563, Standard Specification for Carbon and Alloy Steel Nuts.
 - h. A780, Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings.
 - i. F436, Standard Specification for Hardened Steel Washers.
 - j. F593, Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs.
 - k. F594, Standard Specification for Stainless Steel Nuts.
 - l. F1554, Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength.
 - m. F2329, Standard Specification for Zinc Coating, Hot-Dip, Requirements for Application to Carbon and Alloy Steel Bolts, Screws, Washers, Nuts, and Special Threaded Fasteners

5. ICC Evaluation Service (ICC-ES):
 - a. AC193, Acceptance Criteria for Mechanical Anchors in Concrete Elements.
 - b. AC308, Acceptance Criteria for Post-Installed Adhesive Anchors in Concrete Elements.
- B. Qualifications:
 1. Anchor designer for Contractor-designed post-installed anchors and cast in place anchorage shall be a professional structural engineer licensed in the State of Washington.
 2. Installer for post-installed anchors shall be trained by the manufacturer or certified by a training program approved by the Engineer.
- C. Post-installed anchors and related materials shall be listed by the following agencies:
 1. ICC-ES.
 2. Engineer approved equivalent.

1.3 DEFINITIONS

- A. Adhesive Anchors:
 1. Post-installed anchors developing their strength primarily from chemical bond between the concrete and the anchor.
 2. Includes anchors using acrylics, epoxy and other similar adhesives.
- B. Anchor Bolt: Any cast-in-place anchorage that is made of a headed (i.e. bolt) material.
- C. Anchor Rod: Any cast-in-place or post-installed anchorage made from unheaded, threaded, rod or deformed bar material.
- D. Concrete Anchor: Generic term for either an anchor bolt or an anchor rod.
- E. Galvanizing: Hot-dip galvanizing per ASTM A123, ASTM A153 or ASTM F2329 with minimum coating of 2.0 OZ of zinc per square foot of metal (average of specimens) unless noted otherwise or dictated by standard.
- F. Hardware: As defined in ASTM F2329.
- G. Installer or Applicator:
 1. Installer or applicator is the person actually installing or applying the product in the field at the Project site.
 2. Installer and applicator are synonymous.
- H. MPII: Manufacturer's printed installation instructions.
- I. Mechanical Anchors:
 1. Post-installed anchors developing their strength from attachment other than thru adhesives or chemical bond to concrete.
 2. Includes expansion anchors, expansion sleeve, screw anchors, undercut anchors, specialty inserts and other similar types of anchorages.
 3. Drop-in anchors and other similar anchors are not allowed.
- J. Post-Installed Anchor: Any adhesive or mechanical anchor installed into previously placed and adequately cured concrete.

1.4 SUBMITTALS

- A. Shop Drawings:
 1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
 2. Product technical data including:
 - a. Acknowledgement that submitted products meet requirements of referenced standards.
 - b. Manufacturer material data sheet for each anchor.
 - 1) Clearly indicate which products on the data sheet are proposed for use on the Project.
 - c. Manufacturer's printed installation instructions.

- d. Current ICC-ES report for each post-installed anchor system indicating the following:
 - 1) Certification that anchors meet all requirements indicated in this Specification.
 - 2) Performance data showing that anchor is approved for use in cracked concrete.
 - 3) Seismic design categories for which anchor system has been approved.
 - 4) Required installation procedures.
 - 5) Special inspection requirements for installation.
 - e. Anchorage layout drawings and details:
 - 1) Indicate anchor diameter, embedment, length, anchor type, material and finish.
 - 2) Drawings showing location, configuration, spacing and edge distance.
 - f. Contractor Designed Post-Installed Anchors:
 - 1) Show diameter and embedment depth of each anchor.
 - 2) Indicate compliance with ACI 318, Chapter 17.
 - 3) Design tension and shear loads used for anchor design.
 - 4) Engineering design calculations:
 - a) Indicate design load to each anchor.
 - b) When the design load is not indicated on Drawings, include calculations to develop anchor forces based on Design Criteria listed herein.
 - c) Sealed and signed by contractor's professional [structural] engineer.
 - d) Calculations will be submitted for information purposes only.
 - 5) Type of post-installed anchor system used.
 - a) Provide manufacturer's ICC-ES report for the following:
 - (1) Mechanical anchorage per ICC-ES AC193.
 - (2) Adhesive anchorage per ICC-ES AC308.
- B. Samples:
- 1. Representative samples of concrete anchors may be requested by Engineer. Review will be for type and finish only. Compliance with all other requirements is exclusively the responsibility of the Contractor.
- C. Informational Submittals:
- 1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
 - 2. Certification of qualifications for each installer of post-installed anchors.
 - a. Indicate successful completion or certification for each type of approved post-installed anchor as required by the Contract Documents.
 - b. Provide one of the following for each type of anchor, as required by this specification section:
 - 1) Letter from manufacturer documenting successful training completion [for mechanical anchors only].
 - 2) Certification of completion for Engineer approved program.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to job site in manufacturer's or distributor's packaging undamaged and complete with installation instructions.
- B. Store above ground on skids or other supports to keep items free of dirt and other foreign debris and to protect against corrosion.
- C. Protect and handle materials in accordance with manufacturer's recommendations to prevent damage or deterioration.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Cast-in-place Concrete Anchors:
 - 1. Building, nonbuilding structures, and equipment:
 - a. ASTM F1554, Grade 36 or Grade 55 with weldability supplement S1 for galvanized threaded rods.
 - b. ASTM A307, Grade A for galvanized headed bolts.
 - 2. All other cast-in-place concrete anchors:
 - a. Stainless steel with matching nut and washer.
 - b. Submerged application: ASTM F593, Type 316.
 - c. Non-submerged application: ASTM F593, Type 304 or Type 316.
- B. Post-Installed Mechanical and Adhesive Concrete Anchors:
 - 1. Stainless steel with matching nut and washer.
 - 2. Submerged application: ASTM F593, Type 316.
 - 3. Non-submerged application: ASTM F593, Type 304 or Type 316.
- C. Reinforcement: See Section 03 21 00.
- D. Headed Studs: ASTM A108 with a minimum yield strength of 50,000 PSI and a minimum tensile strength of 60,000 PSI.
- E. Deformed Bar Anchors: ASTM A496 with minimum yield strength of 70,000 PSI and a minimum tensile strength of 80,000 PSI.
- F. Washers:
 - 1. ASTM F436 unless noted otherwise.
 - 2. If stainless steel anchorage is being used for cast-in-place anchorage, furnish washers of the same material and alloy as in the accompanying anchorage.
 - 3. Plate washers: Minimum 1/2 IN thick fabricated ASTM A36 square plates as required.
 - 4. Follow manufacturer's requirements for all post-installed anchorage.
- G. Nuts:
 - 1. ASTM A563 for all cast-in-place anchorage.
 - 2. If stainless steel anchorage is being used for cast-in-place anchorage, nuts shall meet ASTM F594 and be the matching material and alloy as in the accompanying anchorage.
 - 3. Follow manufacturer's requirements if using post-installed anchorage.
- H. Galvanizing Repair Paint:
 - 1. High zinc dust content paint for reglvanizing welds and abrasions.
 - 2. ASTM A780.
 - 3. Zinc content: Minimum 92 PCT in dry film.
 - 4. ZRC "ZRC Cold Galvanizing" or Clearco "High Performance Zinc Spray."
- I. Dissimilar Materials Protection: See Specification Section 09 96 00.

2.2 CONTRACTOR DESIGNED ANCHORAGE

- A. Manufacturers:
 - 1. Post-installed anchor systems for the listed manufacturers will be considered only if a current ICC-ES evaluation report is submitted in accordance with the SUBMITTALS Article in PART 1 of this Specification Section and if the anchor system is approved by the Engineer.
 - a. Hilti.
 - b. Dewalt.
 - c. Simpson Strong-Tie.
 - 2. Submit request for substitution in accordance with Specification Section 01 25 13.

- B. Design the anchorage when any of the following occur:
 - 1. Design load for concrete anchorage is shown on the Drawings.
 - 2. When specifically required by the Contract Documents.
 - 3. When an anchorage is required but not specified in the Drawings.
 - 4. When an anchorage is shown on Drawings other than Structural Drawings.
- C. Anchorage Design Loads:
 - 1. Determine all of the design loads, including wind and seismic loads, per the building code.
 - a. Anchorage of equipment and non-structural components: Use the actual dead and operating loads provided by the manufacturer.
- D. When Contract Drawings, other than the Structural Drawings, indicate an anchor diameter or length, the Contractor design shall incorporate these as “minimums.”
- E. Cast-in-Place Concrete Anchors:
 - 1. Provide the material, nominal diameter, embedment length, spacing, edge distance and design capacity to resist the calculated load based on the requirements given in the building code.
 - 2. Design assuming cracked concrete.
- F. Post-installed Concrete Anchors:
 - 1. Provide the manufacturer’s system name/type, nominal diameter, embedment depth, spacing, minimum edge distance, cover, and design capacity to resist the specified [or calculated] load based on requirements given in the building code, ACI 318, Chapter 17, and current ICC-ES report, for the anchor to be used.
 - 2. Design assuming cracked concrete.

2.3 ENGINEER DESIGNED ANCHORAGE

- A. When the size, length and details of anchorages are shown on Contract Structural Drawings, Contractor design of anchorage is not required.
- B. Manufacturers:
 - 1. Additional newer post-installed anchor systems for the listed manufacturers will be considered only if a current evaluation agency report is submitted in accordance with the SUBMITTALS Article in PART 1 of this Specification Section, the anchor system is certified by ICC-ES for cracked concrete conditions, and if approved by the Engineer.
 - 2. Mechanical Anchors:
 - a. Hilti:
 - 1) Kwik Bolt TZ (ICC-ES ESR-1917).
 - 3. Adhesive Concrete Anchors:
 - a. Hilti:
 - 1) HIT RE 500 V3 (ICC-ES ESR-3814).
 - 4. Concrete Screw Anchors:
 - a. Hilti:
 - 1) Kwik HUS-EZ Screw (ICC-ES ESR-3027).
 - 5. Submit request for substitution in accordance with Specification Section 01 25 13.
 - a. Substitution request to indicate the proposed anchor has the at least the same tension and shear strength as the specified anchor installed as indicated in the Contract Drawings.
 - b. Calculations to be stamped by a Professional Structural Engineer registered in Washington State.

PART 3 - EXECUTION

3.1 GENERAL

- A. Cast-in-Place Anchorage:
 - 1. Use where anchor rods or bolts are indicated on the Drawings, unless another anchor type is approved by the Engineer.
 - 2. Provide concrete anchorage as shown on the Drawings or as required to secure components to concrete.
- B. Adhesive Anchorage:
 - 1. Use only where specifically indicated on the Drawings or when approved for use by the Engineer.
 - 2. May be used where subjected to vibration or where buried or submerged.
 - 3. Do not use in overhead applications or sustained tension loading conditions such as utility hangers.
 - 4. Contact Engineer for clarification when anchors will not be installed in compliance with manufacturer's printed installation requirements.
- C. Mechanical Anchorage:
 - 1. Use only where specifically indicated on the Drawings or when approved for use by the Engineer.
 - 2. Do not use where subjected to vibration.
 - 3. May be used in overhead applications.
 - 4. Contact Engineer for clarification when anchors will not be installed in compliance with manufacturer's printed installation requirements.
- D. Do not use powder actuated fasteners and other types of bolts and fasteners not specified herein for structural applications unless approved by the Engineer or specified in Contract Documents.

3.2 PREPARATION

- A. Provide adequate time to allow for proper installation and inspection prior to placing concrete for cast-in-place concrete anchorage.
- B. Prior to installation, inspect and verify areas and conditions under which concrete anchorage is to be installed.
 - 1. Notify Engineer of conditions detrimental to proper and timely completion of work.
 - 2. Do not proceed with work until unsatisfactory conditions have been corrected in a manner acceptable to the Engineer.
- C. Special Inspection is required in accordance with the building code for all concrete anchorage.
 - 1. Notify the Special Inspector that an inspection is required prior to concrete placement (or during post-installed anchorage installation).
 - 2. See the FIELD QUALITY CONTROL Article in PART 3 of this Specification Section for additional requirements.
- D. Post-installed anchor manufacturer's representative shall demonstrate and observe the proper installation procedures for the post-installed anchors at no additional expense to the Owner.
 - 1. Follow such procedures to assure acceptable installation.
 - 2. Adhesive anchors must be installed in concrete aged a minimum of 21 days.

3.3 INSTALLATION

- A. Tie cast-in-place anchorage in position to embedded reinforcing steel using wire.
 - 1. Tack welding of anchorage is prohibited.
 - 2. Coat the projected portion of carbon steel anchors and nut threads with a heavy coat of clean grease after concrete has cured.
 - 3. Anchorage location tolerance shall be in accordance with AISC 303.

4. Provide steel or durable wood templates for all column and equipment anchorage.
 - a. Templates to be placed above top of concrete and not impede proper concrete placement and consolidation.
- B. Unless noted or specified otherwise:
 1. Connect aluminum and steel members to concrete and masonry using stainless steel cast-in-place anchorage unless shown otherwise.
 - a. Provide dissimilar materials protection per Specification Section 09 96 00.
 2. Provide washers for all anchorage.
 3. Where exposed, extend threaded anchorage a minimum of 1/2 IN above the top of the fully engaged nut.
 - a. If anchorage is cut off to the required maximum height, threads must be dressed to allow nuts to be removed without damage to the nuts.
- C. Do the following after nuts are snug-tightened down:
 1. If using post-installed anchorage, follow MPII.
 2. Upset threads of anchorage to prevent nuts from backing off.
 - a. Provide double nut or lock nut in lieu of upset threads for items that may require removal in the future.
 3. For all other cast-in-place anchorage material, tighten nuts down an additional 1/8 turn to prevent nuts from backing off.
 4. If two nuts are used per concrete anchor above the base plate, tighten the top nut an additional 1/8 turn to "lock" the two nuts together.
 5. If using post-installed anchorage, follow manufacturer's installation procedures.
- D. Assure that embedded items are protected from damage and are not filled in with concrete.
- E. Secure architectural components such that it will not be aesthetically distorted nor fasteners overstressed from expansion, contraction or installation.
- F. Coat aluminum surfaces in contact with dissimilar materials in accordance with Specification Section 09 96 00.
- G. Repair damaged galvanized surfaces in accordance with ASTM A780.
 1. Prepare damaged surfaces by abrasive blasting or power sanding.
 2. Apply galvanizing repair paint to minimum 6 mils DFT in accordance with manufacturer's instructions and ASTM A780.
- H. For post-installed anchors, comply with the MPII on the hole diameter and depth required to fully develop the tensile strength of the anchor or reinforcing bar.
 1. Use hammer drills to create holes.
 2. Properly clean out the hole per the ICC-ES reports utilizing a non-metallic fiber bristle brush and compressed air or as otherwise required to remove all loose material from the hole prior to installing the anchor in the presence of the Special Inspector.

3.4 FIELD QUALITY CONTROL

- A. Special Inspection:
 1. See Section 01 45 33.
 2. See Section 03 05 05.

3.5 CLEANING

- A. After concrete has been placed, remove protection and clean all anchorage of all concrete, dirt, and other foreign matter.
- B. Provide surface acceptable to receive field applied paint coatings when specified in Specification Section 09 96 00.

END OF SECTION

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SECTION 03 21 00

REINFORCEMENT

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Reinforcing bar requirements for concrete construction.
- B. Related Specification Sections include but are not necessarily limited to:
 - 1. Division 00 - Procurement and Contracting Requirements.
 - 2. Division 01 - General Requirements.
 - 3. Section 03 05 05 - Concrete Testing and Inspection.
 - 4. Section 03 15 19 - Anchorage to Concrete.

1.2 QUALITY ASSURANCE

- A. Referenced Standards:
 - 1. American Concrete Institute (ACI):
 - a. SP 66, ACI Detailing Manual.
 - b. 117, Specification for Tolerances for Concrete Construction and Materials.
 - c. 315, Manual of Standard Practice for Detailing Reinforced Concrete Structures.
 - d. 318, Building Code Requirements for Structural Concrete.
 - 2. ASTM International (ASTM):
 - a. A36, Standard Specification for Carbon Structural Steel.
 - b. A276, Standard Specification for Stainless Steel Bars and Shapes.
 - c. A615, Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.
 - d. A706, Standard Specification for Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement.
 - e. A970, Standard Specification for Headed Steel Bars for Concrete Reinforcement.
 - f. A1064, Standard Specification for Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete.
 - 3. Concrete Reinforcing Steel Institute (CRSI):
 - a. Manual of Standard Practice.

1.3 SUBMITTALS

- A. Shop Drawings:
 - 1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
 - 2. Product technical data including:
 - a. Acknowledgement that products submitted meet requirements of standards referenced.
 - b. Manufacturer's installation instructions.
 - c. Mill certificates for all reinforcing.
 - d. Manufacturer and type of proprietary reinforcing mechanical splices.
 - 3. Qualifications of welding operators, welding processes and procedures.
 - 4. Reinforcing number, sizes, spacing, dimensions, configurations, locations, mark numbers, lap splice lengths and locations, concrete cover and reinforcing supports.
 - 5. Sufficient reinforcing details to permit installation of reinforcing.
 - 6. Reinforcing details in accordance with ACI SP 66 and ACI 315.
 - 7. Locations where proprietary reinforcing mechanical splices are required or proposed for use.

8. Shop Drawings shall be in sufficient detail to permit installation of reinforcing without reference to Contract Drawings.
 - a. Shop Drawings shall not be prepared by reproducing the plans and details indicated on the Contract Drawings but shall consist of completely redrawn plans and details as necessary to indicate complete fabrication and installation of all reinforcing steel.
 - b. Where multiple types of supports for reinforcing steel (such as chairs, runners, bolsters, and other types of supports) will be used in the Work, clearly indicate on the Shop Drawings the support types and materials of supports.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Support and store all reinforcing above ground.
- B. Ship to jobsite with attached plastic or metal tags with permanent mark numbers which match the Shop Drawing mark numbers.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURES

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
 1. Reinforcing adhesive anchors:
 - a. See Specification Section 03 15 19.
 2. Reinforcing mechanical splices:
 - a. Lenton Rebar Splicing by Erico, Inc.
 - b. Richmond dowel bar splicer system by Richmond Screw and Anchor Co., Inc.
 - c. Bar-Grip Systems by Barsplice Products, Inc.
- B. Submit request for substitution in accordance with Specification Section 01 25 13.

2.2 MATERIALS

- A. Reinforcing Bars: ASTM A615, grade 60, deformed.
- B. Reinforcing Bars to be Welded: ASTM A706, Grade 60, deformed.
- C. Welded Wire Reinforcement: ASTM A1064 or ASTM A1022 where noted on Drawings.
- D. Smooth Dowel Bars:
 1. Water containing structures: ASTM A276, Type 316.
 2. All other locations: ASTM A36, with metal end cap to allow longitudinal movement equal to joint width plus 1 IN.
- E. Proprietary Reinforcing Mechanical Splices: To develop in tension and compression a minimum of 125 PCT of the yield strength of the reinforcing bars being spliced.
- F. Headed Deformed Bars:
 1. ASTM A970.
- G. Reinforcing Adhesive Anchors:
 1. See Specification 03 15 19.

2.3 ACCESSORIES

- A. Chairs, Runners, Bolsters, Spacers, Hangers, and Other Reinforcing Supports:
 1. Metal fabrications with plastic-coated tips in contact with forms.
 - a. Plastic coating meeting requirements of CRSI Manual of Standard Practice.
 2. All plastic construction meeting the requirements of CRSI Manual of Standard Practice.
 - a. 100 PCT non-metallic, non-corrosive.
 - b. Required for all walls and elevated construction exposed to liquid containing structures.
- B. Protective plastic caps at mechanical splices.

2.4 FABRICATION

- A. Tolerances:
 - 1. Conforms to ACI 117, except as modified herein.
 - 2. Sheared lengths: +1 IN.
 - 3. Overall dimensions of stirrups, ties and spirals: +1/2 IN.
 - 4. All other bends: +0 IN, -1/2 IN.
- B. Minimum diameter of bends measured on the inside of the reinforcing bar to be as indicated in ACI 318 Paragraph 7.2.
- C. Ship reinforcing to jobsite with attached plastic or metal tags.
 - 1. Place on each tag the mark number of the reinforcing corresponding to the mark number indicated on the Shop Drawing.
 - 2. Mark numbers on tags to be so placed that the numbers cannot be removed.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Tolerances:
 - 1. Conform to ACI 117, except as modified herein.
 - 2. Reinforcing placement:
 - a. Clear distance to formed surfaces: +1/4 IN.
 - b. Minimum spacing between bars: -1/4 IN.
 - c. Top bars in slabs and beams:
 - 1) Members 8 IN deep or less: +1/4 IN.
 - 2) Members between 8 IN and 2 FT deep: -1/4 IN, +1/2 IN.
 - 3) Members more than 2 FT deep: -1/4 IN, +1 IN.
 - d. Crosswise of members: Spaced evenly within +1 IN.
 - e. Lengthwise of members: +2 IN.
 - 3. Minimum clear distances between reinforcing bars:
 - a. Beams, walls and slabs: Distance equal to bar diameter or 1 IN, whichever is greater.
 - b. Columns: Distance equal to 1-1/2 times the bar diameter or 1-1/2 IN, whichever is greater.
 - c. Beam and slab reinforcing shall be threaded through the column vertical rebars without displacing the column vertical bars and still maintaining the clear distances required for the beam and slab reinforcing bars.
- B. Minimum concrete protective covering for reinforcement: As shown on Drawings.
- C. Unless indicated otherwise on Drawings, provide splice lengths for reinforcing as follows:
 - 1. For reinforcing: Class B splice meeting the requirements of ACI 318 (Mechanical Building) or ACI 350 (Digester 4).
 - 2. For welded wire reinforcement:
 - a. Splice lap length measured between outermost cross wires of each fabric sheet shall not be less than one spacing of cross wires plus 2 IN, nor less than 1.5 x development length nor less than 6 IN.
 - b. Development length shall be as required for the yield strength of the welded wire reinforcement in accordance with ACI 318 (Mechanical Building) or ACI 350 (Digester 4).
 - 3. Provide splices of reinforcing not specifically indicated or specified subject to approval of Engineer.
 - a. Mechanical proprietary splice connectors may only be used when approved or indicated on the Contract Drawings.
- D. Welding:
 - 1. Welding reinforcing is not permitted.

- E. Placing Reinforcing:
1. Assure that reinforcement at time concrete is placed is free of mud, oil or other materials that may affect or reduce bond.
 2. Reinforcement with rust, mill scale or a combination of both will be accepted as being satisfactory without cleaning or brushing provided dimensions and weights including heights of deformations on a cleaned sample is not less than required by applicable ASTM specification that governs for the reinforcing supplied.
 3. Reinforcing support:
 - a. Uncoated reinforcing:
 - 1) Support reinforcing and fasten together to prevent displacement by construction operations.
 - a) Locate and support reinforcement with bar supports to maintain minimum concrete cover.
 - b) Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.
 - c) Reinforcement shown on the Contract Documents may not be repositioned for use as a support for reinforcement. Additional drop bars may be provided for support of reinforcing.
 - 2) Reinforcing supported on ground:
 - a) Slab on grade and other members with only one mat of reinforcing:
 - (1) Provide metal bar supports with bottom plate.
 - (2) Do not use concrete blocks to support slab-on-grade reinforcing.
 - b) All other members: Provide supporting concrete blocks or metal bar supports with bottom plate.
 - 3) Reinforcing supported on formwork:
 - a) Concrete surfaces in contact with or over process liquid: All-Plastic chairs, runners and bar supports.
 - b) All other formed surfaces:
 - (1) Provide plastic-coated metal chairs, runners, bolsters, spacers, hangers and other reinforcing support.
 - (2) Only tips in contact with the forms need to be plastic coated.
 4. Support reinforcing over cardboard void forms by means of concrete supports which will not puncture or damage the void forms during construction nor impair the strength of the concrete members in any way.
 5. Where parallel horizontal reinforcement in beams is indicated to be placed in two or more layers, bars in the upper layers shall be placed directly above bars in the bottom layer with clear distance between layers to be 1 IN.
 - a. Place spacer bars at 3 FT maximum centers to maintain the required 1 IN clear distance between layers.
 6. Extend reinforcement to within 2 IN of concrete perimeter edges.
 - a. If perimeter edge is formed by earth or stay-in-place forms, extend reinforcement to within 3 IN of the edge.
 7. To assure proper placement, furnish templates for all column vertical bars and dowels.
 8. Do not bend reinforcement after embedding in hardened concrete unless approved by Engineer.
 - a. Do not bend reinforcing by means of heat.
 9. Do not tack weld reinforcing.
 10. Embed reinforcing into hardened concrete utilizing a adhesive anchor system specifically manufactured for such installation:
 - a. See Specification Section 03 15 19.

3.2 FIELD QUALITY CONTROL

- A. Reinforcement Congestion and Interferences:
 - 1. Notify Engineer whenever the specified clearances between bars cannot be met.
 - 2. Do not place any concrete until the Engineer submits a solution to reinforcing congestion problem.
 - 3. Reinforcing may be moved as necessary to avoid interference with other reinforcing steel, conduits, or embedded items.
 - 4. If bars are moved more than one bar diameter, obtain Engineer's approval of resulting arrangement of reinforcing.
 - 5. No cutting of reinforcing shall be done without written approval of Engineer.
- B. Special Inspection:
 - 1. See Section 01 45 33.
 - 2. See Section 03 05 05.

END OF SECTION

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SECTION 03 31 30
CONCRETE, MATERIALS AND PROPORTIONING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Concrete materials, strengths and proportioning for concrete work.
 - 2. Grouting:
 - a. Base plates for columns and equipment.
 - b. As specified and indicated in the Contract Document.
- B. Related Specification Sections include but are not necessarily limited to:
 - 1. Division 00 - Procurement and Contracting Requirements.
 - 2. Division 01 - General Requirements.
 - 3. Section 03 05 05 - Concrete Testing and Inspection.
 - 4. Section 03 15 19 - Anchorage to Concrete.
 - 5. Section 03 31 31 - Concrete Mixing, Placing, Jointing, and Curing.
 - 6. Section 03 41 33 - Precast and Prestressed Concrete.

1.2 QUALITY ASSURANCE

- A. Referenced Standards:
 - 1. American Concrete Institute (ACI):
 - a. CT-13, Concrete Terminology.
 - b. 211.1, Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete.
 - c. 212.3R, Chemical Admixtures for Concrete.
 - d. 232.2R, Use of Fly Ash in Concrete.
 - e. 350, Code Requirements for Environmental Engineering Concrete Structures.
 - 2. ASTM International (ASTM):
 - a. C33, Standard Specification for Concrete Aggregates.
 - b. C39, Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.
 - c. C94/C94M, Standard Specification for Ready-Mixed Concrete.
 - d. C150, Standard Specification for Portland Cement.
 - e. C157, Standard Test Method for Length Change of Hardened Hydraulic-Cement, Mortar, and Concrete.
 - f. C192, Standard Practice for Making and Curing Concrete Test Specimens in the Laboratory.
 - g. C260, Standard Specification for Air-Entraining Admixtures for Concrete.
 - h. C227, Standard Test Method for Potential Alkali Reactivity of Cement-Aggregate Combinations (Mortar-Bar Method).
 - i. C494, Standard Specification for Chemical Admixtures for Concrete.
 - j. C618, Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete.
 - k. C1107, Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Non-shrink).
 - l. C1116, Standard Specification for Fiber-Reinforced Concrete.
 - m. C1260, Standard Test Method for Potential Alkali Reactivity of Aggregates (Mortar-Bar Method).
 - n. C1293, Standard Test Method for Determination of Length Change of Concrete Due to Alkali-Silica Reaction.
 - o. C1399, Standard Test Method for Obtaining Average Residual-Strength of Fiber-Reinforced Concrete.

- p. C1567, Standard Test Method for Determining the Potential Alkali-Silica Reactivity of Combinations of Cementitious Materials and Aggregate (Accelerated Mortar-Bar Method).
- q. C1609, Standard Test Method for Flexural Performance of Fiber-Reinforced Concrete (Using Beam with Third-Point Loading).
- 3. Steel Deck Institute (SDI):
 - a. 31, Design Manual for Composite Decks, Form Decks and Roof Decks.

1.3 DEFINITIONS

- A. Words and terms used in these Specifications are defined in ACI CT-13.
- B. Water-Bearing Concrete: Any concrete surface to be in contact with process fluids during normal operation of the facility, including, but not limited to, tank, channels, wet wells, and distribution chambers.
- C. Supplementary Cementitious Materials (SCM): Fly ash, silica fume and ground granulated blast furnace slag.

1.4 SUBMITTALS

- A. Shop Drawings:
 - 1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
 - 2. Product technical data including:
 - a. Acknowledgement that products submitted meet requirements of standards referenced.
 - b. Manufacturer's instructions.
 - c. Concrete mix designs as required by Specification Section 03 05 05.
 - d. Manufacturer and type of proposed admixtures.
 - e. Manufacturer and type of proposed non-shrink grout and grout cure/seal compound.
 - 3. Certifications:
 - a. Certification of standard deviation value in psi for ready mix plant supplying the concrete.
 - b. Certification that the SCM meet the quality requirements stated in this Specification Section, and SCM supplier's certified test reports for each shipment of SCM delivered to concrete supplier.
 - c. Certification that the class of coarse aggregate meets the requirements of ASTM C33 for type and location of concrete construction.
 - d. Certification of aggregate gradation.
 - e. Certification of coarse aggregate impurities as relates to alkali-silica reactivity per ASTM C33, Appendix X.
 - f. Certification of shrinkage test results.
 - 4. Test reports:
 - a. Cement and SCM mill reports for all cement to be supplied.
 - b. Provide test results for alkali-silica reactive impurities on coarse aggregates per referenced ASTM standards.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Storage of Materials:
 - 1. Store cement and SCM in weathertight buildings, bins, or silos which will exclude moisture and contaminants.
 - 2. Arrange aggregate stockpiles and use in a manner to avoid excessive segregation and to prevent contamination with other materials or with other sizes of like aggregates.
 - 3. Allow natural sand to drain until it has reached a relatively uniform moisture content before use.
 - 4. Do not use frozen or partially frozen aggregates.
 - 5. Do not use bottom 6 IN layer of stockpiled material in contact with ground.

6. Store admixtures in such a manner as to avoid contamination, evaporation, or damage.
 - a. For those used in form of suspensions or non-stable solutions, provide a gitating equipment to assure thorough distribution of ingredients.
 - b. Protect liquid admixtures from freezing and temperature changes which would adversely affect their characteristics and performance.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with the Contract Documents, the manufacturers are acceptable:
 1. Non-shrink grout:
 - a. BASF Corporation.
 - b. Euclid Chemical Company.
 - c. Five Star Products, Inc.
 2. Epoxy grout:
 - a. BASF Corporation.
 - b. Five Star Products, Inc.
 - c. Euclid Chemical Company.
 - d. Sika Corporation.
 3. Synthetic fibers:
 - a. GCP Applied Technologies, Inc.
 - b. BASF Corporation.
 - c. Euclid Chemical Company.
- B. Submit request for substitution in accordance with Specification Section 01 25 13.

2.2 MATERIALS

- A. Cement:
 1. ASTM C150, Type I for the Mechanical Building and Type II or Type IL for Digester 4.
 2. Cement type used shall correspond to that upon which selection of concrete proportions was based in the mix design.
- B. SCM:
 1. Fly Ash:
 - a. ASTM C618, Class F or Class C.
 - b. Non-staining.
 - c. Suited to provide hardened concrete of uniform light gray color.
 - d. Compatible with other concrete ingredients and having no deleterious effects on the hardened concrete.
 - e. Produced by source approved by the State Highway Department in the state where the Project is located for use in concrete for bridges.
 - f. Evaluate and use in accordance with ACI 232.2R.
 2. Cement and SCM type used shall correspond to that upon which selection of concrete proportions was based in the mix design.
- C. Admixtures:
 1. Air entraining: ASTM C260.
 2. Water reducing, retarding, and accelerating: Conform to ASTM C494, Types A through E, and provisions of ACI 212.3R.
 3. High range water reducers (superplasticizers): Conform to ASTM C494, Types F or G.
 4. All concrete mixes require the use of water reducers to maintain the specified water-to-cement ratios without additional cement.
 5. SCM: Per above.
 6. Admixtures to be chloride free.
 - a. Do not use calcium chloride.

7. Provide admixtures of same type, manufacturer, and quantity as used in establishing required concrete proportions in the mix design.
 8. Provide admixtures certified by manufacturer to be compatible with other admixtures.
 9. Shrinkage reducing admixtures:
 - a. Admixture used to reduce the shrinkage of Portland Cement concrete.
 - b. Utilize at dosage necessary to help achieve required shrinkage value stated herein.
 - c. Similar to:
 - 1) Eclipse 4500 by GCP Applied Technologies, Inc.
 - 2) Conex by Euclid Chemical Co.
 - 3) MasterLife SRA 20 or MasterLife CRA 007 by BASF Corporation.
- D. Macrosynthetic Fibers:
1. Conform to ASTM C1116.
 2. Dosage to obtain a minimum average residual strength at a net deflection of L/150: PSI in accordance with ASTM C1609 and ASTM C1399.
 3. Acceptable manufacturers:
 - a. MasterFiber MAC Series by BASF Corporation.
 - b. Strux 90/40 by GCP Applied Technologies, Inc.
 - c. Tuf-Strand SF by Euclid Chemical Company.
- E. Microsynthetic Fibers:
1. Conform to ASTM C1116.
 2. Minimum average residual strength at a net deflection of L/150: PSI in accordance with ASTM C1609.
 3. Acceptable manufacturers:
 - a. BASF Corporation; MasterFiber F or M Series.
 - b. Fiberstrand by Euclid Chemical Company.
 - c. Gilco Fibers by GCP Applied Technologies, Inc.
- F. Water:
1. Potable.
 2. Clean and free from deleterious substances.
 3. Free of oils, acids, and organic matter.
- G. Aggregates for Normal Weight Concrete:
1. ASTM C33.
 2. Fine and coarse aggregates to be regarded as separate ingredients.
 3. Provide aggregates approved for bridge construction by the Washington State Department of Transportation.
 4. Coarse aggregate:
 - a. Use only washed aggregates.
 - b. Coarse aggregate sieve analysis:
 - 1) Per Table 1 IN the PART 2 MIXES Article.
 5. Fine aggregates to be natural, not manufactured.
 6. Do not use aggregates that may be deleteriously reactive when combined with alkalis in cement.
 - a. Evaluate proposed aggregates for potential deleterious expansion due to alkali silica reactivity per ASTM C33 (Appendix X), ASTM C227, ASTM C1260, ASTM 1293, or ASTM C1567.
- H. Maximum total chloride ion content for concrete mix including all ingredients measured as a weight percent of cement in accordance with ASTM C1218:
1. Prestressed concrete: 0.06.
 2. All other concrete: 0.10.

- I. Sand Cement Grout (referred to as "Grout" on the Drawings):
 - 1. Approximately three parts sand, one part Portland cement, 6 ± 1 PCT entrained air and water to produce a slump which allows grout to completely fill required areas and surround adjacent reinforcing.
 - a. Provide sand in accordance with requirements for fine aggregate for concrete.
 - 2. Minimum 28 day compressive strength:
 - a. 3000 PSI.
 - b. Shall be at least strength of parent concrete when used at construction joints.
- J. Non-shrink Grout:
 - 1. Non-shrink, nonmetallic, noncorrosive, and nonstaining.
 - a. Conform to ASTM C1107.
 - 2. Premixed with only water to be added in accordance with manufacturer's instructions at jobsite.
 - 3. Grout to produce a positive but controlled expansion.
 - a. Mass expansion shall not be created by gas liberation or by other means.
 - 4. Minimum 28 day compressive strength: 7,000 PSI.
 - 5. Acceptable manufacturers:
 - a. BASF Admixtures, Inc. "Masterflow, 713".
 - b. Euclid Chemical "NS Grout".
 - c. Sika Corporation "Sika Grout 212".
 - d. Sauereisen, Inc. "F-100 Level Fill Grout".
- K. Epoxy Grout:
 - 1. Three-component epoxy resin system:
 - a. Two liquid epoxy components.
 - b. One inert aggregate filler component.
 - 2. Adhesive acceptable manufacturers:
 - a. BASF "Masterflow 648".
 - b. Five Start Products, Inc. "DP Five Start Epoxy Grout."
 - c. Euclid Chemical "E3 Flowable."
 - d. Sika "Sikadur Hi-Mod."
 - 3. Aggregate acceptable manufacturers:
 - a. BASF "Masterflow 648".
 - b. Five Start Products, Inc. "DP Five Start Epoxy Grout."
 - c. Euclid Chemical "Euclid aggregate."
 - d. Sika aggregate.
 - 4. Aggregate manufacturer shall be the same as the adhesive manufacturer.
 - 5. The aggregate shall be compatible with the adhesive.
 - 6. Each component furnished in separate package for mixing at jobsite.
- L. See Specification Section 03 31 31 for Grout Schedule of use.

2.3 MIXES

- A. General:
 - 1. Provide concrete capable of being placed without aggregate segregation and, when cured, of developing all properties specified.
 - 2. Ready-mixed concrete shall conform to ASTM C94/C94M.
 - 3. All concrete to be normal weight concrete, weighing approximately 145 to 150 LBS per cubic foot at 28 days after placement.
- B. Concrete Mixes: Refer to Table 1 below.
- C. Air Entrainment:
 - 1. Provide air entrainment in concrete resulting in a total air content percent by volume per Table 1 below.
 - a. Adjust dosage rate as necessary to compensate for shrinkage reducing admixtures.

- D. Slump:
1. Measure slump at point of discharge into concrete members.
 2. Walls and columns:
 - a. 8 IN maximum, 4 IN minimum measured at the point of discharge into the concrete member.
 - b. Slump shall be obtained by use of mid-range or high-range water reducer conforming to ASTM C494.
 3. All other members:
 - a. Concrete using a water reducer per ASTM C494: 8 IN maximum, 4 IN minimum measured at the point of discharge into the concrete member.
 - b. Concrete without a water reducer per ASTM C494: 5 IN maximum, 1 IN minimum measured at point of discharge into the concrete member.
 4. Concrete of lower than minimum slump may be used provided it can be properly placed and consolidated.
 5. Provide additional water or water reducing admixture at ready mix plant for concrete that is to be pumped to allow for slump loss due to pumping.
 - a. Provide only enough additional water so that slump of concrete at discharge end of pump hose does not exceed maximum slump specified and the maximum specified water-cement ratio is not exceeded.
 6. Slump may be adjusted in the field through the use of water reducers.
 - a. Coordinate dosage and mixing requirements with concrete supplier.
 7. Slump tolerances shall comply with the requirements of ACI 117.
- E. Proportioning:
1. General:
 - a. Proportion ingredients to produce a mixture which will work readily into corners and angles of forms and around reinforcement by methods of placement and consolidation employed without permitting materials to segregate or excessive free water to collect on surface.
 - b. Proportion ingredients to produce proper placability, durability, strength and other required properties.
 2. Normal weight concrete target cementitious materials contents and maximum water cementitious ratios per Table 1 below.
 - a. Target cementitious materials contents are intended to provide a crack free, durable finished product, not one with excessive strength
 3. SCM:
 - a. Fly ash:
 - 1) For cast-in-place concrete only, a maximum of 25 PCT by weight of Portland cement content per cubic yard may be replaced with fly ash at a rate of 1 LB fly ash for 1 LB cement.
 - 2) If fly ash is used, the water to fly ash plus cement ratio not to exceed the maximum water cement ratio specified in this Specification Section.
 - 3) Concrete containing fly ash shall not be used in the construction of the precast concrete units specified in Specification Section 03 41 33.
 4. Water reducing, retarding, and accelerating admixtures:
 - a. Use in accordance with manufacturer's instructions.
 - b. Add to mix at batching plant.
 - c. Use water-reducing or high-range water reducing admixture in concrete, as required, for placement and workability.
 - 1) Water reducers are required to maintain specified maximum water to cement ratios.
 5. High range water reducers (superplasticizers):
 - a. Use required for:
 - 1) All concrete to be pumped except slabs on grade.
 - 2) All concrete for water containing structures.
 - 3) Other concrete members at Contractor's option.

- b. Maximum concrete slump before addition of admixture to be 3 IN maximum slump after addition to be 8 IN.
 - c. Reference Specification Section 03 31 31 for additional requirements.
6. Fiber Reinforcement:
- a. Dosage:
 - 1) Determined by Contractor and concrete supplier as required to meet the specified minimum average residual strength.
 - 2) Per ASTM C1399 and ASTM C1609.
 - 3) Under no circumstances shall dosage be less than:
 - a) 4 LBS per cubic yard when used in concrete slabs on metal deck per SDI 31.
 - b) 3 LBS per cubic yard for all specified locations.
 - b. Provide Micro Fiber in concrete mixtures as indicated on Drawings.
 - c. Use for concrete where indicated on Drawings.
7. Concrete mix proportioning methods for normal weight concrete:
- a. Method 1:
 - 1) Used when combination of materials proposed is to be evaluated and proportions selected to be on a basis of trial mixes.
 - 2) Produce mixes having suitable proportions and consistencies based on ACI 211.1, using at least three different water cement ratios or cement contents which will produce a range of compressive strengths encompassing the required average strength.
 - 3) Design trial mixes to produce a slump within 0.75 IN of maximum specified, and for air entrained concrete, air content within 0.5 PCT specified.
 - 4) For each water cement ratio or cement content, make at least three trial strength tests for specified test age, and cure in accordance with ASTM C192.
 - a) Cylinder size: Per ASTM C31.
 - b) Test for strength at 28 days in accordance with ASTM C39.
 - (1) Quantity of cylinders per trial strength test:
 - (a) 6 IN DIA cylinders: Two.
 - (b) 4 IN DIA cylinders: Three.
 - 5) From results of these tests, plot a curve showing relationship between water cement ratio or cement content and compressive strength.
 - 6) From this curve select water cement ratio or cement content to be used to produce required average strength.
 - 7) Use cement content and mixture proportions such that maximum water cement ratio is not exceeded when slump is maximum specified.
 - 8) Base field control on maintenance of proper cement content, slump, air content and water cement ratio.
 - 9) See paragraph hereafter for definition of required average strength.
 - b. Method 2:
 - 1) In lieu of trial mixes, field test records for concrete made with similar ingredients may be used.
 - 2) Use of proposed concrete mix proportions based on field test records subject to approval by Engineer based on information contained in field test records and demonstrated ability to provide the required average strength.
 - 3) Field test records to represent materials, proportions, and conditions similar to those specified.
 - a) Changes in the materials, proportions and conditions within the test records shall have not been more restricted than those for the proposed concrete mix.
 - b) Field test records shall meet the requirements of ACI 318, Paragraph 5.3.
 - 4) Required concrete proportions may be established by interpolation between the strengths and proportions of two or more test records each of which meets the requirements of this Specification Section.

8. Required average strength to exceed the specified 28 day compressive strength by the amount determined or calculated in accordance with ACI 318, Chapter 5 using the standard deviation of the proposed concrete production facility as described in ACI 318, Chapter 5.
- F. Controlled Low-Strength Material (CLSM):
1. A mixture of cement, fly ash, fine sand, water and air having a consistency which will flow under a very low head.
 2. Approximate quantities of each component per cubic yard of mixed material:
 - a. Cement (Type I or II): 50 LBS.
 - b. Fly ash: 200 LBS.
 - c. Fine sand: 2,700 LBS.
 - d. Water (approximate): 420 LBS.
 - e. Air content (approximate): 10 PCT.
 3. Actual quantities shall be adjusted to provide a yield of 1 CUYD with the materials used.
 4. Approximate compressive strength should be 85 to 175 PSI.
 5. Fine sand shall be an evenly graded material having not less than 95 PCT passing the No. 4 sieve and not more than 5 PCT passing the No. 200 sieve.
- G. Allowable Shrinkage:
1. Per Table 1 when tested in accordance with ASTM C157 at 28 Days.
 2. Continue testing to 64 weeks for informational purposes.

TYPE OF CONCRETE	28 DAY COMPRESSIVE STRENGTH	W/C RATIO	TARGET TOTAL CEMENT	SCM	ASTM C33 Size No.	AIR CONTENT	ALLOWABLE SHRINKAGE LIMIT
Roof slabs: Normal weight precast concrete	5000 PSI	0.42	611		57	4-1/2 to 7-1/2	None
Mechanical Building (slabs): Normal weight concrete w/ power trowel finish	4000 PSI	0.45	564	Note 1	67	0 to 2	0.048 PCT
Digester 4: Normal weight water-bearing concrete	4500 PSI	0.42	564	Note 1	67	4-1/2 to 7-1/2	0.032 PCT
Mechanical Building (formed surfaces): Normal weight all other concrete	4000 PSI	0.45	564	Note 1	57	4-1/2 to 7-1/2	0.048 PCT

Notes:

1. If fly ash or GGBFS is proposed for use, the weight of fly ash plus weight of Portland cement shall be used to meet total target cement requirement.

2.4 SOURCE QUALITY CONTROL

- A. To assure stockpiles are not contaminated or materials are segregated, perform any test for determining conformance to requirements for cleanness and grading on samples secured from aggregates at point of batching.

PART 3 - EXECUTION

3.1 FIELD QUALITY CONTROL

- A. Special Inspection:
 - 1. See Specification Section 01 45 33.
 - 2. See Specification Section 03 05 05.
- B. Perform concrete tests per Specification Section 03 05 05.
 - 1. Perform a strength test on all concrete to which water or superplasticizer, above the amount stated in the approved concrete mix design, has been added.
 - a. Perform sampling after water or superplasticizer has been added and additional mixing has been performed.

END OF SECTION

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. SECTION 03 31 31
CONCRETE MIXING, PLACING, JOINTING, AND CURING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Mixing, placing, jointing, and curing of concrete construction.
- B. Related Specification Sections include but are not necessarily limited to:
 - 1. Division 00 - Procurement and Contracting Requirements.
 - 2. Division 01 - General Requirements.
 - 3. Section 01 45 33 – Special Inspections and Testing Program.
 - 4. Section 03 05 05 - Concrete Testing and Inspection.
 - 5. Section 03 11 13 - Formwork.
 - 6. Section 03 21 00 - Reinforcement.
 - 7. Section 03 31 30 - Concrete, Materials and Proportioning.
 - 8. Section 03 35 00 - Concrete Finishing and Repair of Surface Defects.
 - 9. Section 07 92 00 - Joint Sealants.

1.2 QUALITY ASSURANCE

- A. Referenced Standards:
 - 1. American Concrete Institute (ACI):
 - a. CT-13, Concrete Terminology.
 - b. 117, Specification for Tolerances for Concrete Construction and Materials.
 - c. 304R, Guide for Measuring, Mixing, Transporting and Placing Concrete.
 - d. 304.2R, Placing Concrete by Pumping Methods.
 - e. 305R, Guide to Hot Weather Concreting.
 - f. 305.1, Specification for Hot Weather Concreting.
 - g. 306R, Guide to Cold Weather Concreting.
 - h. 306.1, Standard Specification for Cold Weather Concreting.
 - i. 308.1, Specification for Curing Concrete.
 - j. 309R, Guide for Consolidation of Concrete.
 - k. 318, Building Code Requirements for Structural Concrete and Commentary.
 - l. 350, Code Requirements for Environmental Engineering Concrete Structures.
 - m. 360R, Guide to Design of Slabs-on-Ground.
 - 2. ASTM International (ASTM):
 - a. C94/C94M, Standard Specification for Ready-Mixed Concrete.
 - b. C309, Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
 - c. C1315, Standard Specification for Liquid Membrane-Forming Compounds Having Special Properties for Curing and Sealing Concrete.
 - d. D994, Standard Specification for Preformed Expansion Joint Filler for Concrete (Bituminous Type).
 - e. D1056, Standard Specification for Flexible Cellular Materials-Sponge or Expanded Rubber.
 - f. D1751, Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types).
 - 3. Corps of Engineers (COE):
 - a. CRD-C572, Specifications for Polyvinylchloride Waterstop.
 - 4. National Ready Mixed Concrete Association (NRMCA):
 - a. Checklist for Certification of Ready Mixed Concrete Production Facilities.

- B. Qualifications:
 - 1. Ready Mixed Concrete Batch Plant: Certified by NRMCA.
 - 2. Waterstop manufacturer's representative shall provide on-site training of waterstop installation, field splicing, welding and inspection procedures prior to construction, and at no additional cost to Owner.
- C. Pre-Concreting Conference:
 - 1. A meeting to review the detailed requirements of the Contractor's proposed concrete design mixes, to determine the procedures for producing proper concrete construction, and to clarify the roles of the parties involved shall be held no later than 30 days after the Notice to Proceed.
 - a. Schedule the meeting to occur no later than [five] days in advance of the first scheduled date of concrete placement.
 - 2. All parties involved in the concrete work shall attend the conference, including:
 - a. Contractor's representative.
 - b. Testing laboratory representative/inspectors.
 - c. Concrete subcontractor.
 - d. Reinforcing steel installer.
 - e. Concrete supplier.
 - f. Owner.
 - g. Resident Engineer or Project Representative.
 - h. Design Engineer.
 - i. Building Code Official.
 - 3. The conference shall be held at a mutually agreed upon time and location.
 - 4. The agenda shall include but not be limited to the following:
 - a. Scheduling, sequence and notification of concrete placements.
 - b. Contractor's concrete pre-placement plan checklist.
 - c. Delivery time from batch plant, maximum time in truck, and approved exceptions to the limits.
 - d. Review of approved design mix including the limits of water that can be added and who is authorized to add water, if water has been withheld at the plant.
 - 5. Additional test cylinders for structural elements the Contractor intends to subject to live loads earlier than 28 days.
 - 6. Duties and authority of testing and inspection agency.
 - 7. Curing procedures.
 - 8. Temperature/weather issues.
 - 9. Test cylinder storage and protection.
 - 10. Approval and rejection of work.
 - 11. Mock-up panels as the standard.

1.3 DEFINITIONS

- A. Words and terms used in this Specification Section are defined in ACI CT-13.

1.4 SUBMITTALS

- A. Shop Drawings:
 - 1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
 - 2. Product technical data including:
 - a. Acknowledgement that products submitted meet requirements of standards referenced.
 - b. Manufacturer's installation instructions.
 - 1) Procedure for adding high-range water reducer at the jobsite.
 - c. Scaled (minimum 1/8 IN per foot) drawings showing proposed locations of construction joints, control joints, expansion joints (as applicable) and joint profile dimensions for each joint type.

- d. Manufacturers and types:
 - 1) Joint fillers.
 - 2) Curing agents.
 - 3) Construction joint bonding adhesive.
 - 4) Waterstops.
- 3. Certifications:
 - a. Ready mix concrete plant certification.
- B. Informational Submittals:
 - 1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
 - 2. Copies of concrete delivery tickets.
 - 3. Description of proposed curing methods.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Concrete Delivery:
 - 1. Prepare a delivery ticket for each load of ready mixed concrete.
 - 2. Truck operator shall hand ticket to Contractor at the time of delivery.
 - 3. Ticket to show:
 - a. Mix identification.
 - b. Quantity delivered.
 - c. Amount of material in each batch.
 - d. Outdoor temperature in the shade.
 - e. Time at which cement was added.
 - f. Time of delivery.
 - g. Time of discharge.
 - h. Amount of water that may be added at the site without exceeding the specified water-cement ratio.
 - i. Amount of any approved water added at the site.

1.6 PROJECT CONDITIONS

- A. Adjust concrete mix design when material characteristics, job conditions, weather, strength test results or other circumstances warrant.
 - 1. Do not use revised concrete mixes until submitted to and approved by Engineer.

1.7 SEQUENCING AND SCHEDULING

- A. Do not begin concrete production until proposed concrete mix design has been approved by Engineer.
 - 1. Approval of concrete mix design does not relieve Contractor of his responsibility to provide concrete that meets the requirements of the Contract Documents.

PART 2 - PRODUCTS

2.1 PRODUCTS

- A. Subject to compliance with the Contract Documents, the manufacturers listed in this article are acceptable.
- B. Neoprene Expansion Joint Fillers:
 - 1. Acceptable manufacturers:
 - a. Permaglaze.
 - b. Rubatex.
 - c. Williams Products.
 - 2. Materials:
 - a. Closed cell neoprene.
 - b. ASTM D1056, Type 2, Class A or C.

- c. Grade: Compression deflection as required to limit deflection to 25 PCT of joint thickness under pressure from concrete pour height.
- C. Asphalt Expansion Joint Fillers:
- 1. Acceptable manufacturers:
 - a. W.R Meadows.
 - b. J and P Petroleum Products.
 - 2. Materials: ASTM D994.
- D. Fiber Expansion Joint Fillers:
- 1. Materials: ASTM D1751.
- E. Waterstops, PVC Type:
- 1. Acceptable manufacturers:
 - a. Sika Greenstreak Plastic Products.
 - b. W.R Meadows.
 - c. Vinylex Corporation.
 - d. Bometals, Inc.
 - 2. Materials:
 - a. Virgin polyvinyl chloride compound not containing any scrap or reclaimed materials or pigment.
 - b. Cast-in-place type: COE CRD-572.
 - 3. Approved profiles as listed.
 - a. Construction joints:
 - 1) Ribbed: 6 IN wide by 3/8 IN.
 - 2) Sika Greenstreak Plastic Products Style #679, or equal.
 - b. Control joints:
 - 1) 6 IN wide by 3/8 IN thick with ribs and center bulb.
 - 2) Sika Greenstreak Plastic Products Style #705, or equal.
 - c. Expansion joint:
 - 1) 9 IN wide by 3/8 IN thick center bulb 2 inch OD.
 - 2) Sika Greenstreak Plastic Products Style #739, or equal.
 - 4. Provide factory-made waterstop fabrications at all changes in direction, intersections and transitions, leaving only straight butt splices for the field. Butt welds to be a minimum 6 IN clear of the intersection.
 - 5. Factory prepunched (less than 18 IN centers, each edge, staggered) for wire supports.
 - a. Provide hog rings or grommets at all punched holes along the length of the waterstop.
 - 6. See Drawings for application and other requirements.
- F. Waterstops, Prefomed Strip Type:
- 1. Acceptable manufacturers:
 - a. Sika Greenstreak Plastics, Inc. (Hydrotite).
 - b. Adeka Ultra Seal USA (MC-2010MN).
 - c. DeNeef (Swellseal 2010).
 - 2. Hydrophilic, non-bentonite composition.
 - 3. Manufactured solely for the purpose of preventing water from traveling through construction joints.
 - 4. Volumetric expansion limited to 3 times maximum.
 - 5. See Drawings for application and other requirements.
- G. Water Swelling Sealant:
- 1. Required adhesive for use with strip-type waterstop.
 - 2. Compatible with strip-type waterstop.
 - 3. Single component, gun applied.
 - 4. Moisture cured.
 - 5. Minimum 70 PCT volumetric expansion swelling capability.

- H. Curing Products to conform to one or more of the following:
1. Absorbent Covers.
 2. Moisture Retaining Covers.
 - a. Moisture Retaining Fabric.
 3. Dissipating curing compound:
 - a. Fugitive dye, waterborne, membrane-forming.
 - b. ASTM C309, Type 1D, Class A or B, shall be composed of hydrocarbon resins, and dissipating agents that begin to break down upon exposure to UV light, and traffic, approximately four to six weeks after applications, providing a film that is removable with standard degreasing agents, and mechanized scrubbing actions so as to not impair the later addition and performance of applied finishes.
 - c. Acceptable Products:
 - 1) Dayton Superior Corporation; Day Chem Rez Cure (J-11-WD).
 - 2) Euclid Chemical Company (The); Kurez DR VOX.
 - 3) L&M Construction Chemicals, Inc.; L&M Cure R.
 4. Clear, water-borne, membrane-forming curing and sealing compound:
 - a. ASTM C1315, Type 1, Class A.
 - b. Moisture loss shall be not more than 0.40 KG/M² when applied at 300 SQFT/GAL.
 - c. Manufacturer's certification is required.
 - d. Subject to project requirements, provide one of the following products:
 - e. Products:
 - 1) Euclid Chemical Company; Super Diamond Clear, Luster Seal 300 (exterior), Super Rez-Seal (interior).
 - 2) L&M Construction Chemicals, Inc.; Lumiseal Plus.
 - 3) Meadows, W.R., Inc.; CS-309/30.
 - 4) Euclid Chemical Company; Super Diamond Clear VOX.
 - 5) L&M Construction Chemicals, Inc.; Lumiseal WB Plus.
 - 6) Meadows, W.R., Inc.; Vocomp-30.
- I. Vapor Retarder: See Specification Section 07 2600.
- J. Sand cement grout, non-shrink grout and epoxy grout: See Specification Section 03 31 30 for this non-structural material and use.

2.2 SOURCE QUALITY CONTROL

- A. The concrete plant shall conform to the Checklist for Certification of Ready Mixed Concrete Production Facilities of the NRMCA.

PART 3 - EXECUTION

3.1 PREPARATION

- A. General:
1. All materials and construction shall conform to the tolerances as specified in ACI 117.
 2. Complete formwork.
 - a. See Specification Section 03 11 13.
 3. Remove earth, snow, ice, water, and other extraneous/foreign materials from areas that will receive concrete.
 4. Secure reinforcement in place.
 - a. See Specification Section 03 21 00.
 5. Position expansion joint material, anchors, and other embedded items.
 6. Obtain approval of formwork, reinforcement installation, and placement prior to placing concrete.

7. Do not place concrete during rain, sleet, or snow, unless adequate protection is provided and prior Engineer approval is obtained.
 - a. Plan size of crews with due regard for effects of concrete temperature and atmospheric conditions on rate of hardening of concrete as required to obtain good surfaces and a void unplanned cold joints.
 - b. Do not allow rainwater to increase mixing water nor to damage surface finish.
 8. Remove hardened concrete and foreign materials from inner surfaces of conveying equipment and formwork.
 9. Provide slabs and beams of minimum indicated required depth when sloping structural foundation base slabs and elevated slabs to drains.
 - a. For floor slabs on grade, slope top of subgrade to provide slab of required uniform thickness.
- B. Preparation of Subgrade for Slabs On Ground:
1. Subgrade to be wetted without standing water immediately prior to placing concrete.
 2. Obtain approval of subgrade compaction density prior to placing slabs on ground.
- C. Edge Forms and Screeds:
1. Set accurately to produce designated elevations and contours of finished surface.
 2. Sufficiently strong to support vibrating screeds or roller pipe screeds, if required.
 3. Use strike off templates, or approved vibrating type screeds, to align concrete surfaces to contours of screed strips.

3.2 CONCRETE MIXING

- A. General:
1. Provide all concrete from a central plant conforming to Checklist for Certification of Ready Mixed Concrete Production Facilities of the NRMCA.
 2. Batch, mix, and transport in accordance with ASTM C94/C94M.
- B. Control of Admixtures:
1. Control at the batch plant:
 - a. All admixtures to be introduced at the batch plant in accordance with manufacturer's recommendations.
 - b. Charge admixtures into mixer as solutions.
 - 1) Measure by means of an approved mechanical dispensing device.
 - 2) Liquid considered a part of mixing water.
 - 3) Admixtures that cannot be added in solution may be weighed or measured by volume if so recommended by manufacturer.
 - c. Add separately, when two or more admixtures are used in concrete, to avoid possible interaction that might interfere with efficiency of either admixture, or adversely affect concrete.
 - d. Complete addition of retarding admixtures within one minute after addition of water to cement has been completed, or prior to beginning of last three quarters of required mixing, whichever occurs first.
 2. Control of Admixtures in the field:
 - a. Additional quantities of admixtures (with the exception of retarders) may be added in the field provided:
 - 1) Addition of admixtures shall be under the supervision of the ready mix quality control representative.
 - 2) Addition of each admixture to be documented on the delivery ticket.
 - 3) Provide additional mixing per ASTM C94.
- C. Tempering and Control of Mixing Water:
1. Mix concrete only in quantities for immediate use.
 2. Discard concrete which has set.
 3. Discharge concrete from ready mix trucks within time limit stated in ASTM C94.

4. Addition of water at the jobsite:
 - a. See Specification Section 03 31 30 for specified water cement ratio and slump.
 - b. Do not exceed maximum specified water cement ratio or slump.
 - c. Incorporate water by additional mixing equal to at least half of total mixing required.

3.3 . PLACING OF CONCRETE

A. General:

1. Place concrete as such a rate that concrete, which is being integrated with fresh concrete, is still workable.
 - a. Select placement equipment and manpower in order to assure timely delivery of concrete into forms to avoid unintended cold joints and placement consolidation issues.
2. . Comply with ACI 304R and ACI 304.2R.
3. Do not begin placing concrete during rain, sleet, or snow.
 - a. Protect fresh concrete from ensuing inclement weather.
4. Do not deposit concrete which has partially hardened or has been contaminated by foreign materials.
5. Begin work only when work of other trades affecting concrete is complete.
6. Do not use excess grout or mortar to lubricate lines when pumping concrete.
7. Do not use excess water for workability or any reason when placing concrete by freefall.
8. Deposit concrete continuously to avoid cold joints.
9. Locate construction joints at locations specified or approved by Engineer.
 - a. Plan size of crews with due regard for effects of concrete temperature and atmosphere conditions to avoid unplanned cold joints.
10. Spreaders:
 - a. Temporary: Remove as soon as concrete placing renders their function unnecessary.
 - b. Embedded:
 - 1) Obtain approval of Engineer for their use.
 - 2) Materials: Concrete or metal.
 - 3) Ends of metal spreaders coated with plastic coating 2 IN from each end.
11. Deposit concrete as nearly as practicable in its final position to avoid segregation.
 - a. Maximum free fall: 4 FT.
 - b. Place concrete by means of hopper, elephant trunk or tremie pipe extending down to within 4 FT of surface.
12. Perform the following operations before bleeding water has an opportunity to collect on surface:
 - a. Spread.
 - b. Consolidate.
 - c. Straightedge.
 - d. Darby or bull float.
13. No water shall be added to the concrete surface to ease finishing operation.
14. Do not discharge water into forms.
15. Consider use of form vibrators for certain placement situations.

B. Cold Weather Concrete Placement:

1. Comply with ACI 306.1.
2. Do not place concrete on forms or subgrades that are below 32 DEGF or contain frozen material.
3. Maintain all materials, forms, reinforcement, subgrade and any other items which concrete will come in contact with free of frost, ice or snow at time of concrete placement.
4. Temperature of concrete when discharged at site: Per ACI 306.1.
5. Heat subgrade forms, embedments and reinforcement to between 45 and 70 DEGF, when temperature of surrounding air is 40 DEGF or below at time concrete is placed.
 - a. Remove all frost from subgrade, forms and reinforcement before concrete is placed.
6. Combine water with aggregate in mixer before cement is added, if water or aggregate is heated above 90 DEGF.

7. Do not mix cement with water or with mixtures of water and aggregate having a temperature greater than 90 DEGF.
 8. Follow ACI 306R for specific requirements dealing with elevated steel troweled slabs that will be exposed to freeze-thaw cycles.
- C. Hot Weather Concrete Placement:
1. Comply with ACI 305.1.
 2. Cool ingredients before mixing, or add flake ice or well crushed ice of a size that will melt completely during mixing for all or part of mixing water if high temperature, low slump, flash set, cold joints, or shrinkage cracks are encountered.
 3. Temperature of concrete at point of delivery (i.e. truck discharge) when placed:
 - a. Not to exceed 90 DEGF.
 - b. Not so high as to cause:
 - 1) Shrinkage cracks.
 - 2) Difficulty in placement due to loss of slump.
 - 3) Flash set.
 4. Temperature of forms and reinforcing when placing concrete:
 - a. Not to exceed 90 DEGF.
 - b. May be reduced by spraying with water to cool below 90 DEGF.
 - 1) Leave no standing water to contact concrete being placed.
 5. Prevent plastic shrinkage cracking and/or slab curling due to evaporation.
- D. Consolidating:
1. Consolidate in accordance with ACI 309R except as modified herein.
 2. Consolidate by vibration so that concrete is thoroughly worked around reinforcement, embedded items and into corners of forms.
 - a. Ensure no displacement of reinforcing or other embeds from final position.
 - b. Eliminate:
 - 1) Air or stone pockets.
 - 2) Honeycombing or pitting.
 - 3) Planes of weakness.
 3. Use suitable form vibrators located just below top surface of concrete, where internal vibrators cannot be used in areas of congested reinforcing.
 - a. Size and coordinate external vibrators to specifically match forming system used.
 4. Internal vibrators:
 - a. Minimum frequency of 8000 vibrations per minute.
 - b. Insert and withdraw at points approximately 18 IN apart.
 - 1) Allow sufficient duration at each insertion to consolidate concrete but not sufficient to cause segregation.
 - c. Use in:
 - 1) Beams and girders of framed slabs.
 - 2) Columns and walls.
 - 3) Vibrating concrete around all waterstops.
 - d. Size of vibrators shall be in accordance with ACI 309R, Table 5.1.5.
 5. Obtain consolidation of slabs with internal vibrators, vibrating screeds, roller pipe screeds, or other approved means.
 6. Do not use vibrators to transport concrete within forms.
 7. When placing self-consolidating concrete, the use of form or pencil vibrators is acceptable, provided such methods do not cause aggregate segregation, or otherwise adversely affect the quality of the work.
 8. Provide sufficient spare vibrators on jobsite during all concrete placing operations to assure continuous vibration.
 9. Bring a full surface of mortar against form by vibration supplemented if necessary by spading to work coarse aggregate back from formed surface, where concrete is to have an as-cast finish.

10. Prevent construction equipment, construction operations, and personnel from introducing vibrations into freshly placed concrete after the concrete has been placed and consolidated.
- E. Handle concrete from mixer to place of final deposit by methods which will prevent segregation or loss of ingredients and in a manner which will assure that required quality of concrete is maintained.
1. Use truck mixers, agitators, and non-agitating units in accordance with ASTM C94.
 2. Horizontal belt conveyors:
 - a. Mount at a slope which will not cause segregation or loss of ingredients.
 - b. Protect concrete against undue drying or rise in temperature.
 - c. Use an arrangement at discharge end to prevent segregation.
 - d. Do not allow mortar to adhere to return length of belt.
 - e. Discharge conveyor runs into equipment specially designed for spreading concrete.
 3. Metal or metal lined chutes:
 - a. Slope not exceeding 1 vertical to 2 horizontal and not less than 1 vertical to 3 horizontal.
 - b. Chutes more than 20 FT long and chutes not meeting slope requirements may be used provided they discharge into a hopper before distribution.
 - c. Provide end of each chute with a device to prevent segregation.
 4. Pumping or pneumatic conveying equipment:
 - a. Designed for concrete application and having adequate pumping capacity.
 - b. Control pneumatic placement so segregation is avoided in discharged concrete.
 - c. Loss of slump in pumping or pneumatic conveying equipment shall not exceed 1-1/2 IN.
 - d. Do not convey concrete through pipe made of aluminum or a aluminum alloy.
 - e. Provide pumping equipment without Y sections.
- F. Placing of Concrete on Metal Deck:
1. Prior to concrete placement, the metal deck shall be free of soil, debris, standing water, loose mill scale, and all other foreign matter.
 2. Care shall be exercised when placing concrete so that the deck will not be subject to construction loads or impact that exceed the design capacity of the deck.
 3. Concrete shall be placed in a uniform manner and spread toward the center of the deck span.
 4. If buggies are used to place concrete, runways shall be planked, and the buggies shall only operate on planking.
 - a. Planks shall be of adequate stiffness to transfer loads to the steel supports without damaging the deck.
 5. Deck damage caused by careless placement of concrete shall be repaired or replaced.
 6. Pour concrete to the elevations noted on Drawings.

3.4 JOINTS AND EMBEDDED ITEMS

- A. Construction Joints - General:
1. Locate joints as indicated on Contract Drawings or as shown on approved Shop Drawings.
 - a. Where construction joint spacing shown on Drawings exceeds the joint spacing indicated in Paragraph B. below, submit proposed construction joint location in conformance with this Specification Section.
 2. Unplanned construction joints will not be allowed.
 - a. If concrete cannot be completely placed between planned construction joints, then it must be removed.
 3. In general, locate joints near middle of spans of slabs, beams and girders unless a beam intersects a girder at this point, in which case, offset joint in girder a distance equal to twice the width of the beam.
 4. Locate joints in walls and columns at underside of floors, slabs, beams, or girders, and at tops of foundations or floor slabs, unless shown otherwise.
 - a. At Contractor's option, beam pockets may be formed into concrete walls.
 - b. Size pockets to allow beam reinforcing to be placed as detailed on Drawings.

5. Place beams, girders, column capitals and drop panels at same time as slabs.
 6. Place corbels monolithically with their supporting members.
 - a. Locate wall vertical construction joints midway between corbels.
 - b. Where only a single corbel is located, place it also monolithically with wall and locate wall vertical construction joint a minimum of 3 FT from face of corbel.
 7. Make joints perpendicular to main reinforcement with all reinforcement continuous across joints.
 8. Provide the following joints unless noted otherwise on Drawings:
 - a. Roughen joints: horizontal construction joints.
 - b. Keyed joints: vertical construction joints.
 9. Roughen construction joints:
 - a. Clean the previously hardened concrete interface and remove all laitance.
 - b. Intentionally roughen the interface to a full amplitude of 1/4 IN.
 10. Keyways:
 - a. Construction joint keyways shall have the following dimensions, unless shown otherwise on Drawings or as directed by Engineer.
 - b. Wall keys:
 - 1) Keyway width, not less than 1/3 and not more than 1/2 the wall thickness measured perpendicular to wall faces.
 - 2) Keyway depth to be not less than 1-1/2 IN.
 - 3) Continuous along length of wall.
 - 4) Place keyway in wall center unless shown otherwise on Drawings.
 - c. Keyways in footings, foundations, base slabs, and structural or elevated slabs:
 - 1) Keyway height not less than 1/3 and not more than 1/2 the footing or slab thickness.
 - 2) Keyway depth not less than 1-1/2 IN.
 - 3) Continuous along footing or slab.
 - 4) Keyway in footing or slab center unless shown otherwise on Drawings.
 - d. Beam keyways:
 - 1) Full width of beam.
 - 2) Keyway height not less than 5-1/2 IN.
 - 3) Keyway depth not less than 1-1/2 IN.
 - 4) Keyway located in initial beam pour, directly above the bottom reinforcing, unless shown otherwise on Drawings.
 11. Minimum time before placement of adjoining concrete construction:
 - a. All concrete: 60 HRS, unless otherwise noted.
- B. Construction Joints - Spacing Unless Otherwise Specified:
1. Structures not intended to contain liquid:
 - a. Wall vertical construction joints:
 - 1) 50 FT maximum centers.
 - 2) At wall intersections, 4 FT minimum from corner.
 - b. Base slab, floor, and roof slab construction joints:
 - 1) Placements to be approximately square and not to exceed 4000 SQFT.
 - 2) Maximum side dimension of a slab pour to be 70 FT.
 2. Water retaining structures:
 - a. Wall vertical construction joints:
 - 1) 30 FT maximum centers.
 - 2) At wall intersections, 6 FT minimum from corner.
 - b. Wall horizontal construction joints: 18 FT centers.
 - c. Floor slab, construction joints:
 - 1) Placements to be approximately square and not to exceed 2000 SQFT.
 - 2) Maximum side dimension of a slab pour to be less than:
 - a) Twice the length of the short side.
 - b) 60 FT.

- d. Elevated slab construction joints:
 - 1) Placements to be approximately square and not to exceed 4000 SQFT.
 - 2) Maximum side dimension of a slab pour to be less than:
 - a) Twice the length of the short side.
 - b) 70 FT.
- C. Construction Joints - Bonding:
 - 1. Obtain bond between concrete pours at construction joints by thoroughly cleaning and removing all laitance from construction joints.
 - 2. Before new concrete is placed, all construction joints shall be coated with cement grout, or dampened, as outlined below:
 - 3. Roughen construction joints:
 - a. Roughen the surface of the concrete to expose the coarse aggregate uniformly with 1/4 IN minimum amplitude.
 - 1) Remove laitance, loosened particles of aggregate or damaged concrete at the surface.
 - 4. Keyed construction joints:
 - a. Thoroughly clean construction joints and remove all laitance.
 - b. Dampen the hardened concrete immediately prior to placing of fresh concrete.
- D. Slab On Grade Joints:
 - 1. Locate construction and control joints in slabs on grade as indicated on Drawings.
 - 2. Time cutting properly with set of concrete, if saw cut joints are required or permitted.
 - a. Start cutting as soon as concrete has hardened sufficiently to prevent aggregates being dislodged by saw.
 - b. Complete before shrinkage stresses become sufficient to produce cracking.
- E. Expansion Joints:
 - 1. Do not permit reinforcement or other embedded metal items bonded to concrete (except smooth dowels bonded on only one side of joint) to extend continuously through an expansion joint.
 - 2. Use neoprene expansion joint fillers, unless noted otherwise on Drawings.
 - 3. Seal expansion joints as shown on Drawings.
 - a. See Specification Section 079200 for requirements.
- F. Waterstops - General:
 - 1. Waterstop to be continuous with splices in accordance with manufacturer's instructions and create water tight joints.
 - 2. Do not mix different types of waterstop materials in the same structure without specific approval from the Engineer unless shown on Drawings.
 - 3. Preformed strip type:
 - a. Locate waterstop at center of wall, unless noted otherwise on Drawings.
 - 1) Maintain at least 3 IN from edge of concrete or as recommended by manufacturer.
 - b. Install in a bed of swelling sealant on smooth surface of hardened concrete by use of nails, adhesive or other means as recommended by manufacturer to prevent movement of waterstop during placement of concrete.
 - c. Roughened joints shall be especially prepared during concrete placement to provide smooth surface for proper water stop installation.
 - d. Use in joints against existing concrete where indicated on Drawings.
 - 4. PVC waterstops:
 - a. Pre-position waterstop accurately in joints, with adequate clearance from all reinforcing. Do not push waterstop into wet concrete.
 - b. Secure waterstops in correct position using hog rings or grommets spaced no more than 18 IN maximum staggered along each edge full length and passed through the edge of the waterstop.
 - 1) Tie wire to adjacent reinforcing.
 - c. Hold horizontal waterstops in place with continuous supports.

- d. Install according to manufacturer's instructions.
 - 1) Do not displace reinforcement from required location.
 - e. Splice ends and intersections with perpendicular butt splice using electrical splicing iron in accordance with manufacturer's instructions.
 - 1) Use factory fabricated "T" and corner intersection fittings.
 - 2) Field splice straight runs of material.
 - f. Unless otherwise noted, use for all construction joints in new construction for all structures indicated on Drawings.
- G. Other Embedded Items:
- 1. Place sleeves, inserts, anchors, and embedded items required for adjoining work or for its support, prior to initiating concreting.
 - a. Give Contractor whose work is related or integral to concrete, or supported by it, ample notice and opportunity to furnish and install items before placing concrete.
 - 2. Do not route electrical conduit, drains, or pipes in concrete slabs, walls, columns, foundations, beams or other structural members unless approved by Engineer.
- H. Placing Embedded Items:
- 1. Support against displacement.
 - 2. Fill voids in sleeves, inserts and anchor slots temporarily with readily removable material to prevent entry of concrete into voids.
 - 3. Provide adequate means for anchoring waterstop in concrete.
 - a. Provide means to prevent waterstops in the forms from being folded over by the concrete as it is placed.

3.5 FINISHING

- A. See Specification Section 03 35 00.
- B. Coordinate mixing and placing with finishing.

3.6 INSTALLATION OF GROUT

- A. Grout Schedule:
- 1. Sand cement grout:
 - a. Fill key ways in precast HCU.
 - b. Construction joint bedding (base of wall pours with comparable compressive strength to wall).
 - c. General use.
 - d. As noted on Drawings.
 - 2. Non-shrinking non-metallic grout:
 - a. Filling form tie holes.
 - b. Under column and beam base plates.
 - c. Other uses indicated on the Drawings.
 - 3. Epoxy grout:
 - a. Patching cavities in concrete.
 - b. Grouting of dowels and anchor bolts into existing concrete.
 - c. Grouting of rotating or oscillating equipment base.
 - d. As noted on the Drawings.
- B. Grout Installation:
- 1. Sand cement grout:
 - a. Fill wetted key ways between precast concrete hollow core slabs with sand cement grout.
 - b. Consolidate grout by rodding or by other means to assure complete filling of key ways.
 - c. Cure grout by one of methods specified.
 - 2. Non-shrink non-metallic grout:
 - a. Clean concrete surface to receive grout.
 - b. Saturate concrete with water for 24 HRS prior to grouting.

- c. Mix in a mechanical mixer.
 - d. Use no more water than necessary to produce flowable grout.
 - e. Place in accordance with manufacturer's instructions.
 - f. Provide under beam, column, and equipment base plates, in joints between precast concrete and cast slabs, and in other locations indicated on the Drawings.
 - g. Completely fill all spaces and cavities below the top of base plates.
 - h. Provide forms where base plates and bed plates do not confine grout.
 - i. Where exposed to view, finish grout edges smooth.
 - j. Except where a slope is indicated on the Drawings, finish edges flush at the base plate, bed plate, member, or piece of equipment.
 - k. Coat exposed edges of grout with cure or seal compound recommended by the grout manufacturer.
3. . Epoxy grout:
- a. Mix and place in accordance with manufacturer's instructions.
 - b. Apply only to clean, dry, sound surface.
 - c. Completely fill all cavities and spaces around dowels and anchors without voids.
 - d. Grout base and bed plates as specified for non-shrinking, non-metallic grout.
 - e. Obtain manufacturer's field technical assistance as required to assure proper placement.

3.7 CURING AND PROTECTION

- A. Protect concrete from premature drying, excessively hot or cold temperatures, and mechanical injury immediately after placement, and maintain with minimal moisture loss at relatively constant temperature for period necessary for hydration of cement, hardening, and compressive strength gain.
 - 1. Follow recommendations of ACI 308.1 except as modified herein.
 - 2. All traffic shall be kept from the surface as necessary to protect the concrete but not less than the first 48 HRS of curing.
- B. For surfaces of non-water bearing structures, apply one of the following curing procedures immediately after completion of placement and finishing (surfaces not in contact with forms).
 - 1. Ponding or continuous sprinkling. Take care to avoid eroding the surface of freshly placed concrete.
 - 2. Application of wet Absorbent Covers:
 - a. Minimum lap: 12 IN.
 - b. Provide continuous uniform supply of moisture, such as sprinklers or soaker hoses as required to keep concrete surface continuously wet.
 - c. Monitor Absorbent Covers as required to prevent cover materials or concrete surface from drying out.
 - 3. Continuous application of steam (not exceeding 150 DEGF) or mist spray.
 - 4. Application of Moisture Retaining Cover sheet materials.
 - a. Place as soon as possible after final finishing and without marring the surface.
 - b. Minimum lap: 12 IN.
 - c. Seal all edges to make water-tight.
 - d. Place Moisture Retaining Cover in intimate contact with the concrete surface, without wrinkles and weighted to hold in place.
 - e. Hold cover and edges in place as required to prevent wind from displacing the cover.
 - f. Moisture Retaining Fabric:
 - 1) Install in accordance with manufacturer's written recommendations.
 - 2) Saturate concrete surface and fabric side of cover immediately prior to placing.
 - g. Monitor continuously during the curing period:
 - 1) Repair any holes, tears or displaced cover.
 - 2) Rewet as required to keep concrete moist under cover.
 - 5. Application of other moisture retaining covering as approved by Engineer.
 - 6. Water used for curing shall be within 20 DEGF of the concrete temperature.

7. Application of a curing compound.
 - a. Apply curing compound in accordance with manufacturer's recommendations immediately after any water sheen, which may develop after finishing, has disappeared from concrete surface.
 - b. Do not use on any surface against which additional concrete or other material is to be bonded unless it is proven that curing compound will not prevent bond.
 - c. Where a vertical surface is cured with a curing compound, the vertical surface shall be covered with a minimum of two coats of the curing compound.
 - 1) Apply the first coat of curing compound to a vertical surface immediately after form removal.
 - 2) The vertical concrete surface at the time of receiving the first coat shall be damp with no free water on the surface.
 - 3) Allow the preceding coat to completely dry prior to applying the next coat.
 - 4) A vertical surface: Any surface steeper than 1 vertical to 4 horizontal.
 8. Surfaces In Contact with Forms:
 - a. Formed surfaces: Cure formed concrete surfaces utilizing final curing methods per ACI 308.1, including underside of beams, supported slabs, and other similar surfaces,
 - 1) See Section 03 11 13.
 - b. Minimize moisture loss from and temperature gain of concrete placed in forms exposed to heating by sun by keeping forms wet and cool until they can be safely removed.
 - c. Make provisions to keep concrete wall moist while stripping forms and until curing measures are in place.
 - d. After form removal, cure concrete until end of time prescribed.
 - e. Use one of the methods listed above.
 - f. Forms left in place shall not be used as a method of curing in hot weather.
 - g. The term "hot weather", where used in these specifications, is defined in ACI 305.1.
 - h. In hot weather, remove forms from vertical surfaces as soon as concrete has gained sufficient strength so that the formwork is no longer required to support the concrete.
- C. Curing Period:
1. Continue curing for at least seven days for all concrete except Type III, high early strength concrete for which period shall be at least three days.
 - a. If one of curing procedures indicated above is used initially, it may be replaced by one of other procedures indicated any time after concrete is two days old, provided concrete is not permitted to become surface dry during transition.
- D. Cold Weather:
1. Follow recommendations of ACI 306.1.
 2. Maintain temperature of concrete per ACI 306.1 for a minimum of 72 HRs after concrete is placed, when outdoor temperature is 40 DEGF, or less.
 - a. Maximum temperature rate of decrease: Per ACI 306.1.
 3. Use heating, covering, insulating, or housing of the concrete work to maintain required temperature without injury due to concentration of heat.
 4. Do not use combustion heaters unless precautions are taken to prevent exposure of concrete to exhaust gases which contain carbon dioxide.
 5. Interior slabs in areas intended to be heated shall be adequately protected so that frost does not develop in the supporting subgrade.
- E. Hot Weather:
1. Follow recommendations of ACI 305.1 and ACI 308.1.
 2. Make provision for cooling forms, reinforcement and concrete, windbreaks, shading, fog spraying, sprinkling, ponding, or wet covering with a light colored material.
 3. Provide protective measures as quickly as concrete hardening and finishing operations will allow.
 4. Maximum temperature rate of decrease: Per ACI 305.1.

- F. Rate of Temperature Change:
 - 1. Keep changes in temperature of air immediately adjacent to concrete as uniform as possible, during and immediately following curing period.
- G. Protection from Mechanical Injury:
 - 1. Protect concrete from damaging mechanical disturbances, such as load stresses, heavy shock, and excessive vibration.
 - 2. Protect finished concrete surfaces from damage by construction equipment, materials, or methods, and by rain or running water.
 - 3. Do not load self-supporting structures in such a way as to overstress concrete.

3.8 FIELD QUALITY CONTROL

- A. Special Inspections per building code:
 - 1. See Section 01 45 33 and 03 05 05.

END OF SECTION

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SECTION 03 35 00

CONCRETE FINISHING AND REPAIR OF SURFACE DEFECTS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Concrete finishing and repair of surface defects.
 - 2. Chemical Sealers.
 - 3. Polymer Modified Cementitious Coating.
 - 4. Resurfacing Mortar.
- B. Related Specification Sections include but are not necessarily limited to:
 - 1. Division 00 - Procurement and Contracting Requirements.
 - 2. Division 01 - General Requirements.
 - 3. Section 03 11 13 - Formwork.
 - 4. Section 03 31 30 - Concrete, Materials and Proportioning.
 - 5. Section 03 31 31 - Concrete Mixing, Placing, Jointing, and Curing.

1.2 QUALITY ASSURANCE

- A. Referenced Standards:
 - 1. American Concrete Institute (ACI):
 - a. CT-13, Concrete Terminology.
 - b. 117, Specification for Tolerances for Concrete Construction and Materials.
 - c. 303R, Guide to Cast-in-Place Architectural Concrete Practice.
 - d. 308, Standard Practice for Curing Concrete.
 - e. 350, Requirements for Environmental Engineering Concrete Structures and Commentary.
 - 2. ASTM International (ASTM):
 - a. C109, Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or 50-mm Cube Specimens).
 - b. C150, Standard Specification for Portland Cement.
 - c. C157, Standard Test Method for Length Change of Hardened Hydraulic-Cement Mortar and Concrete.
 - d. C309, Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
 - e. C666, Standard Test Method for Resistance of Concrete to Rapid Freezing and Thawing.
 - f. C779, Standard Test Method for Abrasion Resistance of Horizontal Concrete Surfaces.
 - g. C1315, Standard Specification for Liquid Membrane-Forming Compounds Having Special Properties for Curing and Sealing Concrete.
 - h. D4258, Standard Practice for Surface Cleaning Concrete for Coating.
 - i. D4259, Standard Practice for Abrading Concrete.
 - j. E1155, Standard Test Method for Determining F(F) Floor Flatness and F(L) Floor Levelness Numbers.
 - k. E1486, Standard Test Method for Determining Floor Tolerances Using Waviness, Wheel Path and Levelness Criteria.
 - 3. International Concrete Repair Institute (ICRI):
 - a. 310.2R, Selecting and Specifying Concrete Surface Preparation for Sealers, Coatings, and Polymer Overlays.
 - 4. National Council Highway Research Program (NCHRP):
 - a. 244, Concrete Sealers for the Protection of Bridge Structures.
 - 5. The Society for Protective Coatings/NACE International (SSPC/NACE):
 - a. SP 13/NACE No. 6, Surface Preparation of Concrete.

- B. Qualifications:
 - 1. Chemical Sealer CS-2:
 - a. Applicator shall be factory trained and approved, in writing, by the manufacturer to apply the product.
 - b. Applicator shall have a minimum of five years of experience successfully applying materials specified.
- C. Mock-Ups.
 - 1. General:
 - a. Construct additional mock-ups as required until accepted.
 - b. Mock-ups constitute minimum standard of quality for actual construction.
 - c. Maintain mock-up during construction.
 - d. Remove when directed by Engineer.
 - 2. Construct mock-up for each type of wall finish specified for review and acceptance by Engineer.
 - a. Minimum 4 x 4 FT area for each different wall finish specified.
 - b. Mock-ups shall include:
 - 1) Sample of patched tie hole.
 - 2) Sample of all jointery being used in the walls.
 - c. Include mock-up of wall having polymer modified cementitious coating.
 - 1) Mock-up shall be stepped to show surface preparation, repairs, and coating in all stages of application.
 - 3. Construct mock-up floor slab for review and acceptance by Engineer.
 - a. Minimum 10 x 10 FT.

1.3 DEFINITIONS

- A. Vertical Surface Defects:
 - 1. Any void in the face of the concrete deeper than 1/8 IN, such as:
 - a. Tie holes.
 - b. Air pockets (bug holes).
 - c. Honeycombs.
 - d. Rock holes.
 - 2. Scabbing:
 - a. Scabbing is defect in which parts of the form face, including release agent, adhere to concrete.
 - 3. Foreign material embedded in face of concrete.
 - 4. Fins 1/16 IN or more in height.
- B. Installer or Applicator:
 - 1. Installer or applicator is the person actually installing or applying the product in the field at the Project site.
 - 2. Installer and applicator are synonymous.
- C. Other words and terms used in this Specification Section are defined in ACI CT-13.

1.4 SUBMITTALS

- A. Shop Drawings:
 - 1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
 - 2. Product technical data including:
 - a. Acknowledgement that products submitted meet requirements of standards referenced.
 - b. Manufacturer's installation instructions.
 - 3. Certifications:
 - a. Certification of aggregate gradation.
 - b. Certification of manufacturer experience qualifications and performance history.

- c. Certification of applicator's qualifications.
 - 1) Refer to Qualifications paragraph.
 - 2) Provide manufacturer's written approval of applicators.
 - 3) Provide references substantiating specialty experience.
- B. Informational Submittals:
 - 1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Comply with manufacturer's recommendations and requirements for materials used.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
 - 1. Bonding Agents:
 - a. BASF Master Builders Solutions.
 - b. Euclid Chemical Co.
 - c. Latcrete - L&M Construction Chemicals.
 - 2. Chemical Sealers:
 - a. BASF Master Builders Solutions.
 - b. Euclid Chemical Co.
 - c. Latcrete - L&M Construction Chemicals.
 - d. Tnemec Chemprobe.
 - 3. Polymer Modified Cementitious Coating:
 - a. Aqua fin International.
 - b. BASF Master Builders Solutions.
 - c. Euclid Chemical Co.
 - 4. Patching Mortar:
 - a. BASF Master Builders Solutions.
 - b. Euclid Chemical Co.
 - c. Latcrete - L&M Construction Chemicals.
 - d. Sika Corporation.
- B. Submit request for substitution in accordance with Specification Section 01 25 13.

2.2 MATERIALS

- A. Chemical Sealer CS-1:
 - 1. High solids, water-based solution containing a acrylic copolymers.
 - a. ASTM C 1315, Type I, Class A.
 - b. Non-yellowing UV resistant.
 - c. VOC Content: <200 G/L.
 - 2. USDA approved as a concrete floor sealer.
 - 3. Euclid Chemical Super Diamond Clear VOX.
- B. Chemical Sealer CS-2:
 - 1. Water based chemical solution containing a blend of silicate and silicate polymers designed to seal, harden and dustproof concrete floors.
 - 2. VOC Content: 0 G/L.
 - 3. Performance of treated concrete floor:
 - a. Coefficient of Friction:
 - 1) Dry: 0.81.
 - 2) Wet: 0.72.

- b. Liquid repellency, RILEM Method 11.4:
 - 1) ≥ 1 mL.
 - 4. Euclid Chemical Euco Diamond Hard.
- C. Chemical Sealer CS-3:
 - 1. Clear, penetrating, breathable, waterborne silane-siloxane solution.
 - 2. VOC content: ≤ 50 G/L.
 - 3. Odorless.
 - 4. Flash point: >200 DEGF.
 - 5. Water absorption: 85 PCT reduction per NCHRP 244.
 - 6. Chloride penetration: 82 PCT reduction per NCHRP 244.
 - 7. Euclid Chemical Baracade WB 244.
- D. Patching Mortar: Trowelable cementitious repair mortar for vertical, overhead, and horizontal repairs.
 - 1. Portland cement-based, rapid set repair mortar for interior or exterior use.
 - 2. Compressive Strength, ASTM C109:
 - a. Minimum 3000 PSI at 7 days.
 - b. Minimum 5000 PSI at 28 days.
 - 3. Freeze Thaw Durability, ASTM C666: 96.75 PCT at 300 Cycles.
 - 4. Shrinkage, ASTM C157: 0.069 PCT.
 - 5. Euclid Chemical Speed Crete Red Line.
- E. Bonding Agents:
 - 1. For use only on concrete surfaces not receiving liquid water repellent coating:
 - a. High solids acrylic latex base liquid for interior or exterior application as a bonding agent to improve adhesion and mechanical properties of concrete patching mortars.
 - 1) BASF Master Builders MasterEmaco A 660.
 - 2) Euclid Chemical Co. Flex-Con.
 - 3) Laticrete L&MEverbond.
 - 2. For use only on concrete surface receiving liquid water repellent:
 - a. Non-acrylic base liquid for interior or exterior application as a bonding agent to improve adhesion and mechanical properties of concrete patching mortars.
- F. Cement:
 - 1. ASTM C150, Type II Portland for areas exposed to sewage.
 - 2. ASTM C150, Type I-II Portland elsewhere.
- G. Aggregate:
 - 1. Sand: Maximum size #30 mesh sieve.
 - 2. For exposed aggregate finish surfaces: Same as surrounding wall.
- H. Water: Potable.
- I. Polymer modified cementitious coating:
 - 1. Polymer modified Portland cement based coating for concrete and masonry.
 - a. Waterproof.
 - b. Resistant to both positive and negative hydrostatic pressure.
 - c. Breathable.
 - 2. BASF MasterSeal 581 or Euclid Chemical Tamoseal.
 - a. Color:
 - 1) Interior surfaces: Standard gray.
 - 2) Exterior surfaces: Standard gray.
 - b. Texture: Fine.
- J. Nonshrink Grout: See Specification Section 03 31 30 and Specification Section 03 31 31.

2.3 MIXES

- A. Bonding Grout: One part cement to one part aggregate.
- B. Patching Mortar:
 - 1. One part cement to 2-1/2 parts aggregate by damp loose volume.
 - a. Substitute white Portland cement for a part of gray Portland cement to produce color matching surrounding concrete.

PART 3 - EXECUTION

3.1 PREPARATION

- A. For methods of curing, see Specification Section 03 31 31.
- B. Surface Preparation:
 - 1. Clean surfaces in accordance with ASTM D4258 to remove dust, dirt, form oil, grease, or other contaminants prior to abrasive blasting, chipping, grinding, or wire brushing.
 - 2. Prepare surfaces in accordance with ASTM D4259 and SSPC SP 13/NACE No. 6 to completely open defects down to sound concrete and remove laitance.
 - a. Provide concrete surface profile (CSP) in accordance with ICRI 310.2:
 - 1) Areas to receive Repair Mortar:
 - a) Areas larger than 1 SF or deeper than 1/4 IN Abrasive blast, scarify or needle scale to CSP No. 6-8.
 - b. If additional chipping or wire brushing is necessary, make edges perpendicular to surface or slightly undercut.
 - c. No feathered edges will be permitted.
 - d. Rinse surface with clean water to remove all dust, dirt, debris, loosened concrete, laitance, and other contaminants.
- C. Preparation of Bonding Grout Mixture:
 - 1. Mix cement and aggregate.
 - 2. Mix bonding agent and water together in separate container in accordance with manufacturer's instructions.
 - 3. Add bonding agent/water mixture to cement/aggregate mixture.
 - 4. Mix to consistency of thick cream.
 - 5. Bonding agent itself may be used as bonding grout if approved by manufacturer and Engineer.
- D. Preparation of Patching Mortar Mixture:
 - 1. Mix specified patching mortar per manufacturer's published recommendations.
 - 2. For repairs exceeding 2 IN in depth, mix with clean, pre-dampened 3/8 IN pea gravel in accordance with the manufacturer's recommendations.
- E. Polymer modified cementitious coating:
 - 1. Mix in accordance with manufacturer's recommendations using bonding agent acceptable to coating manufacturer.

3.2 INSTALLATION AND APPLICATION

- A. Do not repair surface defects or apply wall or floor finishes when temperature is or is expected to be below 50 DEGF.
 - 1. If necessary, enclose and heat area to between 50 and 70 DEGF during repair of surface defects and curing of patching material.
 - a. Use only clean fuel, indirect fired heating apparatus.
 - b. Exhaust combustion byproducts outside of work area.

B. Chemical Sealer Application:

1. General:
 - a. Immediately prior to Substantial Completion, thoroughly clean floor in accordance with ASTM D4258 and prepare to receive chemical sealer.
 - 1) Remove previously applied membrane curing compounds.
 - 2) Remove soil, oils, stains, discoloration, or any other imperfection having a negative impact on the appearance of the finished floor.
 - b. Apply product to floor areas indicated on the Drawings.
 - c. Apply in accordance with manufacturer's published installation instructions.
2. Chemical Sealer (CS-1):
 - a. Apply two uniform coats at rate recommended by manufacturer.
 - 1) Apply using manufacturer's recommended equipment with a fan-tip nozzle.
 - 2) Do not allow material to puddle.
 - b. Allow first coat to completely dry before applying second coat.
 - c. Spotted or mottled appearances will not be accepted.
3. Chemical Sealer (CS-2):
 - a. Apply two uniform coats at rate recommended by manufacturer.
 - 1) Scrub the material into the floor using a mechanical scrubber.
 - a) Keep the surface wet for not less than 30 minutes.
 - b) Continue scrubbing in accordance with manufacturer's application instructions.
 - c) After material has thickened, but not more than 60 minutes after application, remove all excess liquid.
 - 2) Thoroughly rinse with clean water to remove all residue.
 - a) Damp mop with clean water to remove any streaks.
 - b) Do not allow residue to dry on floor surface.
 - 3) Do not track material onto untreated surfaces.
 - b. After rinsing, allow floor to dry completely and apply second coat following the same procedures.
 - c. Final floor finish shall have uniform sheen without streaking, stains or white residue.
4. Chemical Sealer (CS-3):
 - a. Apply uniform coats at rate recommended by manufacturer.
 - 1) Apply with fine, uniform spray or microfiber pad.
 - b. Allow floor to dry completely and remove any dried residue using hot water and mild citric acid.
 - c. Final floor finish shall be uniform, free of residue, and shall repel water.
 - d. Apply additional coat(s) as necessary to achieve water repellent finish.

C. Repairing Surface Defects:

1. This method is to be used on vertical concrete surfaces as indicated in the Concrete Finishes for Vertical Wall Surfaces paragraph of this Specification Section and similar concrete surfaces not otherwise specified to receive another finish or coating.
 - a. For surfaces indicated to receive finish or coating other than those specified herein; refer to the applicable Specification Section for surface preparation requirements:
 - 1) Fluid Applied Waterproofing: See Specification Section 07 14 00.
 - 2) High Performance Industrial Coatings: See Specification Section 09 96 00.
2. Fill and repair surface defects and tie-holes using patching mortar mix specified in the MATERIALS Article in PART 2.
 - a. Prime exposed reinforcing steel, embeds or other steel surfaces with primer as recommended by patching mortar manufacturer.
 - b. Scrub bond coat:
 - 1) Wet substrate to a saturated surface dry (SSD) condition.
 - 2) Mix patching mortar to a scrub coat or slurry consistency per manufacturer's published recommendations and apply to entire area.
 - c. As an alternate to the scrub bond coat, concrete may be primed with manufacturer's recommended epoxy primer.

- d. Patching Mortar Application:
 - 1) Mix and apply Patching Mortar per manufacturer's recommendations within the open time of the product scrub coat or any bonding agents.
 - 2) Finish to level of surrounding concrete surface utilizing techniques recommended by manufacturer.
 3. Consolidate patching mortar into place and strike off so as to leave patch slightly higher than surrounding surface.
 4. Leave undisturbed until mortar has stiffened before finishing level with surrounding surface.
 - a. Do not use steel tools in finishing a patch in a formed wall which will be exposed to view.
 5. Cure patching mortar in accordance with ACI 308.
- D. Concrete Finishes for Vertical Wall Surfaces:
1. General:
 - a. Give concrete surfaces finish as specified below after removal of formwork and repair of surface defects.
 - b. Finish numbers not listed are "Not Used".
 2. Finish #1 - As cast rough form finish:
 - a. Selected forming materials are not required.
 - b. Prepare surface in accordance with the PREPARATION Article in PART 3 of this Specification Section.
 - c. Repair the following surface defects using patching mortar specified in PART 2:
 - 1) Tie holes.
 - 2) Honeycombs deeper than 1/4 IN.
 - 3) Air pockets deeper than 1/4 IN.
 - 4) Rock holes deeper than 1/4 IN.
 - d. Chip or rub off fins exceeding 1/4 IN in height.
 - e. Provide at unexposed surfaces such as:
 - 1) Foundations.
 - 2) Below-grade walls not to be waterproofed.
 - 3) Concealed surface of concrete back-up wythe in cavity wall construction.
 3. Finish #2 - As cast form finish:
 - a. Form facing material shall produce a smooth, hard, uniform texture.
 - 1) Use forms specified for surfaces exposed to view in accordance with Specification Section 03 11 13.
 - b. Prepare surface in accordance with the PREPARATION Article in PART 3 of this Specification Section.
 - 1) Chip or rub off fins exceeding 1/8 IN in height.
 - 2) Abrasive blast surfaces in accordance with ASTM D4259 and SSPC SP 13/NACE No. 6 to completely open defects down to sound concrete and remove laitance.
 - a) Provide ICRI 310.2 Concrete Surface Profile (CSP) No. 3, minimum across the entire surface.
 - (1) For contiguous repair areas larger than 1 SF or deeper than 1/4 IN Abrasive blast, scarify or needle scale to CSP No. 6-8.
 - b) If additional chipping or wire brushing is necessary, make edges perpendicular to surface or slightly undercut.
 - c) No feather edges will be permitted.
 - 3) Rinse surface with clean water and allow surface water to evaporate prior to repairing surface defects.
 - 4) Repair the following surface defects using patching mortar specified in PART 2:
 - a) Tie holes.
 - b) Honeycombs deeper than 1/4 IN or larger than 1/4 IN DIA.
 - c) Air pockets deeper than 1/4 IN or larger than 1/4 IN DIA.
 - d) Rock holes deeper than 1/4 IN or larger than 1/4 IN DIA.
 - e) Scabbing.
 - 5) Brush blast repaired areas to match adjacent surface texture.

- c. Provide this finish for:
 - 1) Interior walls of below grade equipment rooms.
 - 2) Underside of horizontal elements adjacent to the finished surface.
 - 3) Exposed surfaces not specified to receive another finish.
- 4. Finish #3 - Grout rubbed finish:
 - a. Provide this finish for a above grade interior walls.
- 5. Finish #4 - Polymer modified cementitious coating:
 - a. Form facing material shall produce a smooth, hard, uniform texture.
 - 1) Use forms specified for surfaces exposed to view in accordance with Specification Section 03 11 13.
 - 2) Comply with ACI 303R for formwork accuracy and form joint handling to prevent grout leakage.
 - b. Prepare surface in accordance with the PREPARATION Article in PART 3 of this Specification Section.
 - 1) Chip or rub off fins exceeding 1/8 IN in height.
 - 2) Abrasive blast and repair surface defects in accordance with Concrete Finish #2.
 - c. Apply decorative coating to entire surface.
 - 1) As a mixing liquid for the coating, use bonding agent and water mixture as recommended by coating manufacturer.
 - 2) Apply two coats at 2 LBS per square yard per coat.
 - a) During application of first coat, complete fill all voids, depressions or other surface imperfections.
 - d. When second coat is set, float to a uniform texture with a sponge float.
 - e. Provide this finish on all exposed to view:
 - 1) Exterior building surfaces not otherwise indicated to receive [an Architectural Abrasive Blast Finish].
 - 2) Interior walls, columns and similar vertical surfaces where indicated on Room Finish Schedule on the Drawings.
 - 3) Underside of horizontal elements adjacent to the finished surface.
 - f. Construct mock-up per the Mock-Ups paragraph in the QUALITY ASSURANCE Article in PART 1 of this Specification Section.
- E. Related Unformed Surfaces (Except Slabs):
 - 1. Strike smooth and level tops of walls or buttresses, horizontal offsets, and similar unformed surfaces occurring adjacent to formed surfaces after concrete is placed.
 - 2. Float surface to a texture consistent with that of formed surfaces.
 - a. If more than one finish occurs immediately adjacent to unformed surface, provide surface with most stringent formed surface requirement.
 - 3. Continue treatment uniformly across unformed surfaces.
- F. Concrete Finishes for Horizontal Slab Surfaces:
 - 1. General:
 - a. Tamp concrete to force coarse aggregate down from surface.
 - b. Scream with straightedge, eliminate high and low places, bring surface to required finish elevations; slope uniformly to drains.
 - c. Dusting of surface with dry cement or sand during finishing processes not permitted.
 - 2. Unspecified slab finish:
 - a. When type of finish is not indicated, use following finishes as applicable:
 - 1) Surfaces intended to receive bonded applied cementitious applications: Scratched finish.
 - 2) Surfaces intended to receive roofing, except future floors, or waterproofing membranes: Floated finish.
 - 3) Floors: Troweled finish.
 - 4) Garage floors and ramps: Broom or belt finish.
 - 5) Exterior slabs, sidewalks, platforms, steps and landings, and ramps, not covered by other finish materials: Broom or belt finish.

- 6) All slabs to receive a floated finish before final finishing.
3. Scratched slab finish: After concrete has been placed, consolidated, struck off, and leveled to a Class B tolerance, roughen surface with stiff brushes or rakes before final set.
4. Floated finish:
 - a. After concrete has been placed, consolidated, struck off, and leveled to a Class B tolerance, do no further work until ready for floating.
 - b. Begin floating when water sheen has disappeared and surface has stiffened sufficiently to permit operations.
 - 1) Use wood or cork float.
 - c. During or after first floating, check planeness of entire surface with a 10 FT straightedge applied at not less than two different angles.
5. Cut down all high spots and fill all low spots to produce a surface with Class B tolerance throughout.
 - a. Refloat slab immediately to a uniform texture.
6. Troweled finish:
 - a. Float finish surface to true, even plane.
 - b. Power trowel, and finally hand trowel.
 - c. First troweling after power troweling shall produce a smooth surface which is relatively free of defects, but which may still show some trowel marks.
 - d. Perform additional trowelings by hand after surface has hardened sufficiently.
 - e. Final trowel when a ringing sound is produced as trowel is moved over surface.
 - f. Thoroughly consolidate surface by hand troweling.
 - g. Finish in accordance with the FIELD QUALITY CONTROL Article in PART 3 of this Specification Section.
 - 1) Leave finished surface essentially free of trowel marks, uniform in texture and appearance.
 - h. On surfaces intended to support floor coverings, remove any defects that would show through floor covering.
7. Broom or belt finish: Immediately after concrete has received a float finish as specified, give it a transverse scored texture by drawing a broom or burlap belt across surface.
8. Underside of concrete slab finish:
 - a. Match finish as specified for adjacent vertical surfaces.
 - b. If more than one finish occurs immediately adjacent to underside of slab surface, provide surface with most stringent formed surface requirement.

3.3 FIELD QUALITY CONTROL

- A. Tolerances:
 1. Finished floor slabs:
 - a. Provide Floor Flatness (F_F) and Floor Levelness (F_L) in accordance with ACI 117.
 - 1) Measure in accordance with ASTM E1155.
 - b. Slabs not indicated to be sloped:
 - 1) F_F : Equal or greater than 35.
 - 2) F_L : Equal or greater than 25.
 - c. Slabs indicated to be sloped or curved:
 - 1) Measure in accordance with ASTM E1486.
 - 2) Provide slopes or curves as indicated on the Drawings.
 - d. Slabs indicated to receive polished concrete floor:
 - 1) F_F : Equal or greater than 45.
 - 2) F_L : Equal or greater than 35.
 - 3) Refer to Room Finish Schedule on Drawings.
 2. Horizontal surfaces other than finished floor slabs, including but not limited to, top of footings, top of walls, concrete fill in tankage, channels, and similar applications:
 - a. Gap between a 10 FT straightedge placed anywhere and the finished surface shall not exceed:
 - 1) Class A tolerance: 1/4 IN.

- 2) Class B tolerance: 3/8 IN.
 - 3) Class C tolerance: 1/2 IN.
 - b. Accumulated deviation from intended true plane of finished surface shall not exceed 1/2 IN.
- B. Unacceptable finishes shall be replaced or, if approved in writing by Engineer, may be corrected provided strength and appearance are not adversely affected.
 - 1. High spots to be removed by grinding and/or low spots filled with a patching compound or other remedial measures to match adjacent surfaces.
- C. Provide services of manufacturer's technical representative:
 - 1. A certified manufacturer's representative experienced in the use of the products used shall be present on a full-time basis to observe and oversee all operations associated with the installation.
 - 2. Contractor, along with manufacturer, shall be fully responsible for the proper application, including all means and methods incidental thereto necessary for a sound, secure and complete installation.
 - 3. Manufacturer's representative shall be present for installation of:
 - a. Dry-shake Hardener.
 - b. Heavy-duty Metallic Aggregate Topping.

3.4 PROTECTION

- A. All horizontal slab surfaces receiving chemical sealer shall be kept free of traffic and loads for minimum of 72 HRS following installation of sealer.

END OF SECTION

SECTION 03 41 33
PRECAST AND PRESTRESSED CONCRETE

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Precast and prestressed concrete.
- B. Related Specification Sections include but are not necessarily limited to:
 - 1. Division 00 - Procurement and Contracting Requirements.
 - 2. Division 01 - General Requirements.
 - 3. Section 09 96 00 - High Performance Industrial Coatings.

1.2 QUALITY ASSURANCE

- A. Referenced Standards:
 - 1. American Association of State Highway and Transportation Officials (AASHTO):
 - a. HB, Standard Specifications for Highway Bridges.
 - 2. American Concrete Institute (ACI):
 - a. 318, Building Code Requirements for Structural Concrete.
 - 3. ASTM International (ASTM):
 - a. A36, Standard Specification for Carbon Structural Steel.
 - b. A108, Standard Specification for Steel Bar, Carbon and Alloy, Cold-Finished.
 - c. A416, Standard Specification for Steel Strand, Uncoated Seven-Wire for Prestressed Concrete.
 - d. A496, Standard Specification for Steel Wire, Deformed, for Concrete Reinforcement.
 - e. A1064, Standard Specification for Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete.
 - f. C33, Standard Specification for Concrete Aggregates.
 - g. C150, Standard Specification for Portland Cement.
 - h. C330, Standard Specification for Lightweight Aggregates for Structural Concrete.
 - i. D2240, Standard Test Method for Rubber Property-Durometer Hardness.
 - j. E329, Standard Specification for Agencies Engaged in Construction Inspection and/or Testing.
 - 4. American Welding Society (AWS):
 - a. A5.1/A5.1M, Specification for Carbon Steel Electrodes for Shielded Metal Arc Welding.
 - b. A5.5/A5.5M, Specification for Low-Alloy Steel Electrodes for Shielded Metal Arc Welding.
 - c. D1.1, Structural Welding Code - Steel.
 - d. D1.4, Structural Welding Code - Reinforcing Steel.
 - e. D1.6, Structural Welding Code - Stainless Steel.
 - 5. Occupational Safety and Health Administration (OSHA).
 - 6. Precast/Prestressed Concrete Institute (PCI):
 - a. MNL 116, Manual for Quality Control for Plants and Production of Precast and Prestressed Concrete Products.
 - b. MNL 120, Design Handbook - Precast and Prestressed Concrete.
- B. Qualifications:
 - 1. Provide precast and prestressed concrete units produced by an active member of PCI.
 - 2. Plant to be certified by the Precast/Prestressed Concrete Institute, Plant Certification Program, as applicable:
 - a. Certification Code C1: Precast Concrete Products.
 - b. Certification Code C2: Precast Hollow Core and Repetitive Products.

- c. Certification Code C3: Prestressed Straight Strand Structural Members.
- d. Certification Code C4: Prestressed Deflected Strand Structural Members.
- e. Plant shall have been certified within past year from bid date.
- 3. Plant shall be certified by IAS and shall be acceptable to the Building Code Official to assure compliance with approved fabricator Special Inspection requirements in accordance with the building code.
 - a. Plants that are not certified by IAS or not acceptable to the Building Code Official may be acceptable to work on the Project, provided:
 - 1) Plant meets all remaining qualifications.
 - 2) Contractor reimburses the Owner the cost of Special Inspection services.
- 4. Provide units manufactured by plant which has regularly and continuously engaged in manufacture of units of same type as those required for a minimum of three years.
- 5. Assure manufacturer's testing facilities meet requirements of ASTM E329.
- 6. Welding operators and processes to be qualified in accordance with:
 - a. AWS D1.1 for welding steel shapes and plates.
 - b. AWS D1.4 for welding reinforcing bars.
- 7. Welding operators to have passed qualification tests for type of welding required during the previous 12 months prior to commencement of welding.
- 8. Engineer for all precast or prestressed members: Professional Structural Engineer licensed in the State of Washington.
 - a. Engineer to have minimum five years of experience in design of precast and prestressed members with scope similar to this Project.
- 9. Precast erector:
 - a. Minimum three years of experience with projects of similar size and complexity.

1.3 DEFINITIONS

- A. Slabs: May refer to hollow core slabs or solid flat slabs, prestressed or non-prestressed.

1.4 SUBMITTALS

- A. Shop Drawings:
 - 1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
 - 2. Product technical data including:
 - a. Acknowledgement that products submitted meet requirements of standards referenced.
 - b. Manufacturer's installation instructions.
 - c. Sizes, types and manufacturer of bearing pads.
 - d. Hardware to be utilized to support suspended appurtenances.
 - 3. Shop Drawings and erection plans for precast units, their connections and supports showing:
 - a. Member size and location.
 - b. Size, configuration, location and quantity of reinforcing bars and prestressing strands.
 - c. Initial prestress forces.
 - d. Size and location of openings verified by Contractor.
 - e. Size, number, and locations of embedded metal items and connections.
 - f. Required concrete strengths.
 - g. Identification of each unit using same standard marking numbers as used to mark actual units.
 - 4. Calculations for members and connections designed by fabricator.
 - a. Calculations to be sealed by a professional Structural Engineer registered in the State of Washington.
 - b. Perform calculations using the dead load of the members plus the superimposed uniform and concentrated loads shown on the Drawings and indicated in this Specification Section.

- c. Indicate the following:
 - 1) Design for maximum moment, maximum shear, and maximum torsion.
 - 2) Final top and bottom flexural stresses resulting from the stresses due to maximum moment and prestress force.
 - 3) Ultimate moment capacity.
 - 4) Final top and bottom flexural stresses, ultimate moment capacity, and ultimate shear capacity, if affected, for members with reduced cross sections due to openings or penetrations.
 - 5) When required on Drawings, a check for no tension in top and bottom of members due to prestress force and member dead load plus superimposed loads indicated on Drawings and in this Specification Section.
 - 6) Column design for maximum axial load and maximum moment.
- 5. Submit test results, when so required on Drawings, showing that embedded connection items will adequately support the indicated loads.
 - a. Connection items to have an ultimate load capacity of at least two times the required indicated load.
- 6. Concrete mix design(s) including submittal information defined in Specification Section 03 05 05.
- 7. Fabricator's quality control documentation for special inspections as required by the building code.
- 8. Copies of source quality control tests.
- 9. Certification of manufacturer's testing facility qualifications.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
 - 1. Headed studs and deformed bar anchors:
 - a. Nelson Stud Welding Div., TRW, Inc.
 - b. KSM Division, Omark Industries.
 - 2. Bearing pads:
 - a. JVI, Inc.
- B. Submit request for substitution in accordance with Specification Section 01 25 13.

2.2 MATERIALS

- A. Embedded Steel Plates and Shapes:
 - 1. ASTM A36.
- B. Bearing Pads:
 - 1. Under slabs:
 - a. Plastic bearing strips.
 - b. Minimum compressive strength: 8,000 PSI with no fracture at 26,000 PSI.
 - c. Korolath of New England, Inc., or equal.
 - 2. For all other locations:
 - a. Random, fiber-reinforced elastomeric pads.
 - b. Preformed, randomly oriented synthetic fibers set in elastomer.
 - c. Capable of supporting a compressive stress of 3000 PSI with no cracking, splitting, excessive bulging or delaminating in the internal portions of the pad.
 - d. Size pad to keep a minimum stress 200 PSI under minimum dead load.
 - e. Masticord as manufactured by JVI, Inc., or equal.

- C. Cement:
 - 1. Comply with ASTM C150, Type I or III.
 - 2. Type II cement to be used in the following precast units:
 - a. Precast weir troughs.
- D. Aggregates for Normal Weight Concrete:
 - 1. ASTM C33 with coarse aggregate meeting the gradation for Size 67 as stated in ASTM C33.
 - 2. Provide aggregates approved for bridge construction by the State Highway Department in the state where the precast units are fabricated or in the state where the Project is located.
 - 3. All fine aggregate to be natural not manufactured.
- E. Water:
 - 1. Potable, clean.
 - 2. Free of oils, acids, and organic matter.
- F. Maximum total chloride ion content contributed from all ingredients of concrete including water, aggregates, cement, and admixtures measured as a weight percent of cement to not exceed 0.06 for prestressed concrete and 0.10 for all other precast concrete.
- G. Prestressing Strands:
 - 1. Either 250K or 270K high tensile strength uncoated seven wire strand.
 - 2. Manufacture and test strands in accordance with ASTM A416.
- H. Reinforcing Steel and Welded Wire Reinforcement: See Specification Section 03 21 00.
- I. Headed Studs:
 - 1. ASTM A108.
 - 2. Minimum yield strength: 50,000 PSI.
 - 3. Minimum tensile strength: 60,000 PSI.
- J. Deformed Bar Anchors:
 - 1. ASTM A496 or ASTM A1064.
 - 2. Minimum tensile strength: 80,000 PSI.
 - 3. Minimum yield strength: 70,000 PSI.
- K. Electrodes:
 - 1. E70 series conforming to AWS A5.1/A5.1M or AWS A5.5/A5.5M for welding steel shapes and plates.
 - 2. E90 series conforming to AWS A5.5/A5.5M for welding rebar.
- L. Concrete and cement grout in key ways between slabs.
 - 1. See Specification Section 03 31 30.

2.3 DESIGN

- A. General Design Requirements:
 - 1. Design units and connections in strict accordance with ACI 318 and the PCI MNL 120.
 - 2. Design units for spans, dead load of members, dead and live loads indicated on the Drawings with concentrated loads placed in their actual locations.
 - a. Verify weights and locations of concentrated loads.
 - 3. Design units taking into account reduced cross section at openings and penetrations.
 - 4. Provide all reinforcing in units as indicated.
 - a. Where not indicated, design and provide all reinforcing and prestressing strands subject to approval of Engineer.
 - 5. Due to presence of corrosive atmosphere, design prestressed members where indicated on Drawings for no tension in top and bottom of members resulting from loads indicated on Drawings and in this Specification Section.
 - 6. Design connections to allow rotation and/or movement as appropriate to avoid damage to connections, supporting members, joint sealants and other building components.

7. Design double tee flanges to carry all dead and live loads to be placed thereon.
 - a. Do not place concentrated equipment loads on flanges but support the loads on the double tee legs.

2.4 MIXES

- A. See Specification Section 03 31 30.
- B. Do not begin fabrication of units until concrete mix design(s) have been approved by Engineer.

2.5 FABRICATION

- A. Do not fabricate units until Shop Drawings have been approved by Engineer and returned to Contractor and support locations have been field verified by Contractor.
- B. Manufacture, quality, dimensional and erection tolerances of all units to be in accordance with both PCI MNL 116 and PCI MNL 120.
- C. Cast all members in smooth rigid forms which will provide straight, true members of uniform thickness and uniform color and finish.
- D. Use sand cement grout mixture to fill all air pockets and voids, and to repair chipped edges.
- E. Finish all repairs smooth and to match adjacent surface texture and color.
- F. Where units are to receive concrete topping, provide units having heavy broom finish on top surface for bond.
 1. Provide roughness of top surface to provide bond with topping and design for horizontal shear at topping and unit interface in accordance with requirements of ACI 318, Horizontal Shear Strength paragraph.
 2. Make all other surfaces smooth.
- G. Incorporate embedded plates, angles, and flange welding strips into members at time of manufacture.
 1. Provide embedded items as shown on the Drawings unless prior approval is received from Engineer to do otherwise.
 2. Provide flange welding strips on all flanged edges of all double tee units as indicated on Drawings.
 3. Space strips as shown on Drawings.
 4. Cast lifting handles into units at or near support points.
 - a. Remove lifting handles after units are erected.
- H. Cast openings larger than 6 IN SQ or 6 IN DIA in units at time of manufacture.
 1. Make smaller openings by neat cutting or neat drilling by trades requiring them.
 2. Coordinate sizes and locations of all openings before fabrication of units.
- I. Make provisions for support of suspended ceilings, lighting fixtures, ducts, piping, conduits and other suspended work.
 1. When drilled expansion bolts or powder-driven fasteners are approved for use, coordinate prestress strand location with prestress concrete member supplier so that drilled expansion bolts or powder-driven fasteners do not hit or are drilled or driven into prestress strands.
 2. Install powder-driven fasteners by means of a low velocity powder-actuated tool complying with requirements of OSHA.
 - a. Assure that the load to be supported by each in place drilled expansion bolt or powder-driven fastener does not exceed the maximum allowable load recommended by the bolt or fastener manufacturer for the concrete strength encountered and for the type, size and embedment length of expansion bolt or driven fastener installed.
- J. Automatically weld headed studs and deformed bar anchors to members to provide full penetration weld between studs, bar anchors and members they are attached to.
- K. Weld steel shapes and plates per AWS D1.1 and reinforcing steel per AWS D1.4.

- L. Minimum concrete compressive strength at time of strand release: 3500 PSI.
- M. Mark each unit as indicated on the erection plans.
 - 1. Place mark on non-exposed-to-view surface.
- N. Coat or finish ends of exposed prestressing strands to prevent rusting.
- O. Fabricate the following types of precast and prestressed units (all units to be made with normal weight concrete unless noted otherwise on Drawings):
 - 1. Prestressed hollow core slabs of sizes indicated.
 - a. Weight of hollow core slabs not to exceed the following:

2.6 SOURCE QUALITY CONTROL

- A. During production of precast concrete units, conduct strength tests of concrete placed in units as required in Specification Section 03 05 05 for concrete placed during fabrication.
 - 1. Results of strength tests to be sent immediately to Engineer, Contractor, and Owner.
 - 2. Test reports to indicate units they represent.
- B. When approved by Engineer, strength tests may be made by precast manufacturer after he has submitted certification that his testing facilities meet the requirements of ASTM E329.
- C. Conduct tests on precast concrete using the following procedures:
 - 1. If the precast manufacturer's quality control program requires more frequent or more stringent testing requirements, the manufacturer's quality control program will take precedence over the specific type of test.
 - a. Precast manufacturer to employ services of an independent testing laboratory to perform concrete testing for manufacturer's production procedures (not listed below) and quality control program.
 - 2. If the precast fabrication plant is not certified by IAS and acceptable to the Building Code Official, Owner will employ and pay for precast concrete production special inspection.
 - a. Coordinate with Owner's special inspector.
 - 1) Provide minimum 7 calendar days' notice prior to the start of fabrication.
 - 2) Provide minimum 24 HRS notice prior to fabrication of any precast members.
 - 3. If precast fabrication plant is certified by IAS and acceptable to the Building Code Official, perform concrete tests as specified in Section 03 09 00. Frequency of tests: Per PCI MNL-116 or PCI MNL-117 as applicable.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Verify acceptability and location of supports to receive units.
 - 1. Check bearing surfaces to determine that they are level and uniform.
- B. Verify compressive strengths of concrete and masonry supports.
 - 1. Do not start erection of units until supports have reached their 28 day required compressive strengths.

3.2 ERECTION

- A. Sequence erection to provide a balance of loads across beams and columns.
- B. Give consideration to possible lack of stability or capacity of partially completed frame or structure.
- C. Contractor to be responsible for guying, shoring, and bracing of frame, walls and individual members as necessary to resist forces due to wind, erection, or any other source that may occur before structure is completed.

- D. Use only erection equipment adequate for placing units at lines and elevations indicated on Drawings.
 - 1. Do not damage units or existing construction during erection.
 - 2. Erect units using lifting handles cast into the units.
- E. Place each leg of all double tees on a 3/8 IN thick bearing pad held 1 IN back from edge of support.
 - 1. Pad dimensions equal to length of bearing -1 IN x bearing width +2 IN.
- F. Place slabs on continuous 1/4 IN thick bearing pad so that width equals bearing length -1 IN.
- G. Provide a 1/2 IN thick bearing pad on the top of all precast concrete columns.
- H. Pad to cover entire top surface of column except hold pad back 1 IN from face of column all around.
- I. Weir Trough:
 - 1. Anchor weir troughs to supports as indicated on Drawings.
 - 2. Provide continuous 3/8 IN thick bearing pad under troughs at support.
 - 3. Hold back pads 1 IN from edge of support.
- J. After erection, verify that there is no direct contact between bottom of units and supporting members.
 - 1. Where direct contact occurs, install additional layers of bearing material to raise units off supports.
- K. Weld steel shapes and plates per AWS D1.1 and reinforcing steel per AWS D1.4.
- L. Fill all keyways between slabs with concrete sand cement grout.
 - 1. See Specification Section 03 31 30.
- M. After all precast units are erected and all precast unit connections have been made, coat all exposed surfaces of the connections.
 - 1. See Specification Section 09 96 00.

3.3 FIELD QUALITY CONTROL

- A. Testing and Special Inspections: See Section 01 45 33.
- B. Causes for rejection of units include, but are not necessarily limited to the following:
 - 1. Cracked units.
 - 2. Chipped, broken, or spalled edges.
 - 3. Units not within allowable casting tolerances.
 - 4. Voids or air pockets which, in opinion of Engineer, are too numerous or too large.
 - 5. Non-uniform finish or appearance.
 - 6. Low concrete strength.
 - 7. Improperly placed embedded items and/or openings.
 - 8. Exposed wire mesh, reinforcing or prestressing strands.

END OF SECTION

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DIVISION 05
METALS



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SECTION 05 12 00
STRUCTURAL STEEL

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Structural steel, including the fabrication and erection of support and bracing members, including connections.
 - 2. Connection detail design as required.
- B. Related Specification Sections include but are not necessarily limited to:
 - 1. Division 00 - Procurement and Contracting Requirements.
 - 2. Division 01 - General Requirements.
 - 3. Section 03 15 19 - Anchorage to Concrete.
 - 4. Section 09 96 00 - High Performance Industrial Coatings.

1.2 QUALITY ASSURANCE

- A. Referenced Standards:
 - 1. American Institute of Steel Construction (AISC):
 - a. 303, Code of Standard Practice for Steel Buildings and Bridges.
 - b. 360, Specifications for Structural Steel Buildings.
 - c. Quality Certification Program for Fabricators.
 - 2. American Society of Mechanical Engineers (ASME):
 - a. B18.21.1, Washers: Helical Spring-Lock, Tooth Lock, and Plain Washers (Inch Series).
 - 3. ASTM International (ASTM):
 - a. A2, Standard Specification for Carbon Steel Girder Rails of Plain, Grooved, and Guard Types.
 - b. A6/A6M, Standard Specification for General Requirements for Rolled Structural Steel Bars, Plates, Shapes, and Sheet Piling.
 - c. A36/A36M, Standard Specification for Carbon Structural Steel.
 - d. A53/A53M, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
 - e. A108, Standard Specification for Steel Bar, Carbon and Alloy, Cold-Finished.
 - f. A123/A123M, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
 - g. A153/A153M, Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
 - h. A307, Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
 - i. A500/A500M, Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.
 - j. A563, Standard Specification for Carbon and Alloy Steel Nuts.
 - k. A992/A992M, Standard Specification for Structural Steel Shapes.
 - l. A1064/A1064M, Standard Specification for Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete.
 - m. F436, Standard Specification for Hardened Steel Washers.
 - n. F959, Standard Specification for Compressible-Washer-Type Direct Tension Indicators for Use with Structural Fasteners.
 - o. F1554, Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength.

- p. F3125, Standard Specification for High Strength Structural Bolts, Steel and Alloy Steel, Heat Treated, 120 KSI (830 MPa) and 150 KSI (1040 MPa) Minimum Tensile Strength, Inch and Metric Dimensions.
- 4. American Welding Society (AWS):
 - a. A5.1/A5.1M, Specification for Carbon Steel Electrodes for Shielded Metal Arc Welding.
 - b. A5.5/A5.5M, Specification for Low-Alloy Steel Electrodes for Shielded Metal Arc Welding.
 - c. A5.17/A5.17M, Specification for Carbon Steel Electrodes and Fluxes for Submerged Arc Welding.
 - d. A5.18/A5.18M, Specification for Carbon Steel Electrodes and Rods for Gas Shielded Arc Welding.
 - e. A5.20/A5.20M, Specification for Carbon Steel Electrodes for Flux Cored Arc Welding.
 - f. A5.23/A5.23M, Specification for Low-Alloy Steel Electrodes and Fluxes for Submerged Arc Welding.
 - g. A5.28/A5.28M, Specification for Low-Alloy Steel Electrodes and Rods for Gas Shielded Arc Welding.
 - h. A5.29/A5.29M, Specification for Low-Alloy Steel Electrodes for Flux Cored Arc Welding.
 - i. D1.1/D1.1M, Structural Welding Code - Steel.
 - 1) Steel stud connectors and their installation to comply with requirements of AWS D1.1/D1.1M.
- 5. National Institute of Steel Detailing (NISD).
- 6. Research Council on Structural Connections (RCSC):
 - a. Specification for Structural Joints Using High-Strength Bolts.
- B. Qualifications:
 - 1. Steel fabricator:
 - a. Minimum of 10 years of experience in fabrication of structural steel or participate in the AISC Certification program and is designated an AISC Certified Plant, Category BU (formally known as STD) at time of bid.
 - b. Fabricator plant quality control and inspection program: Meet requirements of the building code and/or be an Approved Fabricator.
 - c. Plants that are not an Approved Fabricator may be acceptable, provided:
 - 1) Plant meets all remaining qualifications.
 - 2) Contractor reimburses the Owner the cost of required Special Inspection services.
 - 2. Steelerector:
 - a. Minimum of 10 years of experience in erection of structural steel similar in the scope of this project or certified as CSE under the AISC Quality Certification Program.
 - b. With an active and enforced quality assurance program in place, as described in the applicable Codes.
 - 3. Qualify welding procedures and welding operators in accordance with AWS.

1.3 DEFINITIONS

- A. Owner: May mean the Owner's Designated Representative for Construction as defined by the AISC 303.
- B. Galvanizing: Hot-dipped galvanizing per ASTM A153/A153M and/or ASTM A123/A123M with minimum coating of 2.0 OZ of zinc per square foot of metal (average of specimens) unless noted otherwise or dictated by a forementioned standards.
- C. Approved Fabricator: Approved by the Building Official to perform the building code required Special Inspections.

1.4 SUBMITTALS

- A. Shop Drawings:
 - 1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
 - 2. Product technical data including:
 - a. Acknowledgement that products submitted meet requirements of standards referenced.
 - b. Manufacturer's installation instructions.
 - c. Detailed supplemental specification relating to load indicator washers or high-strength bolts.
 - 1) Alternate design for Engineer approval (submitted at Contractor's option if desired by Contractor for use).
 - d. Source and certification of quality for high-strength bolts, nuts, and washers.
 - 3. Fabrication and/or layout drawings:
 - a. Prepare Shop Drawings under NISD Quality Procedures Program certification.
 - b. Complete Shop Drawings for all of the work showing clearly all pieces, sizes, dimensions, details, connections materials and shop coatings.
 - 1) All Shop Drawings must be checked and signed "approved" before submittal.
 - 2) Show all cuts, copes, and holes.
 - 3) Indicate all shop and field bolts.
 - 4) Indicate all shop and field welds using AWS symbols.
 - c. Prepare complete erection drawings showing the location and marks of all pieces.
 - 1) Copies of up-to-date erection drawings shall accompany the Shop Drawings.
 - 2) Use match marks on the erection drawings to indicate the sheet number on which each particular member is detailed.
 - d. Correct any incorrect or unacceptable material or fabrication due to incorrect detailing, shop work, or erection, without additional charge.
 - 4. Certifications:
 - a. Certificates of compliance with standards specified for all major components and fasteners incorporated into work.
 - b. Copies of current welding certificates for each welder assigned to perform welding indicating compliance with testing specified by AWS.
 - c. Welder qualification data and prequalified procedures.
 - d. Special Inspections reports.
 - e. Source Quality Control Documentation, including certificate of compliance stating that the work performed in the fabrication shop was done in accordance with the approved construction documents.
 - 1) Certification is required only if the fabricator is fabricator approved by the Building Official.
 - 5. Test reports:
 - a. Certified copies of mill tests.
 - b. Manufacturer's load test and temperature sensitivity data for post-installed anchor bolts.
 - c. Test reports for all structural steel work.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Handle and store steel members above ground on skids or other supports.
 - 1. Keep free of dirt and other foreign material and protect against corrosion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
1. High-strength bolts:
 - a. Portland Bolt and Manufacturing Company.
 - b. Lewis Bolt & Nut Company.
 - c. Nucor Fasteners.
 - d. St. Louis Screw and Bolt Company.
 2. Load indicator washers for high-strength bolts:
 - a. Portland Bolt and Manufacturing Company.
 - b. Mid-South Bolt and Screw Co., Inc.
 - c. J and M Turner, Inc.
 3. Alternate design high-strength bolts:
 - a. T. C. Bolt Corporation.
 - b. Construction Fastener Systems Division of Bristol Machine Company.
 - c. LeJuene Bolt Co.
 4. Headed studs and deformed bar anchors:
 - a. Nelson Stud Welding Division, TRW, Inc.
 - b. Stud Welding Products, Inc.
 5. Mechanical anchor bolts:
 - a. See Section 03 15 19.
 6. Adhesive anchors bolts:
 - a. See Section 03 15 19.
 7. Anchor bolt sleeves:
 - a. Sinco/Wilson.
- B. Submit request for substitution in accordance with Specification Section 01 25 13.

2.2 MATERIALS

- A. Steel, Structural Shapes and Plate (unless noted otherwise on Drawings):
1. All W-shapes and WT-shapes: ASTM A992/A992M.
 2. All other plates, bars and rolled shapes: ASTM A36/A36M.
- B. Pipe: ASTM A53/A53M, Grade B (Type E or S) (Fy=35).
- C. Hollow Structural Sections (HSS):
1. Round: ASTM A500/A500M, Grade C (Fy=46).
 2. Square or rectangular: ASTM A500/A500M, Grade C (Fy=50).
- D. High-Strength Bolts, Nuts and Washers:
1. ASTM F3125, Grade A325 with ASTM A563 nuts galvanized:
 2. High-strength bolts:
 - a. Provide two ASTM F436 washers for all bolts galvanized.
 - b. Provide beveled washers at connections of sloped/tapered sections.
 3. High-strength bolts with compressible washer type direct tension indicators (DTI), ASTM F959.
 - a. Provide at Contractor's option and subject to approval of Engineer.
 4. Alternate high-strength design: Provide at Contractor's option and subject to approval of Engineer.
- E. Bolts, Non-high Strength: ASTM A307, Grade A.
- F. Threaded Rod: ASTM F1554, Grade 36.
- G. Washers, Plain (for Non-high Strength Bolts): ASME B18.22.1, Type B.

- H. Welding Electrodes:
 1. Shielded metal arc: AWS A5.1/A5.1M or AWS A5.5/A5.5M, E70XX or E801X-X.
 2. Submerged arc: AWS A5.17/A5.17M or AWS A5.23/A5.23M, F7XX-EXXX or F8XX-EXXX-XX.
 3. Gas metal arc: AWS A5.18/A5.18M, E70S-X or E70U-1 or AWS A5.28/A5.28M, ER80S-XX, E80C-XXX.
 4. Flux cored arc: AWS A5.20/A5.20M, E7XT-X (except 2, 3, 10, GS), AWS A5.29/A5.29M, E7XT-X or E8XTX-X, E8XTX-XM.
- I. Anchor Rods and Bolts:
 1. See Section 03 15 19.
- J. Headed Studs and Deformed Bar Anchors:
 1. Headed studs:
 - a. ASTM A108, complying with AWS D1.1/D1.1M, Section 7, Type B; minimum yield strength 50,000 PSI, minimum tensile strength 60,000 PSI.
 - b. Uniform diameter.
 - c. Heads: Concentric and normal to shaft.
 - d. Weld end: Chamfered and solid flux.
 2. Deformed bar anchor:
 - a. ASTM A1064/A1064M, complying with AWS D1.1/D1.1M, Section 7, Type C.
 - b. Minimum yield strength: 70,000 PSI.
 - c. Minimum tensile strength: 80,000 PSI.
 - d. Straight, unless indicated otherwise.
 - e. Solid flux.
 3. After welding, remove ceramic ferrules and maintain free from any substance which would interfere with function, or prevent bonding to concrete.
- K. Nonshrink Grout: See Specification Section 03 31 30 and Section 03 31 31.
- L. Mechanical and Adhesive Anchor Bolts for Fastening to Concrete:
 1. See Specification Section 03 15 19.

2.3 FABRICATION

- A. Comply with requirements of applicable building code and AISC 360 with modifications and additional requirements specified herein.
 1. Identify high-strength steel material in fabricated members in accordance with ASTM A6/A6M.
- B. Minimize the amount of field welding.
 1. Shop assemble components into largest size possible commensurate with transportation and handling limitations.
 2. Shop connections: Bolted with high-strength bolts or welded.
- C. Connection Details:
 1. Provide as a minimum, two, 3/4 IN DIA, high-strength bolts for all bolted connections unless otherwise specified.
- D. Provide bearing type connections for all bolted connections, unless otherwise noted.
- E. Field Connections:
 1. Provide bolts for all field connections except where shown otherwise on the Drawings.
 2. Use high-strength bolts unless shown or specified otherwise.
 3. Use of high-strength bolts: Conform to RCSC Specification for Structural Joints Using High-Strength Bolts.
 4. If structural steel details (field welds versus shop welds, etc.) shown on design Drawings are not compatible with selected erection procedures, submit proposed modifications for review.

5. Connections to structural steel provided by others: Provide all connectors and coordinate location of bolt holes to match connection holes in steel provided by others.
- F. Accurately mill column end bearing surfaces to true plane.
 - G. Fabricate and erect beams with non-specified camber in accordance with AISC 360, Chapter L1.
 - H. Cut, drill, or punch holes at right angles to surface of metal.
 1. Do not make or enlarge holes by burning.
 2. Make holes clean cut, without torn or ragged edges.
 3. Remove outside burrs resulting from drilling or reaming operations with tool making 1/16 IN bevel.
 4. Provide holes in members to permit connection of work of other trades or contractors.
 - I. Make allowance for draw in all cross bracing to provide small amount of initial tension in members.
 - J. Make splices only where indicated or where approved.
 - K. Cope at 45 DEG, corners of stiffener plates at junction of member flanges with webs.
 - L. Flame cut bevels for welds, provided such cutting is done automatically.
 1. Leave free of burrs and slag by grinding or planing the cut edges.
 - M. Grind smooth all rough welds and sharp steel edges shall be ground to approximately 1/8 IN radius.
 - N. Tolerances (unless noted otherwise on Drawings):
 1. When material received from the mill does not satisfy ASTM A6/A6M tolerances for camber, profile, flatness or sweep, Contractor is permitted to perform corrective work by the use of controlled heating, and mechanical straightening, subject to the limitations of the AISC 360.
 2. Fabrication tolerance:
 - a. Member length:
 - 1) Both ends finished for contact bearing: 1/32 IN.
 - 2) Framing members: 30 FT or less: 1/16 IN.
 - b. Member straightness:
 - 1) Compression members: 1/1000 of a axial length between points laterally supported.
 - 2) Non-compression members: ASTM A6/A6M tolerance for wide flange shapes.
 - c. Specified member camber (except compression members):
 - 1) 50 FT or less: -0/+1/2 IN.
 - 2) Over 50 FT: -0/+1/2 IN (+1/8 IN per 10 FT over 50 FT).
 - 3) Members received from mill with 75 PCT of specified camber require no further cambering.
 - 4) Fabricate beams/trusses without specified camber so after erection, camber is upward.
 - 5) Measure camber in fabrication shop in unstressed condition.
 - d. Use filler plates at bolted splices to take up depth deviation.
 - 1) At welded joints, adjust weld profile to conform to variation in depth.
 - 2) Slope weld surface per AWS requirements.
 - e. Free finished members from twists, bends, and open joints.
 - 1) Sharp kinks, bends, and deviation from the above tolerances are cause for rejection of material.

2.4 WELDING

- A. Comply with AWS D1.1/D1.1M, and other requirements indicated herein, for all welding, techniques of welding employed, a ppearance and quality of welds, and methods used to correct defective work.
 1. Qualify joint welding procedures or test in accordance with AWS qualification procedures.

- B. Test and qualify welders, welding operators and tackers in compliance with AWS D1.1/D1.1M for position and type of welding to which they will be assigned.
 - 1. Conduct tests in presence of a approved testing agency.
 - 2. Certification within previous 12 months will be acceptable, provided samples of the welder's work are satisfactory.
- C. Before Starting Welding:
 - 1. Carefully plumb and align members in compliance with specified requirements.
 - 2. Fully tighten all bolts.
 - 3. Comply with AWS D1.1/D1.1M, Section 5 for assembly and surface preparation.
 - 4. Preheat base metal to temperature stated in AWS D1.1/D1.1M.
 - a. When no preheat temperature is given in AWS D1.1/D1.1M and base metal is below 50 DEGF, preheat base metal to at least 70 DEGF.
 - b. Maintain temperature during welding.
 - c. Preheat surface of all base metal within distance from point of welding equal to thickness of thicker part being welded or 3 IN, whichever is greater, to specified preheat temperature.
 - d. Maintain this temperature during welding.
 - 5. Mark welds with an identifying mark unique to each welder.
- D. Make flange welds before making web welds.
- E. Where groove welds have back-up plates, make first three passes with 1/8 IN round electrodes.
 - 1. Use backup plates in accordance with AWS D1.1/D1.1M, extending minimum of 1 IN either side of joint.
- F. Flame cut edges of stiffener plates at shop or field butt weld.
 - 1. Do not shear.
- G. Grind flush web fillets at webs notched to receive backup plates for flange groove welds.
- H. Low Hydrogen Electrodes: Dry and store electrodes in compliance with AWS D1.1/D1.1M.
- I. Do not perform welding when ambient temperature is lower than 0 DEGF or where surfaces are wet or exposed to rain, snow, or high wind, or when welders are exposed to inclement conditions.
- J. Headed Studs and Deformed Bar Anchors:
 - 1. Automatically end welded in accordance with the AWS D1.1/D1.1M and manufacturer's recommendations.
 - 2. Fillet welding of headed studs and deformed bar anchors is not allowed unless approved by Engineer.
- K. Test in-place studs in accordance with requirements of AWS D1.1/D1.1M to ensure satisfactory welding of studs to members.
 - 1. Replace studs failing this test.
- L. When headed stud-type shear connectors are to be applied, clean top surface of members to receive studs in shop to remove oil, scale, rust, dirt, and other materials injurious to satisfactory welding.
 - 1. Do not shop paint or galvanize metal surfaces to receive field applied studs.

2.5 SHOP COATING

- A. Refer to Specification Section 09 96 00 and coordinate shop primer, surface preparation and coating with field applied primers and coatings where specified.
- B. Provide suitable methods of handling and transporting painted steel to avoid damage to coating.

- C. Do not coat following surfaces:
 - 1. Machined surfaces, surfaces adjacent to field welds, and surfaces fully embedded in concrete.
 - 2. All other members for which no coating is specified.
 - 3. Contact surfaces at bolted slip-critical connections, unless surface condition conforms to the RCSC Specification for Structural Joints Using High-Strength Bolts, Part 3.2.2.
- D. Clean thoroughly all surfaces not coated before shipping.
 - 1. Remove loose mill scale, rust, dirt, oil, and grease.
 - 2. Protect machined surfaces.

2.6 SOURCE QUALITY CONTROL

- A. Special Inspection and Testing:
 - 1. See Specification Section 01 45 33.
 - 2. If the fabricator is not an Approved Fabricator, Owner will employ the services of an independent testing agency to inspect and test structural steel shop work for compliance with Specifications.
 - a. Contractor provides sufficient notification and access so inspection and testing can be accomplished.
 - 3. Contractor responsible for testing to qualify shop welders and as needed for Contractor's own quality control to ensure compliance with Contract Documents.
- B. Approved Fabricator or Testing Agency Responsibilities:
 - 1. Inspect shop and field welding in accordance with AWS D1.1/D1.1M, Section 6 including the following non-destructive testing:
 - a. Visually inspect all welds.
 - b. In addition to visual inspection, test 50 PCT of full penetration welds and 20 PCT of fillet welds with liquid dye penetrant.
 - c. Test 20 PCT of liquid dye penetrant tested full penetration welds with ultrasonic or radiographic testing.
 - 2. Inspect high-strength bolting in accordance with the RCSC Specification for Structural Joints Using High-Strength Bolts, Section 9.
 - a. Verify proper pretension for slip-critical bolted connection only.
 - b. Verify direct tension indicator gaps for slip-critical bolted connection only.
 - 3. Inspect stud welding in accordance with AWS D1.1/D1.1M, Section 7.8.
 - 4. Prepare and submit inspection and test reports to Engineer.

2.7 GENERAL

- A. Contractor is solely responsible for safety.
 - 1. Construction means and methods and sequencing of work is the prerogative of the Contractor.
 - 2. Take into consideration that full structural capacity of many structural members is not realized until structural assembly is complete; e.g., until slabs, decks, bracing or rigid connections are installed.
 - 3. Partially complete structural members shall not be loaded without an investigation by the Contractor.
 - 4. Until all elements of the permanent structure and lateral bracing system are complete, provide temporary bracing designed, furnished, and installed by the Contractor for the partially complete structure.
- B. Adequate temporary bracing to provide safety, stability and to resist all loads to which the partially complete structure may be subjected, including wind, construction activities, and operation of equipment, is the responsibility of the Contractor.
 - 1. Use temporary guys, braces, shoring, connections, etc., necessary to maintain the structural framing plumb and in proper alignment until permanent connections are made, the succeeding work is in place, and temporary work is no longer necessary.

2. Use temporary guys, bracing, shoring, and other work to prevent injury or damage to adjacent work or construction from stresses due to erection procedures and operation of erection equipment, construction loads, and wind.
 3. Design of the temporary bracing system and consideration of the sequence and schedule of placement of such elements and effects of loads imposed on the structural steel members by partially or completely installed work, including work of all other trades, is the Contractor's responsibility.
 - a. If not obvious from experience or from the Drawings, confer with the Engineer to identify those structural steel elements that must be complete before the temporary bracing system is removed.
 4. Remove and dispose of all temporary work and facilities off-site.
- C. Examine work-in-place on which specified work is in any way dependent to ensure that conditions are satisfactory for the installation of the work.
1. Report defects in work-in-place which may influence satisfactory completion of the work.
 2. Absence of such notification will be construed as acceptance of work-in-place.
- D. Field Measurement:
1. Take field measurements as necessary to verify or supplement dimensions indicated on the Drawings.
 2. Contractor is responsible for the accurate fit of the work.
- E. Check the elevations of all finished footings or foundations and the location and alignment of all anchor bolts before starting erection.
1. Notify Engineer of any errors or deviations found by such checking.

PART 3 - EXECUTION

3.1 ERECTION

- A. Framing member location tolerances after erection shall not exceed the framing tolerances listed in the FIELD QUALITY CONTROL Article in PART 3 of this Specification Section.
- B. Erect plumb and level; introduce temporary bracing required to support erection loads.
- C. Use light drifting necessary to draw holes together.
1. Drifting to match unfair holes is not allowed.
- D. Welding:
1. Conform to AWS D1.1/D1.1M and requirements of this Specification Section.
 2. Join two (2) sections of steel of different ASTM designations using welding techniques in accordance with a qualified AWS D1.1/D1.1M procedure.
- E. Shore existing members when unbolting of common connections is required.
1. Use new bolts for rebolting connections.
- F. Clean stored material of all foreign matter accumulated during erection period.
- G. Clean bearing and contact surfaces before assembly.
- H. Set beam and column base and bearing plates accurately, as indicated, on nonshrink grout.
1. Set and anchor each base plate to proper line and elevation.
 2. Use metal wedges, shims or setting nuts as required and tighten anchor bolts.
 - a. Use same metal as base plate.
 - b. Cut off protrusions of wedges and shims flush with edge of base plate.
 3. Fill sleeves around anchor bolts with nonshrink grout.
 4. Pack grout solidly between bottom of plate and bearing surface.
 5. Refer to Specification Section 03 31 30 for nonshrink grout requirements.
- I. Cast-in-place Anchor Bolts:
1. See Specification Section 03 15 19.

- J. Install high strength bolts with hardened washers.
 - 1. Install and tighten in accordance with the RCSC Specification for Structural Joints Using High-Strength Bolts, Section 8.
 - 2. Coordinate installation with inspection.
 - a. Do not start installation until coordination with Testing Agency is complete.
 - 3. Bearing-type connections: High-strength bolts shall be tightened to snug-tight condition.
 - 4. Slip-critical connections:
 - a. Perform calibration testing for all methods of installation of high-strength bolts in accordance with RCSC Specification for Structural Joints Using High-Strength Bolts, Section 8.2.
 - b. Turn-of-nut tightening:
 - 1) Inspector shall observe the pre-installation verification testing.
 - 2) Subsequently, ensure by routine observation that the bolting crew properly rotates the turned element relative to the unturned element by the amount specified.
 - 3) Alternatively, when fastener assemblies are match-marked after the initial fitup of the joint but prior to pretensioning, visual inspection after pretensioning is permitted in lieu of routine observation.
 - c. Calibrated wrench tightening: Calibrate on a daily basis.
 - d. Direct tension indicator tightening: If previously approved by Engineer.
 - e. Installation of alternate design bolts: If previously approved by Engineer.
 - 5. In the event any bolt in a connection is found to be defective, check and retighten all bolts in the connection.
- K. Do not use gas cutting to correct fabrication errors.
 - 1. In case members do not fit or holes do not match, ream out the holes and insert the next larger size bolt.
 - a. Drill new holes if the connections require new holes.
 - b. Make no such corrections without prior approval of the Engineer.
 - 2. Burning of holes is not permitted.
- L. Prior to making field connections to existing structural steel, remove completely all paint from existing steel which will be in contact with new steel and new welds.
- M. Tighten and leave in place erection bolts used in welded construction.
- N. Provide beveled washers to give full bearing to bolt head or nut where bolts are to be used on surfaces having slopes greater than 1 in 20 with a plane normal to bolt axis.
- O. After bolts are tightened, upset threads of non-high strength bolts and anchor bolts to prevent nuts from backing off.
- P. After Erection:
 - 1. Grind smooth all sharp surface irregularities resulting from field cutting or welding.
 - 2. Power tool clean welds, bolts, washers and abrasions to shop coat removing all rust and foreign matter.
- Q. Mechanical Anchor Bolts and Adhesive Anchor Bolts:
 - 1. See Specification Section 03 15 19.

3.2 FIELD QUALITY CONTROL

- A. Special Inspection and Testing:
 - 1. See Specification Section 01 45 33.
 - 2. Special Inspection to be in accordance with the building code.
 - 3. Special Inspection is required for:
 - a. Material verification of high-strength bolts, nuts, and washers.
 - 1) Frequency: All high-strength bolts, prior to being covered up or substantial completion.

- b. Inspection of high-strength boltings:
 - 1) Frequency:
 - a) All high-strength bolts, prior to being covered up or substantial completion.
 - b) Pretensioned and slip-critical joints using turn-of-nut without match marking or calibrated wrench methods of installation require continuous inspection.
 - c. Material verification of structural steel.
 - 1) Frequency: Prior to being covered up or substantial completion,
 - d. Material verification of weld filler materials.
 - 1) Frequency:
 - a) Prior to welding on site.
 - b) Randomly thereafter.
 - e. Inspection of welding.
 - 1) Frequency:
 - a) Visually inspect all welds.
 - b) In addition to visual inspection, test 50 PCT of full penetration welds and 20 PCT of fillet welds with liquid dye penetrant or magnetic particle.
 - c) Test 20 PCT of liquid dye penetrant tested full penetration welds with ultrasonic or radiographic testing.
 - f. Inspect structural steel which has been erected.
 - 1) Frequency: Prior to members being covered up or substantial completion.
 - g. Inspect stud welding in accordance with AWS D1.1/D1.1M, Section 7.8.
- B. Erected Framing Tolerance, unless noted otherwise on the Drawings:
- 1. Do not exceed cumulative effect of rolling, fabrication, and erection tolerance for overall finished dimensions.
 - 2. Erection tolerances are defined relative to member working points and working lines as follows:
 - a. Actual centerline of top flange or surface at each end for horizontal members.
 - b. Actual center of member at each end for all other members.
 - c. Other points may be used, providing they are based on these definitions.
 - d. Working line is straight line connecting member working points.
 - 3. Tolerances on position and alignment are as specified in the Code, unless otherwise modified.
 - a. Provide "adjustable items" such as lintels, wall supports, curb angles, window mullions and similar members with adjustable connections to supporting structural framing.
 - 4. Certification by steel erector:
 - a. Certify the location of erected structural steel is acceptable for plumbness, level and aligned within tolerances specified.
 - b. Provide certification upon completion of any part of work.
 - c. Provide certification prior to start of work by other trades that may be supported; attach to structural steel work.

3.3 CLEANING AND REPAIR OF SHOP PRIMER PAINT

- A. After erection, clean all steel of mud or other foreign materials, and repair any damage.
 - 1. Touchup coatings to comply with Specification Section 09 96 00.

END OF SECTION

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SECTION 05 50 00
METAL FABRICATIONS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
1. Custom fabricated metal items and certain manufactured units not otherwise indicated to be supplied under work of other Specification Sections.
 2. Design of all temporary bracing not indicated on Drawings.
 3. Design of systems and components, including but not limited to:
 - a. Stairs.
 - b. Landings.
 - c. Ladders.
- B. Related Specification Sections include but are not necessarily limited to:
1. Division 00 - Procurement and Contracting Requirements.
 2. Division 01 - General Requirements.
 3. Section 03 09 00 - Concrete.
 4. Section 03 15 19 - Anchorage to Concrete.
 5. Section 03 31 30 - Concrete, Materials and Proportioning.
 6. Section 05 12 00 - Structural Steel.
 7. Section 09 96 00 - High Performance Industrial Coatings.

1.2 QUALITY ASSURANCE

- A. Referenced Standards:
1. American Association of State Highway and Transportation Officials (AASHTO):
 - a. HB, Standard Specifications for Highway Bridges.
 2. American Institute of Steel Construction (AISC):
 - a. 325, Manual of Steel Construction.
 - b. 360, Specifications for Structural Steel Buildings (referred to herein as AISC Specification).
 3. The American Ladder Institute (ALI):
 - a. A14.3, Ladders - Fixed - Safety Requirements.
 4. American Society of Civil Engineers (ASCE):
 - a. 7, Minimum Design Loads for Buildings and Other Structures.
 5. ASTM International (ASTM):
 - a. A6, Standard Specification for General Requirements for Rolled Structural Steel Bars, Plates, Shapes, and Sheet Piling.
 - b. A36, Standard Specification for Carbon Structural Steel.
 - c. A47, Standard Specification for Ferritic Malleable Iron Castings.
 - d. A48, Standard Specification for Gray Iron Castings.
 - e. A53, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
 - f. A108, Standard Specification for Steel Bar, Carbon and Alloy, Cold Finished.
 - g. A123/A123M, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
 - h. A153/A153M, Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
 - i. A197, Standard Specification for Cupola Malleable Iron.
 - j. A269, Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service.
 - k. A276, Standard Specification for Stainless Steel Bars and Shapes.

- l. A307, Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
 - m. A312, Standard Specification for Seamless, Welded, and Heavily Cold Worked Austenitic Stainless Steel Pipes.
 - n. A380, Standard Practice for Cleaning, Descaling, and Passivation of Stainless Steel Parts, Equipment, and Systems.
 - o. A500, Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.
 - p. A501, Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing.
 - q. A536, Standard Specification for Ductile Iron Castings.
 - r. A554, Standard Specification for Welded Stainless Steel Mechanical Tubing.
 - s. A572, Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel.
 - t. A563, Standard Specification for Carbon and Alloy Steel Nuts.
 - u. A666, Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.
 - v. A668, Standard Specification for Steel Forgings, Carbon and Alloy, for General Industrial Use.
 - w. A780, Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings.
 - x. A786, Standard Specification for Hot-Rolled Carbon, Low-Alloy, High-Strength Low-Alloy, and Alloy Steel Floor Plates.
 - y. A992, Standard Specification for Steel for Structural Shapes.
 - z. A1064, Standard Specification for Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete.
 - aa. A1011, Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength.
 - bb. F436, Standard Specification for Hardened Steel Washers Inch and Metric Dimensions.
 - cc. F467, Standard Specification for Nonferrous Nuts for General Use.
 - dd. F468, Standard Specification for Nonferrous Bolts, Hex Cap Screws, and Studs for General Use.
 - ee. F593, Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs.
 - ff. F835, Standard Specification for Alloy Steel Socket Button and Flat Countersunk Head Cap Screws.
 - gg. F879, Standard Specification for Stainless Steel Socket Button and Flat Countersunk Head Cap Screws.
 - hh. F1789, Standard Terminology for F16 Mechanical Fasteners.
 - ii. F3125, Standard Specification for High Strength Structural Bolts, Steel and Alloy Steel, Heat Treated, 120 ksi (830 MPa) and 150 ksi (1040 MPa) Minimum Tensile Strength, Inch and Metric Dimensions.
6. American Welding Society (AWS):
 - a. A5.1/A5.1M, Specification for Carbon Steel Electrodes for Shielded Metal Arc Welding.
 - b. D1.1, Structural Welding Code - Steel.
 - c. D1.6/D1.6M, Structural Welding Code - Stainless Steel.
 7. National Association of Architectural Metal Manufacturers (NAAMM):
 - a. AMP 510, Metal Stairs Manual.
 - b. AMP 555, Code of Standard Practice for the Architectural Metal Industry (Including Miscellaneous Iron).
 - c. MBG 531, Metal Bar Grating Manual.
 8. NACE International (NACE).

9. Nickel Development Institute (NiDI):
 - a. Publication 11 007, Guidelines for the welded fabrication of nickel-containing stainless steels for corrosion resistant services.
 10. Occupational Safety and Health Administration (OSHA):
 - a. 29 CFR 1910, Occupational Safety and Health Standards, referred to herein as OSHA Standards.
- B. Qualifications:
1. Qualify welding procedures and welding operators in accordance with AWS.
 2. Fabricator shall have minimum of 10 years of experience in fabrication of metal items specified.
 3. Engineer for contractor-designed systems and components: Professional Structural Engineer licensed in the State of Washington.
 4. NACE certified inspector shall have minimum of two years of experience performing inspections as indicated.
 - a. Have a current Level III coating inspector certification.

1.3 DEFINITIONS

- A. Fasteners: As defined in ASTM F1789.
- B. Galvanizing: Hot-dip galvanizing per ASTM A123/A123M or ASTM A153/A153M with minimum coating of 2.0 OZ of zinc per square foot of metal (average of specimens) unless noted otherwise or dictated by standard.
- C. Hardware: As defined in ASTM A153/A153M.
- D. Installer or Applicator:
 1. Installer or applicator is the person actually installing or applying the product in the field at the Project site.
 2. Installer and applicator are synonymous.

1.4 SUBMITTALS

- A. Shop Drawings:
 1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
 2. Fabrication and/or layout drawings and details:
 - a. Submit drawings for all fabrications and assemblies.
 - 1) Include erection drawings, plans, sections, details and connection details.
 - 2) Identify materials of construction, shop coatings and third party accessories.
 - b. Identify materials of construction, shop coatings and third party accessories.
 3. Product technical data including:
 - a. Acknowledgement that products submitted meet requirements of standards referenced.
 - b. Manufacturer's installation instructions.
 - c. Provide manufacturer's standard allowable load tables for the following:
 - 1) Grating and checkered plate.
 - 2) Castings, trench covers and accessories.
 4. Contractor designed systems and components:
 - a. Certification that manufactured units meet all design loads specified.
 - b. Shop Drawings and engineering design calculations:
 - 1) Indicate design live loads.
 - 2) Sealed by a licensed professional Structural Engineer, registered in the State of Washington.
 - 3) Engineer will review for general compliance with Contract Documents.
 - c. Contractor designed systems and components include the following:

- B. Informational Submittals:
 - 1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
 - 2. Certification of welders and welding processes.
 - a. Indicate compliance with AWS.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver and handle fabrications to avoid damage.
- B. Store above ground on skids or other supports to keep items free of dirt and other foreign debris and to protect against corrosion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
 - 1. Abrasive stair nosings (embedded in concrete stairs):
 - a. American Safety Tread.
 - b. Balco.
 - 2. Headed studs and deformed bar anchors:
 - a. Nelson Stud Welding Div., TRW Inc.
 - b. Stud Welding Products, Inc.
 - 3. Mechanical anchor bolts:
 - a. See Section 03 15 19.
 - 4. Epoxy adhesive anchor bolts:
 - a. See Section 03 15 19.
 - 5. Concrete screw anchors:
 - a. See Section 03 15 19.
 - 6. Castings, trench covers and accessories:
 - a. Neenah Foundry Co.
 - b. Deeter Foundry Co.
 - c. Barry Craft Construction Casting Co.
 - d. McKinley Iron Works.
 - 7. Galvanizing repair paint:
 - a. Clearco Products Co., Inc.
 - b. ZRC Products.
 - 8. Ladder safety extension post:
 - a. Bilco.
- B. Submit request for substitution in accordance with Specification Section 01 25 13.

2.2 MATERIALS

- A. Steel:
 - 1. Structural:
 - a. W-shapes and WT-shapes: ASTM A992, Grade 50.
 - b. All other plates and rolled sections: ASTM A36.
 - 2. Pipe: ASTM A53, Types E or S, Grade B or ASTM A501.
 - 3. Hollow Structural Sections:
 - a. ASTM A500, Grade C.
 - 4. Bolts, high strength:
 - a. ASTM F3125, Grade A325.
 - 5. Nuts, high strength:
 - a. ASTM A563.

6. Washers (hardened):
 - a. ASTM F436.
 - b. Provide two (2) washers with all bolts.
 7. Bolts and nuts (unfinished):
 - a. ASTM A307, Grade A.
 8. Welding electrodes: AWS D1.1, E70 Series.
 9. Steel forgings: ASTM A668.
- B. Iron:
1. Ductile iron: ASTM A536.
 2. Gray cast iron: ASTM A48 (minimum 30,000 PSI tensile strength).
 3. Malleable iron: ASTM A47, ASTM A197.
- C. Stainless Steel:
1. Stainless steel in welded applications: Low carbon 'L' type.
 2. Minimum yield strength of 30,000 PSI and minimum tensile strength of 75,000 PSI.
 - a. Bars, shapes: ASTM A276, Type [304].
 - b. Tubing and pipe: ASTM A269, ASTM A312 or ASTM A554, Type 304 or 316.
 - c. Strip, plate and flat bars: ASTM A666, Type 304 or 316.
 - d. Bolts and nuts: ASTM F593, Type 304 or 316.
 3. Minimum yield strength of 25,000 PSI and minimum tensile strength of 70,000 PSI.
 - a. Strip, plate and flat bar for welded connections, ASTM A666, Type 304L or 316L.
 4. Welding electrodes: In accordance with AWS for metal alloy being welded.
- D. Aluminum:
1. Alloy 6061-T6, 32,000 PSI tensile yield strength minimum.
 - a. ASTM B221 and ASTM B308 for shapes including beams, channels, angles, tees and zees.
 - b. Weir plates, baffles and deflector plates, ASTM B209.
 2. Alloy 6063-T5 or T6, 15,000 PSI tensile yield strength minimum.
 - a. ASTM B221 and ASTM B429 for bars, rods, wires, pipes and tubes.
 3. ASTM B26 for castings.
 4. ASTM F468, alloy 2024 T4 for bolts.
 5. ASTM F467, alloy 2024 T4 for nuts.
 6. Electrodes for welding aluminum: AWS D1.2, filler alloy 4043 or 5356.
- E. Washers: Same material and alloy as found in accompanying bolts and nuts.
- F. Embedded Anchor Bolts:
1. See Specification Section 03 15 19.
- G. Mechanical Anchor Bolts and Adhesive Anchor Bolts:
1. See Specification Section 03 15 19.
- H. Headed Studs: ASTM A108 with a minimum yield strength of 50,000 PSI and a minimum tensile strength of 60,000 PSI.
- I. Deformed Bar Anchors: ASTM A1064 with a minimum yield strength of 70,000 PSI and a minimum tensile strength of 80,000 PSI.
- J. Iron and Steel Hardware: Galvanized in accordance with ASTM A153/A153M when required to be galvanized.
- K. Galvanizing Repair Paint:
1. High zinc dust content paint for reglazing welds and abrasions.
 2. ASTM A780.
 3. Zinc content: Minimum 92 PCT in dry film.
 4. ZRC "ZRC Cold Galvanizing" or Clearco "High Performance Zinc Spray."
- L. Dissimilar Materials Protection: See Specification Section 09 96 00.

2.3 MANUFACTURED UNITS

A. Ladders:

1. General:
 - a. Fully welded type.
 - 1) All welds to be full penetration welds, unless otherwise specified.
 - b. All ladders of a particular material shall have consistent construction and material shapes and sizes unless noted otherwise on the Drawings.
 - c. Design ladder in accordance with OSHA Standards, ANSI A14.3, ASCE 7 and the building code.
 - d. Ladders shall be designed to support a minimum concentrated live load of 300LBS at any point to produce the maximum stress in the member being designed.
 - 1) Apply additional 300LB loads for each section of ladder exceeding 10 FT.
 - e. Maximum lateral deflection: Side rail span/240 when lateral load of 100LBS is applied at any location.
2. Material:
 - a. Stainless steel, Type 316.
 - b. Finish:
 - 1) Mill.
3. Rails:
 - a. Round pipe or rectangular tubing:
 - 1) Round pipe:
 - a) 1-1/2 IN nominal diameter.
 - b) Schedule 80.
 - 2) Rectangular tubing:
 - a) Cross-section: 3 by 2 IN maximum.
 - b) Thickness: 0.125 IN minimum.
 - b. Spacing:
 - 1) Minimum clear distance between rails to be 18 IN.
 - 2) Step-through ladder extensions: 24 IN, centerline to centerline.
 - c. Provide cap at exposed top and bottom of side rails.
 - 1) Provide weep holes as necessary to prevent the accumulation of moisture within hollow members.
 - d. Extend side rails of step-through ladders a minimum of 42 IN above the landing.
4. Rungs:
 - a. Minimum 1 IN DIA or 1 IN square solid bar.
 - 1) Integral non-slip finish on all sides.
 - a) Non-slip finish: Coarse knurling or extruded serrations.
 - b) Shop or field-applied grit tape and cap type non-slip finishes are not acceptable.
 - b. Rungs shall penetrate inside wall of side rails.
 - 1) Do not extend rungs beyond the outside face of the side rail.
 - 2) Provide fillet weld all around rung at inside face of side rail and plug weld at outside face of side rail.
 - c. Rung spacing:
 - 1) Equally spaced not less than 10 IN and not more than 14 IN as measured between the centerlines of the rungs.
 - a) Ladder rungs and steps in elevator shafts shall be spaced not less than 6 IN and not more than 16.5 IN as measured between the centerlines of the rungs.
 - 2) Top rung shall be level with landing or platform.
 - a) Where top of ladder terminates at grating cover, floor access door, roof hatch or similar condition; locate top rung as close as practicable to, but not more than 6 IN below, adjacent walking surface.

5. Brackets:
 - a. Angle or bent plate brackets welded to side rails:
 - 1) 3/8 IN by 2-1/2 IN by length required.
 - 2) Provide punched holes for 3/4 IN bolts or anchors.
 - 3) Minimum distance from centerline of rung to wall or any obstruction: 7 IN.
 - 4) Maximum spacing: 6 FT OC.
 - b. For floor supported ladders, provide 3/8 by 2-1/2 by 4 IN rectangular bracket or 3/8 by 6 by 6 IN square plate welded to rails with punched holes for 3/4 IN bolts.
 - 1) Provide wall brackets on floor supported units if vertical run is over 4 FT.
 6. Landings:
 - a. Construct landing, railing and all supports of same material as the ladder.
 - b. Design live load for landing platform and supporting structure:
 - 1) 100 PSF, uniform load.
 - 2) 300 LBS concentrated load on 4 IN square area.
 - 3) All components to be adequate for the uniform load or the concentrated load, whichever requires the stronger component.
 - 4) Maximum deflection: 1/300 of span under a superimposed live load of 100 PSF.
 - c. Grating:
 - 1) Per this Specification Section.
 - d. Structural support: Channel or tubular sections with bracing, plates, angles, etc., to support guardrail and grating and to support landing from the side of the structure.
 - 1) Weld or bolt all connections using galvanized bolts, nuts, and washers.
 - e. Guardrails:
 - 1) Match ladder side rails.
 - a) Space intermediate rails equally between top rail and top of kickplate.
 - 2) Provide 4 IN high x 3/8 IN thick toeboard each side of landing.
 7. Gates:
 - a. Constructed of same material and sizes as the railing system.
 - b. Hinges:
 - 1) Stainless steel.
 - 2) Heavy-duty, self-closing.
 - c. Gate stop:
 - 1) Galvanized steel.
 8. Ladder safety extension post:
 - a. Telescoping tubular stainless steel section that automatically locks into place when fully extended.
 - b. Non-ferrous corrosion-resistant spring and hardware.
 - c. Factory assembled with all hardware necessary for mounting to ladder.
 - d. Bilco "LadderUp" safety post.
 9. Deflector plate:
 - a. For stainless steel ladders: Minimum 0.0625 IN stainless steel plate, ASTM A666.
 - b. For mild steel ladders: Minimum 0.0625 IN steel plate, ASTM A6.
 - c. Profile as shown on Drawings.
 - d. Fabricate to shapes and sizes required to meet OSHA Standards.
- B. Bollards:
1. 8 IN DIA extra strength steel pipe, ASTM A53.
 - a. Galvanized.
 - b. See Specification Section 099600 for painting requirements.
- C. Abrasive Stair Nosings:
1. Exterior cast-in-place concrete stairs:
 - a. One piece cast aluminum with wing anchors.
 - b. Diamond abrasive pattern.
 - c. Babcock Davis "BSTCA-C3W".

2. Interior stairs:
 - a. Two component consisting of an embedded subchannel and an abrasive tread plate.
 - b. Subchannel: 6063-T5 extruded aluminum.
 - 1) Complete with concrete anchors.
 - c. Tread plate:
 - 1) 6063-T5 extruded aluminum.
 - 2) Solid epoxy abrasive filler.
 - a) Color: Safety yellow.
 - d. Balco "DXH-330".
 - e. Finish: Mill.
 3. Length:
 - a. Concrete stairs and landings:
 - 1) 4 IN less than overall stair width.
 - 2) Where tread mounted railing post occurs, hold nosing back 4 IN clear from railing centerline.
 - b. Concrete filled metal pan stairs: Full length of tread.
 - c. Concrete landings at metal stairs: 4 IN less than clear width between stringers.
- D. Metal Stairs:
1. Treads: Grating as specified.
 - a. Provide integral corrugated non-slip nosing.
 2. Risers:
 - a. Grating treads:
 - 1) Solid plate welded to trailing edge of tread or landing.
 - 2) Minimum 3/16 IN thick by 4 IN high.
 - b. Checkered plate treads: Solid checkered plate riser integral with tread.
 3. Landings:
 - a. Grating as specified.
 - b. Provide integral corrugated non-slip nosing at edge acting as stair tread/nosing.
 4. Design live load for landing platform and supporting structure:
 - a. 100 PSF, uniform load.
 - b. 300 LBS concentrated load [on 4 IN square area].
 - c. All components to be adequate for the uniform load or the concentrated load, whichever requires the stronger component.
 - d. Maximum deflection: 1/300 of span under a superimposed live load of 100 PSF.
 5. Design, fabricate, and install in compliance with NAAMM and applicable codes.
 - a. NAAMM AMP 510:
 - 1) Exterior at site structures and equipment: Industrial Class.
 - 2) Interior or exterior at buildings: Service Class.
 6. Handrails and guardrails: Refer to Specification Section 05 52 05.
 7. Material:
 - a. Steel: ASTM A36, galvanized after fabrication.
- E. Steel Grating:
1. NAAMM MBG 531.
 2. Bearing bars:
 - a. Rectangular 1-1/2 by 3/16 IN unless otherwise noted on Drawings.
 - b. Maximum 1-3/16 IN OC spacing.
 3. Cross bars:
 - a. Welded, swagged or pressure locked to bearing bars.
 - b. Maximum 4 IN OC spacing.
 4. Top edges of bars: Serrated or grooved.
 5. Removable grating sections: Not wider than 3 FT and not more than 100 LBS.
 6. Finish:
 - a. Galvanized.
 - b. Clips and bolts: Galvanized.

- c. Seat angles: Galvanized steel.
 - 7. Ends and perimeter edges: Banded.
 - 8. Openings through grating: Reinforced to provide required load carrying capacity and banded with 4 IN high toe plate.
 - 9. Provide joints at openings between individual grating sections.
- F. Heavy-Duty Castings, Trench Covers, and Accessories:
- 1. Prefabricated, ductile iron ASTM A536.
 - 2. Design load: AASHTO HS-20 wheel loading for indicated span.
 - 3. Machine horizontal mating surfaces.
- G. Access Cover:
- 1. Tank type manhole frame and solid lid: ASTM A48 or ASTM A536, cast iron.
 - 2. Unless shown otherwise, design of cover shall be such that top of frame extends several inches above slab to prevent surface water from entering tank.
 - 3. Equip lid with four stainless steel screws to secure lid to frame.
- H. Loose Lintels:
- 1. Steel, ASTM A36 or ASTM A572 Grade 50, sizes as indicated on Drawings.
 - 2. Hot-dip galvanized per ASTM A123/A123M.
- I. Alternating Tread Stair - Aluminum:
- 1. Cast aluminum treads and landings, mounting feet, stringer and foot divider.
 - 2. Integrally cast handrail support arms.
 - 3. 68-degree incline.
 - 4. Mill finish.
 - 5. Continuous aluminum handrails 1-1/2 IN square minimum 0.125 IN thick.
 - 6. Provide all landings as indicated on Drawings.
 - 7. Manufacturer: Lapeyre Stair, Inc. Harahan, LA., or equal

2.4 FABRICATION

- A. Verify field conditions and dimensions prior to fabrication.
- B. Form materials to shapes indicated with straight lines, true angles, and smooth curves.
- 1. Grind smooth all rough welds and sharp edges.
 - a. Round all corners to approximately 1/16 IN nominal radius.
- C. Provide drilled or punched holes with smooth edges.
- 1. Punch or drill for field connections and for attachment of work by other trades.
- D. Weld Shop Connections:
- 1. Welds to be continuous fillet type unless indicated otherwise.
 - 2. Full penetration butt weld at bends in stair stringers and ladder side rails.
 - 3. Weld structural steel in accordance with AWS D1.1 using Series E70 electrodes conforming to AWS A5.1/A5.1M.
 - 4. Weld aluminum in accordance with AWS D1.2.
 - 5. Weld stainless steel in accordance with AWS D1.6.
 - a. Treat all welded areas in accordance with ASTM A380.
 - 6. All headed studs to be welded using automatically timed stud welding equipment.
 - 7. Grind smooth welds that will be exposed.
- E. Passivate stainless steel items and stainless steel welds after they have been ground smooth[, where indicated on Drawings].
- 1. ASTM A380.
- F. Conceal fastenings where practicable.
- G. Fabricate work in shop in as large assemblies as is practicable.

- H. Tolerances:
1. Rolling:
 - a. ASTM A6.
 - b. When material received from the mill does not satisfy ASTM A6 tolerances for camber, profile, flatness, or sweep, the Contractor is permitted to perform corrective work by the use of controlled heating and mechanical straightening, subject to the limitations of the AISC Specification.
 2. Fabrication tolerance:
 - a. Member length:
 - 1) Both ends finished for contact bearing: 1/32 IN.
 - 2) Framed members:
 - a) 30 FT or less: 1/16 IN.
 - b) Over 30 FT: 1/8 IN.
 - b. Member straightness:
 - 1) Compression members: 1/1000 of a xial length between points laterally supported.
 - 2) Non-compression members: ASTM A6 tolerance for wide flange shapes.
 - c. Specified member camber (except compression members):
 - 1) 50 FT or less: -0/+1/2 IN.
 - 2) Over 50 FT: -0/+1/2 IN (+1/8 IN per 10 FT over 50 FT).
 - 3) Members received from mill with 75 PCT of specified camber require no further cambering.
 - 4) Beams/trusses without specified camber shall be fabricated so after erection, camber is upward.
 - 5) Camber shall be measured in fabrication shop in unstressed condition.
 - d. At bolted splices, depth deviation shall be taken up by filler plates.
 - 1) At welded joints, adjust weld profile to conform to variation in depth.
 - 2) Slope weld surface per AWS requirements.
 - e. Finished members shall be free from twists, bends, and open joints.
 - 1) Sharp kinks, bends, and deviation from a bove tolerances are ca use for rejection of material.
- I. Fabricate grating, checkered plate, stairs, ladders, and accessories using galvanized steel unless shown otherwise on Drawings.
1. Finish:
 - a. Mill, unless noted otherwise.
 - b. Coat surfaces in contact with dissimilar materials.
 - 1) See Specification Section 099600.
- J. Fabricate grating in accordance with NAAMM MBG 531.
1. Maximum tolerance for difference in depth between grating depth and seat or support angle depth: 1/8 IN.
 2. Distance between edge of grating and face of embedded seat angle or face of wall or other structural member: 1/4 IN.
 - a. Tolerance: NAAMM MBG 531.
 3. Removable sections: Not wider than 3 FT and not heavier than 100LBS.
 4. Ends and perimeter edges: Banded, with alternate bearing bars welded to band.
 - a. Provide full depth banding unless noted otherwise.
 - b. Banding at trenches and sumps to be 1/4 IN less than grating depth to allow for drainage.
 5. Openings through grating: Reinforced to provide required load carrying capacity and banded with 4 IN high toe plate.
 6. Provide joints at openings between individual grating sections.
 7. Fabricate grating so that bearing bars and cross bars in adjacent sections are aligned.
- K. Fabricate checkered plate and miscellaneous metals in accordance with NAAMM AMP 555.
1. Workmanship: Class 2 unless noted otherwise.

- L. See Specification Section 09 96 00 for preparation and painting of ferrous metals and other surfaces.

2.5 SOURCE QUALITY CONTROL

- A. Surface Preparation:
 - 1. Refer to Specification Section 09 96 00 for surface preparation requirements.
 - 2. All miscellaneous metal fabrication item surfaces shall be inspected and approved by NACE certified coatings inspector prior to application of shop-applied coatings.
 - a. Inspection shall be performed to determine depth of blast profile and cleanliness of surface.
 - b. Fabricator shall reblast and or re-clean surfaces as required until acceptable.
- B. Shop Applied Coating Application:
 - 1. Refer to Specification Section 09 96 00 for coating requirements.
 - 2. After surface has been accepted in writing by NACE certified coatings inspector, fabricator may proceed with application of coatings.
 - 3. Application of coatings shall be observed and certified by NACE certified coatings inspector.
- C. Shop Inspection and Testing:
 - 1. Owner will employ and pay for the services of a qualified independent testing agency to inspect and test all structural steel work for compliance with Contract Documents.
 - 2. Contractor responsible for testing to qualify shop and field welders and as needed for Contractor's own quality control to ensure compliance with Contract Documents.
 - 3. Independent testing agency shall have a minimum of five years performing similar work and shall be subject to Owner's approval.
- D. Responsibilities of Testing Agency:
 - 1. Inspect shop and field welding in accordance with AWS Code including the following non-destructive testing:
 - a. Visually inspect all welds.
 - b. In addition to visual inspection, test 50 PCT of full penetration welds and 20 PCT of fillet welds with liquid dye penetrant or mag particle.
 - c. Test 20 PCT of liquid dye penetrant tested full penetration welds with ultrasonic or radiographic testing.
 - 2. Inspect high-strength bolting in accordance with the RCSC Specification for Structural Joints Using High-Strength Bolts, Section 9.
 - a. Verify direct tension indicator gaps, if applicable.
 - 3. Inspect structural steel which has been erected.
 - 4. Inspect stud welding in accordance with AWS Code.
 - 5. Prepare and submit inspection and test reports to Engineer.
 - a. Assist Engineer to determine corrective measures necessary for defective work.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Provide items to be built into other construction in time to allow their installation.
 - 1. If such items are not provided in time for installation, cut in and install.
- B. Prior to installation, inspect and verify condition of substrate.
- C. Correct surface defects or conditions which may interfere with or prevent a satisfactory installation.
 - 1. Field welding aluminum is not permitted unless approved in writing by Engineer.

3.2 INSTALLATION

- A. Set metal work level, true to line, plumb.
 - 1. Shim and grout as necessary.
- B. Contractor is solely responsible for safety.
 - 1. Construction means and methods and sequencing of work is the prerogative of the Contractor.
 - 2. Take into consideration that full structural capacity of many structural members is not realized until structural assembly is complete; e.g., until slabs, decks, and diagonal bracing or rigid connections are installed.
 - 3. Partially complete structural members shall not be loaded without an investigation by the Contractor.
 - 4. Until all elements of the permanent structure and lateral bracing system are complete, temporary bracing for the partially complete structure will be required.
- C. Adequate temporary bracing to provide safety, stability and to resist all loads to which the partially complete structure may be subjected, including construction activities and operation of equipment is the responsibility of the Contractor.
 - 1. Plumb, align, and set structural steel members to specified tolerances.
 - 2. Use temporary guys, braces, shoring, connections, etc., necessary to maintain the structural framing plumb and in proper alignment until permanent connections are made, the succeeding work is in place, and temporary work is no longer necessary.
 - 3. Use temporary guys, bracing, shoring, and other work to prevent injury or damage to adjacent work or construction from stresses due to erection procedures and operation of erection equipment, construction loads, and wind.
 - 4. Contractor shall be responsible for the design of the temporary bracing system and must consider the sequence and schedule of placement of such elements and effects of loads imposed on the structural steel members by partially or completely installed work, including work of all other trades.
 - a. If not obvious from experience or from the Drawings, confer with the Engineer to identify those structural steel elements that must be complete before the temporary bracing system is removed.
 - 5. Remove and dispose of all temporary work and facilities off-site.
- D. Examine work-in-place on which specified work is in any way dependent to ensure that conditions are satisfactory for the installation of the work.
 - 1. Report defects in work-in-place which may influence satisfactory completion of the work.
 - 2. Absence of such notification will be construed as acceptance of work-in-place.
- E. Field Measurement:
 - 1. Take field measurements as necessary to verify or supplement dimensions indicated on the Drawings.
 - 2. Contractor responsible for the accurate fit of the work.
- F. Check the elevations of all finished footings or foundations and the location and alignment of all anchor bolts before starting erection.
 - 1. Use surveyor's level.
 - 2. Notify Engineer of any errors or deviations found by such checking.
- G. Framing member location tolerances after erection shall not exceed the frame tolerances listed in the FIELD QUALITY CONTROL Article in PART 3 of this Specification Section.
- H. Erect plumb and level; introduce temporary bracing required to support erection loads.
- I. Use light drifting necessary to draw holes together.
 - 1. Drifting to match unfair holes is not allowed.

- J. Welding:
 - 1. Conform to AWS D1.1 and requirements of the FABRICATION Article in PART 2 of this Specification Section.
 - 2. When joining two sections of steel of different ASTM designations, welding techniques shall be in accordance with a qualified AWS D1.1 procedure.
- K. Shore existing members when unbolting of common connections is required.
 - 1. Use new bolts for rebolting connections.
- L. Clean stored material of all foreign matter accumulated prior to the completion of erection.
- M. Bolt Field Connections: Where practicable, conceal fastenings.
- N. Field Welding:
 - 1. Follow AWS procedures.
 - 2. Grind welds smooth where field welding is required.
- O. Field cutting grating or checkered plate to correct fabrication errors is not acceptable.
 - 1. Replace entire section.
- P. Remove all burrs and radius all sharp edges and corners of miscellaneous plates, angles, framing system elements, etc.
- Q. Unless noted or specified otherwise:
 - 1. Connect steel members to steel members with 3/4 IN DIA ASTM F3125, Grade A325 high strength bolts.
 - 2. Connect aluminum to a luminum with 3/4 IN DIA stainless bolts.
 - 3. Connect aluminum to structural steel using 3/4 IN DIA stainless steel bolts.
 - a. Provide dissimilar metals protection.
 - 4. Connect aluminum and steel members to concrete and masonry using stainless steel mechanical anchor bolts or a adhesive anchor bolts unless shown otherwise.
 - a. Provide dissimilar materials protection.
 - 5. Provide washers for all bolted connections.
 - 6. Where exposed, bolts shall extend a maximum of 3/4 IN and a minimum of 1/2 IN above the top of installed nut.
 - a. If bolts are cut off to required maximum height, threads must be dressed to allow nuts to be removed without damage to the bolt or the nuts.
- R. Install and tighten ASTM F3125, Grade A325 high-strength bolts in accordance with the AISC 325, Allowable Stress Design (ASD).
 - 1. Provide hardened washers for all Grade A325 bolts.
 - a. Provide the hardened washer under the element (nut or bolt head) turned in tightening.
- S. After bolts are tightened, upset threads of ASTM A307 bolts or anchor bolts to prevent nuts from backing off.
- T. Secure metal to wood with lag screws of a adequate size with a appropriate washers.
- U. Do not field splice fabricated items unless said items exceed standard shipping length or change of direction requires splicing.
 - 1. Provide full penetration welded splices where continuity is required.
- V. Provide each fabricated item complete with attachment devices as indicated or required to install.
- W. Anchor such that work will not be distorted nor fasteners overstressed from expansion and contraction.

- X. Set beam and column base plates accurately on nonshrink grout as indicated on Drawings.
 - 1. See Division 03 Specification Sections for non-shrink grout and anchorage.
 - 2. Set and anchor each base plate to proper line and elevation.
 - a. Use metal wedges, shims, or setting nuts for leveling and plumbing columns and beams.
 - 1) Wedges, shims, and setting nuts to be of same metal as base plate they support.
 - 2) Tighten nuts on anchor bolts.
 - b. Fill space between bearing surface and bottom of base plate with nonshrink grout.
 - 1) Fill space until voids are completely filled and base plates are fully bedded on wedges, shims, and grout.
 - c. Do not remove wedges or shims.
 - 1) Where they protrude, cut off flush with edge of base plate.
 - d. Fill sleeves around anchor bolts solid with non-shrink grout.
- Y. Tie anchor bolts in position to embedded reinforcing steel using wire.
 - 1. Tack welding prohibited.
 - a. Coat projecting bolt threads and nuts with heavy coat of clean grease.
 - 2. Anchor bolt location tolerance:
 - a. Per Section 03 15 19.
- Z. Install bollards as detailed on Drawings.
 - 1. Fill pipe with concrete and round off at top.
- AA. Provide a abrasive stair nosings in each tread and landing of all concrete stairs and at each concrete stair landing having metal stair structure attaching to the concrete landing.
 - 1. Center stair nosings in stair width.
- BB. Accurately locate and place frames for openings before casting into floor slab so top of plate is flush with surface of finished floor.
 - 1. Keep screw holes clean and ready to receive screws.
- CC. Attach grating to end and intermediate supports with grating saddle clips and bolts.
 - 1. Maximum spacing: 2 FT OC with minimum of two per side.
 - 2. Attach individual units of a aluminum grating together with clips at 2 FT OC maximum with a minimum of two clips per side.
- DD. Coat aluminum surfaces in contact with dissimilar materials in accordance with Specification Section 09 96 00.
- EE. Repair damaged galvanized surfaces in accordance with ASTM A780.
 - 1. Prepare damaged surfaces by a abrasive blasting or power sanding.
 - 2. Apply galvanizing repair paint to minimum 6 mils DFT in accordance with manufacturer's instructions.
- FF. Anchor ladder to concrete structure with minimum 3/4 IN stainless steel anchor bolts with minimum 6 IN embedment.
- GG. Install ladder safety extension post in accordance with manufacturer's instructions.
 - 1. Mount device opposite the climbing side.
 - 2. Provide ladder safety extension device for all ladders unless noted otherwise.
- HH. Mount ladder fall protection system with rail offset from ladder side rail approximately 3 IN.
- II. Install factory pre-fabricated stairs in location indicated in the Contract Documents and a approved submittals.

3.3 FIELD QUALITY CONTROL

- A. Tolerances shall meet structural requirements of Specification Section 05 12 00 for erecting items of structural nature.
- B. Owner Pays for Field Inspection and Testing:
 - 1. Owner will employ and pay for services of an independent testing agency to inspect and test structural steel shop and field work for compliance with this Specification Section.
 - 2. Contractor provides sufficient notification and access so inspection and testing can be accomplished.
 - 3. Contractor pays for retesting of failed tests and for additional testing required when defects are discovered.

3.4 CLEANING

- A. After fabrication, erection, installation, or application, clean all miscellaneous metal fabrication surfaces of all dirt, weld slag and other foreign matter.
- B. All stainless steel products in addition to Paragraph A. above:
 - 1. Remove all heat tint, rusting, discoloration by passivation, ASTM A380, or other acceptable means as listed in NiDI 11 007 as approved by the Engineer.
- C. Provide surface acceptable to receive field applied paint coatings specified in Specification Section 09 96 00.

END OF SECTION

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SECTION 05 52 02
ALUMINUM RAILINGS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Aluminum handrail, stair rail and guardrail.
 - 2. Aluminum guardrail gates.

- B. Related Specification Sections include but are not necessarily limited to:
 - 1. Division 00 - Procurement and Contracting Requirements.
 - 2. Division 01 - General Requirements.
 - 3. Section 05 50 00 - Metal Fabrications.
 - 4. Section 09 96 00 - High Performance Industrial Coatings.

1.2 QUALITY ASSURANCE

- A. Referenced Standards:
 - 1. Aluminum Association (AA):
 - a. ADM 1, Aluminum Design Manual.
 - 2. American Society of Mechanical Engineers (ASME):
 - a. Section IX, Qualification Standard for Welding and Brazing Procedures, Welders, Brazers, and Welding and Brazing Operators.
 - 3. ASTM International (ASTM):
 - a. B108, Standard Specification for Aluminum-Alloy Permanent Mold Castings.
 - b. B209, Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
 - c. B221, Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.
 - d. B247, Standard Specification for Aluminum and Aluminum-Alloy Die Forgings, Hand Forgings, and Rolled Ring Forgings.
 - e. B308, Standard Specification for Aluminum-Alloy 6061-T6 Standard Structural Profiles.
 - f. B429, Standard Specification for Aluminum-Alloy Extruded Structural Pipe and Tube.
 - 4. American Welding Society (AWS):
 - a. C5.5, Recommended Practices for Gas Tungsten Arc Welding.
 - b. D1.2, Structural Welding Code - Aluminum.
 - 5. National Association of Architectural Metal Manufacturers (NAAMM):
 - a. AMP 521, Pipe Railing Systems Manual.
 - 6. U.S. Department of Justice, Architectural and Transportation Barriers Compliance Board (Access Board):
 - a. Americans with Disabilities Act (ADA):
 - 1) Accessibility Guidelines for Buildings and Facilities (ADAAG).
 - 7. Occupational Safety and Health Administration (OSHA):
 - a. 29 CFR 1910, Occupational Safety and Health Standards, referred to herein as OSHA Standards.

- B. Qualifications:
 - 1. Qualify welding procedures and welding operators in accordance with AWS and ASME Section IX.

1.3 DEFINITIONS

- A. Guardrail: A system of building components located near the open sides of elevated walking surfaces for the purpose of minimizing the possibility of an accidental fall from the walking surface to the lower level.
- B. Handrail: A horizontal or sloping rail intended for grasping by the hand for guidance or support.
- C. Railing: A generic term referring to guardrail, handrail, and/or stair rails.
- D. Stair Rail: A guardrail, installed at the open side of stairways with either a handrail mounted to the inside face of the guardrail, or where allowed by applicable codes, with the top rail mounted at handrail height and serving the function of a handrail.

1.4 SUBMITTALS

- A. Shop Drawings:
 - 1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
 - 2. Fabrication and/or layout drawings:
 - a. Drawings showing profile, location, sections, and fabrication details including all welding information of each railing.
 - b. Type and details of anchorage.
 - c. Location and type of expansion joints.
 - d. Materials of construction, shop coatings, and all third-party accessories.
 - 3. Product technical data including:
 - a. Acknowledgement that products submitted meet requirements of standards referenced.
 - b. Manufacturer's installation details.
 - 4. Certification that railings have been designed and fabricated to meet the loading requirements specified.
 - 5. Calculations for all proposed deviations from the Specification.
 - a. Calculations shall be performed, sealed, signed, and dated by a registered professional structural engineer licensed in the State of Washington.
 - b. Calculations shall be specific to this Project and shall include all assumptions, references, and design interpretations used to achieve the results obtained by the Engineer.
 - c. Reduction in load criteria is not acceptable as reason for deviation from sizes indicated in the Specification.
- B. Informational Submittals:
 - 1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
 - 2. Certification of welders and welding procedures indicating compliance with AWS requirements.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Deliver and handle railings to preclude damage.
- B. Store railings on skids, keep free of dirt and other foreign matter which will damage railings or finish and protect against corrosion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
 - 1. Welded railing systems:
 - a. Any manufacturer meeting this Specification Section.

- B. Submit request for substitution in accordance with Specification Section 01 25 13.

2.2 MATERIALS

- A. Alloy 6061-T6.
 - 1. ASTM B209 for sheets and plates.
 - 2. ASTM B221 and ASTM B308 for shapes - beams, channels, angles, tees, and zees.
 - 3. ASTM B247 for forgings.
- B. Alloy 6063-T5 or T6.
 - 1. ASTM B221 and ASTM B429 for bars, rods, wires, pipes and tubes.
- C. Cast Fittings: Aluminum, ASTM B108.
- D. Shims: Aluminum of same alloy as component being shimmed.
- E. Fasteners: See Specification Section 05 50 00.
- F. Expansion and Adhesive Anchors: See Specification Section 03 15 19.
- G. Electrodes for Welding:
 - 1. Aluminum: AWS D1.2.
 - 2. Filler alloy 5356 or 4043.

2.3 FABRICATION

- A. General:
 - 1. Verify field conditions and dimensions prior to fabrication.
 - 2. For fabrication of items which will be exposed to view, use only materials which are smooth and free of surface blemishes including pitting, seam marks, roller marks, rolled trade names, and roughness.
 - a. Remove blemishes by grinding and buffing or by welding and grinding, prior to cleaning, treating, and application of surface finishes.
 - 3. Form exposed work with smooth, short radius bends, accurate angles, and straight edges.
 - a. Ease exposed edges to a radius of approximately 1/32 IN.
 - b. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.
 - c. Drill or punch holes with smooth edges.
 - 4. Form exposed connections with flush, smooth, hairline joints, using stainless steel or aluminum splice locks to splice sections together or by welding.
 - a. Ease the edges of top rail splices and expansion joints and remove all burrs left from cutting.
 - 5. Provide for anchorage of type indicated on Drawings or as required by field conditions.
 - a. Drill or punch holes with smooth edges.
 - 6. Design railings and anchorage system in accordance with NAAMM AMP 521 to resist loading as required by the building code.
 - a. Maximum allowable stresses per AA ADM 1.
 - 7. Design railings in accordance with accessibility requirements per the building code and ADAAG.
- B. Custom fabricate railings to dimensions and profiles indicated.
 - 1. Guardrails:
 - a. All Schedule 40 pipe, unless otherwise noted.
 - b. Top rails: 2 IN nominal diameter.
 - c. Intermediate rails: 1-1/2 IN nominal diameter.
 - d. Vertical posts:
 - 1) 2 IN nominal diameter.
 - 2) Vertical posts that are to be side-bracket mounted to a vertical concrete surface or metal structure shall use Alloy 6061-T6 or 6063-T6.
 - 2. Handrail mounted to wall or to guardrail vertical posts: 1-1/4 IN nominal diameter Schedule 40 pipe.

3. Where details are not indicated, space intermediate rails to requirements of the building code or OSHA Standards, whichever requires the more restrictive design.
4. Space vertical posts as required by loading requirements but not more than 4 FT on center.
 - a. Avoid locating vertical posts at changes in direction of railing.
 - b. Hold vertical post back from corner and provide radiused corners.
5. Space handrail brackets as required by loading requirements but not more than 4 FT on center.
6. Base plate for vertical guardrail posts mounted to top of concrete surface:
 - a. 3/8 x 6 x 6 IN square plate.
 - b. Predrilled to accept four anchors.
 - c. Provide a 2 IN DIA x 8 IN long solid aluminum rod welded to the base plate.
 - d. Fit the vertical post over the solid rod and weld the post to the base plate.
7. Base plate for vertical guardrail post mounted to flange of metal structure:
 - a. 3/8 x 3 x 8 IN plate.
 - b. Predrilled to accept two fasteners.
 - c. Provide a 2 IN DIA x 8 IN long solid aluminum rod welded to the base plate.
 - d. Fit the vertical post over the solid rod and weld the post to the base plate.
8. Mounting bracket for vertical guardrail post mounted to vertical concrete surface or web of metal structural member:
 - a. Pair of 3/8 IN angles or bent plates.
 - b. Predrilled to accept two fasteners each.
 - c. Weld angles or bent plates to vertical posts.
 - d. Provide toeboards on walkway side of all elevated walkways, platforms and stair landings, and where indicated on the Drawings or required by OSHA Standards.
 - 1) 4 IN high extruded toeboard with stiffener ribs and angled toe.
 - a) Similar to Wagner, Model "IR94102."
 - e. Guardrail gates:
 - 1) Constructed of same material and sizes as the guardrail system.
 - 2) Width of gate as shown on Drawings.
 - 3) Hinges:
 - a) Cast aluminum.
 - b) Self-closing.
 - (1) Stainless steel torsion spring.
 - c) Similar to Wagner, Model "IR100."
 - 4) Gate latch and stop:
 - a) Cast aluminum.
 - b) Spring-loaded pin latch.
 - (1) Stainless steel spring.
 - c) Similar to Wagner, Model "IR101."

C. Railing Fabrication:

1. All railings are to be welded systems.
2. Use wire welding for all joints.
3. All welding to be continuous in accordance with AWS C5.5 and AWS D1.2.
 - a. All welded railing joints shall have full penetration welds unless noted otherwise.
4. All exposed welds to be ground smooth and flush to match and blend with adjoining surfaces.
 - a. NAAMM AMP 521, Type 2.
5. No ragged edges, surface defects, or undercutting of adjoining surfaces will be accepted.
6. Finishing joints with filler is not acceptable.
7. Provide flush weld fittings using locking weld connectors or coped drive-on connectors.
8. Fit exposed ends of guardrails and handrails with solid terminations.
 - a. Return ends of handrail to wall, but do not attach to wall.
 - b. Where guardrail terminates at a wall, provide a vertical post or end-loop 4 IN off the wall to center of vertical member.

9. Preassemble items in shop to greatest extent possible to minimize field splicing and assembly of units at project site.
 10. Install weeps to drain water from hollow sections of railing at exterior and high humidity conditions.
 - a. Drill 1/4 IN weep hole in railings closed at bottom:
 - 1) 1 IN above walkway surface at bottom of posts set in concrete.
 - 2) 1 IN above solid aluminum rod at posts having base plate.
 - 3) At low point of intermediate rails.
 - b. Do not drill weep holes:
 - 1) In bottom of base plate.
 11. Expansion joints:
 - a. Joints to be designed to allow expansion and contraction of railing and still meet design loads required.
 - 1) Top rail splices and expansion joints shall be located within 8 IN of post or other support.
 - 2) Where railings span building expansion joints; provide a railing expansion joint in the span crossing the building expansion joint.
 - b. Provide expansion joints in any continuous run exceeding 20 FT in length.
 - 1) Space expansion joints at not more than 40 FT on center.
 - c. Provide minimum 0.10 IN of expansion joint for each 20 FT length of top rail for each 25 DEGF differential between installation temperature and maximum design temperature.
 - 1) Maximum expansion joint width at time of installation shall not exceed 3/8 IN.
 - a) Provide additional expansion joints as required to limit expansion joint width.
 - d. Provide slip-joint with internal sleeve.
 - 1) Extend slip joint min 2 IN beyond joint at maximum design width.
 - 2) Fasten internal sleeve securely to one side.
 - a) Provide allen-head set screw located in bottom of rail.
 - b) Rivets or exposed screw heads are not acceptable.
- D. Finish:
1. Mill.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Prior to installation, inspect and verify condition of substrate.
- B. Correct surface defects or conditions which may interfere with or prevent a satisfactory installation.
 1. Field welding aluminum is not permitted unless approved in writing by Engineer.

3.2 INSTALLATION

- A. Install handrails and guardrails to meet loading requirements of the building code.
- B. Install products in accordance with manufacturer's instructions.
- C. Set work accurately in location, alignment, and elevation; plumb, level and true.
 1. Measure from established lines and items which are to be built into concrete, masonry, or similar construction.
- D. Align railings prior to securing in place to assure proper matching at butting and expansion joints and correct alignment throughout their length.
 1. Provide shims as required.
- E. Install proper sized expansion joints based on temperature at time of installation and differential coefficient of expansion of materials in all railings as recommended by manufacturer.
 1. Lubricate expansion joint splice bar for smooth movement of railing sections.

- F. Provide removable railing sections where indicated on Drawings.
- G. Attach handrails to walls or guardrail with brackets designed for condition:
 - 1. Provide brackets which provide a minimum 1-1/2 IN clearance between handrail and nearest obstruction.
 - a. Handrails shall not project more than 4-1/2 IN into required stairway width.
 - 2. Anchor handrail brackets to concrete or masonry walls with 1/2 IN stainless steel adhesive anchors with stainless steel hex head bolts.
- H. Anchor railings to concrete with minimum 1/2 IN stainless steel adhesive anchors with stainless steel bolts, nuts and washers unless noted otherwise in the Contract Documents.
 - 1. Where exposed, bolts shall extend minimum 1/2 IN and maximum 3/4 IN above the top nut.
 - a. If bolts are cut off to required height, threads must be dressed to allow nuts to be removed without damage to the bolt or the nut.
 - b. Bevel the top of the bolt after cutting to provide a smooth surface.
- I. Anchor railings to metal structure with minimum 3/4 IN stainless steel bolts, nuts, and washers.
- J. Install toeboards to fit tight to the walking surface.
 - 1. Attach to railing vertical post with manufacturer's standard mounting clamp:
 - a. Adjustable.
 - b. Designed to engage in extruded slot on back of toeboard.
 - 2. Provide splice bars, corner splices, and brackets:
 - a. Manufacturer's standard items as required for a complete installation.
 - 3. Notch toeboards at base plates or other obstructions.
 - 4. Bottom of toeboard shall not exceed 1/4 IN above walking surface.
- K. Coat aluminum in contact with dissimilar metal or concrete in accordance with Specification Section 09 96 00.
- L. Provide railings as required for stair construction identified in Specification Section 05 50 00.
- M. Install guardrail gate plumb and level in location shown on Drawings.
 - 1. Center gate in opening.
 - 2. Top of gate to match top of guardrail.
 - 3. Fasten hinges to gate and jamb post:
 - a. Minimum three, 1/4 IN stainless steel countersunk machine screws per leaf.
 - b. Drill and tap into railing and gate vertical posts.
 - 4. Provide not less than two hinges per gate.
 - 5. Install gate latch and stop on strike side of opening.
 - a. Fasten to gate with 1/4 IN stainless steel countersunk machine screws.
 - b. Drill and tap into gate vertical post.
 - c. Drill hole in railing vertical post to receive latch pin.
 - 6. Adjust to provide smooth operation:
 - a. Self-closing and self-latching.

END OF SECTION



DIVISION 06

WOOD, PLASTICS, AND COMPOSITES



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SECTION 06 10 00
ROUGH CARPENTRY

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Rough carpentry.
- B. Related Specification Sections include but are not necessarily limited to:
 - 1. Division 00 - Procurement and Contracting Requirements.
 - 2. Division 01 - General Requirements.
 - 3. Section 03 15 19 – Anchorage to Concrete
 - 4. Section 07 54 19 – Adhered PVC Membrane Roofing.
 - 5. Section 09 77 61 – Fiberglass Reinforced Plastic (FRP) Panels

1.2 QUALITY ASSURANCE

- A. Referenced Standards:
 - 1. The Engineered Wood Association (APA):
 - a. PRP-108, Performance Standards and Qualification Policy for Structural Use Panels.
 - b. U450, Storage and Handling of APA Trademarked Panels.
 - c. Y510, Plywood Design Specification.
 - 2. ASTM International (ASTM):
 - a. A153/A153M, Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
 - b. D153, Standard Test Methods for Specific Gravity of Pigments.
 - c. D2898, Standard Practice for Accelerated Weathering of Fire-Retardant-Treated Wood for Fire Testing.
 - d. D4442, Standard Test Methods for Direct Moisture Content Measurement of Wood and Wood-Base Materials.
 - e. D4444, Standard Test Method for Laboratory Standardization and Calibration of Hand-Held Moisture Meters.
 - f. E84, Standard Test Method for Surface Burning Characteristics of Building Materials.
 - 3. American Wood Protection Association (AWPA):
 - a. M2, Standard for Inspection of Preservative Treated for Industrial Use.
 - b. M3, Standard for the Quality Control of Preservative Treated Products for Industrial Use.
 - c. M4, Standard for the Care of Preservative-Treated Wood Products.
 - d. P5, Standard for Waterborne Preservatives.
 - e. U1, Use Category System: User Specification for Treated Wood.
 - 4. American National Standards Institute/Single Ply Roofing Industry (ANSI/SPRI):
 - a. ES-1, Wind Design Standard for Edge Systems Used with Low Slope Roof Systems.
 - 5. Environmental Protection Agency (EPA).
 - 6. FM Global (FM):
 - a. 1-49, Property Loss Prevention Data Sheets - Perimeter Flashing.
 - 7. National Institute of Standards and Technology (NIST):
 - a. PS 1, Quantitative NMR (Benzoic Acid).
 - b. PS 20, American Softwood Lumber Standard.
 - 8. Underwriters Laboratories, Inc. (UL):
 - a. 723, Standard for Test for Surface Burning Characteristics of Building Materials.
- B. Qualifications:
 - 1. Wood Treatment Plant: AWPAM3.
 - 2. Treated Wood Inspection: AWPAM2.

- C. Miscellaneous:
 - 1. Factory marking:
 - a. Lumber:
 - 1) Identify type, grade, moisture content, inspection service, producing mill, and other qualities specified.
 - 2) Marking may be omitted, as allowed by the building code, if certificate of inspection is provided for each shipment.

1.3 SUBMITTALS

- A. Shop Drawings:
 - 1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
 - 2. Fabrication drawings of all fabricated items.
 - 3. Product technical data including:
 - a. Acknowledgement that products submitted meet requirements of standards referenced.
 - b. Manufacturer's installation instructions for all products specified.
 - 4. Certifications:
 - a. Chemicals used in treatment process are registered with and approved by EPA.
 - b. Moisture content of material prior to treatment: 25 PCT maximum.
 - c. Material has been kiln-dried after treatment (KDAT) to the moisture content specified.
 - 5. Documentation of treatment of treated material in accordance with standards referenced.

1.4 DELIVERY AND STORAGE

- A. Delivery, storage and handling of untreated wood products:
 - 1. Lumber: As recommended by the grading agency indicated on the grade stamp.
 - 2. Plywood: APA U450.
- B. Delivery, storage, handling and disposal of treated wood products: AWPA M4.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with the Contract Documents, the manufacturers listed in the applicable Articles below are acceptable.
- B. Submit request for substitution in accordance with Specification Section 01 25 13.

2.2 MATERIALS

- A. General:
 - 1. Lumber (for framing, blocking, nailers, furring, grounds and similar members):
 - a. NIST PS 20.
 - b. Species:
 - 1) Treated material: As indicated in the appropriate AWPA standard.
 - a) Provide species of FRTM as necessary to achieve UL rating listed.
 - c. Grade:
 - 1) For nominal sizes up to and including 2 x 4: Standard and better.
 - 2) For nominal sizes up to 2 IN thick and wider than 4 IN: #2 and better.
 - 2. Non-structural plywood:
 - a. NIST PS 1.
 - b. C-C plugged:
 - 1) Exposure: INT.
 - 2) Thickness: 1/2 IN.
 - 3) Touch sanded.

- B. Preservative Treated Material:
 - 1. Moisture content:
 - a. Prior to treatment: 25 PCT.
 - b. Kiln-dry after treatment (KDAT), ASTM D4442 and ASTM D4444:
 - 1) Lumber: 19 PCT maximum.
 - 2) Plywood: 18 PCT maximum.
 - 2. Preservative:
 - a. Waterborne: AWPAP5.
 - b. As indicated in the appropriate AWP standard.
 - 3. Pressure-treat material in accordance with AWP U1.
 - 4. Wherever practicable, material to be treated shall be manufactured in its final form prior to treatment.
- C. Fire-Retardant Treated Material (FRTM):
 - 1. Acceptable manufacturer:
 - a. Hoover Treated Wood Products, Inc.:
 - 1) Interior: "Pyro-Guard".
 - 2) Exterior: "Exterior Fire-X".
 - 2. Maximum moisture content:
 - a. Prior to treatment: 25 PCT.
 - b. Kiln-dry after treatment (KDAT), ASTM D4442 and ASTM D4444:
 - 1) Lumber: 19 PCT (KDAT).
 - 2) Plywood: 15 PCT (KD-15).
 - 3. Fire-retardant preservative:
 - a. Provide protection against decay:
 - 1) EPA registered for use as a wood preservative.
 - b. Shall not bleed-through or adversely affect bond of any finish.
 - 4. Pressure-treat material in accordance with AWP U1.
 - 5. UL Classified:
 - a. FR-S, UL 723.
 - b. Exterior: No increase in classification when subjected to the Standard Rain Test, ASTM D2898.
 - c. Provide UL mark on each piece of FRTM.
 - 6. Maximum flame spread rating: 25, ASTM E84.
 - 7. Wherever practicable, material to be treated shall be manufactured in its final form prior to treatment.
- D. Fasteners and Anchors:
 - 1. Nails and screws:
 - a. Dry, non-corrosive exposure: Hot dipped galvanized meeting ASTM D153 or Type 304 stainless steel.
 - b. Wet, corrosive, marine, and/or below grade: Type 316 stainless steel.
 - 2. Adhesive anchors, expansion anchors, self-tapping concrete anchors, bolts, nuts, and washers: See Specification Section 03 15 19.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Verify measurements, dimensions, and shop drawing details before proceeding.
- B. Coordinate location of studs, nailers, blocking, grounds and similar supports for attached work.
- C. Eliminate sharp projections which would puncture roofing, flashing or underlayment material.

3.2 ERECTION AND INSTALLATION

- A. General:
 - 1. Provide preservative treated material for all wood used:
 - a. Outside building.
 - b. Below grade.
 - 2. Provide fire-retardant treated material for all wood used:
 - a. Inside building.
 - b. Exterior building walls.
 - c. Roof construction.
 - d. Parapet walls.
 - e. Roofing nailers.
- B. Attach work securely by anchoring and fastening as indicated or required to support applied loading.
 - 1. Anchor wood to concrete using a adhesive or expansion anchors as specified in Specification Section 03 15 19.
 - a. Separate wood from direct contact to concrete with polyethylene foam gasket strip.
 - 1) Size: 1/4 IN by width of wood member.
 - 2) Owens Corning "SillSealR".
 - 2. Anchor wood to metal using bolts and nuts as specified in Specification Section 03 15 19.
 - 3. Provide flat washers under all bolt heads and nuts.
 - 4. Fasten plywood in accordance with APA recommendations.
 - 5. Use fasteners of size that will not penetrate members where opposite side will be exposed to view or receive finish materials.
 - 6. Install fasteners without splitting of wood; predrill as required.
 - 7. Do not drive threaded friction type fasteners.
 - 8. Tighten bolts and lag screws at installation and retighten as required.
- C. Set work to required levels and lines, plumb, true.
 - 1. Shim as required.
 - 2. Cut and fit accurately.
- D. Provide wood grounds, nailers, or blocking where required for attachment of other work and surface applied items.
 - 1. Form to shapes indicated or required.
 - a. FRTM lumber:
 - 1) Do not rip or mill.
 - 2) Cross-cutting and drilling are allowable in accordance with manufacturer's recommendations and UL requirements.
 - 3) Resurfacing, planing or fabrication of special shapes or profiles shall be done prior to treatment.
 - b. FRTM plywood:
 - 1) Cross-cutting, ripping and drilling are allowable in accordance with manufacturer's recommendations and UL requirements.
 - c. Light sanding of FRTM as permitted by UL to remove raised grain or prepare for finishing is allowable.
 - d. Field treat cuts and holes in preservative treated material in accordance with AWPA M4 and manufacturer's published recommendations.
 - 2. Grounds:
 - a. Dressed, key beveled lumber minimum 1-1/2 IN wide of thickness required to bring face of ground even with finish material.
 - b. Remove temporary grounds when no longer required.

3. Install roofing nailers as necessary for attachment of flashing, curbs, fascia, coping, and related accessories:
 - a. Match height of nailers to insulation.
 - b. Anchor nailers to resist force of 300 PLF unless required otherwise by FM Global or roofing manufacturer.
 - 1) Metal decking attachment:
 - a) Attach base nailer to metal roof deck using self-tapping stainless steel sheet metal screws (STSMS) with plate washers or with minimum 3/8 IN Type 304 stainless steel hex head bolts with nuts and washers.
 - b) Countersink heads of bolts flush with top of nailer.
 - 2) Concrete decking attachment:
 - a) Attach base nailer to concrete roof deck using minimum 3/8 IN stainless steel adhesive anchors with minimum 3 IN embedment.
 - b) Countersink heads of bolts flush with top of nailer.
 - 3) Provide size and spacing of anchorage as required to meet loading criteria specified.
 - a) Fasten blocking for perimeter flashing in accordance with ANSI/SPRIES-1 and FM Global 1-49.
 - c. Provide 1/2 IN vent spaces between lengths of nailers.
 - d. Install nailers over vapor retarder.
- E. When wood has been exposed to moisture allow to completely dry out prior to covering with additional wood or another material.
- F. Correct or replace wood which shows bowing, warping or twisting to provide a straight, plumb and level substrate for applications of other materials.

END OF SECTION

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SECTION 06 82 00
FIBERGLASS REINFORCED PLASTIC FABRICATIONS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Fiberglass reinforced plastic (FRP) fabrications including but not limited to:
 - a. Solid plate.
 - b. Railings.
 - c. Grating.
 - d. Stairs.
 - e. Ladders.
 - f. Structural members.
 - g. Supporting structure design.
- B. Related Specification Sections include but are not necessarily limited to:
 - 1. Division 00 - Procurement and Contracting Requirements.
 - 2. Division 01 - General Requirements.

1.2 QUALITY ASSURANCE

- A. Referenced Standards:
 - 1. American National Standards Institute (ANSI):
 - a. A14.3, Safety Requirements for Fixed Ladders and Workplace Surfaces Package.
 - 2. ASTM International (ASTM):
 - a. E84, Standard Test Method for Surface Burning Characteristics of Building Materials.
 - 3. Occupational Safety and Health Administration (OSHA):
 - a. 29 CFR 1910, Occupational Safety and Health Standards, referred to herein as OSHA Standards.

1.3 DEFINITIONS

- A. Skid-resistant:
 - 1. Manufacturer's standard applied abrasive grit coating.
 - 2. Abrasive coated tape is not acceptable.
- B. FRP: Fiberglass Reinforced Plastic.
- C. Guardrail: A system of building components located near the open sides of elevated walking surfaces for the purpose of minimizing the possibility of an accidental fall from the walking surface to the lower level.
- D. Handrail: A railing provided for grasping with the hand for support.
- E. Railing: A generic term referring to guardrail, handrail and/or stair rails.
- F. Stair Rail: A guardrail, installed at the open side of stairways with either a handrail mounted to the inside face of the guardrail, or where allowed by applicable codes, with the top rail mounted at handrail height and serving the function of a handrail.

1.4 SYSTEM DESCRIPTION

- A. All fiberglass reinforced plastic support systems shall be designed by a registered professional structural engineer licensed in the State of Washington.

1.5 SUBMITTALS

- A. Shop Drawings:
 - 1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
 - 2. Product technical data including:
 - a. Acknowledgement that products submitted meet requirements of standards referenced.
 - b. Manufacturer's installation instructions.
 - c. Manufacturer's recommendations on reinforcing field cut openings.
 - 3. Fabrication and/or layout drawings.
 - a. Plan showing profile, location, section and details of each item including anchorage or support system(s).
 - b. Locations and type of expansion joints.
 - c. Materials of construction including shop applied coatings.
 - d. Listing of all accessory items being provided indicating material, finish, etc.
 - 4. Certifications:
 - a. Certification of Structural Engineer's qualifications.
 - b. Certification that all components and systems have been designed and fabricated to meet the loading requirements specified.
 - 5. Manufacturer's full line of colors available for each component.
- B. Informational Submittals:
 - 1. Complete design calculations of all supporting structure and fastening conditions.
 - a. Design calculations to be for information only.
 - b. Engineer will not review or take any action on submittal.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver and handle each item to preclude damage.
- B. Store all items on skids above ground.
 - 1. Keep free of dirt and other foreign matter which will damage items or finish and protect from corrosion and UV exposure.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
 - 1. Railings:
 - a. AICKIN.
 - b. American Grating.
 - c. Enduro Composites.
 - d. Fibergrate Composite Structures, Inc.
 - e. Harsco Industrial IKG.
 - f. International Grating Inc.
 - g. Mona Composites.
 - h. Seasafe, Inc.
 - i. Strongwell Corporation.
 - 2. Grating and solid plate:
 - a. American Grating.
 - b. Enduro Composites.
 - c. Fibergrate Composite Structures, Inc.
 - d. Harsco Industrial IKG.
 - e. International Grating Inc.
 - f. Mona Composites.
 - g. Seasafe, Inc.

- h. Strongwell Corporation.
- 3. Stairs:
 - a. American Grating.
 - b. Enduro Composites.
 - c. Fibergrate Composite Structures, Inc.
 - d. Harsco Industrial IKG.
 - e. Mona Composites.
 - f. Seasafe, Inc.
 - g. Strongwell Corporation.
- 4. Ladders:
 - a. American Grating.
 - b. Enduro Composites.
 - c. Fibergrate Composite Structures, Inc.
 - d. Harsco Industrial IKG.
 - e. Mona Composites.
 - f. Seasafe, Inc.
 - g. Strongwell Corporation.
- 5. Structural shapes:
 - a. American Grating.
 - b. Enduro Composites.
 - c. Fibergrate Composite Structures, Inc.
 - d. Mona Composites.
 - e. Strongwell Corporation.
- 6. Modular framing system:
 - a. AICKIN.
 - b. Enduro Composites.
 - c. Seasafe, Inc.
 - d. Unistrut by Atkore International, Inc.

B. Submit request for substitution in accordance with Specification Section 01 25 13.

2.2 MATERIALS

- A. Fiberglass Reinforced Plastic (FRP):
 - 1. Vinyl ester with fiberglass reinforcing.
 - a. Type V.
 - 2. Fire retardant.
 - a. Flame spread: ASTM E84, 25 or less.
 - 3. Color: To be selected by Engineer when more than one color is available for any one component.
- B. Fasteners, Clips, Saddles, and Miscellaneous Components:
 - 1. Fiberglass where possible.
 - 2. Stainless steel may be used if fiberglass component is not available.
- C. Adhesive: Recommended by manufacturer.
- D. Skid-resistant Surfacing: Manufacturer-applied abrasive grit coating.

2.3 FABRICATION

- A. General:
 - 1. Verify field conditions and dimensions prior to fabrication.
 - 2. Preassemble items in shop to greatest extent possible.
 - 3. All components shall be treated with UV inhibitor.
 - 4. Drill or punch holes with smooth edges.

- B. Railings:
1. Custom fabricate handrail and guardrail to profiles and dimensions indicated on Drawings.
 2. Where not indicated on Drawings, set intermediate horizontal rails to requirements of the building code.
 3. Minimum 2 IN SQ x 0.187 IN tube.
 4. Kickplate:
 - a. 4 x 1/2 IN (corrugated) x 0.125 IN thick.
 - b. Provide at all elevated platforms and where required by OSHA Standards.
 5. Provide handrail supports at 4 FT maximum spacing for wall brackets and 4 FT maximum spacing for posts.
 - a. Provide vertical supports at 4 FT maximum spacing on all inclined rail sections.
 - b. Provide brackets which provide a 1-1/2 IN projection from finish wall surface or guardrail to wall or guardrail side of rail.
 - c. Handrails shall not project more than 4-1/2 IN into required stairway width.
 6. Fit exposed ends of guardrails and handrails with solid terminations.
 - a. Return ends of handrail to wall but do not attach end to wall.
 - b. Where guardrail terminates at a wall or other obstruction, provide a vertical support post located 4 IN off wall or obstruction to center of post.
 7. Design railings to resist loading as required by the building code.
 8. Form connections with flush, smooth, hairline joints.
 - a. Provide concealed splice fitting at all connections.
 - b. Top rail splices and expansion joints shall be located within 8 IN of support.
 9. Fabricate items free of blemishes, seam marks, roller marks, rolled trade names and roughness.
 10. Provide removable railing where indicated.
 11. Provide weeps to drain moisture from hollow railing sections at exterior and in high humidity areas.
 - a. 1/4 IN weep hole in railing 1 IN above walkway surface at bottom of posts set in concrete or otherwise closed at bottom, and at other low points where moisture can collect.
- C. Grating and Solid Plate Material:
1. Design live load:
 - a. 100 PSF uniform live load.
 - b. 300 LBS concentrated load.
 - c. Maximum deflection of 1/300 of span under a superimposed live load.
 - d. Design for the most severe loading condition noted above.
 2. Minimum grating depth: 1-1/2 IN.
 3. Bar span: Maximum of 1-1/2 IN center to center.
 4. Walking surface: Manufacturer's standard applied abrasive grit coating.
- D. Embedded Grating Supports:
1. Fiberglass.
 2. Size to suit depth of grating.
 3. Provide leg or strap for embedding and anchoring into concrete.
 4. Similar to Strongwell "Dura dek Fiberglass Curb Angle."
- E. Stairs:
1. Fabricated to profiles indicated.
 2. Treads: Grating with integral 1 IN skid-resistant nosing.
 - a. Provide center reinforcing for treads over 36 IN wide.
 3. Risers:
 - a. Solid plate material to match treads.
 - b. Provide center vertical reinforcing for risers over 36 IN wide.

4. Landings:
 - a. Solid plate with manufacturer's standard applied skid-resistant abrasive grit coating.
 - 1) Provide skid-resistant nosing on leading edge of stairs.
 - b. Provide intermediate support as required to meet loading requirements.
 5. Design and fabricate stair, platforms and landings, and all connections to support a 100 PSF uniform live load plus a 300 PSF concentrated load.
 6. Provide railing per this Specification Section.
- F. Ladders:
1. Design in accordance with ANSI A14.3, OSHA Standards and building code requirements unless noted otherwise below.
 2. Ladders shall be designed to support a minimum 300 LB concentrated vertical load with 150 LB concentrated horizontal load without failure or permanent set.
 - a. Maximum lateral deflection: Side rail span/300.
 3. Rungs:
 - a. 1 IN square or diameter solid bar with skid-resistant surface on all sides.
 - b. Uniform maximum spacing of 12 IN.
 - c. Top rung level with top of platform.
 - d. Rungs shall not extend beyond the outside face of the ladder side rail.
 4. Rails:
 - a. 2 IN SQ tube, minimum 0.156 IN thick.
 - b. Provide minimum 1/2 x 2-1/2 IN x length required standoff brackets on each side rail with punched holes for 3/4 IN anchors.
 - 1) Maximum vertical spacing: 5 FT OC.
 - c. The side rails of through ladder extensions shall extend 42 IN above the top rung or landing and shall flare out on each side to provide a clearance of 24 IN between the rails.
 5. Minimum distance from centerline of rungs to wall or obstruction shall be 7 IN.
- G. Modular Framing System:
1. Material: Heavy duty pultruded.
 2. Shapes as required for condition.
 3. Fasteners: Stainless steel or fiberglass.
 4. Provide end caps for all exposed terminations.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Set work accurately in location, alignment and elevation, plumb, level, and true.
 1. Measure from established lines and levels.
 2. Provide temporary bracing or anchors in formwork for items which are to be built into concrete, masonry or similar construction.
 3. Tolerances:
 - a. Maximum variation from plumb in vertical line: 1/8 IN in 3 FT.
 - b. Maximum variation from level of horizontal line: 1/4 IN in 20 FT.
 - c. Maximum variation from plan location: 1/4 IN in 20 FT.
- C. Railings:
 1. Adjust railings prior to securing in place to ensure proper matching at butting joints and correct alignment throughout their length.
 - a. Plumb posts in each direction.
 2. Provide posts with floor flange, attached to post and with predrilled holes for bolting to stringer, floor or beam.

3. Anchor handrails to walls or guardrails with brackets designed for condition.
 - a. For concrete and solid masonry anchorage, use stainless steel adhesive anchors with stainless steel bolts with hex nuts.
 - b. Anchor size and embedment to be designed by component fabricator.
 - 1) Provide minimum of 1/2 IN anchor bolts.
- D. Coat all exposed surfaces of stainless steel fasteners with minimum 15 MIL gel coating to match component being anchored.
- E. Fasten railings to beams and stair stringers with stainless steel bolts, nuts and washers.
 1. Provide two washers for each bolt.
- F. Attach grating to each end and intermediate support clip or saddle with bolts, nuts and washers.
 1. Maximum spacing: 2 FT OC with minimum of two per side.
 2. Attach clips or saddles to bearing bars only.
 3. Reinforce all field cut openings in accordance with manufacturer's recommendations.
- G. Attach stair treads at ends to stair stringer with hold-down clips, bolts, nuts, and washers.
 1. Minimum two clips per end.
- H. File cut ends of all fiberglass to a 1/32 IN radius.
- I. Seal cut ends of all items with catalyzed resin as recommended by manufacturer.
 1. Provide same resin used in fabrication of item as a minimum.
- J. Provide all modular framing components as required to suit condition.
 1. Install in accordance with manufacturer's recommendations.

END OF SECTION



DIVISION 07

THERMAL AND MOISTURE PROTECTION



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SECTION 07 14 00
FLUID APPLIED WATERPROOFING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Fluid applied waterproofing.
 - 2. Protection course.
 - 3. Specific concrete finishing requirements.
- B. Related Specification Sections include but are not necessarily limited to:
 - 1. Division 00 - Procurement and Contracting Requirements.
 - 2. Division 01 - General Requirements.
 - 3. Division 03 - Concrete.
 - 4. Section 07 21 00 - Building Insulation.

1.2 QUALITY ASSURANCE

- A. Referenced Standards:
 - 1. ASTM International (ASTM):
 - a. C836/C836M, Standard Specification for High Solids Content, Cold Liquid-Applied Elastomeric Waterproofing Membrane for Use with Separate Wearing Course.
 - b. D4258, Standard Practice for Surface Cleaning Concrete for Coating.
 - 2. International Concrete Repair Institute (ICRI):
 - a. 310.2R, Selecting and Specifying Concrete Surface Preparation for Sealers, Coatings, Polymer Overlays, and Concrete Repair.
 - 3. The Society for Protective Coatings/NACE International (SSPC/NACE):
 - a. SP 6/NACE No. 3, Commercial Blast Cleaning.
 - b. SP 13/NACE No. 6, Surface Preparation of Concrete.
- B. Qualifications:
 - 1. Applicator(s) licensed or approved in writing by manufacturer.
 - 2. Applicator(s) shall have minimum of seven years experience in application of cold liquid-applied elastomeric waterproofing membranes with minimum of two years installation of products specified or accepted for use on this Project.
 - a. Provide list of projects completed in last two years using products proposed for use.
 - 1) Include name of structure, area waterproofed (SQFT) and name of contact with phone number.
- C. Miscellaneous:
 - 1. Manufacturer's authorized representative shall review substrate preparation and provide written approval of substrate prior to installation of product.

1.3 DEFINITIONS

- A. Installer or Applicator:
 - 1. Installer or applicator is the person actually installing or applying the product in the field at the Project site.
 - 2. Installer and applicator are synonymous.

1.4 SUBMITTALS

- A. Shop Drawings:
 - 1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
 - 2. Details showing flashing of penetrations, terminations, expansion joints, protection course attachment and other special conditions.
 - 3. Product technical data including:
 - a. Acknowledgement that products submitted meet requirements of standards referenced.
 - b. Manufacturer's installation instructions.
 - 4. Certification of Applicator qualifications.
 - 5. Applicator's experience record.
 - 6. Listing of projects completed in last two years.
- B. Informational Submittals:
 - 1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
 - 2. Manufacturer's written approval of substrate.
 - 3. Warranty.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
 - 1. Waterproofing system:
 - a. Tremco Commercial Sealants & Waterproofing.
 - b. Carlisle Coatings & Waterproofing.
- B. Submit request for substitution in accordance with Specification Section 01 25 13.

2.2 MATERIALS

- A. Primer: Manufacturer's recommended primer appropriate to substrate.
- B. Waterproofing System:
 - 1. One or two component, moisture curing polyurethane elastomer meeting requirements of ASTM C836/C836M.
 - 2. Flowing type for surfaces up to 5 PCT slope.
 - 3. Non-flow type for surfaces exceeding 5 PCT.
 - 4. Carlisle "MiraSEAL" or Tremco "TREMproof 201/60."
- C. Adhesive: Manufacturer's standard.
- D. Flashing Reinforcement: Woven uncoated fiberglass mesh.
- E. Sealant: Manufacturer's recommended sealant.
- F. Protection Course:
 - 1. Material capable of protecting cured membrane from damage caused by rocks and other debris in the backfill material.
 - 2. Acceptable to waterproofing manufacturer.
- G. Backer Rod: Closed cell polyurethane foam rod.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Cure concrete and masonry in accordance with manufacturer's recommendations.
 - 1. Verify moisture content does not exceed manufacturer's maximum allowable.
 - 2. Ensure that curing agents used are compatible with coating system.
- B. Remove surface contamination by high pressure water cleaning per ASTM D4258.
- C. Verify that concrete has been troweled and broomed, free of fins, ridges or voids.
 - 1. Verify that all tie holes and honeycomb areas, holes and voids have been patched in accordance with Specification Section 03 35 00 and coating manufacturer's recommendations.
- D. Prepare substrate per manufacturer's published instructions and this Specification Section.
 - 1. Concrete surfaces:
 - a. Abrasive blast in accordance with SSPC SP 13/NACE No. 6 to provide a profiled surface.
 - 1) Profile: ICRI 310.2R, CSP 3 minimum.
 - 2. Metal surfaces:
 - a. Abrasive blast in accordance with SSPC SP 6/NACE No. 3.
 - 1) Minimum 1 MIL surface profile.
 - b. Prime coat all metal surfaces.
 - 3. Flash all penetrations and other areas in accordance with manufacturer's instructions.
 - 4. Clean and seal cracks and joints in accordance with manufacturer's instructions.
- E. Protect adjacent surfaces.

3.2 APPLICATION AND INSTALLATION

- A. Apply waterproofing system in accordance with manufacturer's printed instructions and this Specification Section.
 - 1. Provide minimum 60 MIL dry film thickness.
 - 2. Apply waterproofing to the exterior side of vertical concrete wall surfaces (surfaces against earth) where finished interior building space occurs on the opposite side of the wall and where indicated on the Drawings.
 - a. Terminate top of waterproofing in accordance with manufacturer's instructions approximately 4 IN below finished grade unless shown otherwise on Drawings.
- B. Extend coating over all previously flashed areas.
- C. Allow vertical applications to cure minimum of 12 HRS at 75 DEGF or as recommended by manufacturer, prior to backfilling.
- D. Protection Course:
 - 1. Protection course is to be installed prior to any perimeter insulation specified in Specification Section 07 21 00.
 - a. Secure protection course to prevent displacement during backfilling.
 - 1) Adhere to cured waterproofing membrane.
 - 2) Mechanical fasteners are not acceptable.

END OF SECTION

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SECTION 07 19 00
LIQUID WATER REPELLENT

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Liquid water repellent.
- B. Related Sections include but are not necessarily limited to:
 - 1. Division 00 - Procurement and Contracting Requirements.
 - 2. Division 01 - General Requirements.
 - 3. Division 03 - Concrete.

1.2 QUALITY ASSURANCE

- A. Referenced Standards:
 - 1. ASTM International (ASTM):
 - a. E514, Standard Test Method for Water Penetration and Leakage through Masonry.
- B. Mock-Ups:
 - 1. Product shall be applied to mock-up erected under Division 03.

1.3 SUBMITTALS

- A. Shop Drawings:
 - 1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
 - 2. Product technical data including:
 - a. Acknowledgement that products submitted meet requirements of standards referenced.
 - b. Manufacturer's installation instructions.
- B. Informational Submittals:
 - 1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
 - 2. Letter from manufacturer stating that product is suitable for intended use and is compatible with and will not cause discoloration of treated concrete surfaces.
 - 3. Field conducted water spray test results.

1.4 JOB SITE CONDITIONS

- A. Material shall be stored at temperatures between 40 and 90 DEGF.
- B. Do not apply Penetrating Water Repellent to frost filled surfaces.
 - 1. Both substrate and ambient temps shall be 45 DEGF and rising at time of application.
- C. Do not apply Penetrating Water Repellent at temperatures above 90 DEGF.
- D. Do not apply Penetrating Water Repellent if rain is expected within 12 HRS.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
 - 1. Liquid water repellent:
 - a. Chemprobe by Tnemec, Inc.
 - b. L&M by LATICRETE International, Inc.

- c. Master Builders Solutions by BASF.
- d. The Euclid Chemical Company.

B. Submit request for substitution in accordance with Specification Section 01 25 13.

2.2 MATERIALS

A. Liquid Water Repellent (LWR-1):

- 1. Water Based, clear, penetrating water repellent designed for use on porous masonry and concrete surfaces.
 - a. Ready to use, silane/siloxane blend.
 - b. Reduction in Leakage ASTM E514:
 - 1) Brick: 100 PCT.
 - 2) Mortar Block: >91 PCT.
 - c. VOC: 50 G/L.

B. Euclid "CHEMSTOP WB HEAVY DUTY".

C. Liquid Water Repellent (LWR-2):

- 1. Water Based, clear, penetrating water repellent sealer designed for use on dense concrete and masonry surfaces.
 - a. Ready to use, silane/siloxane blend.
 - b. VOC: 50 G/L.

D. Euclid "CHEMSTOP WB REGULAR".

PART 3 - EXECUTION

3.1 PREPARATION

- A. Protect adjacent surfaces not intended to receive water repellent.
- B. Clean surfaces to be covered in accordance with manufacturer's recommendations.
 - 1. Surface shall be structurally sound, clean, dry, free of dust, dirt, paint, efflorescence, laitance and other contaminants that will prevent the proper penetration of penetrating water repellent.
 - 2. A dry substrate is required for proper penetration of the sealer.
 - 3. Prior to application, joints or cracks must be properly sealed.
 - 4. If an acid is used for cleaning, neutralize completely before application of penetrating water repellent.
- C. Make all mortar repairs at least 72 HRS prior to application.
- D. Allow masonry surfaces to cure minimum of 10 days prior to application.
- E. Cure concrete surfaces in accordance with manufacturer's recommendations.
 - 1. New concrete shall be a minimum 28 days old.
 - 2. Concrete repairs shall be a minimum seven days old.

3.2 INSTALLATION AND APPLICATION

- A. Install products in accordance with manufacturer's instructions.
 - 1. At a minimum apply material in accordance with manufacturer's recommended application rates using procedures and equipment recommended by manufacturer.
 - 2. Apply two coats of material.
 - a. Second coat shall be applied "wet on wet" before the first coat dries.
 - b. Do not allow material to puddle on surface.
 - 3. Using manufacturer's recommended application rates, apply as many coats of material as necessary to obtain results required by the FIELD QUALITY CONTROL Article.
- B. Apply LWR-2 to exterior surfaces and to exterior dense brick surfaces.

- C. Apply liquid water repellent to interior surfaces where scheduled on Room Finish Schedule on Drawings.

3.3 FIELD QUALITY CONTROL

- A. Manufacturer or manufacturer's designated representative shall conduct a water spray test to an area of the mock-up wall specified in Specification Section 03 35 00 for a period of 5 HRS.
 - 1. Begin water spray test a minimum of seven days after application of water repellent sample.
 - 2. Water from the spray shall impact the wall at a 45 DEG angle to the vertical and shall cover an area of not less than 9 SQFT.
 - 3. Water flow shall be minimum 5 GPM at 60 PSI pressure.
 - 4. If, within 5 HRS, moisture appears on the inside face of the wall within the test area, the wall shall be recoated.
- B. Retest as required.
- C. Recoat as required until wall area remains dry within limits of testing procedure.
- D. Results of this test shall be used to determine material quantity in excess of manufacturer's minimum recommended amounts to be applied per square foot to the building surface.
- E. Protect adjacent materials not required to be coated.

3.4 SCHEDULE

- A. Apply liquid water repellent to the following surfaces:

STRUCTURE	SURFACE
All Structures	Exposed concrete wall surfaces unless other coating is specified at designated area.

END OF SECTION

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SECTION 07 21 00
BUILDING INSULATION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Building insulation.
 - a. Does not include roof insulation or roof vapor retarder; see Specification Section 07 54 19.
- B. Related Specification Sections include but are not necessarily limited to:
 - 1. Division 00 - Procurement and Contracting Requirements.
 - 2. Division 01 - General Requirements.
 - 3. Section 09 29 00 - Gypsum Board.

1.2 QUALITY ASSURANCE

- A. Referenced Standards:
 - 1. ASTM International (ASTM):
 - a. C272/C272M, Standard Test Method for Water Absorption of Core Materials for Structural Sandwich Constructions
 - b. C423, Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method.
 - c. C518, Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus.
 - d. C578, Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation.
 - e. C665, Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing.
 - f. D1621, Standard Test Method for Compressive Properties of Rigid Cellular Plastics.
 - g. E96/E96M, Standard Test Methods for Water Vapor Transmission of Materials.
 - 2. Underwriters Laboratories, Inc. (UL):
 - a. Building Materials Directory.

1.3 SUBMITTALS

- A. Shop Drawings:
 - 1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
 - 2. Product technical data including:
 - a. Acknowledgement that products submitted meet requirements of standards referenced.
 - b. Manufacturer's installation instructions.
 - c. Manufacturer's recommendations on sealants, tapes and mastics.
- B. Informational Submittals:
 - 1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
 - 2. Certification from insulation manufacturer stating that insulation proposed is acceptable for intended use per the Drawings.

1.4 SITE CONDITIONS

- A. For purposes of this Specification Section, design frost line for this Project is 18 IN below grade.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
 - 1. Rigid extruded polystyrene board insulation:
 - a. Dow.
 - b. DiversiFoam Products.
 - c. Owens Corning.
 - 2. Blanket or batt thermal insulation:
 - a. Owens Corning.
 - b. USG Corporation.
 - c. CertainTeed.
 - 3. Sound control insulation:
 - a. ROCKWOOL Group.
 - b. Thermafiber by Owens Corning.
 - 4. Vapor retarder:
 - a. Raven Industries, Inc.
 - b. Reef Industries, Inc.
 - c. Fortifiber Building Systems Group, Inc by Henry Company.
 - d. Alumiseal.
- B. Submit request for substitution in accordance with Specification Section 01 25 13.

2.2 MATERIALS

- A. General:
 - 1. Foam plastic insulation used in buildings and structures shall comply with the requirements of the building code.
 - a. Surface burning characteristics: ASTM E84.
 - b. Flame spread index: Maximum 75.
 - c. Smoke developed: Maximum 450.
- B. Rigid Polystyrene Board Insulation:
 - 1. Extruded: ASTM C578, Type IV.
 - a. Water vapor transmission: ASTM E96/E96M, 1.1 perm-IN maximum.
 - b. Water absorption: ASTM C272/C272M, 0.3 PCT maximum.
 - c. Thermal resistance: ASTM C518 at 75 DEGF mean temperature, 5.0/IN.
 - 2. Provide insulation designed for intended use.
 - a. Perimeter insulation and protection board.
 - 1) Similar to Dow "Styrofoam PERIMATE."
 - 2) Compressive strength: ASTM D1621, 30 PSI.
 - 3) Thickness:
 - a) Perimeter insulation: 2 IN.
 - b) Protection board: 1 IN.
 - 4) Edges:
 - a) Long edge: Shiplap.
 - b) Short edge: Square.
 - b. Cavity insulation:
 - 1) Similar to Dow "CAVITYMATE."
 - 2) Compressive strength: ASTM D1621, 15 PSI.
 - 3) Thickness: 2 IN.
 - 4) Edges: Square.
- C. Sealant and Mastic (for setting polystyrene and/or polyisocyanurate insulation board):
Manufacturer's recommended standard.

- D. Blanket or Batt Thermal Insulation:
 - 1. Glass or other inorganic fibers and resinous binders formed into flexible blankets or semi-rigid sheets.
 - 2. Unfaced:
 - a. ASTM C665, Type 1.
 - 3. Minimum thickness as noted on Drawings.
- E. Vapor Retarder:
 - 1. Fire rated, reinforced, 3 ply, Class 1 material.
 - 2. Perm rating: Not exceeding 0.035 grains/HR-FT²-IN-Hg when determined in accordance with ASTM E96/E96M.
 - 3. Griffolyn "TX-1200FR."
- F. Vapor Retarder Tape: As recommended by vapor retarder manufacturer.
- G. Sound Control Insulation:
 - 1. Mineral wool batts.
 - a. ASTM C665, Type I.
 - b. UL listed when used in fire rated construction.
 - 2. Density: Minimum 2.5 PCF.
 - 3. Sound Reduction, ASTM C423.
 - a. Minimum NRC for 3 IN thick material: 1.05.
 - 4. Thickness: As noted on Drawings.
 - 5. Thermafiber "SAFB".

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. General:
 - 1. Insulate full thickness over surfaces to be insulated.
 - 2. Fit tightly around obstructions, fill voids.
 - 3. Cover all penetrations (electrical junction boxes, switch boxes, piping, conduits, etc.) with insulation, taking care not to compromise the workings of the device.
 - 4. Fit butted joints of batt or blanket insulations tightly together.
 - 5. Apply single or double layer to achieve total thickness.
 - a. If double layer is provided, stagger all joints minimum 12 IN.
 - 6. Do not use broken or torn pieces of insulation.
 - 7. Install so that completed installation is vapor tight.
 - a. Seal all joints.
 - b. Seal to abutting materials to maintain vapor retarder integrity.
 - c. Provide manufacturer's recommended vapor retarder tape for use with faced batt insulation or separate vapor retarder.
 - 1) If vapor retarder tape fails to adhere to any surface, apply sprayed-on adhesive as recommended by tape manufacturer to promote adhesion.
 - d. Provide manufacturer's recommended solvent-free sealant compatible with insulation board for rigid board insulation.
 - 1) Tape is not acceptable for use with rigid board insulation.
- C. Blanket or Batt Insulation using Separate Vapor Retarder Sheet in Exterior Stud Wall Systems:
 - 1. Verify that all piping, conduit, electrical box and other in-wall work is complete prior to installing insulation and vapor retarder.
 - 2. Install insulation friction fit between studs.
 - 3. Tightly butt ends.
 - 4. Install vapor retarder to warm side of building exterior wall.
 - a. Completely seal each wall area to surrounding construction.

5. Install vapor retarder vertically.
 - a. Use widest practical sheet.
 - b. Install in continuous sheets, floor to structure above, without horizontal joints.
 - c. Fold flaps of vapor retarder over studs.
 - d. Tape flaps together continuously.
 - e. Tape bottom and top edges to structure continuously.
 - f. After installation of any additional conduit, boxes, piping or other items within wall system, repair all tears or penetrations of vapor retarder with vapor retarder tape prior to installation of gypsum board.
- D. Rigid Board Insulation in Cavity Walls:
1. Do not proceed with installation until subsequent work which conceals insulation is ready to be performed.
 2. Set each piece of insulation flush with the abutting piece to eliminate ledges in the face of the insulation.
 3. Install mastic on face of concrete or masonry back-up in accordance with mastic and insulation manufacturer's recommendation.
 4. Press courses of insulation between wall ties (horizontal reinforcing) with edges butted tightly both ways.
 5. Set units firmly into mastic.
 6. Seal all horizontal and vertical joints with sealant recommended by insulation manufacturer.
 7. Do not use damaged insulation.
- E. Rigid Insulation at Perimeter Below Grade and Under Slab:
1. Install insulation below grade on outside face of foundation walls.
 - a. Install in mastic with tight joints.
 2. Where footings are located below the design frost line, extend insulation down to the design frost line.
 - a. Where indicated on the Drawings, extend beyond the design frost line.
 3. Where footings are located at the design frost line, extend insulation down to top of footing or as indicated on Drawings.
- F. Protect insulation from damage and/or displacement during backfilling and/or pouring of floor slab
- Sound Control Insulation:
1. Install friction fit between studs.
 2. Do not obstruct ventilation spaces.
 3. Fill all miscellaneous voids unless noted otherwise on Drawings.
 4. After installation of conduit, boxes, piping or other items within wall system, reposition displaced insulation and fill all voids.

3.2 FIELD QUALITY CONTROL

- A. Repair or replace damaged insulation and/or vapor retarder as directed by Engineer.
- B. Provide minimum cover of 5/8 IN Type X gypsum board over foam insulation exposed to the building interior.

END OF SECTION

SECTION 07 24 13
EXTERIOR INSULATION AND FINISH SYSTEM (EIFS)

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Exterior insulation and finish system (EIFS).
- B. Related Sections include but are not necessarily limited to:
 - 1. Division 00 - Procurement and Contracting Requirements.
 - 2. Division 01 - General Requirements.
 - 3. Section 07 62 00 - Flashing and Sheet Metal.
 - 4. Section 07 92 00 - Joint Sealants.

1.2 QUALITY ASSURANCE

- A. Referenced Standards:
 - 1. ASTM International (ASTM):
 - a. C150, Standard Specification for Portland Cement.
 - b. C578, Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation.
- B. Qualifications:
 - 1. Applicator shall be licensed or approved in writing by manufacturer.
 - 2. Applicator shall have minimum 15 years' experience installing similar products on projects with similar scope.
 - 3. Applicator shall have successfully completed minimum of three projects with similar scope during past three years.
 - 4. Insulation board manufacturer shall be approved in writing by finish system manufacturer.
- C. Mock-Ups:
 - 1. Build in conjunction with work in Section.
 - 2. Mock-up shall constitute minimum standard of quality for actual construction.
 - a. Maintain mock-up during construction.
 - b. Protect mock-up from damage.
 - 3. If not acceptable, construct additional mock-up as required.
 - 4. Remove when directed by Engineer.
 - 5. Mock-up shall be constructed using stepped construction showing each operation involved in constructing the wall systems.
 - a. Include mock-up of all corners, joints, terminations and flashing details.

1.3 DEFINITIONS

- A. Installer or Applicator:
 - 1. Installer or applicator is the person actually installing or applying the product in the field at the Project site.

1.4 SYSTEM DESCRIPTION

- A. Project Design Wind Load Per IBC 2018.
- B. Design system for high impact resistance.

1.5 SUBMITTALS

- A. Shop Drawings:
 - 1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
 - 2. Product technical data including:
 - a. Acknowledgement that products submitted meet requirements of standards referenced.
 - b. Scaled details of all joints, corners, terminations and flashings.
 - 1) Minimum scale of details: 1-1/2 IN = 1 FT.
 - c. Manufacturer's installation instructions.
 - 3. Manufacturer recommendations for using metal lath specific to this Project.
- B. Samples:
 - 1. For initial color selection, provide manufacturer's full line color samples for Engineer's finish and color selection.
 - 2. After initial color selection, provide 12 x 12 IN sample of selected finish(es) and color(s).
- C. Contract Closeout Information:
 - 1. Operation and Maintenance Data:
 - a. See Specification Section 01 33 04 for requirements for the mechanics, administration, and the content of Operation and Maintenance Manual submittals.
- D. Informational Submittals:
 - 1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
 - 2. Applicator qualifications.
 - 3. Warranty.
 - 4. Letter from EIFS manufacturer stating insulation to be used is acceptable as substrate for system specified.
 - a. Provide certification that insulation has achieved minimum aging requirements.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver material in original containers bearing manufacturer's name, identification of contents, written application instructions, and health, hazard and safety data.

1.7 WARRANTY

- A. Provide manufacturer's standard limited materials warranty signed by the manufacturer.
 - 1. Warranty period shall be three years.
- B. Provide three-year installation warranty signed by applicator against water intrusion, system or component loss of bond from substrate, peeling, flaking, chipping or cracking of surface as result of application defects.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
 - 1. Exterior insulation and finish system (EIFS):
 - a. Dryvit System, Inc.
 - b. STO Industries, Inc.
 - c. SYENERGY Wall Systems.
 - d. TEC, Inc.
 - 2. Polystyrene insulation board:
 - a. Any manufacturer acceptable to EIFS manufacturer.
 - 3. Sealant: See Section 07 92 00.

B. Submit request for substitution in accordance with Specification Section 01 25 13.

2.2 MATERIALS

- A. Primer/Adhesive: silicone emulsion based material mixed with Portland cement as recommended by manufacturer for use as an adhesive and for fabric embedment.
- B. Portland Cement: ASTM C150, Type 1 or II.
- C. Rigid Polystyrene Board Insulation:
1. Foamed, expanded:
 - a. ASTM C578, Type 1.
 2. Density:
 - a. Minimum 1.0 PCF.
 - b. Minimum 2.0 PCF at mechanically attached areas.
 3. Compressive strength:
 - a. 1.0 PCF density: 10 PSI minimum.
 - b. 2.0 PCF density: 25 PSI minimum.
 4. Thermal conductivity (K value at 75 DEGF): 0.25 minimum.
 5. Dimensional tolerances (2 x 4 FT board size):
 - a. Edge trueness: Shall not deviate more than 1/32 IN/FT of length or width.
 - b. Thickness tolerance shall be plus/minus 1/16 IN.
 6. Age (air dry) for minimum of six weeks prior to use.
 7. Thickness: 3 IN and to meet R value as noted on the Drawings.
 8. Maximum size board: 2 x 4 FT.
- D. Reinforcing Fabric:
1. Manufacturer's standard glass fiber field reinforcing fabric.
 2. Manufacturer is responsible for providing heavy-duty reinforcing fabric where required by project conditions.
- E. Finish Coat: silicone emulsion based, factory-mixed coating, having integral color and texture.
- F. Water: Potable.
- G. Primer, Adhesives, Levelers, Groundcoats: As recommended by EIFS manufacturer.
- H. Additives: Rapid binders, anti-freeze, accelerators etc., are NOT ALLOWED.
- I. Sheathing: Acceptable to EIFS manufacturer.
- J. Sealant: Polyurethane based material approved by EIFS manufacturer.
- K. Metal Lath:
1. Diamond mesh 3/4 LB/SQYD minimum galvanized for use in installing system over unsound surfaces.
 2. Verify with system manufacturer.
- L. Fasteners for Mechanically Attached System: As recommended by system manufacturer with washers.
- M. Sheet Metal Drip: See Section 07 62 00.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Provide metal lath over previously painted and/or other unsound surfaces or where indicated on Drawings or where required by EIFS manufacturer.
- C. Verify sheathing and accessories are complete and sound.

- D. Provide expansion, control and/or aesthetic joints in accordance with manufacturer's guidelines and as shown on Drawings.
- E. Seal all control, expansion and other joints in accordance with manufacturer's instruction.
- F. Cure material in accordance with system manufacturer's recommendations.
- G. Provide galvanized sheet metal drip at head of all exterior openings and at bottom of wall above grade.

END OF SECTION

SECTION 07 26 00
UNDER SLAB VAPOR RETARDER

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Under slab vapor retarder.
- B. Related Specification Sections include but are not necessarily limited to:
 - 1. Division 00 - Procurement and Contracting Requirements.
 - 2. Division 01 - General Requirements.

1.2 QUALITY ASSURANCE

- A. Referenced Standards:
 - 1. American Concrete Institute (ACI):
 - a. 302.2R, Guide for Concrete Slabs that Receive Moisture-Sensitive Flooring Materials.
 - 2. ASTM International (ASTM):
 - a. E1 643, Standard Practice for Selection, Design, Installation, and Inspection of Water Vapor Retarders Used in Contact with Earth or Granular Fill Under Concrete Slabs.
 - b. E1 745, Standard Specification for Plastic Water Vapor Retarders Used in Contact with Soil or Granular Fill Under Concrete Slabs.

1.3 SUBMITTALS

- A. Shop Drawings:
 - 1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
 - 2. Product technical data including:
 - a. Acknowledgement that products submitted meet requirements of standards referenced.
 - b. Product data sheet on vapor retarder sheet and vapor retarder tape.
 - c. All accessories proposed for use.
 - d. Manufacturer's installation instructions.
- B. Samples:
 - 1. Provide two, 6 IN x 6 IN samples of vapor retarder material taped together using the vapor retarder tape proposed.
 - 2. Provide two samples of all accessories proposed for use.
- C. Informational Submittals: Manufacturer's recommendation on vapor retarder tape.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
 - 1. Vapor retarder:
 - a. Fortifiber Building Systems Group, Inc. by Henry Company.
 - b. Layfield Group, Ltd.
 - c. ISI Building Products.
 - d. Raven Industries, Inc.
 - e. Reef Industries, Inc.
 - f. Stego Industries, LLC.
 - g. W.R. Meadows, Inc.

- B. Submit request for substitution in accordance with Specification Section 01 25 13.

2.2 PERFORMANCE REQUIREMENTS

- A. Vapor Retarder:
 - 1. ASTM E1745, Class A.
 - 2. Thickness: Minimum 15 MIL.
 - 3. Water vapor permeance: 0.02 maximum.

2.3 ACCESSORIES

- A. Pipe Boots: Manufacturer's standard boot fabricated to maintain the integrity of the vapor retarder system.
- B. Vapor Retarder Tape: As recommended by vapor retarder manufacturers.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Base material over which vapor retarder is to be installed shall be level, compacted and free of debris, foreign objects or other deleterious materials.
- B. Surfaces at perimeter and penetrations of vapor barrier shall be clean, smooth and free of sharp objects, fins or projections.

3.2 INSTALLATION

- A. Install products in accordance with manufacturer's instructions, ASTM E1643 and ACI 302.2R.
- B. Provide vapor retarder where indicated on the Drawings.
 - 1. Place continuous vapor retarder above granular fill subgrade material, unless noted otherwise.
- C. Lap minimum 6 IN and seal in accordance with ASTM E1643 and manufacturer's recommendations.
- D. Extend to extremities of area and seal to adjacent elements.
- E. Seal all penetrations: Provide pipe boot for all pipes or conduit penetrating the floor slab.

3.3 FIELD QUALITY CONTROL

- A. Ensure proper precautions are implemented to prevent damage to installed vapor retarder membrane prior to and during pouring of concrete floor slab.
- B. Inspect vapor retarder immediately prior to placement of concrete.
 - 1. Patch all punctures, tears, holes, etc.
 - a. Patch small punctures with vapor retarder tape as allowed by ASTM E1643 and manufacturer's recommendations.
 - b. Repair larger damage with additional layer of vapor retarder.
 - 1) Lap repairs minimum 6 IN beyond extent of damage in all directions.
 - 2) Seal perimeter of patch with vapor retarder tape or as recommended by manufacturer.

END OF SECTION

SECTION 07 54 19
ADHERED PVC ROOFING

PART 1 - GENERAL

1.1 SUMMARY

- A. Furnish labor, materials, tools, equipment, and services for Adhered PVC Roofing System, in accordance with provisions of Contract Documents.
- B. Completely coordinate with work of other trades.

1.2 QUALITY ASSURANCE

- A. Manufacturer authorized roofing installer.
- B. Component products made by single manufacturer or approved for use with warranted system.
- C. ASTM International (ASTM):
 - 1. ASTM C1289, Standard Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board.
 - 2. ASTM C1303 Standard Test Method for Predicting Long-Term Thermal Resistance of Closed-Cell Foam Insulation
 - 3. ASTM D6754 Standard Specification for Ketone Ethylene Ester Based Sheet Roofing, or D4434 Poly Vinyl Chloride Sheet Roofing depending on product.
 - 4. ASTM E84, Standard Test Method for Surface Burning Characteristics of Building Materials.
 - 5. ASTM E96, Standard Test Methods for Water Vapor Transmission of Materials.
- D. American National Standards Institute (ANSI) / Single Ply Roofing Industry (SPRI):
 - 1. ANSI/SPRI ES-1 Wind Design Standard for Edge Systems Used with Low Slope Roofing Systems
- E. National Roofing Contractors Association (NRCA):
 - 1. Roofing and Waterproofing Manual.
- F. Sheet Metal and Air Conditioning Contractors' National Association (SMACNA):
 - 1. Architectural Sheet Metal Manual.
- G. Underwriters Laboratories (UL):
 - 1. UL 790, Standard for Tests for Fire Resistance of Roof Covering Materials.
- H. Concrete Moisture Testing:
 - 1. Test concrete decks for moisture in accordance with Section 07 16 04.
- I. Fire Resistance Rating:
 - 1. UL 790, Class A.
 - 2. Assembly in conformance with fireproofing as specified.

1.3 SUBMITTALS

- A. Shop Drawings:
 - 1. Roof layout showing insulation thicknesses and details.
 - 2. Detail and indicate location of expansion joints, crickets, saddles, curbs, walkways, safety tiebacks, vents, drains and other penetrations.
 - 3. Indicate slope direction, slope amount, and key vertical elevation points.
 - 4. Profiles of flashing assemblies.
 - 5. Installation Drawings.

- B. Product Data:
 - 1. Manufacturer standard literature for vapor barrier, insulation and roofing system components, including adhesives and accessories indicating compliance with specification requirements.
 - 2. Manufacturer standard literature for roof coping system indicating components and accessories including anchor plate configuration.
- C. Samples:
 - 1. Roofing manufacturer's facsimile of each sheet metal color for pre-selection.
 - 2. 3 IN x 5 IN 75 MM x 125 MM samples of roofing manufacturer's sheet metal color for final approval.
- D. Project Information:
 - 1. Minutes from Preinstallation Conference.
- E. Contract Closeout Information:
 - 1. Warranty.
 - 2. Maintenance Data:
 - a. Include cleaning instruction.

1.4 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of roofing system that fail in materials or workmanship within specified warranty period.
 - 1. Special warranty includes roof membrane, base flashings, edge metal and copings, and other components of roofing system.
 - 2. Warranty to include coverage for peak gusts of wind to:
 - a. 110 MPH 88 KPH at 33 FT 10 M above ground.
 - 3. Warranty Period: 20 years from date of Substantial Completion.
 - 4. Twenty (20) year warranty on 70 PCT PVDF coatings on edge metal and copings.
- B. Special Project Warranty: Submit roofing Installer's warranty, signed by Installer, covering the Work of this Section, including all components of roofing system such as roof membrane, base flashing, and other components of roofing system for the following warranty period:
 - 1. Warranty Period: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Adhered PVC Roofing System:
 - 1. Base:
 - a. Sika Sarnafil Inc.
 - 2. Optional:
 - a. Johns Manville
 - b. Carlisle
- B. Sheathing:
 - 1. Base:
 - a. Georgia-Pacific.
 - 2. Optional:
 - a. Same as Membrane Manufacturer.
 - b. USG Corporation.
 - c. National Gypsum.
- C. Vapor Retarder (VR):
 - 1. Base:
 - a. Same as Membrane Manufacturer.

- D. Sheet Metal Copping and Edge Metal:
 - 1. Base:
 - a. Provided by manufacturer of roofing system.
- E. Other Materials:
 - 1. Base:
 - a. Manufacturers as noted.
- F. Other manufacturers desiring approval comply with Section 01 61 00.

2.2 DESIGN CRITERIA

- A. Determine per Wind Load Design Guide for Low Sloped Flexible Membrane Roofing Systems published by SPRI.
- B. Design roof system and anchorage fastener type and spacing needed to resist uplift pressures including roof covering and metal edge securement to meet design loads and satisfy requirements of applicable building codes, local amendments, and ANSI/SPRI ES-1.
- C. Wind Loads: Use the greater of the following:
 - 1. Wind pressures as required per local building code based on wind speed, exposure factor and importance factor noted in Structural Drawings.
- D. Requirements applicable to designated warranty.
- E. Roof Height and Parapet Height:
 - 1. As indicated.
- F. Static pressure of building interior: Less than 0.5 IN 13 MM water.

2.3 MATERIAL

- A. Sheathing:
 - 1. Install over steel deck or existing roofing materials.
 - 2. Moisture resistant gypsum core with fiberglass mat and non-asphaltic surfacing.
 - 3. Minimum thickness: 5/8 IN.
 - 4. DensDeck Prime Roof Board by Georgia-Pacific.
- B. Vapor Retarder:
 - 1. Rubberized asphalt membrane adhered to polyethylene or polyolefin top sheet.
 - 2. 30 MIL 0.75 MM thick, minimum.
 - 3. Vapor Permeance: Not exceeding 0.05 Perm 2.86 ng/s/m²/Pa.
 - 4. UV protected for 90 day exposure.
 - 5. Primer or adhesive as recommended for substrate by manufacturer.
 - 6. Sika Self-Adhered Vapor Retarder SA-31 or SA-106 as approved by manufacturer for project.
- C. Roof Insulation:
 - 1. Furnished by roofing manufacturer.
 - 2. UL listed for assembly indicated.
 - 3. Provide crickets and saddles as required.
 - 4. Polyisocyanurate (PISO) roof insulation:
 - a. Rigid, closed cell foam core bonded to heavy-duty glass fiber mat facers.
 - b. ASTM C1289 Type II, Class 1.
 - c. R-value: 5.6 per inch 1 per 25 MM in accordance with ASTM C1303, CAN/ULC S770.
 - d. Compressive strength: 25 PSI 170 kPa minimum per ASTM D1621, Grade 3.
 - e. Dimensional stability: 2 PCT maximum linear change in seven days per ASTM D2126.
 - f. Minimum insulation thickness:
 - 1) Areas where tapered insulation is indicated:
 - a) Minimum R-10 RSI-3.5 at roof scupper.
 - b) Taper to provide slope of 1/4 IN per FT 1 MM per 48 MM.

- g. Sarnatherm by Sika Sarnafil
- D. Cover Board:
- 1. Moisture resistant gypsum core with fiberglass facings.
 - a. Minimum thickness: 5/8 IN 16 MM.
 - 2. DensDeck Prime Roof Board by Georgia-Pacific.
- E. Roofing Membrane:
- 1. PVC Sheet: ASTM D 4434/D 4434M, Type III, fabric reinforced and fabric backed.
 - 2. Minimum thickness: 60 MIL 1.5 MM
 - 3. Membrane color and other items unless noted: Off-white.
 - 4. G410 EnergySmart Bareback by Sika Sarnafil
- F. Flashing:
- 1. Roofing components shall be provided by membrane manufacture and included in roof system warranties.
 - 2. Utilize type as indicated in full length pieces wherever possible to minimize number of splices.
 - 3. Wall and curb flashing
 - a. Reinforced membrane:
 - 1) Color: Same as indicated for main roof membrane.
 - 2) Minimum thickness: 60 MIL 1.5 MM.
 - 3) Sheet flashing, cylindrical penetration boots and pre-molded corners.
 - 4) Base Product: G410 Membrane by Sika Sarnafil.
 - 4. Polymer-clad metal:
 - a. 24 GA 7 MM galvanized steel coated with polymer to allow heat welding to room membrane and flashing accessories.
 - b. Fabricate as required for conditions including Cap Flashing at parapets, Extended Wall Flashings, Scuppers, and other unique fabrications.
 - c. Sarnaclad by Sika Sarnafil.
- G. Coping:
- 1. Prefabricated metal, standard duty, multi-part assembly
 - a. Cleats:
 - 1) 20 GA, 0.95 MM thick, galvanized steel.
 - b. Snap-on coping covers:
 - 1) Material:
 - a) 24 GA, G90 0.7 MM, Z275 steel.
 - b) 70 PCT PVDF coating.
 - c) Color: To be selected from manufacturer's standard colors and match existing buildings.
 - 2) Parapet width: As indicated.
 - 2. Internal metal chair drainage system to eliminate caulked joints
 - 3. Wall Grip Coping by Sika Sarnafil.
- H. Walkway Protection:
- 1. Type 1 - Roll:
 - a. Polyester reinforced, weldable membrane with surface embossment.
 - b. Secure with adhesive and hot air weld edges to roof membrane
 - c. Thickness: 96 MIL 2.4 MM.
 - d. Roll width: 39 IN 1000 MM.
 - e. Color: Same as roofing membrane.
 - f. Base: SarnaTred-V by Sika Sarnafil.
- I. Prefabricated Accessories:
- 1. Manufacturer's standard or approved.
- J. Nailing Strips:
- 1. As detailed and required.

- K. Pipe Flashings:
 - 1. Provide for each pipe penetration; include clamps, adhesive and sealants.
- L. Adhesives, cleaners, and primers:
 - 1. As recommended by roofing manufacturer.
- M. Fire-retardant Treated (FRT) wood blocking:
 - 1. See Section 06 10 00.
- N. Other Materials as required by manufacturer for complete system warranty.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Inspect entire area to be roofed for acceptability.
- B. Surface on which insulation or roofing membrane is applied shall be clean, smooth, dry, and free of projections such as fins, sharp edges or foreign materials.
- C. Do not allow grease, fats, oils and other contaminants to contact roofing membrane.
- D. Correct unsatisfactory conditions.
- E. Commencement of roofing activities constitutes acceptance of conditions affecting installation and roofing system performance.

3.2 INSTALLATION

- A. Sheathing:
 - 1. Install per UL requirements.
 - 2. Install base sheathing with long dimension perpendicular to deck flute direction.
 - 3. Lay sheathing tightly butted and cut to fit around penetrations.
 - 4. Attach sheathing to deck in accordance with roofing manufacturer's recommendations.
- B. Vapor Retarder:
 - 1. Install in largest practical widths and lengths.
 - 2. Bond vapor retarder to substrate using approved adhesive.
 - 3. Install continuously at locations indicated.
 - a. Coordinate and sequence installation for proper integration with the exterior wall air barrier.
 - b. Insure that no discontinuities occur, including at seams, penetrations, and edge terminations.
 - c. Join sections of vapor retarder and lap seams in direction of water flow.
 - d. Ensure that surfaces to be taped are clean and dry.
 - 4. Seal around pipes, conduits, curbs, safety tie-backs, and other penetrations with pipe boots in accordance with manufacturer's instructions.
 - 5. Maintain continuity of vapor retarder over expansion joints.
 - 6. Repair holes in vapor retarder as recommended by manufacturer.
 - 7. Protect vapor retarder from damage until covered with insulation.
- C. Wood Nailers:
 - 1. Install where indicated or required for proper securement of roofing system.
 - 2. Install blocking on top of vapor barrier to thickness required by manufacturer for proper support and attachment.
 - 3. Securement of wood blocking:
 - a. Design to resist a minimum of 200 LBS/LF 300 KG/M in any direction per SPRI Test Method RE-1.

- D. Insulation:
1. Where required thickness of insulation is greater than 2 IN 50 MM: Install insulation in at least 2 layers.
 2. Stagger board joints minimum of 6 IN in successive layers laterally and longitudinally.
 3. Butt joints tightly.
 4. Cut insulation neatly to fit around roof penetrations and projections.
 5. Fill voids greater than 1/4 IN with manufacturer approved spray foam insulation.
 6. Secure insulation with approved adhesive.
- E. Cover Board:
1. Install cover board continuously over insulation.
 2. Offset coverboard joints minimum 12 IN from insulation joints immediately beneath.
 3. Secure to substrate in same manner specified for insulation securement.
- F. Membrane:
1. Ensure that substrate is clean, dry, free from debris, and smooth with no surface roughness or contamination.
 2. Position sheets to accommodate contours of roof deck.
 3. Adhering membrane:
 - a. Apply bonding adhesive in accordance with manufacturer's published instructions.
 - b. Do not apply adhesive in seam areas.
 - c. Do not allow adhesive to skin-over or surface-dry prior to installation of membrane.
 - d. Unroll roof membrane into the wet adhesive.
 - e. Overlap subsequent rolls over previous rolls.
 - f. Press each roll firmly into place with a roller in two directions.
 - g. Weld cover strips at seams that do not have a factory selvage edge.
- G. Heat Welded Seams:
1. Hand welding:
 - a. Seam overlaps 4 IN 100 MM wide.
 - b. Complete hand-welded seams in two stages:
 - 1) Weld back edge of seam with a narrow but continuous weld to prevent loss of hot air during final welding.
 - 2) Insert nozzle into seam at a 45 degree angle to edge of membrane.
 - 3) Once proper welding temperature has been reached and membrane begins to flow, position hand roller perpendicular to the nozzle and press lightly.
 2. Machine welding:
 - a. Comply with membrane manufacturer's instructions.
 - b. Machine weld seams 10 FT or longer.
 - c. Seam overlaps 3 IN 75 MM wide.
 - d. Utilize metal tracks to minimize wrinkles.
 3. Inspect welded seams daily for water tightness and continuity.
 - a. Manually probe seams to verify secure weld.
 - b. Inspection shall be performed by Technician and verified by Foreman.
- H. Membrane Flashing:
1. Adhesively-applied membrane flashings:
 - a. Ensure substrates are properly prepared, clean and dry.
 - b. Apply flashing adhesive in smooth, even coats and per manufacturer's instructions.
 - c. Apply only as much material as can be completed flashed during same day's operations.
 - d. Press membrane flashing into place and roll with hand roller.
 - e. Do not apply adhesive to seam areas to be heat welded.
 - f. Install flashing panels in the same manner, overlapping the edges of panels as required by welding techniques.

2. Stops, bars and cords:
 - a. Install Stops, Bars and Cords at locations required by membrane manufacturer including:
 - 1) Base of parapets, walls and curbs.
 - 2) Base of tapered edge strips and at transitions, peaks, and valleys.
 3. Extend flashings at least 8 IN 200 MM above normal roofing level.
 4. Adhere flashing membranes to substrates.
 - a. Interior and exterior corners and miters: Cut to fit and heat-weld into place.
 - b. Do not use, or allow bituminous products to come in contact with PVC materials.
 5. Termination of wall flashings:
 - a. Mechanically fastened along counter-flashed top edge with termination bar at 6 to 8 IN OC 150 x 200 MM OC.
 - b. Install flashings in accordance with manufacturer's instructions.
 - c. Provide additional mechanical securement at flashings extending more than 30 IN 760 MM vertically.
- I. Metal Flashing:
1. Conform to applicable requirements of following:
 - a. Sheet Metal and Air Conditioning Contractors National Association, Inc. (SMACNA).
 - b. Single Ply Roofing Industry (SPRI) guidelines.
 2. Complete metal work in conjunction with roofing and flashings.
 3. Make joints watertight.
 4. Accommodate normal thermal expansion and contraction.
 5. Secure metal flashings to solid wood blocking.
 6. Counterflashing:
 - a. Overlap base flashing minimum 4 IN 100 MM.
- J. Edge Metal and Coping:
1. Install flashings concurrently with roof membrane as work progresses.
 2. Form to profiles indicated and install as indicated.
 3. Utilize full length pieces to minimize field splices.
 4. Secure to wood nailers.
 5. Make joints watertight.
 6. Accommodate normal thermal expansion and contraction.
- K. Walkways:
1. Install walkways at traffic concentration points, such as roof hatches, access doors, rooftop ladders, or locations as indicated.
 2. Do not locate within 10 FT 3 M of roof edge.
 3. Clean surfaces to be adhered.
 4. Adhere pads to membrane per manufacturer's instructions.
- L. Protection:
1. When completion of flashings and terminations is not achieved by end of work day, seal system to temporarily prevent water infiltration.
 2. Remove temporary water cutoffs prior to proceeding with Work.
 3. Remove and replace wet insulation.
 4. Protection:
 - a. Avoid use of roofing as a walking surface or for equipment movement and storage.
 - b. Provide necessary protection and barriers to segregate work and adjacent areas.
 - c. Provide plywood over insulation board for roof areas receiving rooftop traffic during construction.
- M. Field Quality Control:
1. Manufacturer's field services:
 - a. Provide manufacturer's field service consisting of product use recommendations and a minimum of three site visits for inspection of product installation in accordance with manufacturer's instructions.

2. Building enclosure commissioning test responsibilities:
 - a. Thermal imaging.
 - b. Electrical capacitance metering.
 - c. FM 1-52 Bonded Uplift.
3. Repair damage to roof assembly resulting from testing activities.

3.3 SCHEDULE OF ROOF SYSTEMS

- A. Roof System 2 - Fully Adhered PVC over Concrete Deck:
 1. Vapor Retarder.
 2. Insulation.
 3. Cover Board.
 4. PVC Membrane, adhered.

END OF SECTION

SECTION 07 62 00
FLASHING AND SHEET METAL

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Architectural flashing and sheet metal work.
 - 2. Factory formed coping system.
 - 3. Prefinished scuppers, conductor heads and downspouts.
- B. Related Specification Sections include but are not necessarily limited to:
 - 1. Division 00 - Procurement and Contracting Requirements.
 - 2. Division 01 - General Requirements.
 - 3. Section 07 72 33 - Roof Hatches.
 - 4. Section 07 92 00 - Joint Sealants.
 - 5. Section 09 96 00 - High Performance Industrial Coatings.

1.2 QUALITY ASSURANCE

- A. Referenced Standards:
 - 1. American Architectural Manufacturers Association (AAMA):
 - a. 2605, Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels.
 - 2. American National Standards Institute/Single Ply Roofing Industry (ANSI/SPRI):
 - a. ES-1, Wind Design Standard for Edge Systems Used with Low Slope Roof Systems.
 - 3. ASTM International (ASTM):
 - a. A653/A653M, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy Coated (Galvannealed) by the Hot-Dip Process.
 - b. A666, Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.
 - c. B32, Standard Specification for Solder Metal.
 - d. B209, Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
 - 4. FM Global (FM).
 - 5. Sheet Metal and Air Conditioning Contractors' National Association (SMACNA):
 - a. Architectural Sheet Metal Manual.
- B. Qualifications:
 - 1. Sheet metal fabricator shall have minimum 10 years' experience in fabrication of sheet metal items similar to items specified.
 - 2. Sheet metal installer shall have minimum five years' experience installing sheet metal items specified.

1.3 DEFINITIONS

- A. Installer or Applicator:
 - 1. Installer or applicator is the person actually installing or applying the product in the field at the Project site.
 - 2. Installer and applicator are synonymous.
- B. PVDF: Polyvinylidene fluoride.

1.4 SUBMITTALS

- A. Shop Drawings:
 - 1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
 - 2. Product technical data including:
 - a. Acknowledgement that products submitted meet requirements of standards referenced.
 - b. Manufacturer's installation instructions.
 - 3. Fabrication and/or layout drawings.
 - a. Scaled drawing showing expansion joint locations, special conditions, profile, fastening and jointing details.
 - 1) Minimum plan scale: 1/8 IN = 1 FT.
 - 2) Minimum detail scale: 1-1/2 IN = 1 FT.
 - 4. Fabricator qualifications.
 - 5. Installer qualifications.
- B. Samples:
 - 1. Finish and color samples for each product specified for Engineer preliminary color selection.
 - 2. For final color selection, provide two, 2 IN x 3 IN colored metal samples for each color selected during the preliminary color selection.
- C. Informational Submittals:
 - 1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
 - 2. Warranty: Manufacturer's sample warranty language.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
 - 1. Pre-finished sheet metal:
 - a. Carlisle SynTec Systems.
 - b. Firestone Building Products Company.
 - c. Petersen Aluminum Corporation.
 - 2. Factory-formed fascia system.
 - a. OMG Roofing Products.
 - b. MetalEra.
 - 3. Factory-formed coping system.
 - a. OMG Roofing Products.
 - b. MetalEra.
 - 4. Butyl sealant:
 - a. Pecora Corporation.
 - b. Sika.
 - c. Tremco Commercial Sealants & Waterproofing.
- B. Submit request for substitution in accordance with Specification Section 01 25 13.

2.2 MATERIALS

- A. Sheet Metal:
 - 1. Aluminum: ASTM B209.
 - 2. Galvanized Steel: ASTM A653/A653M.
 - 3. Stainless Steel: ASTM A666.
 - a. Type 304.
- B. Fasteners: Non-ferrous compatible with sheet metal.

- C. Sealants:
 - 1. Non-curing Butyl Sealant:
 - a. Pecora "BA-98".
 - b. Sika "Sika Lastomer 511".
 - c. Tremco "TremPro JS-773".
 - 2. Building sealants:
 - a. See Specification Section 079200.
- D. Fasteners: Non-ferrous compatible with sheet metal.
- E. Retainer Clips and Continuous Cleats: Galvanized steel or stainless steel.
- F. Solder: ASTM B32.
- G. Dissimilar Metal Protection: Comply with Specification Section 099600.

2.3 MANUFACTURED ITEMS

- A. Factory Formed Coping System:
 - 1. Formed coping piece which locks to anchor plate fastened to top of wall.
 - 2. ANSI/SPRI ES-1 tested.
 - 3. FM approved.
 - 4. Coping cover:
 - a. Aluminum.
 - 1) Thickness: 0.050 IN.
 - 5. Anchor plate: Stainless steel, minimum 20 GA.
 - 6. Splice plates: Aluminum, minimum 0.032 IN.
 - a. Continuous, minimum 6 IN long.
 - b. Front and back legs with extruded butyl seal.
 - c. Finish: Match coping.
 - 7. Factory fabricated accessories, including but not limited to:
 - a. Corners, end caps, end terminations.
 - b. All accessories to be factory mitered and welded.
 - 8. Profile:
 - a. Metal-Era "Perma-Tite Tapered."
 - b. Front leg: 6 IN.
 - c. Back leg: 5 IN.
- B. Finish:
 - 1. PVDF coating with minimum 70 PCT resin content.
 - a. Meet requirements of AAMA 2605.
 - 1) Color: To match coping color at existing buildings.

2.4 FABRICATED ITEMS

- A. General:
 - 1. Shop fabricate items to maximum extent possible.
 - a. Fabricate true and sharp to profiles and sizes indicated on Drawings.
 - 1) Shop fabricate and weld or solder all corners.
 - 2. Pre-finished aluminum:
 - a. Thickness: Minimum 0.050 IN.
 - b. Texture: Smooth.
 - c. Coated on exposed face with PVDF coating having a minimum 70 PCT resin content and a minimum 1.0 MIL dry film thickness.
 - 1) Meet requirements of AAMA 2605.
 - 2) Color: Match coping and fascia.
- B. Overflow Scuppers:
 - 1. Roofing manufacturer's recommended through-wall scupper design.
 - a. Size and location(s) as shown on Drawings.

- C. Scupper and Conductor Head:
 - 1. Roofing manufacturer's recommended through-wall scupper design.
 - a. Size and location(s) as shown on Drawings.
 - 2. Conductor head profile per SMACNA Figure 1-25F.
 - a. Provide 1 IN x 4 IN overflow opening with drip edge on front face of conductor.
 - 3. 4 IN long outlet tube.
 - a. Size and shape to match downspout.
 - 4. Debris screen:
 - a. Installed in top of conductor head.
 - b. 1/4 x 1/4 IN aluminum mesh screen.
 - c. Screen shall be removable without damage to screen or conductor head.
- D. Retainer Clips and Continuous Cleats:
 - 1. 0.050 IN stainless steel.
- E. Downspouts:
 - 1. Rectangular style similar to SMACNA Figure 1-32B.
 - a. Horizontal cross brace at 5 FT maximum spacing.
 - 2. Fabricated in longest practical lengths.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Provide items to be built into other construction to Contractor in time to allow their installation.

3.2 INSTALLATION

- A. Install products in accordance with manufacturer's instructions, SMACNA, and as indicated on Drawings.
- B. Weld aluminum to achieve weathertight joints and required details.
 - 1. Do not weld slip joints.
 - 2. Touch-up damaged prefinished items.
- C. Set top edges of membrane flashing and sheet metal flashing into reglets wherever practicable.
 - 1. Surface applied terminations will be allowed only where specifically detailed or otherwise approved in writing by the Engineer.
 - 2. Provide counterflashing at all reglets.
 - 3. Seal reglets and counterflashings in accordance with Specification Section 07 9200.
- D. Fasten materials at intervals recommended by SMACNA.
- E. Install slip joints to allow for thermal movement as recommended by SMACNA and manufacturer.
 - 1. Maximum spacing: 10 FT OC.
 - 2. Provide slip joint 24 IN from corners.
 - 3. Provide slip joint at each vertical expansion joint location in wall.
 - a. Provide break in continuous cleat at each vertical expansion joint.
 - b. The above expansion joints do not include brick veneer expansion joints.
- F. Seal slip joints with two beads of non-curing butyl sealant on each side of slip joint overlap.
- G. Form flashings to provide spring action with exposed edges hemmed or folded to create tight junctures.
- H. Provide dissimilar metals and materials protection where dissimilar metals come in contact or where sheet metal contacts mortar, concrete masonry or concrete.

- I. Provide all miscellaneous sheet metal items not specifically covered elsewhere, as indicated or required to provide a weathertight installation.
 - 1. Provide all components necessary to create weather-tight junctures between roofing and sheet metal work.
- J. Provide sheet metal liner at exposed-to-view openings through roof deck, including but not limited to:
 - 1. Roof hatches: See Specification Section 07 7233.
- K. Installation of Scupper and Conductor Head:
 - 1. Flash the opening in the parapet wall and install the scupper and conductor head as indicated in SMACNA Figure 1-27A.
 - 2. Seal all joints to provide complete weathertight installation.
 - 3. Flash roofing material onto scupper per roofing manufacturer's recommendations.
- L. Installation of Downspouts:
 - 1. Install downspouts in locations shown on the Drawings.
 - 2. Provide downspout anchor straps per SMACNA Figure 1-35 as appropriate for downspout style.
 - 3. Provide gutter to downspout connection per SMACNA Figure 1-33B, Detail 1.
 - 4. Seal all joints in downspout for a complete watertight system.
 - 5. Angle bottom of downspout out away from building to direct discharge onto concrete splashblock.
 - 6. Anchor hanger straps to building wall with stainless steel screws and anchor sleeves appropriate for wall construction.
 - a. Provide minimum of two anchors per strap.
 - 7. Maximum spacing of hanger straps shall be 10 FT with minimum of two hanger straps per vertical piece of downspout.
 - 8. Spacing and location of hanger straps shall be consistent from downspout to downspout.

END OF SECTION

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SECTION 07 72 33

ROOF HATCHES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Roof hatches.
 - 2. Hatch railing and gate system.
- B. Related Specification Sections include but are not necessarily limited to:
 - 1. Division 00 - Procurement and Contracting Requirements.
 - 2. Division 01 - General Requirements.
 - 3. Section 05 50 00 - Metal Fabrications.
 - 4. Section 07 62 00 - Flashing and Sheet Metal.
 - 5. Section 09 96 00 - High Performance Industrial Coatings.

1.2 QUALITY ASSURANCE

- A. Referenced Standards:
 - 1. ASTM International (ASTM):
 - a. B209, Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
 - 2. Occupational Safety and Health Organization (OSHA).

1.3 SUBMITTALS

- A. Shop Drawings:
 - 1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
 - 2. Scaled plan of roof showing location of all units and anchoring details.
 - a. Minimum plan scale: 1/8 IN = 1 FT.
 - b. Minimum detail scale: 1-1/2 IN = 1 FT.
 - 3. Product technical data including:
 - a. Acknowledgement that products submitted meet requirements of standards referenced.
 - b. Manufacturer's installation instructions.
- B. Contract Closeout Information:
 - 1. Operation and Maintenance Data:
 - a. See Specification Section 01 33 04 for requirements for the mechanics, administration, and the content of Operation and Maintenance Manual submittals.

- C. Informational Submittals:
 - 1. Warranty.

1.4 WARRANTY

- A. Roof Hatches: Manufacturer's standard five year warranty.
- B. Hatch Rail System: Manufacturer's standard 25 year warranty.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Products specified are manufactured by "The Bilco Company."
- B. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
 - 1. Roof hatches:
 - a. The BILCO Company.
 - b. Dur-Red Products.
 - c. Milcor by Hart & Cooley, Inc.
- C. Submit request for substitution in accordance with Specification Section 01 25 13.

2.2 MATERIALS

- A. Sheet Metal:
 - 1. Aluminum: ASTM B209.
- B. Insulation:
 - 1. Curb: 1 IN rigid fiberboard.
 - 2. Cover: 1 IN fiberglass.
- C. Gaskets: Thermoplastic.
- D. Hardware: Type 316 stainless steel, unless noted otherwise.
- E. Anchors:
 - 1. Stainless steel.
 - 2. See Specification Section 03 15 19.
- F. Hatch Rail System:
 - 1. Posts and rails:
 - a. Pultruded fiberglass.
 - b. UV resistant.
 - c. Fire retardant.
 - 2. Mounting brackets: Hot-dipped galvanized steel.
 - 3. Hinges and post guides: Aluminum, 6063T5 alloy.
 - 4. Fasteners: Type 316 stainless steel.

2.3 MANUFACTURED UNITS

- A. General:
 - 1. 12 IN high.
 - 2. Fully welded corners.
 - 3. Hardware:
 - a. Lifting mechanism and automatic hold-open device.
 - 1) Vinyl-covered grip handle.
 - b. Hinges.
 - c. Latch: Operating handles for inside and outside operation.
 - d. Padlock hasp.
 - 4. Finish: Mill.
- B. Roof Hatches:
 - 1. Curb:
 - a. 11 GA.
 - b. Integral cap flashing.
 - c. Mounting flange:
 - 1) Minimum 3-1/2 IN wide.
 - 2) Punched holes for fastening to roof deck.
 - d. Insulated.

2. Cover:
 - a. Exterior: 11 GA.
 - b. Interior: 18 GA liner.
 - c. Internally reinforced.
 - 1) Minimum 40 PSF live loading.
 - d. Insulated.
 - e. Completely weather sealed and gasketed.
 3. Finish: Mill.
- C. Hatch Rail System:
1. Manufacturer's standard OSHA Compliant railing and gate fall protection system.
 2. Posts and rails:
 - a. Nominal 2 IN round profile.
 - b. Color: Safety Yellow.
 3. Railing system designed to mount to roof hatch cap flashing without penetration of roofing material.
 - a. Mounting brackets: 1/4 IN thick strap anchors with a aluminum post supports.
 4. Gate:
 - a. Same materials and construction as posts and rails.
 - b. Self-closing and self-latching.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install units in accordance with manufacturer's installation instructions.
- B. Securely anchor units as appropriate.
 1. Anchor to wood nailers with 1/2 x 3 IN lag bolts.
 2. Anchor to concrete with 1/2 IN adhesive anchors.
 3. Anchor to steel with 1/2 IN stainless steel bolts, nuts and washers.
 4. Maximum anchor spacing: 12 IN.
 5. Manufacturer's predrilled fastener locations take precedent over this specification.
 6. Provide attachment at each corner as a minimum.
- C. Flash and counterflash to provide weathertight installation.
 1. See Specification Section 07 54 19 for roofing.
- D. Provide a aluminum sheet metal liner at opening through roof deck as shown on the Drawings.
 1. See Specification Section 07 62 00.
- E. Head Deflector Plate: See Specification Section 05 50 00.
- F. Fasten hatch rail system to roof hatch cap flashing in accordance with manufacturer's instructions.
 1. Fasten without penetration of roofing membrane or flashing.
- G. Adjust all components to provide smooth easy operation.
- H. Provide dissimilar metals protection as required.
 1. Refer to Specification Section 09 96 00.

3.2 SCHEDULE

- A. Model numbers refer to "The BILCO Company" products.
- B. Units:
 1. Ladder access units:
 - a. 36 IN x 36 IN: Model "S."

C. Schedule:

ROOF HATCH NO.	DRAWING NO.	LOCATION	MODEL NO.	REMARKS
RH-101	560A-02	Mechanical Building	S	1

Remarks:

1. Provide head deflector; see Specification Section 05 50 00.

http://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=INTERPRETATIONS&p_id=23740

END OF SECTION

SECTION 07 84 00

FIRESTOPPING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Firestopping of joints, through-wall penetrations, and membrane penetrations of fire-resistance rated construction.
 - 2. Selection of firestopping assemblies.
 - 3. Engineering Judgments.
 - 4. Special Inspections.
- B. Related Specification Sections include but are not necessarily limited to:
 - 1. Division 00 - Procurement and Contracting Requirements.
 - 2. Division 01 - General Requirements.

1.2 DEFINITIONS

- A. Firestopping: Material or combination of materials used to retain integrity of fire rated construction by maintaining an effective barrier against the spread of flame, smoke, and hot gases through penetrations in fire rated wall and floor assemblies.

1.3 QUALITY ASSURANCE

- A. Referenced Standards:
 - 1. ASTM International (ASTM):
 - a. E814, Standard Method of Fire Tests of Through Penetration Fire Stops.
 - b. E1399, Standard Test Method for Cyclic Movement and Measuring the Minimum and Maximum Joint Widths of Architectural Joint Systems.
 - c. E1966, Standard Test Method for Fire Resistive Joint Systems.
 - 2. International Firestop Council (IFC).
 - a. Recommended IFC Guidelines for Evaluating Firestop Systems in Engineering Judgments (EJs), referred to herein as IFC Recommended Guidelines.
 - 3. Underwriters Laboratories, Inc. (UL):
 - a. 263, Fire Tests of Building Construction and Materials.
 - b. 1479, Fire Tests of Through Penetration Fire Stops.
 - c. 2079, Standard for Tests for Fire Resistance of Building Joint Systems.
- B. Qualifications:
 - 1. Firestop system installations must meet the requirements of ASTM E814, UL 1479 or UL 2079 tested assemblies that provide a fire rating equal to that of the construction being penetrated.
 - 2. Proposed firestop systems shall conform to applicable governing codes having local jurisdiction.
 - 3. For those fire stop applications that exist for which no qualified tested system is available through a manufacturer, an engineering judgment derived from similar qualified tested system designs or other tests will be submitted to local authorities having jurisdiction for their review and approval prior to installation. Engineering judgment documents shall follow the requirements set forth by the International Firestop Council.

1.4 SUBMITTALS

- A. Shop Drawings:
 - 1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
 - 2. Product technical data, including:
 - a. Manufacturer's listed design number.
 - b. Manufacturer's installation instructions.
 - c. Manufacturer's specification and technical data for each material including the composition and limitations.
 - d. Data sheet for all products and accessories used.
 - e. Detailed drawings of special conditions:
 - 1) Provide UL listing for each type of firestopping assembly to be used.
 - 2) When UL listing is not available, provide a written Engineering Judgment in accordance with IFC Recommended Guidelines.
 - a) Engineering Judgments shall be sealed by a Fire Protection Engineer licensed in the State of Washington.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Deliver materials undamaged in manufacturer's clearly labeled original, unopened containers, identified with brand, type, and UL label where applicable.
- B. Coordinate delivery of materials with scheduled installation date to allow minimum storage time at job-site.
- C. Store materials under cover and protect from weather and damage in compliance with the manufacturer's requirements, including temperature.
- D. Do not use damaged or expired materials.

1.6 PROJECT CONDITIONS

- A. Schedule installation of firestopping after completion of penetrating item installation but prior to covering or concealing of openings.
- B. Verify existing conditions and substrates before starting work. Correct unsatisfactory conditions before proceeding.
- C. Do not proceed with the installation of firestop materials when the ambient temperature is outside the manufacturer's recommended limitations for installation and curing times as printed on the product label and product data sheet.
- D. During installation provide masking and drop cloths to prevent firestopping materials from contaminating any adjacent surfaces.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
 - 1. Safing insulation:
 - a. Johns Manville.
 - b. Owens-Corning.
 - c. Fibrex.
 - d. Roxul.
 - 2. Expanding silicone elastomer:
 - a. Any manufacturer UL listed for system used.

3. Firestop sealant:
 - a. Dow Corning.
 - b. 3M Company.
 - c. Specified Technologies Inc.
 - d. Hilti.
4. Moldable putty:
 - a. 3M Company.
 - b. Specified Technologies Inc.
 - c. Hilti.
 - d. RectorSeal.
5. Fire barrier pillows:
 - a. 3M Company.
 - b. Specified Technologies Inc.
 - c. Hilti.
6. Collars:
 - a. 3 M Company.
 - b. Specified technologies Inc.
 - c. Hilti.
7. Expanding Foams:
 - a. 3 M Company.
 - b. Hilti.

B. Submit request for substitution in accordance with Specification Section 01 25 13.

2.2 MATERIALS

- A. General:
 1. Use only materials that have been UL 1479 or ASTM E814 tested for specific fire-rated construction conditions conforming to construction assembly type, penetrating item type, annular space requirements, and fire rating involved for each separate item.
- B. Safing Insulation shall be tested to ANSI/UL 263 and listed in UL product category BZJZ, Batts and Blankets.
- C. Expanding Silicone Elastomer: UL listed.
 1. Fill, Void or Cavity Materials: Product category XHHW.
 2. Through Penetration Firestop Systems: Product category XHEZ.
- D. Firestop Sealant: UL listed one part silicone installed as required by the listed design.
- E. Moldable Putty: UL listed, product category QCSN or CLIV, Wall Opening Protective Materials.
- F. Firestop collars: UL Listed.
- G. Fire Barrier Pillows:
 1. UL listed.
 2. Removable and reusable.
 3. Pillows have self-locking feature.
- H. Backer rod and/or compressible filler: UL listed, product category XHHW, Fill, Void or Cavity Materials.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. General:
 - 1. Selection and installation of firestopping assemblies is entirely the responsibility of the Contractor.
 - 2. All firestopping shall be provided in accordance with the building code and UL listing requirements as necessary to provide the required fire-resistance rating.
 - 3. When UL listing is not available, install in accordance with a approved written Engineering Judgment.
 - 4. All firestopping products shall be installed in accordance with the manufacturer's instructions.
 - 5. Where firestopping will be exposed to view, provide colors matching adjacent construction or, if approved by manufacturer, and after inspection and approval by AHJ, paint to match.
 - 6. Where firestopping is not exposed to view, provide manufacturer's standard color.
- B. Openings and Penetrations:
 - 1. Provide firestopping assembly tested in accordance with ASTM E814 or UL 1479 for all openings, through-penetrations, and membrane penetrations in fire-rated construction.
 - a. Provide Flame (F), Thermal (T), Smoke (L), and Water (W) rated assemblies as necessary to meet building code requirements.
- C. Building Joint Systems:
 - 1. Provide firestopping assembly tested in accordance with ASTM E1966 and ASTM E1399, or UL 2079 for all joint assemblies in or between fire-resistance-rated walls, floors or floor/ceiling assemblies and roofs or roof/ceiling assemblies.
- D. Refer to Specification Section 01 73 20 for openings and penetrations requiring fire stopping.

3.2 IDENTIFICATION AND DOCUMENTATION

- A. Prior to acceptance by the Owner, provide written statement that all fire-rated penetrations have been sealed using products specified in accordance with UL requirements for required rating.
- B. Provide documents to the Owner of all listed systems installed and all engineering judgments.

3.3 FIELD QUALITY CONTROL

- A. Provide Special Inspection of all firestopping in accordance with IBC Chapter 17 and Specification Section 01 45 33.

END OF SECTION

SECTION 07 92 00

JOINT SEALANTS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Sealing all joints which will permit penetration of dust, air or moisture.
- B. Related Specification Sections include but are not necessarily limited to:
 - 1. Division 00 - Procurement and Contracting Requirements.
 - 2. Division 01 - General Requirements.
 - 3. Section 07 84 00 - Firestopping.
 - 4. Section 09 96 00 - High Performance Industrial Coatings.

1.2 QUALITY ASSURANCE

- A. Referenced Standards:
 - 1. American Concrete Institute (ACI):
 - a. 302.1R, Guide for Concrete Floor and Slab Construction.
 - 2. ASTM International (ASTM):
 - a. C834, Standard Specification for Latex Sealants.
 - b. C920, Standard Specification for Elastomeric Joint Sealants.
 - c. C1521, Standard Practice for Evaluating Adhesion of Installed Weatherproofing Sealant Joints.
 - 3. NSF International (NSF):
 - a. 61, Drinking Water System Components -- Health Effects.
 - 4. Underwriters Laboratories, Inc. (UL).
- B. Qualifications: Sealant applicator shall have minimum five years experience using products specified on projects with similar scope.
- C. Mock-Ups:
 - 1. Before sealant work is started, a mock-up of each type of joint shall be sealed where directed by the Engineer.
 - a. The approved mock-ups shall show the workmanship, bond, and color of sealant materials as specified or selected for the work and shall be the minimum standard of quality on the entire project.
 - b. Each sample shall cure for a minimum of seven days at which time the sealant manufacturer's authorized factory representative shall perform adhesion tests on each sample joint.
 - 1) Perform adhesion tests per ASTM C1521.
 - 2) If mock-up is not acceptable or if adhesion test fails, provide additional mock-up and adhesion testing as required until acceptable to Engineer.

1.3 DEFINITIONS

- A. Defect(ive): Failure of watertightness or airtightness.
- B. Finish sealant: Sealant material per this specification applied over face of compressible sealant or expanding foam sealant specified, to provide a finished, colored sealant joint.
- C. Installer or Applicator:
 - 1. Installer or applicator is the person actually installing or applying the product in the field at the Project site.
 - 2. Installer and applicator are synonymous.

- D. "Interior wet areas": Restroom, Sludge Thickening Room and Sludge Heating & Pump Room are considered wet.]
- E. "Seal," "sealing" and "sealant": Joint sealant work.

1.4 SUBMITTALS

- A. Shop Drawings:
 - 1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
 - 2. Product technical data including:
 - a. Acknowledgement that products submitted meet requirements of standards referenced.
 - b. Manufacturer's installation instructions.
 - c. Manufacturer's recommendations for joint cleaner, primer, backer rod, tooling and bond breaker.
 - 3. Certification from sealant manufacturer stating product being used is recommended for and is best suited for joint in which it is being applied.
 - 4. Certification of applicator qualification.
- B. Test Results:
 - 1. Provide adhesion test results for each sealant sample including adhesion results compared to adhesion requirements.
 - 2. Manufacturer's authorized factory representative recommended remedial measures for all failing tests.
- C. Samples:
 - 1. Cured sample of each color for Engineer's color selection.
 - 2. Color chart not acceptable.
- D. Informational Submittals:
 - 1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver material in manufacturer's original unopened containers with labels intact: Labels shall indicate contents and expiration date on material.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
 - 1. Compressible sealant:
 - a. Schul International Company, LLC.
 - b. Emseal by Sika.
 - c. Norton.
 - d. Sandell Moisture Protection Systems.
 - 2. Expanding foam sealant:
 - a. M-D Building Products, Inc.
 - b. DAP Products, Inc.
 - c. FAI International, Inc.
 - 3. Fire-resistant sealant:
 - a. See Specification Section 07 84 00.
 - 4. Polyether sealants:
 - a. BASF Corporation.
 - b. Chem Link.
 - c. Tremco Commercial Sealants & Waterproofing.

5. Polysulfide rubber sealant:
 - a. Pecora Corporation.
 - b. BASF Corporation.
 - c. PolySpec by ITW Polymers Sealants.
 6. Polyurea joint filler:
 - a. Dayton Superior Corporation.
 - b. Euclid Chemical Company.
 - c. L&M by LATICRETE International, Inc.
 - d. BASF Corporation.
 7. Polyurethane sealants:
 - a. Pecora Corporation.
 - b. Sika.
 - c. BASF Corporation.
 - d. Tremco Commercial Sealants & Waterproofing.
 8. Silicone sealants:
 - a. Chem Link.
 - b. GE Silicones.
 - c. Dow.
 - d. Tremco Commercial Sealants & Waterproofing.
 9. Backer rod, compressible filler, primer, joint cleaners, bond breaker:
 - a. As recommended by sealant manufacturer.
- B. Submit request for substitution in accordance with Specification Section 01 25 13.

2.2 MATERIALS

- A. Sealants - General:
1. Provide colors matching materials being sealed.
 2. Where compound is not exposed to view in finished work, provide manufacturer's color which has best performance.
 3. Nonsagging sealant for vertical and overhead horizontal joints.
 4. Sealants for horizontal joints: Self-leveling pedestrian/traffic grade.
 5. Joint cleaner, primer, bond breaker: As recommended by sealant manufacturer.
 6. Sealant backer rod and/or compressible filler:
 - a. Closed cell polyethylene, polyethylene jacketed polyurethane foam, or other flexible, nonabsorbent, non-bituminous material recommended by sealant manufacturer to:
 - 1) Control joint depth.
 - 2) Break bond of sealant at bottom of joint.
 - 3) Provide proper shape of sealant bead.
 - 4) Serve as expansion joint filler.
- B. Compressible Sealant:
1. Foamed polyurethane strip saturated with polymerized polybutylene waterproofing coated on front face with nonreactive release agent that will act as bond breaker for applied sealant.
 - a. Schul "Sealtite B".
 2. Fire rated where required.
 3. Adhesive: As recommended by sealant manufacturer.
- C. Expanding Foam Sealant:
1. One or two component fire rated moisture cured expanding urethane.
 2. Shall not contain formaldehyde.
 3. Density: Minimum 1.5 PCF.
 4. Closed cell content: Minimum 70 PCT.
 5. R-value: Minimum 5.0/IN.
 6. Flame spread: Less than 25.
 7. Smoke developed: Less than 25.
- D. Fire-Resistant Sealant: See Specification Section 07 84 00.

- E. Polyether Sealant:
 - 1. Silyl-terminated polyether polymer.
 - 2. ASTM C920, Type S, Grade NS, Class 50, Use NT, M, A, and O.
 - a. BASF MasterSeal 150.
 - b. Chem Link DuraLink.
 - c. Tremco Dymonic FC.
- F. Polysulfide Rubber Sealant:
 - 1. One or two component.
 - 2. Meet ASTM C920.
 - a. Pecora Synthacalk GC2+.
 - b. PolySpec THIOKOL 2235.
- G. Polyurea Joint Filler:
 - 1. Two component, semi-rigid material for filling formed or saw-cut control joints in interior concrete slabs.
 - a. Dayton Superior Corporation "Joint Fill, Joint Seal, Joint Saver II" as required for condition and recommended by manufacturer.
 - b. Euclid Chemical Company "EUCCO QWIK" joint.
 - c. L&M "Joint Tite 750".
 - d. BASF MasterSeal "CR100" control joint filler.
 - 2. Comply with ACI 302.1R performance recommendations regarding control and construction joints.
 - 3. Color: Gray.
- H. Polyurethane Sealant:
 - 1. One or two components.
 - 2. Paintable.
 - 3. Meet ASTM C920 Type S or Type M, Grade NS or P, Class 25, Use NT, T, M, A and O.
 - a. Pecora Dynatrol-IXL, Dynatrol II, Urexpand NR-200, NR-201.
 - b. Sika Chemical Corporation Sikaflex-1a, Sikaflex-2CNS/SL.
 - c. BASF MasterSeal NP-1, NP-II, SL-1 SL-2.
 - d. Tremco Dymonic or Dymeric, Vulkem 116,227,45,245.
- I. Silicone Sealant:
 - 1. One component.
 - 2. Meet ASTM C920, Type S, Grade NS, Class 25, Use NT, G, A, O.
 - a. Chem Link DuraSil.
 - b. GE Silpruf, Silglaze II.
 - c. GE Sanitary 1700 sealant for sealing around plumbing fixtures.
 - d. Dow 786 for sealing around plumbing fixtures.
 - e. Dow 7565, 790, 791, 795.
 - f. Tremco Spectrem 1, Spectrem 3, Tremsil 600.
 - 3. Mildew resistant for sealing around plumbing fixtures.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Before use of any sealant, investigate its compatibility with joint surfaces, fillers and other materials in joint system.
- B. Use only compatible materials.
- C. Where required by manufacturer, prime joint surfaces.
 - 1. Limit application to surfaces to receive sealant.
 - 2. Mask off adjacent surfaces.

- D. Provide joint depth for joints receiving polyurea joint filler in accordance with manufacturer's recommendations.

3.2 INSTALLATION

- A. Install products in accordance with manufacturer's instructions and UL requirements.
- B. Clean all joints.
- C. Make all joints water and airtight.
- D. At changes in direction of joints, joint intersections and where sealant joints interface with other construction, install continuous sealant as necessary to ensure a weather-tight seal.
- E. Make depth of sealing compounds, except expanding foam and polyurea sealant, not more than one-half width of joint, but in no case less than 1/4 IN nor more than 1/2 IN unless recommended otherwise by the manufacturer.
- F. Provide correctly sized backer rod, compressible filler or compressible sealant in all joints to depth recommended by manufacturer:
 - 1. Take care to not puncture backer rod and compressible filler.
 - 2. Provide joint backer rod as recommended by the manufacturer for polyurea joint filler.
- G. Apply bond breaker where required.
- H. Tool sealants using sufficient pressure to fill all voids.
- I. Upon completion, leave sealant with smooth, even, neat finish.
- J. Where piping, conduit, ductwork, etc., penetrate wall, seal each side of wall opening.
- K. Install compressible sealant to position at indicated depth.
 - 1. Size so that width of material is twice joint width.
 - 2. Take care to avoid contamination of sides of joint.
 - 3. Protect side walls of joint (to depth of finish sealant).
 - 4. Install with adhesive faces in contact with joint sides.
 - 5. Install finish sealant where indicated.
- L. Install expanding foam sealant to minimum 4 IN depth or thickness of wall being penetrated if less than 4 IN or as indicated on Drawings.
 - 1. Provide adequate fire rated backing material as required.
 - 2. Hold material back from exposed face of wall as necessary to allow for installation of backer rod and finish sealant.
 - a. Allow expanding foam sealant to completely cure prior to installing backer rod and finish sealant.
 - 3. Trim off excess material flush with surface of the wall if not providing finished sealant.

3.3 SEALANT WORK

- A. General:
 - 1. Work includes but is not limited to: Sealing all joints which will permit penetration of dust, air, or moisture.
 - 2. Refer to SCHEDULE for materials to be used.
 - 3. See Specification Section 07 84 00 for firestopping.
- B. Concrete joints:
 - 1. Flooring joints.
 - 2. Isolation joints.
 - 3. Joints between paving or sidewalks and building.
 - 4. Construction, control, and expansion joints.
 - 5. Joints between precast roof units and between precast roof units and walls.
 - 6. Joints between precast wall panels.

7. Precast panel bearing joints:
 - a. At panels bearing at or above grade, seal both sides of panel base joint.
 - b. At panels bearing below grade:
 - 1) Seal exterior panel base joint prior to backfilling and/or placement of site paving.
 - 2) Provide compressible filler and sealant or backer rod and sealant as appropriate for interior slab condition.
- C. Flashing, reglets and retainers.
- D. Exterior Insulation and Finish System joints.
- E. Openings:
 1. Perimeters of door and window frames, louvers, grilles, etc.
 2. Door thresholds shall be set in a full bed of sealant.
 3. Glass and glazing: See specification Section 08 81 00.
- F. Interior finishes:
 1. Perimeter and penetrations of sound insulated walls.
 2. Expansion and control joints in tile work.
- G. Plumbing fixtures.
- H. Penetrations of walls, floors, and decks.
- I. Other joints where sealant, expanding foam sealant or compressible sealant is indicated.

3.4 FIELD QUALITY CONTROL

- A. Adhesion Testing:
 1. Perform adhesion tests in accordance with ASTM C1521 per the following criteria:
 - a. Water bearing structures: One test per every 1000 LF of joint sealed.
 - b. Exterior precast concrete wall panels: One test per every 2000 LF of joint sealed.
 - c. Chemical containment areas: One test per every 1000 LF of joint sealed.
 - d. Building expansion joints: One test per every 500 LF of joint sealed.
 - e. All other type of joints except butt glazing joints: One test per every 3000 LF of joint sealed.
 - f. Manufacturer's authorized factory representative shall recommend, in writing, remedial measures for all failing tests.

3.5 SCHEDULE

- A. Furnish sealant as indicated for the following areas:
 1. Exterior areas:
 - a. Above grade: Polyether.
 - b. Below grade: Polyurethane.
 2. Interior areas:
 - a. Noncorrosive areas:
 - 1) Wet exposure: Silicone.
 - a) Toilet rooms, janitor closets, or similar areas: Mildew resistant silicone.
 - 2) Dry exposure: Polyether Silicone, unless noted otherwise.
 - a) Sound insulated construction: Acoustical sealant.
 - b. Corrosive areas:
 - 1) Wet exposure: Polysulfide.
 - 2) Dry exposure: Polyurethane.
 - c. Fire-rated construction: See Specification Section 07 84 00.
 - d. Sealant exposed to or having the potential of being exposed to concentrated chlorine gas or chlorine liquid: Polysulfide.
 - e. Casework, countertops, and solid surface materials: Silicone.
 - 1) Sinks, fixtures or other areas subject to potential splash, spillage or condensation: Mildew Resistant Silicone.

3. Immersion:
 - a. Prolonged contact with or immersion in:
 - 1) Potable water:
 - a) Polysulfide.
 - b) NSF 61 approved.
 - 2) Nonpotable water, wastewater, or sewage: Polysulfide.
4. Compressible sealant: Where indicated.
5. Exterior wall penetrations: Expanding urethane foam, with finish sealant.
 - a. Finish sealant:
 - 1) Exterior side:
 - a) Above grade: Silicone.
 - b) Below grade: Polyurethane.
 - 2) Interior side:
 - a) Noncorrosive area:
 - (1) Wet exposure: Polyether.
 - (2) Dry exposure: Polyether, unless noted otherwise.
 - b) Corrosive area:
 - (1) Wet exposure: Polysulfide.
 - (2) Dry exposure: Polyurethane.
6. Interior concrete slab formed or saw-cut control joints: Polyurea joint filler.

END OF SECTION

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SECTION 07 95 13
EXPANSION JOINT COVERS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Expansion joint cover assemblies.
 - 2. Fire barriers.

- B. Related Specification Sections include but are not necessarily limited to:
 - 1. Division 00 - Procurement and Contracting Requirements.
 - 2. Division 01 - General Requirements.
 - 3. Section 05 50 00 - Metal Fabrications.
 - 4. Section 07 54 19 - PVC Membrane Roofing - Fully Adhered.
 - 5. Section 07 62 00 - Flashing and Sheet Metal.
 - 6. Section 07 92 00 - Sealants.
 - 7. Section 09 96 00 - Painting and High Performance Industrial Coatings.

1.2 QUALITY ASSURANCE

- A. Referenced Standards:
 - 1. The Aluminum Association (AA):
 - a. DAF 45, Designation System for Aluminum Finishes.
 - 2. ASTM International (ASTM):
 - a. B209, Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
 - b. B221, Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.
 - c. D1784, Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds
 - d. D2000, Standard Classification System for Rubber Products in Automotive Applications.
 - e. E1399, Standard Test Method for Cyclic Movement and Measuring the Minimum and Maximum Joint Widths of Architectural Joint Systems.
 - 3. Underwriters Laboratories, Inc. (UL):
 - a. 2079, Standard for Tests for Fire Resistance of Building Joint Systems.
 - b. Building Materials Directory.

1.3 DEFINITIONS

- A. Installer or Applicator:
 - 1. Installer or applicator is the person actually installing or applying the product in the field at the Project site.
 - 2. Installer and applicator are synonymous.

- B. Heavy Duty: Capable of withstanding a point load of 2000 LB without damage or permanent deformation.

- C. Standard Duty: Capable of withstanding a point load of 500 LB without damage or permanent deformation.

1.4 SUBMITTALS

- A. Shop Drawings:
 - 1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
 - 2. Product technical data including:
 - a. Acknowledgement that products submitted meet requirements of standards referenced.
 - b. Manufacturer's installation instructions.
 - 3. Scaled plan and detail Drawings.
 - a. Drawings shall show expansion joint cover locations, types, extents, joints, controlling dimensions, details, etc.
 - b. Minimum plan scale: 1/8 IN = 1 FT 0 IN.
 - c. Minimum detail scale: 3/4 IN = 1 FT 0 IN.
- B. Samples:
 - 1. Minimum 12 IN long sample of each type of expansion joint assembly and cover specified.
 - a. Actual color samples of resilient inserts for Engineer's selection.
- C. Informational Submittals:
 - 1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
 - 2. Certifications:
 - a. UL Certification of fire rated assemblies

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
 - 1. Expansion joint covers:
 - a. C/S Group.
 - b. MM Systems.
 - c. Balco USA.
- B. Submit request for substitution in accordance with Specification Section 01 25 13.

2.2 MATERIALS

- A. Aluminum:
 - 1. Sheet and plate: ASTM B209, alloy 6061-T6.
 - 2. Extrusions, bars, rods, wire, and tubes: ASTM B221, alloy 6063-T5.
- B. PVC: ASTM D1784.
- C. Thermoplastic Elastomer:
 - 1. Extrusions and sheet goods: ASTM D2000.

2.3 MANUFACTURED UNITS

- A. General:
 - 1. Product numbers listed are based on MM Systems.
 - 2. Provide expansion joint cover assemblies of design, profile, materials and operation indicated.
 - a. Factory fabricated joints, transitions, connections and intersections.
 - 3. Provide manufacturer's standard anchors, fasteners, spacers, vapor seals, filler materials, adhesive and other accessories as required for complete installation.
 - 4. Provide units in longest practicable lengths to minimize number of end joints.
 - a. Locate end joints in non-conspicuous areas; avoid locating in traffic areas.

5. Finishes:
 - a. Aluminum: Clear anodized AA-M12C22A41.
 - b. Elastomeric inserts: To be selected by Engineer.
- B. Floor Expansion Joint Covers:
 1. Continuous extruded aluminum frame assemblies with floating cover plate and seal.
 2. Heavy duty, Surface mount:
 - a. Floor-to-floor joints: Series RSC.
 3. Refer to Drawings for joint width.

2.4 ACCESSORIES

- A. Fasteners:
 1. Stainless steel.
 2. See Specification Section 05 50 00.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Provide items to be built into other construction to Contractor in time to allow their installation.
 1. If such items are not provided in time for installation, coordinate block-out requirements for later installation.
 2. Where block-outs are subject to traffic or potential for damage, provide temporary fillers to protect joint until specified items can be installed.

3.2 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
 1. Locate end joints in non-conspicuous areas; avoid locating in traffic areas.
 2. Seal joints in accordance with manufacturer's written installation instructions.
 3. Ensure bolting joints are fastened such that the two components create a smooth flat surface with hairline jointery unless a wider joint is required by the joint cover manufacturer.
- B. Set work level, true and plumb.
- C. Provide dissimilar materials protection in accordance with Specification Section 09 96 00.
- D. After installation, clean all aluminum surfaces to remove excess sealant, adhesives, etc.
 1. Repair or replace damaged inserts, patch paint coatings on components having scratched or otherwise damaged finish coatings.
 2. Replace all components that cannot be adequately repaired to satisfaction of the Engineer and the Owner.

END OF SECTION

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DIVISION 08
OPENINGS



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SECTION 08 11 00
HOLLOW METAL DOORS AND FRAMES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Metal doors and frames.
- B. Related Specification Sections include but are not necessarily limited to:
 - 1. Division 00 - Procurement and Contracting Requirements.
 - 2. Division 01 - General Requirements.
 - 3. Section 08 70 00 - Finish Hardware.
 - 4. Section 09 96 00 - High Performance Industrial Coatings.

1.2 QUALITY ASSURANCE

- A. Referenced Standards:
 - 1. ASTM International (ASTM):
 - a. A653, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
 - 2. National Association of Architectural Metal Manufacturers (NAAMM):
 - a. Hollow Metal Manufacturers Association (HMMA).
 - 3. Steel Door Institute (SDI):
 - a. 117, Manufacturing Tolerances for Standard Steel Doors and Frames.
 - b. All SDI publications.
 - 4. Steel Door Institute/American National Standards Institute (SDI/ANSI):
 - a. A250.6, Recommended Practice for Hardware Reinforcing on Standard Steel Doors and Frames.
 - b. A250.7, Nomenclature for Standard Steel Doors and Steel Frames.
 - c. A250.8, Specifications for Standard Steel Doors and Frames.
 - d. A250.10, Test Procedure and Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors and Frames.
 - e. A250.11, Recommended Erection Instructions for Steel Frames.
- B. Qualifications: Manufacturer must be current member of SDI, and NAAMM (HMMA).
- C. Wipe coat galvanized steel is not acceptable as substitute for galvanizing finish specified.

1.3 DEFINITIONS

- A. As identified in SDI/ANSI A250.7.

1.4 SUBMITTALS

- A. Shop Drawings:
 - 1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
 - 2. Product technical data including:
 - a. Acknowledgement that products submitted meet requirements of standards referenced.
 - b. Manufacturer's installation instructions.
 - 3. Schedule of doors and frames using same reference numbers as used on Drawings.
 - 4. SDI certification.
- B. Contract Closeout Information:
 - 1. Operation and Maintenance Data:
 - a. See Specification Section 01 33 04 for requirements for the mechanics, administration, and the content of Operation and Maintenance Manual submittals.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Store doors and frames in accordance with SDI/ANSI A250.11.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
 - 1. Metal doors and frames:
 - a. Ceco Door by ASSA ABLOY.
 - b. Steelcraft by Allegion PLC.
 - c. Curries by ASSA ABLOY.
- B. Submit request for substitution in accordance with Specification Section 01 25 13.

2.2 MATERIALS

- A. Steel Sheet: Hot-dipped galvanized steel, ASTM A653, A60 coating.
- B. Frames: Hot-dipped galvanized steel, ASTM A653, A60 coating.
- C. Supports and Reinforcing: Hot-dipped galvanized steel, ASTM A653, A60 coating.
- D. Inserts, Bolts and Fasteners: Manufacturer's standard.
- E. Primer: Manufacturer's standard coating meeting SDI/ANSI A250.10.
- F. Galvanized Coating Repair: See Specification Section 09 96 00.
- G. Thermal Insulation: Polyurethane, CFC free.
- H. Sound Insulation: Fiberglass batt insulation or impregnated Kraft honeycomb.

2.3 ACCESSORIES

- A. Frame Anchors:
 - 1. Jamb anchors:
 - a. Masonry wire anchors: Minimum 0.1875 IN wire, galvanized.
 - b. Existing wall anchor: Minimum 18 GA, galvanized.
 - c. Stud partition and base anchors: Minimum 18 GA, galvanized.

2.4 FABRICATION

- A. General:
 - 1. SDI/ANSI A250.8.
 - 2. Fabricate rigid, neat in appearance and free from defects.
 - 3. Form to sizes and profiles indicated on Drawings.
 - a. Beveled edge.
 - 4. Fit and assemble in shop wherever practical.
 - 5. Mark work that cannot be fully assembled in shop to assure proper assembly at site.
 - 6. Continuously wire weld all joints, dress exposed joints smooth and flush.
 - 7. Fabricate doors and frames to tolerance requirements of SDI 117.
 - 8. Fit doors to SDI clearances.
 - 9. All doors shall be handed.
 - 10. Hinge cut-out depth and size on doors and frames shall match hinge specified in Specification Section 08 70 00.
 - 11. Design and fabricate doors to requirements of the building code.

- B. Hollow Metal Doors:
1. General:
 - a. 1-3/4 IN thick.
 - b. Fabricate with flush top caps.
 - 1) Thickness and material to match door face.
 - 2) Exterior doors: Seal weld top cap to door face and grind smooth and flush.
 - 3) Interior doors:
 - a) Attach top cap to door with concealed fasteners or by welding.
 - b) Factory seal if attached with fasteners.
 - c) No exposed fasteners will be accepted.
 - c. Continuously wire weld all joints and dress, smooth and flush.
 2. Exterior:
 - a. Doors 48 IN wide, or less: SDI/ANSI A250.8, Level 3, and physical performance level A, Model 2.
 - 1) Face sheet minimum thickness: 16 GA.
 - 2) Insulated: Minimum R10.
 3. Interior:
 - a. Doors 48 IN wide, or less: SDI/ANSI A250.8, Level 2, and physical performance level "B", Model 2.
 - 1) Face sheet minimum thickness: 18 GA.
 - b. Sound insulated, minimum STC-35.
- C. Hollow Metal Frames:
1. Door frames:
 - a. Provide 2 IN face at all heads, jambs and mullions for frames in stud walls.
 - b. Provide 4 IN face at head where noted on Drawings or required by wall construction.
 - c. 26 GA galv annealed steel boxes welded to frame at back of all hardware cutouts.
 - d. Steel plate reinforcement welded to frame for hinge, strikes, closers and surface-mounted hardware reinforcing.
 - 1) All plate reinforcement shall meet size and thickness requirements of SDI/ANSI A250.8.
 - e. Split type frames not acceptable.
 - 1) All horizontal and vertical mullions and transom bars shall be welded to adjacent members.
 - f. Conceal all fasteners.
 - g. Frames shall be set up, all face joints continuously wire welded and dressed smooth.
 - h. Exterior (up to 4 FT wide): 16 GA.
 - i. Exterior (over 4 FT wide): 14 GA.
 - j. Interior: 16 GA.
 - k. Provide removable spreaders at bottom of frame.
- D. Prepare for finish hardware in accordance with hardware schedule, templates provided by hardware supplier, and SDI/ANSI A250.6.
1. Locate finish hardware in accordance with SDI/ANSI A250.8.
 2. See Specification Section 08 70 00 for hardware.
 3. Prepare doors for swing direction indicated.
 - a. Preparing doors for non-handed hinges is not acceptable.
- E. After fabrication, clean off mill scale and foreign materials and prime with rust inhibiting primer.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install doors and frames in accordance with SDI/ANSI A250.11, the building code and manufacturer's instructions.
- B. Plumb, align, and brace frames securely until permanently anchored.
 - 1. After completion of walls, remove temporary braces and spreaders.
 - 2. Anchor frames with minimum of three anchors per jamb.
 - a. Number and location of anchors shall be in accordance with SDI and frame manufacturer's recommendations.
- C. At new masonry or metal stud construction, place frames in conjunction with construction of walls or partitions.
 - 1. Masonry construction: Anchor frames using masonry wire anchors.
 - 2. Metal stud construction:
 - a. Anchor frames using steel stud anchors.
 - b. Attach wall anchors with self-tapping screws.
- D. At concrete, precast concrete or existing masonry construction, place frames in rough opening using existing opening anchors.
- E. Use plastic plugs to keep silencer holes clear during construction.
- F. Immediately after erection, sand smooth rusted or damaged areas.
 - 1. Touch-up with rust-inhibiting primer.
 - 2. Finish paint door and frame in accordance with Specification Section 09 96 00.
- G. Install three silencers on strike jamb of single door frame and two on head of double door frame.
 - 1. See Specification Section 08 70 00.
- H. Protect doors and frames during construction.

END OF SECTION

SECTION 08 11 19
STAINLESS STEEL DOORS AND FRAMES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Stainless steel doors and frames.
- B. Related Specification Sections include but are not necessarily limited to:
 - 1. Division 00 - Procurement and Contracting Requirements.
 - 2. Division 01 - General Requirements.
 - 3. Section 08 70 00 - Finish Hardware.

1.2 QUALITY ASSURANCE

- A. Referenced Standards:
 - 1. American National Standards Institute/Steel Door Institute (ANSI/SDI):
 - a. A250.8, Specifications for Standard Steel Doors and Frames (SDI-100).
 - 2. National Association of Architectural Metal Manufacturers (NAAMM):
 - a. Hollow Metal Manufacturers Association (HMMA).
 - 3. National Fire Protection Association (NFPA):
 - a. 80, Standard for Fire Doors and Other Opening Protectives.
 - 4. Steel Door Institute (SDI):
 - a. 117, Manufacturing Tolerances for Standard Steel Doors and Frames.
 - b. All SDI Publications.
 - 5. Steel Door Institute/American National Standards Institute (SDI/ANSI):
 - a. A250.7, Nomenclature for Standard Steel Doors and Steel Frames.
 - 6. Underwriters Laboratories, Inc. (UL):
 - a. Building Materials Directory.
- B. Qualifications: Manufacturer must be current member of SDI, and NAAMM (HMMA).

1.3 DEFINITIONS

- A. As identified in SDI/ANSI A250.7.

1.4 SUBMITTALS

- A. Shop Drawings:
 - 1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
 - 2. Product technical data including:
 - a. Acknowledgement that products submitted meet requirements of standards referenced.
 - b. Manufacturer's installation instructions.
 - 3. Schedule of doors and frames using same reference numbers for doors as indicated on Drawings.
 - 4. SDI certification.
 - 5. UL certification.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Store doors and frames including borrowed lite frames under protective covering.
 - 1. Place units on wood skids providing a minimum 4 IN air space above the ground.
 - 2. Do not store units flat.
 - 3. Set frames and doors on edge providing a minimum 1/2 IN air circulation space between each unit.
 - 4. Provide covering which will ensure air flow around each unit to prevent trapping moisture.

5. If door wrapper becomes wet, remove immediately and provide dry protection equivalent to wrapper removed.
- B. Storage recommendations by unit manufacturer shall take precedence over the above requirements.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
1. Stainless steel doors and frames:
 - a. Next Door Company.
 - b. Curries by ASSA ABLOY.
 - c. Pioneer Industries.
- B. Submit request for substitution in accordance with Specification Section 01 25 13.

2.2 MATERIALS

- A. Steel Sheet and Frames: Type 316 stainless steel.
- B. Hinge Edge Channel: Type 316 stainless steel.
- C. Lock Edge, Top and Bottom Channel: Type 316 stainless steel.
- D. Lock Reinforcement: Type 316 stainless steel plate.
- E. Inserts, Bolts, and Fasteners: Manufacturer's standard stainless steel units.
- F. Insulation: Urethane or polystyrene.

2.3 ACCESSORIES

- A. Glass Panels in Doors and Borrowed Lite Frames:
1. Fixed, integral stops on exterior face.
 2. Snap-in stops or stops secured with countersunk Phillips head machine screws on interior face.
 3. Reinforce cut-out in door panel with minimum 20 GA stainless steel channel.
 4. Glass: See Specification Section 08 81 00.
- B. Frame Anchors:
1. Jamb Anchors:
 - a. 16 GA, stainless steel.
 2. Floor Anchors:
 - a. Minimum 14 GA, stainless steel.

2.4 FABRICATION

- A. General:
1. Fabricate rigid, neat in appearance and free from defects.
 2. Form to sizes and profiles indicated on Drawings.
 3. Fit and assemble in shop wherever practical.
 4. Mark work that cannot be fully assembled in shop to assure proper assembly at site.
 5. Weld all joints continuously, dress exposed joints smooth and flush.
 6. Fabricate doors and frames to tolerance requirements of SDI-117.
 7. Fit doors to SDI and NFPA 80 clearances.
 8. Provide all exposed stainless steel surfaces with #4 finish.

- B. Hollow Metal Doors:
 - 1. General:
 - a. 1-3/4 IN thick.
 - b. 16 GA minimum face sheets.
 - c. Fabricate with flush top closures.
 - d. Weld, fill and grind smooth all joints.
 - 2. Exterior:
 - a. SDI Grade III, Model 4, seamless, insulated minimum R 10.
 - 3. Fire rated:
 - a. SDI Grade II, Model 4, seamless.
 - b. Sound insulated.
 - c. UL fire labeled.
 - d. Maximum transmitted temperature:
 - 1) Fire doors shall have a maximum transmitted temperature end point of not more than 250 DEGF above ambient at the end of 30 minutes of standard fire test exposure.
 - e. Pairs UL fire labeled without astragal.
 - 4. Interior (except fire rated):
 - a. SDI Grade II, Model 4, seamless.
 - b. Sound insulated.
- C. Hollow Metal Frames:
 - 1. Door frames:
 - a. 26 GA stainless steel boxes welded to frame at back of all hardware cutouts.
 - b. 8 GA stainless steel plate reinforcement welded to frame for hinge reinforcing.
 - c. 12 GA stainless steel plate reinforcement welded to frame for strikes, closers and surface-mounted hardware.
 - d. Split-type frames not acceptable.
 - e. Conceal all fasteners.
 - f. Frames shall be set up, all joints welded and ground smooth.
 - 1) Finish of welds to match balance of frame finish.
 - g. Exterior (up to 4 FT wide): 16 GA.
 - h. Exterior (over 4 FT wide): 14 GA.
 - i. Fire rated:
 - 1) UL labeled.
 - 2) Comply with NFPA 80.
 - j. Interior: 16 GA.
 - k. Provide removable spreaders at bottom of frame.
- D. Supports, Reinforcing and Anchors:
 - 1. Minimum 16 GA.
- E. Factory prepare for finish hardware, in accordance with hardware schedule and templates provided by hardware supplier.
 - 1. Locate hardware per ANSI/SDI A250.8.
 - 2. See Specification Section 087000 for hardware.
- F. Clean off mill scale and foreign materials, repair damaged surfaces.
- G. After fabrication thoroughly clean.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install doors and frames in accordance with SDI and manufacturer's instructions.
- B. Place frames prior to construction of enclosing walls and ceilings.

- C. Plumb, align, and brace securely until permanently anchored.
- D. After completion of walls, remove temporary braces and spreaders.
- E. Install fire-rated frames in accordance with NFPA 80 and manufacturer's instructions.
- F. Use plastic plugs to keep silencer holes clear during construction.
- G. Immediately after erection, repair damaged areas.
- H. Install three silencers on strike jamb of single door frame and two on head of double door frame.
 - 1. See Specification Section 0870 00.
- I. Number and location of anchors shall be in accordance with frame manufacturer's recommendation with minimum of three anchors per jamb.
- J. For floor anchors, provide two adjustable 3 IN wide flanged floor clips punched for anchoring.
- K. Protect frames during construction.

END OF SECTION

SECTION 08 31 00

ACCESS DOORS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Ceiling access doors.
 - 2. Floor access doors.
 - 3. Wall access doors.
 - 4. H-20 loading doors.
- B. Related Specification Sections include but are not necessarily limited to:
 - 1. Division 00 - Procurement and Contracting Requirements.
 - 2. Division 01 - General Requirements.
 - 3. Specification Section 09 96 00 - High Performance Industrial Coatings.

1.2 QUALITY ASSURANCE

- A. Referenced Standards:
 - 1. American Association of State Highway and Transportation Officials (AASHTO).
 - 2. ASTM International (ASTM):
 - a. A123/A123M, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
 - b. A153/A153M, Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
 - c. A240/A240M, Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.
 - d. A480/A480M, Standard Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet, and Strip.
 - e. A653/A653M, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
 - f. A666, Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.
 - g. B209, Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
 - h. B221, Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.

1.3 DEFINITIONS

- A. Clear Opening Size: Space within the opening having no obstructions. Furnish model that will provide the minimum clear opening indicated.
- B. Standard Duty: Will support live load of 150 PSF.
- C. Heavy Duty: Will support live load of 300 PSF.
- D. H-20 loading: As defined in AASHTO Guidelines.

1.4 SUBMITTALS

- A. Shop Drawings:
 - 1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
 - 2. Product technical data including:
 - a. Acknowledgement that products submitted meet requirements of standards referenced.
 - b. Manufacturer's installation instructions.

- B. Contract Closeout Information:
 - 1. Operation and Maintenance Data:
 - a. See Specification Section 01 33 04 for requirements for the mechanics, administration, and the content of Operation and Maintenance Manual submittals.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
 - 1. Floor access doors:
 - a. The BILCO Company.
 - b. Babcock-Davis.
 - c. Dur-Red Products.
 - d. Halliday Products.
 - e. USF Fabrication by Eagle Manufacturing Company.
 - 2. H-20 loading doors:
 - a. The BILCO Company.
 - b. Dur-Red Products.
 - c. Halliday Products.
 - d. USF Fabrication by Eagle Manufacturing Company.
 - 3. Ceiling access doors:
 - a. The BILCO Company.
 - b. J.L. Industries.
 - c. Milcor by Hart & Cooley, Inc.
 - d. Dur-Red Products.
 - e. Larsens Manufacturing Company.
 - 4. Wall access doors:
 - a. J.L. Industries.
 - b. Milcor by Hart & Cooley, Inc.
 - c. Larsens Manufacturing Company.
- B. Submit request for substitution in accordance with Specification Section 01 25 13.

2.2 MATERIALS

- A. Aluminum:
 - 1. Sheet and Plate: ASTM B209.
 - 2. Extruded shapes: ASTM B221.
- B. Steel:
 - 1. Sheet Metal: G90 Galvanized, ASTM A653/A653M.
 - 2. Fabrications: Hot-Dip Galvanized, ASTM A123/A123M.
 - 3. Hardware: Hot-Dip Galvanized, ASTM A153/A153M.
- C. Stainless Steel: ASTM A240/A240M or A666.

2.3 MANUFACTURED UNITS

- A. General:
 - 1. All access doors shall be provided by the same manufacturer when possible.
 - 2. Coat all aluminum components in contact with concrete or masonry with manufacturer's standard bituminous coating.
- B. Standard Duty Floor Access Doors:
 - 1. Frame: 1/4 IN mill finished aluminum.
 - a. Fabricate frame with built-in neoprene cushion and strap anchors bolted to exterior.

2. Cover: 1/4 IN mill finished diamond plate aluminum.
 - a. Reinforce cover with a luminum stiffeners.
 - 1) Live load: 150PSF.
 - 2) Deflection: Maximum 1/150 of span.
 - b. Fabricate doors to open to 90 DEG and automatically lock into open position.
 3. Hardware:
 - a. All hardware to be stainless steel.
 - b. Positive hold open arm that engages automatically when door reaches full 90 degree open position.
 - c. Slam lock and removable key handle.
 - d. Bolt hinges to underside of door.
 - 1) Pivot on torsion bars.
 4. Slam Bilco Company, Type "K" or "KD."
 - a. Size(s): Refer to the SCHEDULES Article in PART 3 of this Specification Section.
- C. Heavy Duty Floor Access Doors:
1. Frame: 1/4 IN mill finish a luminum channel with anchor tabs.
 - a. 1-1/2 IN DIA drain coupling.
 2. Cover:
 - a. 1/4 IN mill finished diamond plate a luminum.
 - b. Reinforce cover with a luminum stiffeners.
 - 1) Live load: 300PSF.
 - 2) Deflection: Maximum 1/150 of span.
 3. Hardware:
 - a. All hardware to be stainless steel.
 - b. Positive hold open arm that engages automatically when door reaches full 90 DEG open position.
 - c. Slam lock and removable key handle.
 4. Bilco Company, Type "J-AL" or "JD-AL."
 - a. Size(s): Refer to the SCHEDULES Article in PART 3 of this Specification Section.
- D. H-20 Loading Doors:
1. Frame: 1/4 IN mill finish a luminum channel with anchor tabs.
 - a. 1-1/2 IN DIA drain coupling.
 2. Cover:
 - a. 1/4 IN mill finished diamond plate a luminum.
 - b. Reinforce cover with a luminum stiffeners.
 - 1) Reinforced for AASHTO H-20 wheel loading for use in off street applications.
 - 2) Deflection: Maximum 1/150 of span.
 3. Hardware:
 - a. All hardware to be stainless steel.
 - b. Positive hold open arm that engages automatically when door reaches full 90 degree open position.
 - c. Slam lock and removable key handle.
 4. The BILCO Company, Type "JH-20 IN or "JDH-20."
 - a. Size(s): Refer to the SCHEDULES Article in PART 3 of this Specification Section.
- E. Floodtight Access Door:
1. Frame: 1/4 IN mill finish a luminum channel with anchor tabs.
 - a. 1-1/2 IN DIA drain coupling.
 2. Cover:
 - a. 1/4 IN mill finished diamond plate a luminum.
 - b. Reinforce cover with a luminum stiffeners.
 - 1) Live load: 625 PSF. Reinforced for AASHTO HS-25 wheel loading.
 - 2) Deflection: Maximum 1/150 of span.

- c. Provide hex head bolt down dogging full perimeter of cover.
 - 1) Provide quantity and spacing of bolt-downs as necessary to maintain watertight integrity of hatch.
 - 2) Minimum three per side.
 - d. 1/2 IN by 1-1/4 IN neoprene gasket full perimeter of cover.
 - 3. All hardware: Stainless steel.
 - 4. Fabricate frame with an anchor flange around perimeter and 1-1/2 IN DIA drainage coupling.
 - 5. Fabricate doors to open 90 DEG with assistance of spring operators and automatically lock into open position.
 - 6. Slam lock and removable key handle.
 - 7. Bilco Company, Type "FT" Floodtight single leaf access door.
 - a. Size(s): Refer to the SCHEDULES Article in PART 3 of this Specification Section.
- F. Wall Access Doors:
- 1. Prime painted galvanized steel.
 - 2. Door and Frame: 14 GA.
 - 3. Hinges: Continuous, concealed.
 - 4. Provide flush, screwdriver-operated locks with metal cam.
 - 5. J.L. Industries "TM" Series.
 - 6. Size(s): Refer to the SCHEDULES Article in PART 3 of this Specification Section.

2.4 ACCESSORIES

- A. Secondary Fall Protection System:
- 1. Design and install system such that when in the open position, no part of the system obstructs the clear opening size listed in the SCHEDULES Article in PART 3 of this Specification Section.
 - 2. Platform: Design grating to meet OSHA 29 CFR 1910.23 requirements for protection for floor openings.
 - 3. Finish:
 - a. Powder coated.
 - b. Color: Safety Orange or Safety Yellow.
 - 4. Hardware:
 - a. Stainless steel Type 316.
 - b. Tamper proof Type 316 stainless steel bolts.
 - 5. Provide positive latch to hold grating in upright position.
 - 6. Size: Allow 6 IN clear space on each unhinged side for visual observation.
 - 7. Provide padlock hasp for Owner provided padlock.
 - 8. Double leaf openings:
 - a. Provide two individual grating platforms independent from one another.
 - 1) Provide each platform with a padlock hasp and positive latch to hold grating in upright position.
 - 9. Install secondary fall protection system at the factory.
- B. Load Rating Plates:
- 1. Minimum 18 GA Type 316 stainless steel, ASTM A666.
 - 2. Engraved with maximum design live load allowed for unit on which it will be mounted.
 - 3. Display load in English units as well as metric units.
 - 4. Size as required for text as needed.
 - 5. Text:
 - a. Font: Helvetica Narrow, all caps.
 - b. Size: 1/4 IN height.
 - c. Depth of engraving: 3 MILS.
 - 6. Finish:
 - a. Text:
 - 1) Black epoxy baked on paint.
 - 2) Plate to have finish conducive to paint application.

- b. Coat entire plate with baked on clear coat on front and back side.
- 7. Attach to top of all floor access doors using stainless steel screws in location determined by manufacturer.
 - a. Provide a neoprene gasket under the plate to separate the stainless steel from the aluminum cover or frame.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

3.2 SCHEDULES

A. Floor Access Door Schedule:

DOOR NO.	DRAWING NO.	LOCATION	CLEAR OPENING SIZE (a)	TYPE	REMARKS
FAD02	560A-01	SLUDGE THICKENING ROOM 560-02	4 FT-6IN x 4 FT-6 IN	J-AL	a, b, h, f
FAD33	560A-02	BOILER ROOM	4FT-6IN X 4FT-6IN	J-AL	a, b, h, f

- 1. Note:
 - a. See definition of Clear Opening Size in the DEFINITIONS Article in PART 2 of this Specification Section.
 - b. Provide secondary fall protection system.
 - c. Route piping to sump.
 - d. Route piping to daylight.
 - e. Route piping to nearest wall and provide 90-degree elbow down.
 - f. Route piping to storm sewer.
 - g. Route piping to sanitary sewer.
 - h. H-20 loading rated access door.

B. Wall Access Door Schedule:

DOOR NO.	DRAWING NO.	LOCATION	CLEAR OPENING SIZE	TYPE	REMARKS
AP-01	560A-06	RESTROOM 560-31	2 FT x 2 FT	TM	a

- 1. Note:
 - a. Finish paint door and frame in accordance with Specification Section 09 96 00.

END OF SECTION

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SECTION 08 33 22
ALUMINUM ROLLING OVERHEAD DOORS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Aluminum rolling overhead doors.
 - 2. Motor operators.
 - 3. Control Systems.
- B. Related Specification Sections include but are not necessarily limited to:
 - 1. Division 00 - Procurement and Contracting Requirements.
 - 2. Division 01 - General Requirements.
 - 3. Section 01 61 03 - Equipment - Basic Requirements.

1.2 QUALITY ASSURANCE

- A. Referenced Standards:
 - 1. Aluminum Association (AA):
 - a. DAF 45, Designation System for Aluminum Finishes.
 - 2. American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE):
 - a. 90.1, Energy Standard for Buildings Except Low-Rise Residential Buildings.
 - 3. ASTM International (ASTM):
 - a. A36/A36M, Standard Specification for Carbon Structural Steel.
 - b. A53/A53M, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
 - c. A123/A123M, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
 - d. A153/A153M, Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
 - e. A307, Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60,000 PSI Tensile Strength.
 - f. A666, Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.
 - g. A500/A500M, Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.
 - h. A501/A501M, Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing.
 - i. B209, Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
 - j. B221, Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.
 - k. E90, Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements.
 - l. E330/E330M, Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference.
 - m. F467, Standard Specification for Nonferrous Nuts for General Use.
 - n. F468, Standard Specification for Nonferrous Bolts, Hex Cap Screws, Socket Head Cap Screws, and Studs for General Use.
 - o. F3125, Standard Specification for High Strength Structural Bolts, Steel and Alloy Steel, Heat Treated, 120 KSI (830 MPa) and 150 KSI (1040 MPa) Minimum Tensile Strength, Inch and Metric Dimensions.
 - 4. International Code Council (ICC):
 - a. International Energy Conservation Code (IECC).

5. National Electrical Manufacturers Association (NEMA):
 - a. 250, Enclosures for Electrical Equipment (1000 Volts Maximum).
 6. National Fenestration Manufacturer's Council (NFRC):
 - a. 102, Procedure for Measuring the Steady-State Thermal Transmittance of Fenestration Systems.
 7. Underwriter's Laboratories (UL):
 - a. 325, Standard for Door, Drapery, Gate, Louver, and Window Operators and Systems.
- B. Qualifications:
1. Installer to be licensed or approved in writing by door manufacturer.

1.3 DEFINITIONS

- A. Installer or Applicator:
1. Installer or applicator is the person actually installing or applying the product in the field at the Project site.
 2. Installer and applicator are synonymous.

1.4 SUBMITTALS

- A. Shop Drawings:
1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
 2. Product technical data including:
 - a. Acknowledgement that products submitted meet requirements of standards referenced.
 - b. Manufacturer's installation instructions.
 3. Schedule of doors using same reference number for openings as indicated on Drawings.
 4. Motor operator and accessories technical data including complete wiring and control diagram for motor operators and control stations.
 5. Certifications:
 - a. Certification of Installer's qualifications.
- B. Samples:
1. Actual metal color samples of manufacturer's full line of colors available.
- C. Contract Closeout Information:
1. Operation and Maintenance Data:
 - a. See Specification Section 01 33 04 for requirements for the mechanics, administration, and the content of Operation and Maintenance Manual submittals.
- D. Informational Submittals:
1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
1. Aluminum rolling overhead doors:
 - a. Cornell Cookson
 - b. Wayne Dalton.
 - c. Overhead Door Corporation.
 - d. Raynor Garage Doors.
- B. Submit request for substitution in accordance with Specification Section 01 25 13.

2.2 PERFORMANCE AND DESIGN REQUIREMENTS

- A. Design Wind Load: ASTM E330/E330M.
 - 1. Exterior doors: See Structural Drawings.
 - 2. Interior doors: 20 PSF minimum.
- B. Air Infiltration:
 - 1. Meet ASHRAE 90.1 and IECC C402.4.3.
 - 2. Air leakage: <1.00 CFM/SQFT.
- C. Thermal performance:
 - 1. NFRC 102: U-factor: 0.91.
- D. Sound Rating:
 - 1. ASTM E90.
 - 2. Minimum assembly rating: STC-21.

2.3 MATERIALS

- A. Aluminum:
 - 1. Shapes, plate: ASTM B221.
 - 2. Sheet: ASTM B209.
 - 3. Bolts and nuts: ASTM F467 and F468.
- B. Steel:
 - 1. Hot dipped galvanized:
 - a. Fasteners: ASTM A153/A153M.
 - b. All other components: ASTM A123/A123M.
 - 2. Bars, shapes, and plate: ASTM A36/A36M.
 - 3. Pipe: ASTM A53/A53M or A501/A501M.
 - 4. Tubing: ASTM A500/A500M.
 - 5. Bolts and nuts: ASTM A307 or ASTM F3125, Grade A325.
- C. Insulation:
 - 1. Closed cell polyurethane foam.
 - 2. CFC free.
- D. Weatherproofing:
 - 1. Resilient: Neoprene or vinyl.
 - 2. Brush type: Nylon or polypropylene.
- E. Miscellaneous Fasteners: Aluminum or stainless steel.

2.4 MANUFACTURED UNITS

- A. Door Curtain:
 - 1. Insulated flat profile:
 - a. Overhead Door Corporation "625 Series".
 - b. 2-5/8 IN high.
 - c. Interlocking face sheets:
 - 1) Exterior face: 0.040 IN.
 - 2) Interior face: 0.024 IN.
 - d. Galvanized endlocks.
 - e. Core: Insulated.
 - 2. Bottom bar:
 - a. Two structural angles bolted back-to-back.
 - 1) Minimum 1/8 IN thick.
 - b. Aluminum or stainless steel.
- B. Operation:
 - 1. As scheduled on Door Schedule.

- C. Guides:
 - 1. Manufacturer's standard structural angle guide system for size of door specified.
 - a. Cold-rolled guides are not acceptable.
 - b. Furnish curtain wind locks as necessary for design wind load.
 - c. Material:
 - 1) Interior doors: Aluminum.
 - 2) Exterior doors:
 - a) Doors not requiring wind locks: Aluminum.
 - b) Doors requiring wind locks: Galvanized steel.
 - 2. Mounting:
 - a. Interior face of wall.
- D. Headplates:
 - 1. Galvanized steel plate mounted to guides.
 - 2. Sized to support counterbalance assembly, curtain, motor operator and hood.
 - a. Field verify headroom and side clearances and coordinate motor operator mounting accordingly.
- E. Counterbalance Assembly:
 - 1. Pipe barrel:
 - a. Galvanized Steel.
 - b. Maximum deflection: 0.03 IN/FT.
 - 2. Torsion springs:
 - a. Oil-tempered helical torsion springs on cast anchors.
 - b. 100,000 cycle.
 - 3. Adjustable tension wheel.
- F. Hood:
 - 1. Minimum 0.040 IN aluminum or minimum 24 GA stainless steel.
 - 2. Air baffle extending full length.
- G. Weatherstripping:
 - 1. Guide tracks: Exterior and interior weatherseal.
 - 2. Lintel: Brush-type weatherseal.
 - 3. Bottom seal:
 - a. Manually-operated doors: Resilient weather seal.
 - b. Motor-operated doors: Electric safety edge.
- H. Finish:
 - 1. Curtain:
 - a. Architectural Class 1 coating per AADAF 45.
 - b. Anodized:
 - 1) AA-M12C22A41, clear.
 - c. Powder coat:
 - 2. Hood:
 - a. Aluminum: Match curtain.
 - b. Stainless steel: No. 4 brushed.
 - 3. Guides, head plates, and counterbalance assembly:
 - a. Manufacturer's standard powder coating.
- I. Trim Pieces: Material and finish to match door curtain.
- J. Locking:
 - 1. Motor operated doors: Integral motor brake.
 - 2. Manually operated doors: Slide bolts each jamb.

2.5 ACCESSORIES

- A. Motor Operator:
 - 1. Minimum 1/2HP with integral brake.
 - a. Single or 3 PH, 60 Hz, designed for the supply voltage shown on the Drawings.
 - b. See Specification Section 01 61 03 for additional motor requirements.
 - 1) Provide manufacturer's standard reversing controller with motor thermal protection if motor is not internally protected as specified in Specification Section 01 61 03.
 - c. Motor shall be sized by door manufacturer for door size indicated on Drawings.
 - 1) Opening/Closing rate: Between 2/3 and 1 FPS.
 - 2. Provide enclosures with the required rating per NEMA 250 to meet classifications identified in the Contract Documents.
 - a. See Specification Section 01 61 03.
 - 3. Provide integral backup chain hoist and release with integrated interlock.
 - a. Provide chain keeper for each hoist.
 - 4. Control System:
 - a. General:
 - 1) Control system shall be hard wired to the voltage system in the motor operator.
 - a) Battery powered control stations or receivers are not acceptable.
 - 2) Provide wiring terminations for all supplied control system components.
 - a) Wireless control stations or entrapment protection components are not acceptable.
 - 3) Provide enclosures with the required rating per NEMA 250 to meet classifications identified in the Contract Documents.
 - b. Manual control station:
 - 1) Interior controls: Surface mounted.
 - a) Pushbutton operation: Open, Close, Stop.
 - c. Entrapment protection:
 - 1) Comply with UL 325.
 - a) Instant reversing.
 - b) When activated shall prevent operator from closing an open door.
 - 2) Electric safety edge:
 - a) Contact-type sensor installed on leading edge of the door.
 - b) When activated shall prevent operator from closing an open door.
 - c) Safety edge on exterior doors shall act as a weatherseal.

2.6 MAINTENANCE MATERIALS

- A. Provide 2 OZ of touch-up paint properly labeled for each different color of door.
 - 1. Touch-up paint shall be formulated to be compatible with finish specified and shall be capable of being applied without special equipment or tools.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Installation shall be done by manufacturer's authorized representative.
- C. Provide all required trim, weatherstripping, closures etc., for complete weather tight installation.
- D. Adjust for proper counter balance.
- E. Seal along bottom of vertical track (guides), seal the vertical joint between the two separate track angles (if not filled by welding) and seal all holes in vertical track (not being used for fasteners) to provide a completely weather tight track and door system.
 - 1. At fastener locations provide aluminum washers under bolt head to completely cover the slotted holes in the vertical guide.

- F. Electrical disconnect and conduit and wiring from standard three pushbutton control to motor operator is provided as indicated on the Electrical Drawings.
- G. Provide aluminum or stainless steel bracing for motor operator to eliminate vibration.
- H. Provide dissimilar materials protection on all surfaces coming in contact with dissimilar materials.

3.2 ADJUSTMENT

- A. Prior to occupancy, adjust door for smooth operation.

END OF SECTION

SECTION 08 41 10 STOREFRONT

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Thermally broken storefront.
 - 2. Entrance doors and hardware.

- B. Related Specification Sections include but are not necessarily limited to:
 - 1. Division 00 - Procurement and Contracting Requirements.
 - 2. Division 01 - General Requirements.
 - 3. Section 07 92 00 - Joint Sealants.
 - 4. Section 08 81 00 - Glass and Glazing.
 - 5. Section 08 90 00 - Louvers and Vents

1.2 QUALITY ASSURANCE

- A. Referenced Standards:
 - 1. Aluminum Association (AA):
 - a. DAF 45, Designation System for Aluminum Finishes.
 - 2. American Architectural Manufacturers Association (AAMA):
 - a. 1503, Voluntary Test Method for Thermal Transmittance and Condensation Resistance of Windows, Doors and Glazed Wall Sections.
 - 3. American Society of Civil Engineers (ASCE):
 - a. 7, Minimum Design Loads for Buildings and Other Structures.
 - 4. ASTM International (ASTM):
 - a. A36, Standard Specification for Carbon Structural Steel.
 - b. A653, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
 - c. B221, Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.
 - d. C1363, Standard Test Method for the Thermal Performance of Building Assemblies by Means of a Hot Box Apparatus.
 - e. E283, Standard Test Method for Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen.
 - f. E330, Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights, and Curtain Walls by Uniform Static Air Pressure Difference.
 - g. E331, Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference.
 - 5. American Welding Society (AWS):
 - a. D1.2, Structural Welding Code - Aluminum.

- B. Qualifications:
 - 1. Qualify welders and welding process in accordance with AWS D1.2.

1.3 DEFINITIONS

- A. Installer or Applicator:
 - 1. Installer or applicator is the person actually installing or applying the product in the field at the Project site.
 - 2. Installer and applicator are synonymous.

- B. All weather: Capable of operation from -50 to +120 DEGF.

1.4 SUBMITTALS

- A. Shop Drawings:
 - 1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
 - 2. Product technical data for framing system and major accessories specific to this Project:
 - a. Acknowledgement that products submitted meet requirements of standards referenced.
 - b. Manufacturer's installation instructions.
 - 3. Computer generated elevation drawings indicating all frame and door dimensions and details specific to this Project.
 - 4. Warranty.
 - 5. Test reports.
- B. Samples:
 - 1. Metal samples showing range of anodizing finish specified for Engineer's approval.
 - 2. After approval of color samples, provide three, 2 x 3 IN samples of color and finish approved.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Store units in vertical position off ground with wood spacers between each unit.
 - 1. Store in accordance with manufacturer's instructions.

1.6 WARRANTY

- A. Written warranty signed jointly by fabricator, installer, and Contractor, agreeing to repair or replace any items of work performed under this Specification Section which fail.
 - 1. Failure includes defects in materials, installation, workmanship, water tightness of assembly, sealant, glazing or any other defects in storefront system which affects its ability to perform as weathertight envelope.
 - 2. Warranty period is five years from date of acceptance.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
 - 1. Storefront system:
 - a. Kawneer Co., Inc.
 - b. United States Aluminum.
 - c. Vista Wall.
 - d. YKK-AP America.
 - 2. Electric door assisting device:
 - a. Horton Automatics.
- B. Submit request for substitution in accordance with Specification Section 01 25 13.

2.2 MATERIALS

- A. Storefront: Aluminum, ASTM B221, 6063-T5.
- B. Doors: Aluminum, ASTM B221, 6063-T5.
- C. Thermal Barrier: Extruded copolymer.
- D. Fasteners: Stainless steel.
- E. Sealants: See Specification Section 07 92 00.
- F. Brackets, Anchors, Reinforcements: Aluminum or stainless steel.

2.3 ACCESSORIES

- A. Doors:
 - 1. Types as indicated on Drawings.
 - 2. Factory glazed.
 - 3. Finish to match storefront.
- B. Hardware:
 - 1. Hardware specified is based on Kawneer unless noted otherwise.
 - 2. All hardware to be 630 or 626 finish.
 - 3. Equip doors with following hardware:
 - a. Exterior single door:
 - 1) Butts:
 - a) Manufacturer's heavy duty stainless steel, full mortise, ball bearing type with non-removable pin.
 - b) Size: Minimum 4-1/2 x 4 IN.
 - 2) Pull: "Style G3 IN (doors with exit device).
 - 3) Exit device: Paneline II concealed rod device.
 - 4) Threshold: Manufacturer's standard 1/2 x 4 IN aluminum.
 - 5) Weatherstripping:
 - a) See Specification Section 08 70 00.
 - b) Storefront manufacturer's standard brush type or pile type weatherstripping is not acceptable.
 - 6) Flush bolts: Manufacturer's standard stainless steel automatic bolts top and bottom.
 - 7) Cylinder: See Specification Section 08 70 00.
- C. Glass:
 - 1. ASCE 7.
 - 2. See Specification Section 08 81 00.
- D. Flashing:
 - 1. Minimum 0.040 IN aluminum.
 - 2. Finish to match storefront if exposed.
 - 3. Mill finish if concealed.
- E. Sealant: See Specification Section 07 92 00 and manufacturer's recommendations.
- F. Fasteners:
 - 1. Structural fasteners anchoring framing to building structure: Stainless steel.
 - 2. Exposed fasteners attaching system framing or components to other system framing or components.
 - a. Aluminum: Finish to match finish of system.
 - 3. Provide Phillips head screws where exposed.

2.4 FABRICATION

- A. General:
 - 1. Fully degrease and clean members prior to assembly or application of protective coatings.
 - 2. Weld using methods recommended by manufacturer and AWS to avoid discoloration.
 - 3. Grind exposed welds smooth and restore finish.
 - 4. Ease corners of cut edges to a radius of approximately 1/64 IN.
 - 5. Conceal fasteners wherever possible.
 - 6. Fit and assemble work at shop to maximum extent possible.
 - 7. Maintain true continuity of line and accurate relation of planes and angles.
 - 8. Provide secure attachment and support at mechanical joint, with hairline fit of contacting members.
 - 9. Reinforce work as necessary to withstand wind loadings and to support system.

10. Separate dissimilar metal with bituminous paint or preformed separators to prevent corrosion.
 11. Separate metal surfaces at moving joints with plastic inserts or other nonabrasive concealed inserts to permanently prevent freeze-up of joint.
 12. Frames to be structurally reinforced as required by frame manufacturer.
 - a. Reinforcement:
 - 1) Structural steel, ASTM A36, hot-dip galvanized after fabrication, ASTM A653, G90.
 - 2) Provide dissimilar metals protection; see Specification Section 09 9600.
 - 3) All structural reinforcement sizes shall be determined by the frame manufacturer.
 13. Minimum wall thickness of 0.07 IN for all frame components.
- B. Storefront:
1. Nominal 1-3/4 x 4-1/2 IN minimum section with sightline maximum of 2 IN.
 - a. Depth of system as required for loading criteria indicated.
 - b. Depth of system may be different between thermally broken and non-thermally broken frames but is to be consistent on entire Project for each of the individual systems.
 2. Complete extruded aluminum framing system:
 - a. Thermally broken system:
 - 1) Kawneer VG451T.
 - 2) Provide thermally broken system on all openings in the building exterior wall and where specified on the interior for borrowed lite systems.
 3. Include all sills, mullions, anchors, division bars, and flashing.
 4. Use no through metal connectors in thermally broken systems.
 5. Fabricate thermally broken system to accept 1 IN insulating glass.
 6. Provide complete system under single responsibility.
- C. Doors:
1. ASTM B221, aluminum.
 2. Top rail: 3-1/2 IN.
 3. Side rails: 3-1/2 IN.
 4. Bottom rail: 6-1/2 IN.
 5. Minimum thickness of door components shall be 0.125 IN.
 6. Single acting, full mortise butt hinge operation.
 7. Prepare and reinforce door for hardware specified.
 8. Kawneer Series 350.
- D. Sealants:
1. Refer to Specification Section 07 92 00.
 2. Provide sealant color to match finish of system at exposed locations.
 3. Provide sealants compatible with a aluminum system and recommended for use with this type of installation.
- E. Finishes:
1. Meet requirements of AAMA 2605.
 - a. PVDF coating with minimum 70 PCT resin content.
 - b. Factory-applied, oven baked with total minimum topcoat film thickness of 1.0 MILS.
 - c. Color: To match existing storefront and window color.
- F. Louver:
- a. Refer to Section 08 90 00.
 - b. Finish to match storefront frame.

2.5 SOURCE QUALITY CONTROL

- A. General Test Requirements:
 - 1. Utilize independent testing laboratories specifically qualified to conduct all performance tests required.
 - 2. Performance tests may be conducted in manufacturer's laboratories provided they are witnessed and certified by qualified independent testing laboratory personnel.
 - 3. Provide certification that proposed system has been tested in accordance with and meets the requirements of the standards identified in this Specification Section.
 - 4. Test air infiltration first, water resistance second.
 - a. Other tests may be in any order.
- B. Air Infiltration Tests (Doors):
 - 1. Test in accord with ASTM E283.
 - 2. Air infiltration: 0.50 CFM/LF of perimeter crack of fixed wall area when tested at 1.567 PSF pressure differential.
- C. Air Infiltration Tests (Storefront Framing):
 - 1. Test in accordance with ASTM E283.
 - 2. Air infiltration: 0.06 CUFTM/SF of wall area when tested at a static air pressure differential of 6.24 PSF.
- D. Water Resistance Test:
 - 1. Test in accordance with ASTM E331.
 - 2. No leakage allowed at a minimum static air pressure differential of 8 PSF.
- E. Uniform Load Test:
 - 1. Uniform load:
 - a. A static air design load of 20 PSF shall be applied in the positive and negative direction in accordance with ASTM E330.
 - b. There shall be no deflection in excess of $L/240$ of the span of any framing member.
 - c. At a structural test load equal to 1.5 times the specified design load, no glass breakage shall occur and no permanent set in the framing members in excess of 0.2 PCT of their clear spans shall occur.
- F. Thermal Tests:
 - 1. Perform all thermal tests on unit sized as required to produce representative areas of framing, vision glass, and spandrel glass.
 - 2. Provide test unit which reflects most restrictive situation on project (e.g., worst framing, glass, spandrel proportions for producing desired thermal results).
 - 3. Test in accordance with AAMA 1503.
 - 4. Thermal transmittance of insulated glass and framing areas: Average U-value of 0.65 BTUH/SF/DegF, maximum.
 - 5. Condensation resistance test:
 - a. Determine in accordance with ASTM C1363 and AAMA 1503.
 - b. Provide condensation resistance factor (CRF) not less than 50.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Verify suitability of substrate to accept installation.
 - 1. Correct defects.
- B. Install products in accordance with manufacturer's instructions.
- C. Set units plumb, level and true to line.
- D. Anchor securely in place.

- E. Separate metal surfaces from sources of corrosion or electrolytic action.
- F. Set sill and base members in a bed of sealant.
- G. Provide joint fillers or gaskets for weathertight construction.
- H. Seal all joints within and at perimeter of system.
 - 1. Do not seal joints intended to allow the framing system to drain.
- I. Install flashing where shown on Drawings and/or where required.

3.2 CLEANING

- A. Clean all excess sealant, compounds, metal shavings, dirt, fingerprints, and any other foreign material from frame surface promptly after installation.

END OF SECTION

SECTION 08 51 13
ALUMINUM WINDOWS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Aluminum windows.
- B. Related Sections include but are not necessarily limited to:
 - 1. Division 00 - Procurement and Contracting Requirements.
 - 2. Division 01 - General Requirements.
 - 3. Section 07 92 00 - Joint Sealants.
 - 4. Section 08 81 00 - Glass and Glazing.
 - 5. Section 09 96 00 - High Performance Industrial Coatings.

1.2 QUALITY ASSURANCE

- A. Referenced Standards:
 - 1. American Architectural Manufacturers Association (AAMA):
 - a. 904, Voluntary Specification for Multi-Bar Hinges in Window Applications
 - b. 1503, Voluntary Test Method for Thermal Transmittance and Condensation Resistance of Windows, Doors and Glazed Wall Sections.
 - c. 2605, Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels.
 - 2. ASTM International (ASTM):
 - a. A924, Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process.
 - b. C1363, Standard Test Method for the Thermal Performance of Building Assemblies by Means of a Hot Box Apparatus.
 - c. E283, Standard Test Method for Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen.
 - d. E330, Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights, and Curtain Walls by Uniform Static Air Pressure Difference.
 - e. E331, Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference.
 - 3. American Welding Society (AWS):
 - a. D1.2, Structural Welding Code - Aluminum.

1.3 DEFINITIONS

- A. Installer or Applicator:
 - 1. Installer or applicator is the person actually installing or applying the product in the field at the Project site.
 - 2. Installer and applicator are synonymous.

1.4 SUBMITTALS

- A. Shop Drawings:
 - 1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
 - 2. Product technical data for framing system and major accessories including:
 - a. Acknowledgement that products submitted meet requirements of standards referenced.
 - b. Hardware being provided by window manufacturer.
 - c. Glass being provided by window manufacturer in factory glazed units.
 - d. Manufacturer's installation instructions.

3. Elevation drawings indicating window dimensions and details.
- B. Samples:
1. After initial color selection, provide 2 x 3 IN minimum sample of each color and finish selected.
- C. Informational Submittals:
1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
 2. Qualifications of testing laboratory.
 3. Test results.
 4. Warranty.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Store units in vertical position off ground with wood spacers between each unit.

1.6 WARRANTY

- A. Five year warranty of weathertightness of installation.
1. Air and water integrity and structural adequacy of units and hardware, including sealants and sealing within and around perimeter of installation.
 2. Signed jointly by fabricator, installer, and contractor.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
1. Thermally broken windows:
 - a. Wausau Metals Corp., 2250-T Series.
 - b. Kawneer Company Inc., 8225-T Series.
 - c. EFCO Windows, Series FX32.
- B. Submit request for substitution in accordance with Specification Section 01 25 13.

2.2 MATERIALS

- A. Extruded Aluminum: 6063T5 alloy.
- B. Sealants: As specified in Section 07 92 00.
- C. Thermal Insulator: Poured in place polyurethane, self-adhering to adjacent aluminum surfaces.
- D. Weatherstripping: Sponge neoprene.

2.3 ACCESSORIES

- A. Screens:
1. 18 x 16 mesh aluminum wire screens.
 2. Secure to aluminum shapes with vinyl spline.
 3. Hold in place with spring loaded plungers.
 4. Removable to inside of building.
 5. Finish same as window frames.
- B. Flashing:
1. Minimum 0.040 IN aluminum.
 2. Finish to match window frames.
 3. Mill finish if concealed.

2.4 FABRICATION

- A. General:
 - 1. Fully degrease and clean members prior to assembly or application of protective coatings.
 - 2. Weld by methods recommended by manufacturer and AWS D1.2 to avoid discoloration at welds.
 - 3. Grind exposed welds smooth and restore finish.
 - 4. Ease corners of cut edges to a radius of approximately 1/64 IN.
 - 5. Conceal fasteners wherever possible.
 - 6. Fit and assemble work at shop to maximum extent possible.
 - 7. Maintain true continuity of line and accurate relation of planes and angles.
 - 8. Provide secure attachment and support at mechanical joint, with hairline fit of contacting members.
 - 9. Reinforce work as necessary to withstand wind loadings and to support system.
 - 10. Separate dissimilar metal with paint or preformed separators to prevent corrosion.
 - a. See Section 09 96 00.
 - 11. Separate metal surfaces at moving joints with plastic inserts or other nonabrasive concealed inserts to permanently prevent freeze-up of joint.
 - 12. Reinforce frames for hardware.
 - 13. Structural steel reinforcement hot-dip galvanized after fabrication meeting G-90, ASTM A924, requirements.
- B. Thermal Insulator: Provide minimum 1/4 IN separation between exterior and interior metal surfaces after bridge is removed.
- C. Weatherstripping:
 - 1. Thermally broken type windows:
 - a. Casement and projected:
 - 1) Provide two rows of fin type extruded neoprene weatherstrips extending around perimeter of sash at both inner and outer overlap contacts.
 - 2) Provide corners which are securely staked and joined.
 - 3) Provide units which are easily replaceable.
- D. Window Hardware:
 - 1. General:
 - a. Locking device and strikes: White bronze and/or non-magnetic stainless steel.
 - b. All hardware elements that bridge sash or frame thermal barrier: Reinforced nylon, deirin or suitable non-metallic, low conductivity material.
 - c. Custodial key operation: Secure sash in closed position and automatically lock in washing position.
 - d. Safety keys removable only in closed position.
 - 2. Glass: See Section 08 81 00 for types of glass to be installed under this Section.
- E. Fasteners:
 - 1. Finish exposed fasteners to match finish of system.
 - 2. Provide Phillips flat head screws where exposed.
- F. Finish: AAMA 2605 Fluoropolymer paint; clear anodized.

2.5 SOURCE QUALITY CONTROL

- A. General Test Requirements:
 - 1. Utilize independent testing laboratories specifically qualified to conduct all performance tests required.
 - 2. Performance tests may be conducted in manufacturer's laboratories provided they are witnessed and certified by qualified independent testing laboratory personnel.
 - 3. Perform all tests on "Test Unit":
 - a. Full-sized window unit for project or a minimum 5 x 8 FT unit mounted in test chamber in exact accordance with job conditions including anchorage system, sealing, etc.

- b. Test unit to be completely assembled and glazed.
 - 1) Thermal tests may be conducted on 4 x 6 FT unit.
 - 4. Test air infiltration first, water resistance second.
 - a. Other tests may be in any order.
 - 5. Test data on vertical pivot windows will be accepted for fixed windows for condensation resistance, thermal, temperature exposure and acoustical tests provided the fixed windows are the same as the vertical windows tested in the following respects:
 - a. Same frame section (or same family of extrusions).
 - b. Same basic metal mass inside and outside.
 - c. Identical thermal break.
 - d. Same type of glazing.
- B. Test Requirements:
1. Air infiltration test:
 - a. With sash and ventilators closed and locked, test in accordance with ASTM E283.
 - b. Air infiltration, in CFM/FT of crack length, at pressure differential of 6.24 PSF as follows:
 - 1) Fixed windows: 0.06 maximum, all others 0.10 maximum.
 2. Water resistance test:
 - a. Mount glazed unit in its vertical position, continuously supported around outside perimeter with sash and ventilators closed and locked.
 - b. Test in accordance with ASTM E331.
 - c. No uncontrolled leakage allowed, with pressure differential of 6.24 PSF.
 3. Uniform load deflection test:
 - a. Test in accordance with ASTM E330.
 - b. Subject unit to load of 25 PSF applied to outside of window and 25 PSF applied to inside of window.
 - c. Maximum allowable deflection of any unsupported span: $L/175$.
 - d. No glass breakage, permanent damage to fasteners, hardware parts, support arms or activating mechanisms, or any other damage which would cause window to be inoperable will be allowed.
 4. Uniform load structural test:
 - a. Test in accord with ASTM E330.
 - b. Subject unit to loads indicated below.
 - c. Stabilize pressure and maintain it for minimum period of 10 seconds.
 - d. No glass breakage, permanent damage to fasteners, hardware parts, support arms or activating mechanisms or any other damage which would cause window to be inoperable will be allowed.
 - e. Maximum permanent deformation of any main frame, sash or ventilator member: 0.4 PCT of its span.
 - f. After performing Uniform Load Structural Test, increase loads 1-1/2 times and perform safety test.
 - g. Design unit to withstand following design pressures acting normal to plane of wall, at applicable heights and locations.
 - 1) At height of 30 FT or less: 25 PSF acting inward 25 PSF acting outward.
 5. Condensation resistance test:
 - a. Perform on "test unit," except size may be 3 x 4 FT, minimum.
 - b. Test in accordance with AAMA 1503.
 - c. CRF (Condensation Resistance Factor): 50, minimum.
 6. Thermal test:
 - a. Perform on "test unit" except size may be 4 x 6 FT, minimum.
 - b. Test in guarded hot box ASTM C1363, with an exterior temperature of 18 DEGF, an interior of 68 DEGF and 15 MPH fan-generated wind velocity on exterior.
 - c. "U" value: not to exceed 0.65 BTU/HR/SQFT/DEGF.
 - d. Calculated "U" values from smaller units or data or theoretical assumptions will not be acceptable.

7. Temperature exposure test:
 - a. Perform on "test unit" except size may be 4 x 6 FT, minimum.
 - b. Maintain interior chamber temperature at 70 DEGF.
 - c. Reduce exterior ambient temperature to minus 15 DEGF.
8. Structural thermal barrier tension test:
 - a. Test urethane filled sections of a luminum.
 - b. Mechanically secure interior and exterior faces of 12 IN section in horizontal position.
 - c. Apply heat tape to exterior face to control surface temperature at 180 DEGF 5 minutes before loading, as indicated by a thermocouple wire operated by an automatic controller.
 - d. Apply direct tension (pull) using a Universal testing machine set in 12,000 LB load range.
 - e. Test results: No loss of bond at 4000 LB IN/IN/MIN.
9. Structural thermal barrier shear test:
 - a. Test urethane filled sections of a luminum.
 - b. Mechanically secure interior face of 12 IN section in vertical position.
 - c. Apply heat tape to exterior face to control surface temperature at 180 DEGF 5 minutes before loading, as indicated by a thermocouple wire operated by an automatic controller.
 - d. Apply load to exterior face by a bearing plate resting on top of exterior face, using Universal Testing machine set in 12,000 LB load range at a strain rate of 0.050 IN/IN/MIN.
 - e. Test results: No loss of bond at 5500 LB loading.
10. Structural thermal barrier combined torsion and shear test:
 - a. Test urethane filled sections of a luminum.
 - b. Secure interior face of 12 IN section in horizontal position.
 - c. Apply heat tape to exterior face to control surface temperature at 180 DEGF 5 minutes before loading, as indicated by a thermocouple wire operated by an automatic controller.
 - d. Apply load to bearing plate centered on portion of glazing pocket to exterior side of thermal barrier, using a Universal Testing machine set in the 12,000 LB load range.
 - e. Test results: No loss of bond at 3900 LB load applied at strain rate of 0.05 IN/IN/MIN.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Set units plumb, level, and true to line.
- C. Anchor securely in place.
- D. Separate metal surfaces from sources of corrosion or electrolytic action.
 1. See Section 09 96 00.
- E. Set sill and base members in a bed of sealant.
- F. Provide joint fillers or gaskets for weathertight construction.
- G. Seal all joints within and at perimeter of system.
- H. Provide sealant color to match finish of system at exposed locations.
- I. Provide sealants compatible with a luminum system and recommended for use with this type of installation.
- J. See Section 07 92 00 for sealants.

3.2 FIELD QUALITY CONTROL

- A. Installation supervised or inspected by manufacturer's authorized representative.

END OF SECTION

SECTION 08 70 00
FINISH HARDWARE

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Finish hardware.
 - 2. Inspection and testing of door operation.
- B. Related Specification Sections include but are not necessarily limited to:
 - 1. Division 00 - Procurement and Contracting Requirements.
 - 2. Division 01 - General Requirements.
 - 3. Section 08 11 00 - Metal Doors and Frames.
 - 4. Section 08 11 19 - Stainless Steel Doors and Frames.

1.2 QUALITY ASSURANCE

- A. All door hardware shall be provided by a single hardware supplier.
 - 1. Hardware is to be provided under this Specification Section, unless noted otherwise, for doors specified in:
 - a. Specification Section 08 11 00.
 - b. Specification Section 08 11 19.
- B. Referenced Standards:
 - 1. Americans with Disabilities Act (ADA):
 - a. Accessibility Guidelines for Buildings and Facilities (ADAAG).
 - 2. American National Standards Institute/Builders Hardware Manufacturers Association (ANSI/BHMA):
 - a. A156.1, Butts and Hinges.
 - b. A156.3, Exit Devices.
 - c. A156.4, Door Controls - Closers.
 - d. A156.6, Architectural Door Trim.
 - e. A156.8, Door Controls - Overhead Stops and Holders.
 - f. A156.13, Mortise Locks.
 - g. A156.16, Auxiliary Hardware.
 - h. A156.18, Materials and Finishes.
 - i. A156.21, Thresholds.
 - 3. American National Standards Institute/Steel Door Institute (ANSI/SDI).
 - a. A250.8, Specifications for Standard Steel Doors and Frames (SDI-100).
 - 4. Door and Hardware Institute (DHI).
 - 5. National Fire Protection Association (NFPA):
 - a. 101, Life Safety Code.
- C. Qualifications:
 - 1. Installation shall be inspected by a certified Architectural Hardware Consultant (AHC).

1.3 DEFINITIONS

- A. AHC: Architectural Hardware Consultant, certified by DHI.
- B. Installer or Applicator:
 - 1. Installer or applicator is the person actually installing or applying the product in the field at the Project site.
 - 2. Installer and applicator are synonymous.
- C. All weather: Capable of operation from -50 to +120 DEGF.

- D. Active Leaf: Right-hand leaf when facing door from keyed side unless noted otherwise on Drawings.

1.4 SUBMITTALS

- A. Shop Drawings:
 - 1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
 - 2. Qualifications
 - a. AHC qualifications.
 - 3. Certification from AHC stating:
 - a. All door hardware has been reviewed by AHC and verified to be compatible with doors and frames.
 - b. All electrified door hardware has been reviewed by AHC and has been coordinated with power supply and access control system.
 - c. No submittals will be reviewed until Engineer has received AHC certification.
 - 4. Product technical data including:
 - a. Acknowledgement that products submitted meet requirements of standards referenced.
 - b. Manufacturer's installation instructions.
 - 5. Schedule of all hardware being used on each door.
 - a. Number hardware sets and door references same as those indicated on Drawings.
 - 6. Technical data sheets on each hardware item proposed for use.
 - 7. Warranty information for all hardware devices having extended warranties.
- B. Informational Submittals:
 - 1. Certifications:
 - a. Certification from AHC stating all door hardware has been provided per approved Shop Drawings, has been installed in accordance with manufacturer's recommended installation instructions and all doors have been inspected and tested and found to be in proper working order.
 - 1) Door assemblies required to swing in the direction of egress have been inspected and tested in accordance with NFPA 101.

1.5 WARRANTY

- A. Provide all individual manufacturers' extended warranties as advertised.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
 - 1. Hinges:
 - a. Hager Companies.
 - b. McKinney Manufacturing Co.
 - c. Stanley by dormakaba Holding, Inc.
 - 2. Locksets and latchsets:
 - a. Best Access Solutions, Inc. by dormakaba Holding, Inc.
 - b. Corbin Russwin, Inc. by ASSA ABLOY.
 - 3. Exit devices:
 - a. Corbin Russwin, Inc. by ASSA ABLOY.
 - b. PRECISION by dormakaba Holding, Inc.
 - c. SARGENT Manufacturing Company by ASSA ABLOY.
 - d. Von Duprin by Allegion PLC.
 - 4. Closers:
 - a. Corbin Russwin, Inc. by ASSA ABLOY.
 - b. LCN by Allegion PLC.

- c. Norton by ASSA ABLOY.
 - 5. Door stops and holders:
 - a. Trimco.
 - b. Rockwood by ASSA ABLOY.
 - c. IVES by Allegion PLC.
 - 6. Overhead stops:
 - a. Glynn-Johnson by Allegion PLC.
 - b. Rockwood by ASSA ABLOY.
 - c. Trimco.
 - d. Rixson by ASSA ABLOY.
 - 7. Weatherstripping and thresholds:
 - a. Pemko by ASSA ABLOY.
 - b. Reese Enterprises, Inc.
 - c. Zero International, Inc.
 - d. National Guard Products.
 - 8. Door bolts, coordinators and strikes:
 - a. IVES by Allegion PLC.
 - b. Trimco.
 - c. Hager Companies.
 - d. Rockwood by ASSA ABLOY.
 - e. dormakaba.
 - 9. Other materials: As noted.
- B. Submit request for substitution in accordance with Specification Section 01 25 13.

2.2 MATERIALS

- A. General: As indicated in the FABRICATION Article in PART 2 of this Specification Section.
- B. Fasteners: Stainless steel or aluminum.
- C. Closers:
 - 1. Standard closer:
 - a. Shell: Aluminum or cast iron.
 - b. Arms and piston: Forged steel.
- D. Kickplates:
 - 1. Stainless steel.
- E. Thresholds: Aluminum.
- F. Overhead Stops and Wall Stops: Stainless steel or aluminum.
- G. Keys: Brass or bronze.
- H. Weatherstripping and Smoke Seals: Polypropylene, neoprene, or EPDM.
- I. Pulls and Push Plates: Stainless steel.
- J. Silencers: Rubber.

2.3 COMPONENTS

- A. Hinges:
 - 1. Butt hinges:
 - a. ANSI/BHMA A156.1.
 - 1) A5111: Stainless steel, full-mortise, anti-friction bearing, Grade 1.
 - b. Ball bearing.
 - c. Flat button tips.
 - d. Butt hinges:
 - 1) Hager BB1199.
 - 2) McKinney T4B3386.

- e. Hinge size:
 - 1) Doors up to and including 46 IN wide: 4.5 IN x 4.5 IN.
 - 2) Doors over 46 IN up to and including 60 IN wide: 5 IN high x 4.5 IN.
- B. Power Transfers:
 - 1. General:
 - a. Provide power transfer appropriately sized for door and hardware scheduled.
 - b. Provide modular connectors as necessary for connection to related components.
 - 2. Concealed Power Transfer:
 - a. McKinney "Electrical Power Transfer (EPT)" series.
 - 3. Exposed Power Transfer:
 - a. McKinney "Door Cord" series.
- C. Mortise Locks and Latches:
 - 1. ANSI/BHMA A156.13, Series 1000, Operational Grade 1, Security Grade 1.
 - a. Meet requirements of ADA.
 - 2. Antifriction two-piece mechanical latchbolt with stainless steel anti-friction insert.
 - a. One-piece stainless steel deadbolt, minimum 1-1/4 IN x 9/16 IN thick with 1 IN throw.
 - b. 2-3/4 IN backset.
 - c. Cylinder: Brass, 6-pin, with interchangeable core.
 - d. ADA compliant thumb turn lever.
 - 3. Locking, latching and retracting mechanism and lock case:
 - a. Steel, unless noted otherwise.
 - 1) Chrome or zinc dichromate plated.
 - 4. Trim design: Corbin Russwin, Inc. "NSP".
 - a. Functions as indicated in following table in accordance with ANSI/BHMA A156.13.
 - 5. Electrified Hardware:
 - a. All electric lock hardware to be 24 VDC.

MORTISE LOCK NUMBERS		
ANSI	FUNCTION	CORBIN RUSSWIN, INC.
F01	Passage	ML2010
F19	Privacy	ML2030
F05	Classroom	ML2055
F07	Storeroom	ML2057
F13	Entrance or Office	ML2065
	Electronic Lockset	ML20905 x M92

- D. Exit Devices:
 - 1. ANSI/BHMA A156.3, Grade 1.
 - 2. Single doors: Mortise.
 - 3. Pairs of doors: Concealed vertical rods.
 - 4. Trim: Sargent "ET".
 - a. Lever operation.
 - b. Lever style: Sargent "L".
 - 5. Sargent "80 Series".
 - a. Function as indicated on Hardware Schedule.
 - 6. Electrified Hardware:
 - a. All electric lock hardware to be 24 VDC.

- E. Bolts:
 - 1. ANSI/BHMA A156.16.
 - 2. Surface bolts: Rockwood 580 Series with top and bottom strikes.

- F. Door Closers:
 - 1. ANSI/BHMA A156.4, Grade 1.
 - 2. Size door closers to comply with ANSI recommendations for door size and location.
 - 3. Fabricate all closers with integral back check.
 - 4. Provide integral stop unless noted otherwise.
 - a. Do not provide integral stop at closers indicated to be installed on pull side of door.
 - b. Provide all weather fluid for all closers used in exterior doors.
 - 5. Full cover.
 - a. Manufacturer's standard plastic cover.
 - 6. Arms, brackets, and plates: As required for complete installation.
 - 7. Closers:
 - a. LCN 4040 Series or Norton 7500 Series or Corbin Russwin, Inc. DC6200 Series.
 - 8. Provide manufacturer's standard 10 year warranty.
- G. Door Stops:
 - 1. ANSI/BHMA A156.16.
 - a. Wall stops: IVES WS406-CVX or WS406-CCV.
- H. Overhead Door Holders/Stop:
 - 1. ANSI/BHMA A156.8.
 - 2. Provide 'hold-open' function on all stops unless noted otherwise.
 - a. Do not provide 'hold-open' function at fire rated doors.
 - 3. Surface mounted stops: Rockwood N14400 Series or Glynn Johnson 90 Series.
 - 4. Concealed stops: Rockwood N11000 Series or Glynn Johnson 100 Series.
- I. Kickplates:
 - 1. ANSI/BHMA A156.6.
 - 2. 8 IN high x 2 IN less than door width.
 - 3. Beveled on all edges.
 - 1. Thickness:
 - a. Stainless steel: 0.050 IN.
- J. Thresholds:
 - 1. ANSI/BHMA A156.21.
 - 2. One-piece unit.
 - 3. Height: 1/2 IN high maximum.
 - 4. Width: 5 IN.
 - 5. Provide required bolt cutouts.
- K. Weatherstripping:
 - 1. Weather seal at jambs and head:
 - a. Self-adhesive strip: Reese #797.
 - b. Color: Black.
 - 2. Sweep at bottom of doors:
 - a. Reese 701.
 - b. Color: Dark bronze anodized.
 - 3. Weather seal astragal at meeting edges of pairs of doors:
 - a. Reese 92 each leaf.
 - b. Color: Dark bronze anodized.

2.4 ACCESSORIES

- A. Silencers:
 - 1. Hollow metal frames: Trimco 1229A or Rockwood 608.
 - 2. Self-adhesive silencers are not acceptable.

- B. Keying:
 - 1. Establish keying with Owner.
 - a. Provide and set up complete visible card indexed system with key tags and control slips.
 - b. Tag and identify keys.
 - c. Provide two keys for each lock or cylinder.
 - d. Master key and key in groups as directed.
 - e. Provide construction master keys for all exterior doors.
- C. Strikes:
 - 1. Curved lips.
 - a. Extended lips when required.
 - 2. Furnish strike boxes.
 - 3. Appropriate for function and hardware listed.

2.5 FABRICATION

- A. General:
 - 1. Generally prepare for Phillips head machine screw installation.
 - 2. Exposed screws to match hardware finish or, if exposed in surfaces of other work, to match finish of other work as closely as possible.
 - 3. Provide concealed fasteners unless thru bolted.
 - 4. Through bolt closers on all doors.
 - 5. Furnish items of hardware for proper door swing.
 - 6. Furnish lock devices which allow door to be opened from inside room without a key or any special knowledge.
- B. Hardware:
 - 1. Fabricate hardware for fire rated openings in compliance with UL and NFPA 80.
 - a. This requirement takes precedence over other requirements for such hardware.
 - b. Provide only hardware which has been tested and listed by UL for types and sizes of doors.
 - 2. Provide following ANSI/BHMA A156.18 finishes:
 - a. Locksets, latchsets and strikes: 630.
 - b. Door pulls, push bars, push plates: 630.
 - c. Kickplates:
 - 1) Stainless steel: 630.
 - d. Exit devices: 630 where available; 626 if 630 is not available.
 - 1) Provide 630 finish on trim.
 - e. Butt hinges: 630.
 - f. Door stops, dead locks, mortise bolts, and miscellaneous hardware: 630 where available, 626 if 630 not available.
 - g. Door overhead stops: 630.
 - h. Closers: 600 prime coat with 689 finish coat, unless noted otherwise.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install products in accordance with manufacturer's installation instructions.
 - 1. Perform installation by or under the direct supervision of an AHC.
- B. Provide all hardware in accordance with the building code.
- C. Fit hardware before final door finishing.
- D. Permanently install hardware after door finishing operations are complete.
- E. Locate hardware in accordance with ANSI/SDI A250.8.

- F. Butt Hinges:
 - 1. Provide non-removable pin (NRP) at:
 - a. Exterior doors.
 - b. Reverse handed doors equipped with locks.
 - 2. Quantities:
 - a. Door height 61 - 90 IN: Three.
 - b. Door height 91 - 114 IN: Four.
 - c. Door height 115 - 144 IN: Five.
 - d. Doors over 48 IN wide and over 96 IN high:
 - 1) Provide top butt hinge within 6 IN of the top of the door to top of hinge.
 - 2) Provide one additional butt hinge approximately 6 IN below the bottom of the top butt hinge.
 - 3. Provide power transfer as necessary where electrified lockset or exit device is specified or as otherwise indicated in Hardware Schedule.
- G. Closers:
 - 1. Mount closers on push side of doors unless noted otherwise.
- H. Provide coordinator when required by hardware specified.
- I. Overhead Stops:
 - 1. Provide overhead stop when corrosion resistant closer is specified.
 - 2. Provide concealed overhead stop on doors scheduled to receive closer mounted on pull side of door.
 - 3. Provide at interior doors not scheduled to receive a closer as follows:
 - a. Doors that swing more than 105 DEG without encountering a wall or obstruction.
 - 1) Stop shall limit swing of door from impacting wall or obstruction.
 - b. Inactive leafs of pairs of doors.
- J. Wall Mount Door Stops:
 - 1. Provide where specifically indicated on Hardware Schedule and at doors not otherwise indicated to receive:
 - a. Overhead stop.
 - b. Closer with integral stop.
- K. Floor mounted stops are not acceptable unless noted otherwise in this Specification Section.
- L. Install a stragal on all pairs of UL labeled fire doors.
- M. Provide silencers for door frames.
 - 1. Hollow metal frames: See Specification Section 08 11 00.
- N. Provide weather seal, door sweep and threshold at all exterior doors and where scheduled on interior doors.
 - 1. Set thresholds in a full bed of sealant.
 - 2. Mount door sweeps on exterior face of door.
 - 3. Mount weather seal a stragal at meeting edges of pairs of doors on the exterior face of the doors.
- O. Provide smoke seals on all fire rated doors.
- P. Mount kickplates on push side of doors.

3.2 FIELD QUALITY CONTROL

- A. Adjust and check each operating item of hardware to assure proper operation or function.
 - 1. Lubricate moving parts with lubricant recommended by manufacturer.
- B. During week prior to startup, make a final check and adjustment of all hardware items.
 - 1. Clean and lubricate as necessary to assure proper function and operation.
 - 2. Adjust door control devices to compensate for operation of heating and ventilating equipment.

C. Inspection and Testing:

1. AHC shall inspect and test all door assemblies and provide written certification that door assemblies are in proper working order.
 - a. Door assemblies required to swing in the direction of egress shall be inspected and tested in accordance with NFPA 101.
2. Submit documentation and certification of testing in accordance with the certifications paragraph in the SUBMITTALS Article in PART 1 of this Specification Section.

3.3 SCHEDULES

A. Hardware Schedule:

HARDWARE SCHEDULE			
Hardware Set	Quantity	Unit	Description
HW-1	1-1/2	PR	Butts
	1	EA	Mortise Exit Device – Classroom Function
	1	EA	Closer w/Stop – Push Side Mounted
	1	EA	Smoke Seal
	1	EA	Weatherstripping
	1	EA	Threshold
	1	EA	Sweep
	1	EA	Kickplate
HW-1A	1-1/2	PR	Butts
	1	EA	Mortise Exit Device – Classroom Function
	1	EA	Closer w/Stop – Push Side Mounted
	1	EA	Smoke Seal
HW-2	1-1/2	PR	Butts
	1	EA	Lockset – Night Latch Function
	1	EA	Closer w/Stop – Push Side Mounted
	1	EA	Weatherstripping
	1	EA	Threshold
	1	EA	Sweep
HW-3	Not Used		
HW-4	3	PR	Butts
	2	EA	Pull Handles
	1	EA	Lockset – Classroom Function
	1	EA	Surface Bolts – Top and Bottom
	1	EA	Overhead Stop – Hold-open
	1	EA	Sweep
HW-5	1-1/2	PR	Butts
	1	EA	Lockset – Classroom Function
	1	EA	Closer w/stop – Push Side Mounted

END OF SECTION

SECTION 08 81 00
GLASS AND GLAZING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Glass and glazing.
 - 2. Fire resistance rated glass.

- B. Related Specification Sections include but are not necessarily limited to:
 - 1. Division 00 - Procurement and Contracting Requirements.
 - 2. Division 01 - General Requirements.
 - 3. Section 07 92 00 - Joint Sealants.
 - 4. Section 08 11 00 - Hollow Metal Doors and Frames.
 - 5. Section 08 11 19 - Stainless Steel Doors and Frames.

1.2 QUALITY ASSURANCE

- A. Referenced Standards:
 - 1. American National Standards Institute (ANSI):
 - a. Z97.1, Glazing Materials Used in Buildings - Safety Performance Specifications and Methods of Test.
 - 2. ASTM International (ASTM):
 - a. C864, Standard Specification for Dense Elastomeric Compression Seal Gaskets, Setting Blocks, and Spacers.
 - b. C1036, Standard Specification for Flat Glass.
 - c. C1048, Standard Specification for Heat-Strengthened and Fully Tempered Flat Glass.
 - d. C1376, Standard Specification for Pyrolytic and Vacuum Deposition Coatings on Flat Glass.
 - e. E119, Standard Test Methods for Fire Tests of Building Construction and Materials.
 - f. E2190, Standard Specification for Insulating Glass Unit Performance and Evaluation.
 - 3. Code of Federal Regulations (CFR):
 - a. Title 16 - Commercial Practices, Chapter ii - Consumer Product Safety Commission (CPSC), Subchapter B - Consumer Product Safety Act Regulations:
 - 1) 16 CFR 1201, Safety Standard for Architectural Glazing Materials.
 - 4. Glass Association of North America (GANA):
 - a. Glazing Manual.
 - 5. Insulating Glass Certification Council (IGCC).
 - 6. Insulating Glass Manufacturers Alliance (IGMA):
 - a. TM-3000, North American Glazing Guidelines for Sealed Insulating Glass Units for Commercial & Residential Use.
 - 7. National Fire Protection Association (NFPA).
 - a. 80, Standard for Fire Doors and Other Opening Protectives.
 - b. 251, Standard Methods of Tests of Fire Resistance of Building Construction and Materials.
 - c. 252, Standard Methods of Fire Tests of Door Assemblies.
 - d. 257, Standard on Fire Test for Window and Glass Block Assemblies.
 - 8. Underwriters Laboratories, Inc. (UL):
 - a. 9, Standard for Fire Tests of Window Assemblies.
 - b. 10B, Standard for Fire Tests of Door Assemblies.
 - c. 263, Standard for Fire Tests of Building Construction and Materials.

1.3 DEFINITIONS

- A. Installer or Applicator:
 - 1. Installer or applicator is the person actually installing or applying the product in the field at the Project site.
 - 2. Installer and applicator are synonymous.
- B. Safety Glazing: Glazing meeting the requirements of the building code and CPSC 16 CFR 1201.
- C. Other terms as identified in CPSC 16 CFR 1201.

1.4 SUBMITTALS

- A. Shop Drawings:
 - 1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
 - 2. Product technical data including:
 - a. Acknowledgement that products submitted meet requirements of standards referenced.
 - b. Manufacturer's installation instructions.
 - c. Certification that glass has been tested and approved for use in fire resistance rated doors or walls.
 - 1) Copies of all test criteria.
 - 3. Certification that insulating glass units meet requirements of IGCC and are certified by IGCC to ASTM E2190.
- B. Samples:
 - 1. Two, 12 x 12 IN sample of each type, color, and thickness specified.
 - a. Samples are not required for clear monolithic glass.
- C. Informational Submittals:
 - 1. Warranty.

1.5 WARRANTY

- A. Provide manufacturer's written 10 year warranty to cover deterioration of glass, glass units, coatings and ceramic frit.
 - 1. Insulating glass units shall be warranted against failure of hermetic seal resulting in fogging or film formation on the interior glass surfaces.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
 - 1. Glass:
 - a. Guardian Glass by Guardian Industries.
 - b. Insulite Glass Co., Inc.
 - c. NSG/Pilkington.
 - d. Oldcastle Building Envelope.
 - e. Vitro Architectural Glass.
 - f. Viracon.
 - 2. Fire Resistance Rated Glass:
 - a. SAFTIFIRST by O'Keefe's, Inc.
 - b. Technical Glass Products by Allegion PLC.
 - c. Vetrotech Saint-Gobain.
 - 3. Gaskets, glazing compounds, setting blocks, spacers, sealant, sealant tape, etc., as recommended by glass manufacturer, glass unit fabricator.
 - a. Provide materials as required by NFPA for use in fire-rated units.

- B. Submit request for substitution in accordance with Specification Section 01 25 13.

2.2 MATERIALS

- A. General:
 - 1. ASTM C1036.
 - a. Clear glass: Type I, Class 1, Quality Q3.
 - b. Tinted glass: Type I, Class 2, Quality Q3.
 - 2. Thickness: 1/4 IN, unless noted otherwise.
- B. Heat Strengthened and Fully Tempered Glass: ASTM C1048.
 - 1. General use: Kind HS.
 - 2. Safety glazing: Kind FT.
 - a. Meet requirements of ANSI Z97.1 and CSPC 16 CFR 1201.
 - 3. Condition:
 - a. Clear or tinted vision glass: Condition A.
 - b. Spandrel Glass (ceramic coated): Condition B.
 - c. Coated vision glass: Condition C.
 - 1) ASTM C1376, Kind CV or CO.
- C. Fire Resistance Rated Glass:
 - 1. ASTM E119 or UL 263 listed.
 - 2. Fire rating required: As scheduled on Drawings.
 - a. Fire-rated glazing assemblies shall be marked in accordance with the building code.
 - 3. Thickness required by fire rating.
 - a. Minimum 3/16 IN thick.
 - 4. Optically clear, colorless and free from distortion.
 - 5. Impact safety rated in addition to fire rating; meet ANSI Z97.1, Category 11.

2.3 MANUFACTURED UNITS

- A. Insulating Glass Units:
 - 1. ASTM E2190, Class A.
 - 2. Two lites of glass separated by a hermetically sealed air space.
 - a. Spacer: Stainless steel "warm edge" spacer.
 - 1) Thickness: 1/2 IN.
 - 2) Color: Black.
 - b. Perimeter Sealant: Silicone.
 - 1) Color: Black.

2.4 ACCESSORIES

- A. Glazing Compounds:
 - 1. Non-sag, non-stain type.
 - 2. Pigmented to match frame units not requiring painting.
 - 3. Compatible with adjacent surfaces.
 - 4. One- or two-part polyurethane or silicone sealant for use in setting glass.
 - a. Provide glazing compounds which will not be affected by chemicals stored in rooms where glazing compounds are used.
- B. Sealant Tape: Butyl rubber sealant tape or ribbon having a continuous neoprene shim.
- C. Gaskets:
 - 1. Flexible polyvinyl chloride or neoprene.
 - a. ASTM C864.
 - b. Provide gaskets which will not be affected by chemicals stored in rooms where gaskets are used.
 - 2. Extruded of profile and hardness required to receive glass and provide a watertight installation.
 - 3. Provide gaskets in accordance with NFPA in fire resistance rated glazing.

- D. Setting Blocks and Spacers:
 - 1. Neoprene or EPDM, compatible with sealants used.
 - a. ASTM C864.
- E. Compressible Filler Stock: Closed cell polyethylene or polyethylene jacketed polyurethane foam.
- F. Shims, Clips, Screws and Other Miscellaneous Items: As required by condition.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install in accordance with recommendations of manufacturer, GANA Glazing Manual and IGMA TM-3000.
- B. Install setting blocks in adhesive or sealant.
- C. Install spacers inside and out, of proper size and spacing, for all glass sizes larger than 50 united inches, except where gaskets are used for glazing.
- D. Provide 1/8 IN minimum bite of spacers on glass.
- E. Spacer thickness to equal sealant width.
- F. Prevent sealant exudation from glazing channels of insulating glass which is more than 1/2 IN thick; colored, heat absorbing, coated or laminated glass sizes larger than 75 united inches; and other glass more than 9/32 IN thick or larger than 125 united inches.
 - 1. Leave void at heel (or install filler) at jambs and head.
 - 2. Do not leave void (or install filler) at sill.
- G. Miter cut and bond gasket ends together at corners.
- H. Immediately after installation, attach crossed streamers to framing held away from glass.
- I. Use polysulfide-based glazing sealants in window assembly and as perimeter sealant around frames in areas which may be exposed to chlorine gas or chlorine liquid splash or spillage.
 - 1. See Specification Section 0792 00 for sealants.
- J. Install fire resistance rated glass in accordance with manufacturer's recommendations and in accordance with applicable fire testing criteria.

3.2 FIELD QUALITY CONTROL

- A. Do not install glass with edge damage.
- B. Do not apply anything to surfaces of glass.
- C. Remove and replace damaged glass.

3.3 CLEANING

- A. Maintain glass reasonably clean during construction, so that it will not be damaged by corrosive action and will not contribute to deterioration of other materials.
- B. Wash and polish glass on both faces not more than seven days prior to acceptance of work in each area.
 - 1. Comply with glass manufacturer's recommendations.

3.4 SCHEDULES

- A. General:
 - 1. Provide safety glazing for all applications where required by the building code and CPSC 16 CFR 1201.
 - 2. Provide heat strengthened glazing for all general use applications where safety glazing is not required.
- B. Glass Type 2: Tinted Monolithic Glass.
 - 1. Color: Gray.
- C. Glass Type 5: Insulating Low-E Units.
 - 1. Exterior lite: 1/4 IN with Viracon VUE-50 on #2 surface.
 - a. Color: Gray.
 - 2. 1/2 IN argon filled air space.
 - 3. Interior lite: 1/4 IN clear.
 - 4. Performance Requirements:
 - a. Transmittance:
 - 1) Visible light: 31 PCT.
 - 2) Solar energy: 12 PCT.
 - 3) UV: 3 PCT.
 - b. Reflectance:
 - 1) Exterior: 19 PCT.
 - 2) Interior: 20 PCT.
 - 3) Solar: 27 PCT.
 - c. U-Value
 - 1) Winter: 0.29.
 - 2) Summer: 0.26.
 - d. Shading Coefficient: 0.2.
 - e. Relative Heat Gain: 44.
 - f. Solar Heat Gain Coefficient (SHGC): 0.18.

END OF SECTION

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SECTION 08 90 00
LOUVERS AND VENTS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Louvers and vents.
- B. Related Sections include but are not necessarily limited to:
 - 1. Division 00 - Procurement and Contracting Requirements.
 - 2. Division 01 - General Requirements.
 - 3. Section 07 62 00 - Flashing and Sheet Metal.
 - 4. Section 07 92 00 - Joint Sealants.

1.2 QUALITY ASSURANCE

- A. Referenced Standards:
 - 1. Aluminum Association (AA):
 - a. DAF 45, Designation System for Aluminum Finishes.
 - 2. Air Movement and Control Association (AMCA).
 - 3. ASTM International (ASTM):
 - a. B221, Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.

1.3 SUBMITTALS

- A. Shop Drawings:
 - 1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
 - 2. Drawing showing location of each louver or vent, indicating size and arrangement of blank-off plates if required.
 - 3. Product technical data including:
 - a. Acknowledgement that products submitted meet requirements of standards referenced.
 - b. Manufacturer's installation instructions.
 - c. Color chart showing manufacturer's full line of colors including exotic and special colors for color selection by Engineer.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
 - 1. Louvers:
 - a. Airolite Company LLC.
 - b. Construction Specialties, Inc.
 - c. Ruskin Company.
 - d. Industrial Louvers, Inc.
 - e. American Warming and Ventilating.
- B. Submit request for substitution in accordance with Specification Section 01 25 13.

2.2 MANUFACTURED UNITS

- A. Louvers:
 - 1. 4 IN deep.
 - 2. Drainable with blades at 37-1/2 DEG.
 - 3. Continuous blade appearance.
 - 4. ASTM B221 extruded aluminum, alloy 6063T5, minimum 0.081 IN thick.
 - 5. Minimum free area: 8.58 SQFT for 4 x 4 FT louver.
 - 6. Maximum pressure drop: 0.10 IN of water at 700 FPM.
 - 7. Water penetration: 0.01 OZ/SQFT at 873 FPM.
 - 8. AMCA certified.
 - 9. Ruskin "ELF 375DX".
 - 10. Insect screen (intake louvers):
 - a. 18-16 mesh aluminum.
 - b. Install in standard aluminum frame.
 - 11. Bird screen (exhaust louvers):
 - a. 1/2 IN square mesh.
 - b. 16 GA aluminum.
 - c. Install in standard frame.
- B. Anchors, Fasteners, Reinforcing: Aluminum or stainless steel.
- C. Finish:
 - 1. Architectural Class 1 coating per AA DAF 45.
 - a. AA-M12C22A41 clear anodized.
- D. Size: Refer to Mechanical Drawings for louver size, and refer to Architectural Drawings for louver shapes.
- E. Blank-Off Plates:
 - 1. Aluminum sheet, 0.050 IN minimum thickness.
 - 2. R-9.5 insulation between front and back aluminum sheets.
 - 3. Factory applied flat black painted finish on louver facing side.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Install anchoring and bracing accessories as required.
- C. Seal around perimeter on exterior and interior.
 - 1. See Section 07 92 00.
- D. Install 0.040 IN aluminum flashing at sill to match louver.
 - 1. See Section 07 62 00.

END OF SECTION



DIVISION 09

FINISHES



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SECTION 09 22 16
NON-STRUCTURAL METAL FRAMING

PART 1 - GENERAL

1.1 SUMMARY

- A. Furnish labor, materials, tools, equipment, and services for Non-Structural Metal Framing in accordance with provisions of Contract Documents.
- B. Completely coordinate with work of other trades.

1.2 QUALITY ASSURANCE

- A. Manufacturer Qualifications:
 - 1. Member of Certified Steel Stud Association (CSSA), Steel Stud Manufacturers Association (SSMA) or Steel Framing Industry Association (SFIA).
- B. Referenced Standards:
 - 1. Refer to Division 01 Reference Standards.
 - 2. The American Iron and Steel Institute (AISI):
 - a. AISI S220 North American Standard for Cold-Formed Steel Framing – Nonstructural Members.
 - 3. ASTM International (ASTM):
 - a. ASTM C635 Standard Specification for the Manufacture, Performance, and Testing of Metal Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings
 - b. ASTM C645 Standard Specification for Nonstructural Steel Framing Members.
 - c. ASTM A653 Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
 - d. ASTM C754 Standard Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products.
 - e. ASTM A1003 Standard Specification for Steel Sheet, Carbon, Metallic and Nonmetallic-Coated for Cold-Formed Framing Members.
- C. Gypsum Association (GA):
 - 1. GA-216 Application and Finishing of Gypsum Panel Products.
 - 2. GA-234 Control Joints for Fire-Resistance Rated Systems.

1.3 SUBMITTALS

- A. See Division 01 for requirements.
- B. Product Data:
 - 1. Manufacturer's specifications for each type of material and accessory.
 - a. Where fire resistance classification is indicated, submit copies of nationally recognized testing laboratory listings of products proposed for use.
 - 2. Where EQ coatings are used, submit copies of nationally recognized testing laboratory results showing conformance with ASTM A653 and AISI S220.
 - a. Include data required to show specification compliance.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Non-Structural Metal Framing:
 - 1. Base:
 - a. ClarkDietrich Building Systems

2. Optional:
 - a. CEMCO Steel Framing and Metal Lath
 - b. Custom Stud Inc.
 - c. Marino/WARE
 - d. MBA Metal Framing
 - e. MRI Steel Framing LLC.
 - f. Telling Industries
 - g. The Steel Network
- B. Isolation Strip Material:
 1. Base:
 - a. Reflectix, Inc.
 2. Optional:
 - a. Saint-Gobain
- C. Knee Wall Brace:
 1. Base:
 - a. Pittcon Industries
- D. Interlocking Grid Support Systems for Gypsum Board Ceilings:
 1. Base:
 - a. USG Corporation
 2. Optional:
 - a. Armstrong
 - b. Chicago Metallic
- E. Other manufacturers desiring approval comply with Division 01.
- F. Products proposed for use in fire-rated assemblies:
 1. Approved by nationally recognized testing laboratory.

2.2 DESIGN CRITERIA

- A. Select steel studs in accordance with manufacturer's standard load tables and following design pressures and maximum deflections:

Performance Criteria		
Use Condition ²	Design Pressure	Maximum Deflection
Wall enclosing stairs, elevator hoistways, and other vertical shafts	10 LBS/SF 480 Pa	L/240
Wall enclosing vestibules, ground floor lobbies, and similar spaces subject to intermittent exposure to exterior wind conditions	15 LBS/SF 720 Pa	L/240
Walls scheduled with Tile Backer Board, Moisture-Resistant, Impact-Resistant, or Abuse-Resistant Gypsum Wallboard	5 LBS/SF 240 Pa	L/360
Walls scheduled to receive Tile, lath and plaster, or veneer plaster. ¹		
Typical Interior Walls/Partitions (those not listed above)	5 LBS/SF 240 Pa	L/240
Interior Ceilings, Soffits and Bulkheads	5 LBS/SF 240 Pa	L/360

Footnotes

1. Limit deflection to L/360 where wall cladding on either face is any of the following: Ceramic Tile, Stone Tile, Porcelain Tile, Thin Brick, Lath & Plaster, Simulated Masonry, Adhered Stone, Veneer Plaster and similar brittle finishes which are prone to movement induced cracking.
2. Where elements meet multiple conditions; Use most stringent Deflection and Design Pressure values.

2.3 MATERIALS

- A. Metal Studs and Floor Tracks:
1. C-shaped, roll formed studs and tracks conforming to ASTM C645.
 2. Steel design standard: 33KSI 227 MPa.
 3. Galvanized: G40 or G40EQ conforming to ASTM A653 and AISI S220.
 4. Stud and track depths: As indicated by wall type.
 5. Minimum flange width: 1-1/4 IN 6 MM.
 6. Minimum thickness: 30 MIL (20 GA) 0.752, except as follows:
 - a. Increase member thickness to comply with performance criteria.
 - b. Decrease member thickness to minimum 18 MIL (25 GA), 0.46 MM studs at following condition:
 - 1) Where walls do not extend to overhead structural deck and supporting diagonal bracing or horizontal stiffeners are used.
 7. In lieu of increased member thickness, design may employ diagonal braces above ceiling to reduce overall span.
 - a. Coordinate locations with building services items.
 - b. Do not employ studs with member thickness less than allowed by fire resistance rated assemblies.
 8. High strength 50 KSI 345 MPa or 70 KSI 483 MPa studs shall comply with design criteria of equivalent thickness standard 33KSI 227 MPa studs listed.
 9. At walls designated STC 40 and above, use only studs with physical characteristics of studs used in documented STC testing.
 10. Base product: ProSTUD Drywall Framing by ClarkDietrich.
- B. Head of Wall Accessories:
1. Configure to accommodate deflection of superstructure without inducing axial loading on partition wall.
 2. Maintain structural integrity, fire and smoke-resistance, and sound control as required by each wall.
 3. Slotted top deflection track:
 - a. Deep leg, vertically slotted track.
 - b. Cold-formed sheet steel; galvanized; G60.
 - c. Thickness: 30 MIL (20 GA) 0.752 MM minimum.
 - d. Width: As required for studs sizes indicated.
 - e. Depth: Minimum 2-1/2 IN 63 MM down-standing legs with 1/4 IN 6 MM wide by 1-1/2 IN 38 MM high slots spaced 1 IN 25 MM on center.
 - f. Base product: MaxTrak by ClarkDietrich.
 4. Z-bars, cold formed channels and clips:
 - a. Accommodate thickness of spray-applied fire-resistive materials.
 5. UL-listed fire resistant components tested for compliance with requirements indicated.
 6. Firestopping Materials:
 - a. Sealants, sprays, intumescent strips and forming materials.
 - b. Coordinate with sealants specified in Section 07 92 00.
 - c. Intumescent applications:
 - 1) Factory or field applied.
 - d. Base product: BlazeFrame by ClarkDietrich.
- C. Z-Bar Standoff Clips:
1. 30 MIL (20 GA) 0.752 MM galvanized steel.
 2. Provide Z-bars for attachment of top track to superstructure elements which are to be protected with sprayed fireproofing.
 - a. Size: 2 IN x 2 IN x 2 IN 50 MM x 50 MM x 50 MM.
 3. Length:
 - a. As required to accommodate beam and deck fireproofing.
 - 1) At structural steel member: Length equal to flange width of structural steel member.

- 2) At steel deck: Minimum length equal to partition width, or as required to span steel deck flutes.
 - b. Extend length of Z-bar to accommodate partition offset that will not clear fireproofed steel beam.
- D. Furring Channels:
1. Hat shaped sections.
 2. Galvanized: G40 or certified equivalent.
 3. Sizes: 7/8 IN 22 MM and 1-1/2 IN 38 MM, as indicated.
 4. Minimum Thickness: 30 MIL (20 GA) 0.752 MM; Use heavier gauge as dictated by conditions.
 5. Base product: Furring Channel/ Hat Channel by ClarkDietrich.
- E. Z-Furring:
1. Z-shaped sections, attached to structural parent wall.
 2. Galvanized: G40 or certified equivalent.
 3. Sizes: 1, 1-1/2, and 2 IN 25, and 38, 50mm.
 4. Thickness: 18 MIL (25 GA) 0.457 MM minimum; Use heavier gauge as dictated by conditions.
 5. XPS foam and rigid fiber insulation: Specified in Section 07 21 00.
 6. Base product: Z-Furring Channel by ClarkDietrich.
- F. Accessory Items:
1. Wire Ties:
 - a. Minimum thickness: 43 MIL (18 GA) 1.09 MM soft annealed, galvanized.
 2. Track Fasteners:
 - a. Power driven type, to withstand minimum 190 LBS 86 kg shear when driven.
 3. Closure:
 - a. Continuous 30 MIL (20 GA) 0.752 MM galvanized closure angle to receive vapor retarder and vapor retarder tape.
- G. Support Systems for Gypsum Ceilings:
1. Interlocking Grid Systems:
 - a. ASTM C635, direct-hung system composed of T-Shaped framing members designed to carry load of screw-applied gypsum ceiling board.
 - b. Tabs on Cross-Tees to interlock into slots in Main Runners where intersections occur.
 - c. Base Product: Drywall Suspension System by USG Corporation.
 2. Track and Channel Systems:
 - a. ASTM C645 roll-formed steel with G40 galvanized coating.
 - b. Thickness: 30 MIL (20 GA) 0.752 MM minimum; Use heavier gauge as dictated by conditions.
 - c. Carrying channels:
 - 1) Size: 1-1/2 IN 38 MM.
 - d. Furring channels:
 - 1) Sizes: 7/8 IN and 1-1/2 IN 22 MM x 38 MM, as indicated.
 3. Stud-Framed Ceiling/Soffit Systems:
 - a. C-shaped studs or joists; roll-formed.
 - b. Galvanized: G40.
 - c. Frame member depth: 3-5/8 IN 92 MM minimum, unless otherwise indicated.
 - 1) Use wider stud sections if ceiling span and support requires.
 - d. Flange width: 1-1/4 IN 32 MM minimum.
 - e. Stud thickness: 33 MIL 0.838 MM minimum.
 4. Tie Wire:
 - a. ASTM A641, Class 1 zinc coating, soft temper.
 - b. Diameter, single-strand: 62 mils (14 GA) 1.575 MM minimum.
 - c. Diameter, double-strand: 42 mils (18 GA) 1.067 MM minimum.

5. Wire Hangers:
 - a. ASTM A641, Class 1 zinc coating, soft temper.
 - b. Diameter: 97 mils (12 GA) 2.46 MM minimum.
6. Anchors in Concrete:
 - a. Anchors of type and material indicated below, with holes or loops for attaching hangers of type indicated and with capability to sustain, without failure, a load equal to 5 times that imposed by ceiling construction, as determined by testing per ASTM E488 or ASTM E1512 as applicable.
 - b. Acceptable types: Cast-in-place, post-installed expansion anchors and post-installed bonded anchors.
 - c. Material: Carbon-steel components zinc plated to comply with ASTM-B633, Class Fe/Zn 5 for Class SC 1 service condition.
7. Powder-Actuated Fasteners in Concrete:
 - a. Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hangers of type indicated, and with capability to sustain, without failure, a load equal to 10 times that imposed by ceiling construction, as determined by testing per ASTM E1190.
 - b. Comply with seismic design requirements where applicable.
8. Other items including suspension wire, tie wire, attachment devices: As specified and indicated.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Examine supporting structure and conditions under which system will be installed.
- B. Correct conditions detrimental to proper installation.
- C. Installation constitutes acceptance of responsibility for performance.

3.2 INSTALLATION - GENERAL

- A. Layout and install metal framing accurate to dimensions indicated in drawings.
- B. Installation Standard: ASTM C754, except comply with framing sizes and spacing indicated.
 1. Gypsum Board Assemblies: Comply with additional requirements in ASTM C840 relative to framing installation.
- C. Install supplementary framing, and blocking to support fixtures, equipment services, heavy trim, grab bars, toilet accessories, wall stops, furnishings, or similar construction.
- D. Install bracing at terminations in assemblies.
- E. Do not bridge building control and expansion joints with non-load-bearing steel framing members. Frame both sides of joints independently.
- F. Where studs are installed directly against exterior masonry walls or dissimilar metals at exterior walls, install isolation strip between studs and exterior wall.
- G. Extend framing full height to structural supports.
 1. Exception: Where partitions are indicated to terminate at, or just above, suspended ceilings.
 2. Continue framing around ducts and similar items which penetrate partitions.
- H. Position studs vertically engaging floor track and head of wall deflection track.
 1. Align stud knockouts to facilitate running of wires and conduit.
- I. Space studs maximum 16 IN 400 MM on center.
 1. Stud spacing at Shaftwall: 24 IN 610 MM on center.

- J. Provide additional studs at corners, partition intersections and terminations of partitions, and at each side of control joints.
- K. Positively anchor studs to floor tracks with self-tapping pan head screws, or stud clinching tool per ASTM C754.
- L. Anchor studs to deflection track with wafer head screws on both flanges of each stud.
 - 1. Maintain deflection gap between top of stud and top of slotted track.
 - 2. Install screws at centerline of slot and secure allowing vertical movement.
- M. Anchor fire rated partitions as required by fire resistance design, and firestopping design.
- N. Where partitions abut vertical structural elements, provide perimeter relief per Gypsum Association GA-600 Strain Relief System details.
- O. Head-of-Wall:
 - 1. Provide slotted top track for walls extended to structure.
 - 2. Configure to resist lateral loads while accommodating deflection of overhead building superstructure without inducing axial loading on partition framing.
 - 3. Secure deflection track to structure in accordance with industry standards and regulatory requirements.
 - 4. Secure at corners and at ends.
 - 5. Cut vertical studs 5/8 IN 16 MM short to create a deflection gap when installed into top track.
 - a. Secure vertical studs to top track with framing screw at each stud, screwing through track slots for positive stud connection.
 - 6. Secure Gypsum Wallboard to vertical studs; do not secure Gypsum Wallboard to top track directly.
 - 7. Where partitions attach to structural elements that are scheduled to receive Spray-applied Fire Resistive Materials (SFRM):
 - a. Install Z-bar to underside of steel beams and steel deck before application of sprayed fireproofing.
 - b. Locate Z-bars perpendicular to line of partition, spaced maximum 16 IN on center.
 - c. Attach each Z-bar with two 0.145 IN x 1 IN 3.7 MM x 25 MM powder-actuated fasteners located minimum 1 IN from ends of Z-bar.
 - d. After fireproofing, secure top track to Z-bars with No. 8 x 5/8 IN wafer head framing screws spaced maximum 16 IN 400 MM on center.
 - 8. Where fire-rated partitions are offset and will not clear fireproofed steel beam, extend Z-bar outrigger horizontally from bottom of beam out to minimum 2 IN 50 MM beyond width of head-of-wall.
 - a. Attach 3/4 IN 19 MM expanded metal lath continuous, width of top of Z-bar outriggers prior to fireproofing steel beam to accommodate sprayed fireproofing.
 - 9. Prepare wall for installation of seals, firestopping, or both:
 - a. Fire-rated Walls: Prepare for fire-resistive joint assemblies specified in Section 0784 00.
 - b. Non-fire rated partitions including Smoke Partitions: Prepare for Acoustical Sealant specified in Section 0792 00.
- P. Furring Channels:
 - 1. Attach furring channel systems directly to parent walls.
 - 2. Install channels at maximum 16 IN 400 MM OC.
 - 3. Provide additional framing at openings, cutouts, corners, and control joints.
 - 4. Space fasteners not more than 24 IN 610 MM OC, staggered on opposite flanges of furring channels.

3.3 FRAMING AT OPENINGS

- A. Control Joints (CJ):
 - 1. Install additional stud, maximum 1/2 IN 13 MM from jamb studs.
 - 2. Do not fasten extra stud to track or jamb stud.
 - 3. Refer to specification Section 09 29 00 for control joint locations.
- B. Prefabricated headers, jambs, and sill framing systems option:
 - 1. Proprietary opening framing systems may be used as an alternative to conventionally fabricated framing.
 - 2. Pre-approved Products:
 - a. HDS Framing System by ClarkDietrich.
 - b. Quick Frame Rough Opening System by Marino/Ware.
- C. Door Openings:
 - 1. 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. Screw into web of jamb stud.
 - 2. Unless indicated otherwise, extend jamb studs through suspended ceilings and secure laterally to overhead structure.
 - 3. Jamb Studs:
 - a. Minimum thickness of jamb studs: 30 MIL (20 GA) 0.752 MM at openings.
 - b. Install two studs at each jamb, toe-to-toe unless otherwise indicated.
 - c. Securely attach first stud to frame.
 - d. Fill cavity between studs with acoustic batt insulation where specified in Section 07 21 00 or shown in Drawings.
 - e. Join second stud to first stud on each face with 30 MIL (20 GA) 0.752 MM screw attached steel straps at 42 IN 1070 MM on center maximum.
 - 4. Headers:
 - a. Openings less than 4 FT 1.2 M wide:
 - 1) Cut-to-length section of floor runner above and below wall openings.
 - 2) Split flanges and bend webs at ends.
 - 3) Overlap and screw attach jamb studs to frames.
 - b. Openings over 4 FT 1.2 M wide:
 - 1) Cut-to-length, horizontal box beam studs above and below wall openings.
 - 2) Design for actual span and loading.
 - c. Incorporate miscellaneous steel members, specified in Section 05 50 00, and wood blocking, specified in Section 06 10 00, where indicated.
 - 5. Control Joints at head of jambs:
 - a. Install cripple studs at head adjacent to each jamb stud, with a minimum 1/2 IN 13 MM clearance from jamb stud to allow for installation of control joint in finished assembly.
 - b. Gypsum Wallboard control joints as specified in Section 09 29 00.
- D. Other Framed Openings:
 - 1. Frame openings other than door openings the same as required for door openings, unless otherwise indicated.
 - 2. Install framing below sills of openings to match framing required above door heads.
 - 3. Cripple Studs:
 - a. Install cut-to-length intermediate vertical studs above and below openings.
 - b. Spacing: As indicated for typical full-length studs.
 - 4. Incorporate miscellaneous steel members, specified in Section 05 50 00, and wood blocking specified in Section 06 10 00, where indicated.

3.4 WALL BACKING AND BLOCKING

- A. Metal Wall Backing: Provide in-wall metal wall backing reinforcement where following items are mounted to interior walls and interior face of exterior walls:
 - 1. Crash rails, chair rails, wall bumpers, and similar wall protection devices.
 - 2. Contractor or Owner furnished equipment indicated to be wall mounted.

- B. Verify metal stud framing has been installed to support wall-mounted items specified in Section 05 50 00.
- C. Wood Wall Blocking: Specified in Section 06 10 00.
- D. Coordinate mounting height, location, and coverage with item to be supported.
- E. Determine material width according to item to be supported.
- F. Attachment: Minimum 2 - #10 sheet metal screws at each stud.

3.5 CEILING FRAMING

- A. Install in compliance with manufacturer's recommendations.
- B. Provide required items to support and trim out neatly, flush or recessed mechanical and electrical items.
- C. Frame openings in ceiling support system to accommodate access panels and similar openings and penetrations.
 - 1. Completely frame openings with closed channel side of stud facing opening for support of recessed mechanical and electrical items.

3.6 CEILING SUPPORT SYSTEMS

- A. Install suspension system components in sizes and spacing indicated on Drawings, but not less than required by referenced installation standards for assembly types and other assembly components indicated.
- B. Isolate suspension systems from building structure where abutting or penetrated by building structure.
- C. Suspend hangers from building structure as follows:
 - 1. Install hangers plumb and free from contact with insulation or other objects 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, counter-splaying, or other equally effective means.
 - 2. Where width of ducts and other construction within ceiling plenum 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 secure fasteners appropriate for substrate.
 - 4. Flat Hangers: Secure to structure, including intermediate framing members, by attaching to inserts, eye screws, or other devices and secure fasteners appropriate for structure and hanger.
 - 5. Do not attach hangers to permanent metal forms. Furnish cast-in-place hanger inserts that extend through forms.
 - 6. Do not connect or suspend steel framing from ducts, pipes, or conduit.
- D. Grid Suspension Systems:
 - 1. Attach perimeter wall track or angle where grid suspension systems meet vertical surfaces.
 - 2. Mechanically join main beam and cross-furring members to each other and butt-cut to fit into wall track.
 - 3. Install suspension systems that are level to within 1/8 IN 3 MM in 12 FT 3.66 M measured lengthwise on each member that will receive finishes and transversely between parallel members that will receive finishes.
 - 4. Coordinate support requirements for in-ceiling devices with capacity of ceiling grid system.

END OF SECTION

SECTION 09 29 00
GYPSUM BOARD

PART 1 - GENERAL

1.1 SUMMARY

- A. Furnish labor, materials, tools, equipment, and services for Gypsum Wallboard in accordance with provisions of Contract Documents.
- B. Completely coordinate with work of other trades.

1.2 QUALITY ASSURANCE

- A. ASTM International (ASTM):
 - 1. ASTM C475 Joint Compound and Joint Tape for Finishing Gypsum Board.
 - 2. ASTM C840 Application and Finishing of Gypsum Board.
 - 3. ASTM C841 Installation of Interior Lathing and Furring.
 - 4. ASTM C954 Steel Drill Screws for Application of Gypsum Panel Products or Metal Plaster Bases.
 - 5. ASTM C1002 Steel Self-Piercing Tapping Screws for Application of Gypsum Panel Products or Metal Plaster Bases.
 - 6. ASTM C1047 Standard Specification for Accessories for Gypsum Wallboard and Gypsum Veneer Base.
 - 7. ASTM C1396 Standard Specification for Gypsum Board.
 - 8. ASTM C1629 Abuse-Resistant Non-decorated Interior Gypsum Panel Products and Fiber-Reinforced Cement Panels.
 - 9. ASTM D3273 Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber.
 - 10. ASTM E84 Surface-Burning Characteristics of Building Materials.
 - 11. ASTM E90 Sound Transmission Testing.
 - 12. ASTM E119 Fire Tests of Building Construction.
 - 13. ASTM E413 Classification for Rating Sound Insulation.
 - 14. ASTM F2547 Standard Test Method for Determining the Attenuation Properties in a Primary X-ray Beam of Materials Used to Protect Against Radiation Generated During the Use of X-ray Equipment
- B. Gypsum Association (GA):
 - 1. GA-216 Application and Finishing of Gypsum Panel Products.
 - 2. GA-234 Control Joints for Fire-Resistance Rated Systems.
 - 3. GA-238 Guidelines for Prevention of Mold Growth on Gypsum Board.
- C. Fire Resistant Rated Assemblies:
 - 1. For fire resistance rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E119 by an independent testing agency.
 - 2. Provide materials listed by UL, or other approved testing laboratory, for construction and rating type indicated.
- D. STC Rated Assemblies:
 - 1. Provide materials and construction identical to those tested in assembly indicated according to ASTM E90 and classified according to ASTM E413 by an independent testing agency.
- E. Radiation Shielding Assemblies:
 - 1. National Council on Radiation Protection and Measurement (NCRP):
 - a. NCRP Report No. 147 Structural Shielding and Design Evaluation for Medical Use of X-rays and Gamma Rays of Energies up to 10MeV
 - b. Comply with requirements of local, state or federal regulatory agencies where building or safety standards or criteria exceed NCRP Report Numbers 49 and 147.

2. Fabricator-Installer Qualifications:
 - a. Not less than ten years' experience in successful fabrication and installation of radiation protection similar to work specified.
 - b. Furnish proof of insurance certifying Fabricator-Installer is specifically fabrication and installation of X-ray Protection Materials for Shielding.
3. Certification:
 - a. Furnish certificate of compliance signed by Manufacturer and Fabricator-Installer stating materials are in accordance with Contract Documents and physicist shielding report.

1.3 SUBMITTALS

- A. Product Data:
 1. Manufacturer's specifications for each type of material and accessory.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Gypsum Wallboard:
 1. Base:
 - a. Georgia Pacific (GP).
 2. Optional:
 - a. American Gypsum.
 - b. CertainTeed.
 - c. Continental Building Products.
 - d. National Gypsum Company (NGC).
 - e. Pabco Gypsum.
 - f. United States Gypsum (USG).
- B. Acoustically Enhanced Gypsum Wallboard Composite:
 1. Base:
 - a. National Gypsum Company.
 2. Optional:
 - a. CertainTeed.
 - b. Pabco Gypsum.
 - c. Supress Products, LLC.
- C. Drywall Trim Accessories:
 1. Base:
 - a. United States Gypsum (USG)
 2. Optional:
 - a. CertainTeed.
 - b. ClarkDietrich.
 - c. Phillips Manufacturing.
 - d. Structus Building Technologies.
- D. Specialty Drywall Trim:
 1. Base:
 - a. Pittcon Industries.
 2. Optional:
 - a. Fry Reglet Corp.
 - b. Gordon, Inc.
- E. Foam Tape:
 1. Base:
 - a. As noted.

- F. Sound Attenuation Batts (SAB):
 - 1. Base:
 - a. As noted.
- G. Preformed Acoustical Seal for Wall Boxes:
 - 1. Base:
 - a. STC Architectural Products.
- H. Pressure Sensitive Fire Tape:
 - 1. Base:
 - a. E-Z Taping System.
- I. Other manufacturers desiring approval comply with Section 01 61 00.

2.2 MATERIALS

- A. Furnish in maximum available lengths, consistent with installation requirements.
 - 1. Long Edge: Tapered.
 - 2. Short Ends: Square.
- B. Upgrade listed types to fire rated equivalent products when used in fire rated assemblies.
- C. Provide listed GWB products to mold and moisture resistant types, where wallboard is installed in Electrical, Communication Rooms, Mechanical shafts, Stair Shafts and similar locations where wallboard is installed prior to building being weathertight.
- D. Framing and suspension systems for Gypsum Board Ceilings: Specified in Section 09 22 16.
- E. Firestopping: Specified in Section 07 84 00.
- F. Thermal Insulation: Specified in Section 07 21 00 and other Division 07 sections.
- G. Interior Expansion Joint Covers: Specified in Section 07 95 13.
- H. Interior face of exterior walls and rooms where moisture or high humidity is present:
 - 1. Mold and moisture resistant gypsum panels (MRGWB).
 - 2. Gypsum panels, with glass mat facer per ASTM C 1658.
 - 3. Thickness: 5/8 IN 15 MM.
 - 4. Mold resistance score: 10 per ASTM D3273.
 - 5. Apply continuously to interior face of exterior stud walls prior to framing interior partitions and ceilings.
 - 6. Where MR wallboard is scheduled in fire rated walls, provide approved fire resistive products with comparable moisture resistance.
 - 7. Base product:
 - a. DensArmor Plus Interior Panel and DensArmor Plus Fireguard Interior Panel Fireguard by Georgia Pacific.
- I. Interior Partitions and Ceilings:
 - 1. Gypsum panels - Type X:
 - a. ASTM C 1396.
 - b. Thickness: 5/8 IN 15 MM.
 - c. Type X core.
 - d. Base product:
 - 1) ToughRock Fireguard X Gypsum Wallboard by Georgia Pacific.
 - 2. Tile Backer Board (TBB):
 - a. Moisture resistant treated gypsum core, glass mats on both sides, and acrylic water barrier or water resistant gypsum coating on finished side.
 - b. Provide TBB at walls of showers, tubrooms, toilet rooms, decontamination rooms, and similar walls where tile is scheduled.
 - c. Thickness: 1/2 IN 12.5 MM.
 - d. Thickness: 5/8 IN 15 MM type X at rated walls.
 - e. Mold resistance score: 10 per ASTM D3273.

- f. Base Products:
 - 1) Non-Rated Walls: DensShield Tile Backer by Georgia Pacific.
 - 2) Fire Rated Walls: DensShield Fireguard Tile Backer by Georgia Pacific.
- g. Include Level 5 finish at non-tiled portions.
- 3. Lead Lined Gypsum Wallboard (LLGWB):
 - a. Lead sheet factory laminated to gypsum board carrier.
 - 1) Panel size: 48 IN 1220 MM wide x manufacturer's standard lengths, with lead edge flanges.
 - b. Gypsum wallboard substrate:
 - 1) ASTM C1396
 - 2) 5/8 IN 15 MM thick
 - 3) Type X.
 - c. Lead Sheet:
 - 1) Unpierced, ASTM B749, alloy UNS L51121, chemical-copper lead.
 - 2) Lead Thickness: As indicated.
 - a) Variation in sheet thickness: Less than 3 PCT.
 - d. Accessories:
 - 1) Applied lead sheet as prescribed by UL, to compensate for loss of integrity at screw penetrations.
 - a) 0.125 IN to 0.146 IN 3 MM to 3.7 MM thick.
 - b) Lead Battens: 2 IN 50 MM wide strips.
 - c) Lead Tabs: 2 IN x 5 IN 50 MM x 125 MM.
 - 2) Lead Angles:
 - a) Leak proof, lead angle system providing complete coverage of gamma rays.
 - b) Use at inside corners.
 - 3) Extend lead accessories 1 IN 25 MM beyond edge of gypsum panel.
 - 4) Sheet lead to wrap electrical outlets, pipe and duct penetrations, and similar penetrations.
- J. Trim:
 - 1. Interior Trim:
 - a. Material: Galvanized or aluminum coated steel sheet, rolled zinc, paper faced galvanized steel sheet, or paper faced structural laminate.
 - b. Material for wet areas: Composite.
 - c. Shapes:
 - 1) Corner bead.
 - 2) LC-Bead: J-shaped; exposed long flange receives joint compound.
 - 3) L-Bead: L-shaped; exposed long flange receives joint compound.
 - 4) U-Bead: J-shaped; exposed short flange does not receive joint compound.
 - 5) Control joint.
 - 6) Curved Edge Corner bead: With notched or flexible flanges.
 - 7) Other items as indicated.
- K. Joint Treatment Materials:
 - 1. Use product types recommended by wallboard manufacturer for each condition.
 - 2. Materials compatible with other compounds applied previously or on successive coats.
 - 3. Provide dust control products in occupied areas or adjacent to occupied areas.
 - 4. Joint tape:
 - a. Interior gypsum wallboard: Paper.
 - b. Tile backing panels: As recommended by panel manufacturer.
 - 5. Joint compounds for interior gypsum wallboard:
 - a. Setting type joint compound:
 - 1) Filling open joints and voids.
 - 2) Embedding tape and first coat over joints, fasteners and trim flanges.

6. Lightweight setting type joint compound:
 - a. Second coat.
 - b. Final, skim coat on surfaces receiving a Level 5 finish.
 - c. Drying type all-purpose joint compound:
 - 1) Second and third coats.
 - 2) Final, skim coat, on surfaces receiving a Level 5 finish.
 - d. Spray applied coating compound:
 - 1) Final, skim coat, on surfaces receiving a Level 5 finish.
 7. Joint compounds for moisture resistant gypsum wallboard:
 - a. Setting type joint compound:
 - 1) Filling open joints and voids.
 - 2) Embedding tape and first coat over joints, fasteners and trim flanges.
 - b. Lightweight setting type joint compound:
 - 1) Second and third coats.
 - 2) Final, skim coat on surfaces receiving a Level 5 finish.
- L. Acoustical Materials:
1. Provide where indicated.
 2. Minimum nominal thickness: As required to achieve STC indicated for wall systems.
 3. Density: As required to achieve STC indicated for wall systems.
 4. Sound attenuation batts (SAB):
 - a. Glass or mineral fiber.
 - b. Commercial sound blanket, ASTM C665, Type I, unfaced, produced by combining thermosetting resins with mineral fibers manufactured from glass, slag wool, or rock wool.
 - c. Surface burning characteristics per ASTM E84:
 - 1) Maximum flame spread: 25.
 - 2) Maximum smoke developed: 50.
 - d. Fire rated assemblies: Select SAB materials and thicknesses that are approved for use in assemblies listed.
 - e. Acoustically rated assemblies: Select SAB materials and thicknesses that are approved for use in assemblies listed.
 - f. Batt insulation products shall contain no added formaldehyde, including urea formaldehyde, phenol formaldehyde, and urea-extended phenol formaldehyde.
 - g. Fiberglass base product: Sound Attenuation Batt Insulation by Owens-Corning.
 - h. Mineral wool base product: Thermafiber SAFB FF by Owens-Corning.
 5. Preformed acoustical seal for wall boxes:
 - a. Box Seal by STC Sound Control
 - b. Molded neoprene, durometer A-40 complying with ASTM D2000.
 - c. Formed to fit the electrical device, outlet and service boxes.
 - d. STC improvement: 6 db in accordance to ASTM E90.
 6. Provide at electrical and service box penetrations in sound rated walls.
- M. Interior joint sealants, including acoustical sealants:
1. See Section 07 92 00.
- N. Fasteners:
1. Bugle head screws: ASTM C1002 for use with maximum 22 GA 0.76 MM metal stud framing.
 2. Self-tapping bugle head screws: ASTM C954 for use with minimum 20 GA metal framing.
 3. Type S for gypsum wallboard to metal; Type G for gypsum wallboard to gypsum wallboard.
 4. Screws used with backer boards: As recommended by panel manufacturer.
- O. Laminating Adhesive:
1. Adhesive or joint compound recommended for directly adhering gypsum panels to continuous substrate.

- P. Foam Tape:
 1. PVC 1/2 x 1/4 IN 13 x 6 MM: With pressure sensitive adhesive; Norseal.
 2. EPDM 1/2 x 1/4 IN 13 x 6 MM: With pressure sensitive adhesive; Cellular rubber by Gasket Dynamics.
- Q. Backing for Control Joints:
 1. Fire rated board.
- R. Support straps:
 1. Galvanized steel sheet for retaining and bracing in length and width indicated or as required for a adequate support of a assembly.
 2. Minimum Base-Metal Thickness: 20 gauge.
- S. Sealer for Moisture Resistant Gypsum Wallboard:
 1. Manufacturer's standard compound.
 2. Use at joints, cut edges and screw penetrations.

PART 3 - EXECUTION

3.1 INSPECTION AND PREPARATION

- A. Examine supporting structure and conditions prior to wallboard installation.
- B. Correct unsatisfactory conditions.
- C. Start of installation constitutes acceptance of conditions and responsibility for performance.

3.2 INSTALLATION - GENERAL

- A. Comply with ASTM C840 requirements or gypsum board manufacturer's written recommendations, whichever are more stringent.
- B. Remove loose materials and vacuum cavity of gypsum dust prior to enclosing stud space.
- C. Install wallboard vertically with edges over metal stud framing members and similar framing support members.
- D. Bring boards into contact but do not force into place.
- E. Stagger edge joints on opposite side of partition so they occur on different framing members.
- F. Stagger joints in multi-layer applications not less than one support from previous layer.
- G. Install wallboard over metal framing studs and similar framing support members at interior face of exterior walls full height from floor to structure above.
- H. Wallboard installation prior to building being weathertight:
 1. Replace scheduled GWB products to their mold-resistant counterparts.
 - a. Products proposed are subject to Architect approval.
 2. Exposure time shall be limited by manufacturer requirements.
- I. Sound Insulation:
 1. Install sound insulation in walls from floor to structure above, wherever sound rated walls are indicated.
 2. Install in thicknesses and densities necessary to achieve sound rating.
 3. Fill cavities where studs are installed nested or toe-to-toe.
 4. Pack spaces around electric boxes and other penetrations to maintain full sound rating.
 - a. Fill small voids that remain with Acoustical Sealant.
 5. Where walls either are not finished on both sides or where insulation does not fill the cavity depth, supplementary galvanized steel support straps must be provided to hold product in place at 24 IN on center or at spacing as indicated by the insulation manufacturer's written installation instructions.

- J. Preformed Acoustical Seal for Wall Boxes:
 1. Place preformed seal over exposed outlet box flush with wall surface with device protruding through preformed or precut opening in seal.
 2. Secure in place with outlet cover plate.
- K. Pressure Sensitive Fire Tape:
 1. Where allowed: Install approved pressure sensitive fire tape to above-ceiling wallboard joints in fire rated walls.
 2. Exception: Utilize conventional mud and tape where fire tape is not permitted by UL wall design or by local authorities.
- L. Curved Partitions:
 1. Space studs or furring to prevent flat areas between framing at curved surfaces.
- M. Wall Reveals:
 1. Install reveal wall channels and/or a lumimum framing as recommended by manufacturer.
- N. Screw Placement:
 1. Proceed with attachment from board center toward ends and edges.
 2. Space maximum 8 IN 200 MM OC at edges and 12 IN 300 MM OC in field of board.
 - a. Use closer screw spacing if required by UL.
 - b. Fasten wallboard to each stud where multiple studs are installed at door jambs.
 3. Secure wallboard to vertical studs; do not secure to top track directly.
 - a. Follow top track manufacturer's screw pattern requirements.
 - b. Install additional framing if required.
 - c. Top track is specified in Section 09 22 16.
 4. Set screws between 3/8 IN and 1/2 IN 10 MM and 13 MM from edges.
 5. Drive screws so head rests in slight dimple without cutting face paper or fracturing core.
- O. Access Panels and Doors:
 1. Locations as indicated on drawings.
 2. See Section 08 31 16.

3.3 INSTALLATION - RADIATION SHIELDING

- A. Verify shielding materials meet project requirements prior to installation.
- B. Install in accordance with manufacturer's recommendations and UL requirements.
- C. Perform corrective work to achieve complete radiation isolation, including repair or replacement of finishes.
- D. Typical Procedure:
 1. Construct per UL approved design when fire rating is indicated.
 2. Install lead battens to inside face of stud flange.
 3. Screw lead lined wallboard to studs.
 4. Space screws 8 IN 200 MM OC at edges and 12 IN 300 MM OC in field.
 5. Install 2 IN 50 MM wide sheet lead strip behind joints.
 - a. Install at door and window frame perimeters.
 - b. Overlap lead minimum 1 IN 25 MM.
 6. Adhesively install additional wallboard layers listed in wall type.
- E. Fire Rated Assembly, UL-U430:
 1. One hour.
- F. Installation and Protection at Penetrating Items:
 1. Penetrations of lead linings: Provide lead shields to maintain continuity of protection.
 2. Provide lead linings, sleeves, shields, and other protection in thickness not less than that required in a ssembly being penetrated.
 3. Secure shields at penetrations using adhesive or wire ties but not penetrating fasteners unless indicated on Drawings.

4. Cut wall penetration covers from lead sheet of equal or greater thickness than backing on adjacent wall panels and size to cover penetrations with laps 1 IN 25 MM minimum wide.
5. Adhesive apply lead sheet penetration covers on penetrating boxes and raceways and return penetration covers to backside of lead-backed wall panels with 1 IN 25 MM minimum laps.
 - a. Do not use penetrating fasteners unless indicated otherwise.
6. Outlet boxes and conduit:
 - a. Cover or line with lead sheet lapped over adjacent lead lining at least 1 IN 25 MM.
 - b. Wrap conduit with lead sheet for a distance of not less than 10 IN 250MM from box.
7. Duct openings:
 - a. Unless otherwise indicated, line or wrap ducts with lead sheet for distance from partition or ceiling or both equal to three times the largest opening dimension.
 - b. Lap lead sheet with adjacent lead lining at least 1 IN 25 MM.
8. Duct Penetrations; where lead sheet less than 1/8 IN 3 MM thick and where duct shielding is less than 24 IN 610 MM wide:
 - a. Wrap ducts with wall penetration covers, lapping lead joints 1 IN 25 MM minimum.
 - b. Secure lead sheet in place with 1 IN 25 MM minimum width steel bands spaced not more than 12 IN 300MM on center.
 - c. Do not cut into lead sheet with tightening steel bands.
9. Duct penetrations, where lead sheet is greater than 1/8 IN 3 MM thick or where duct shielding is greater than 24 IN 610 MM wide:
 - a. Laminate wall penetration covers to fire retardant treated plywood or other similar structural panels conforming to shape of duct, lapping lead joints 1 IN 25 MM minimum.
 - b. Secure lead laminated panels to ducts with mechanical fasteners located at duct seams and corners.
 - c. Where necessary to prevent lead laminated panels from overloading duct supports, independently suspend panels from hangers secured to overhead building structure.
 - d. Cover fastener heads with lead sheet matching thickness of adjacent lead.
10. Piping:
 - a. Unless otherwise indicated, wrap piping with lead sheet for a distance of not less than 10 IN 250 MM from point of penetration.

3.4 INSTALLATION - TRIM ACCESSORIES

- A. For trim with back flanges intended for fasteners, attach to framing with same fasteners used for panels. Otherwise, attach trim according to manufacturer's written instructions.
- B. Interior Trim:
 1. Install in following locations:
 2. Corner Bead: Use at outside corners.
 3. J-Bead or LC-Bead: Use at exposed panel edges.
 4. L-Bead: Use where wallboard abuts dissimilar surfaces and where indicated.
- C. Specialty Trim:
 1. Install in locations indicated.

3.5 INSTALLATION - SHAFTWALL

- A. Install shaft walls in compliance with UL and Gypsum Association description.
- B. Provide shaft wall systems permitting entire erection procedure from outside shaft.
- C. Provide special metal runner angles and channels, and studs or splines spaced per manufacturer's requirements.
- D. Comply with requirements for thickness of metal and thickness of wall, for heights of wall indicated.
- E. Use maximum practical board lengths.

- F. Projections in Elevator Hoistways:
 - 1. Inspect elevator shafts to determine if projections greater than 4 IN 100 MM exist.
 - 2. At projections 4 IN 100 MM and greater:
 - a. Install GWB bevels sloping 75 DEG from horizontal.
 - b. Support GWB with metal studs.

3.6 INSTALLATION - CEILING

- A. Install in compliance with manufacturer's recommendations.
- B. Stagger a butting end joints of adjacent panels' not less than one framing member.
- C. During cold or damp weather, insulate before installing gypsum board on a ceiling with a vapor barrier.

3.7 CONTROL JOINTS

- A. General:
 - 1. Install Control Joints in locations indicated and as described in this article and in specific locations approved by Architect for visual effect.
 - 2. Install suitable backing material to maintain required rating where Control Joints occur in fire or sound rated assemblies.
- B. Partitions:
 - 1. Extend control joints continuous full height of partition or wall.
 - 2. Provide vertical control joints on both wall faces which align with door frames, window frames, and similar opening as follows:
 - a. Single Doors and Cased Opening:
 - 1) Locate CJ's at both jambs, from head of opening to top of partition.
 - b. Pair doors:
 - 1) Locate CJ's at both jambs, from head of opening to top of partition.
 - 2) Exception: Control Joints are not required where partition forms a cross-corridor condition.
 - c. Doors with adjacent sidelights:
 - 1) Locate CJ's at both jambs from head of opening to top of partition, and, from sill to floor at sidelight jambs.
 - d. Sliding doors:
 - 1) Locate CJ's at both jambs, from head of opening to top of partition.
 - e. Punched windows less than 30 FT 9 M in width:
 - 1) Both jambs from head of opening to top of partition, and from sill edge to floor.
 - f. Ribbon windows greater than 30 FT 9 M in width:
 - 1) Both jambs from head of opening to top of partition, and from sill edge to floor.
 - 2) Locate additional intermediate CJ's so maximum distance between CJ's does not exceed 30 FT 9 M apart.
 - 3. Provide additional vertical Control Joints, spaced no more than 30 FT apart from each other, from opening related CJ's, or from corners.
 - 4. Provide horizontal control joints at partitions which are more than one story in height:
 - a. Locate horizontal Control Joints where partitions bypass each intermediate floor.
 - b. Align control joint with floor line, unless otherwise indicated.
- C. Ceilings:
 - 1. Use Control Joints to subdivide ceilings/soffits as indicated, and within the following limits:
 - a. Ceilings with perimeter relief:
 - 1) Subdivide so no area exceeds 2500 SQ FT 232 m², and no area has a length which exceeds 50 FT 15 m.
 - a) Exception where ceiling occurs at exterior: Subdivide so that no area exceeds 900 SQ FT 83 m², and no area has a length which exceeds 30 FT.

- b. Ceilings without perimeter relief:
 - 1) Subdivide so that no area exceeds 900 SQFT, and no area has a length which exceeds 30FT 9 m.
 - c. Locate control joints at transitions between areas of different shapes.
- D. Soffits:
- 1. Use control joints to subdivide ceilings/soffits as indicated, and within the following limits:
 - a. Locate Control Joints at transitions between areas of different shapes.
 - b. Continue lines of soffit Control Joints vertically to top of fascia.
 - c. Subdivide exterior applications so no area exceeds 900 SQ FT 83 m2, and no area has a length which exceeds 30FT 9 m.

3.8 WALLBOARD FINISHING

- A. Treat gypsum board joints, interior angles, edge trim, control joints, penetrations, fastener heads, surface defects, and elsewhere as required to prepare gypsum board surfaces for decoration.
- B. Pre-fill open joints and voids, rounded or beveled edges, and damaged surface areas.
- C. Apply joint tape over gypsum board joints, except those with trim having flanges not intended for tape.
- D. Where bead abuts exterior metal window frames or other metal components, separate from other material by use of foam tape.
- E. Remove residual joint compound from adjacent surfaces.
- F. Apply Joint Compound and Tape in accordance with fire rated design.
 - 1. Apply joint treatment compound in accordance with manufacturer's directions.
 - 2. Fill joints, screw heads, and internal corners with compound.
 - 3. Extend joint system vertically from floor to extent described as follows:
 - a. Fire Walls, Barriers, and Partitions: Extend to full height of wall.
 - b. Smoke Barriers and Partitions: Extend to full height of wall.
 - c. Interior face of exterior wall (non-rated): Extend to full height of wall.
 - d. Other interior partitions (non-rated): Extend to 6 IN 150 MM above ceiling.
 - 4. Refer to Drawings for indication of partition heights.
- G. Level 4 Finish:
 - 1. After drying, sand or otherwise smooth final coat of compound as needed to eliminate high spots or excess compound to leave smooth, even, and level surface.
 - 2. Draw down final coat of compound to a smooth even plane.
 - 3. Locations:
 - a. Wallboard scheduled to be finished with Gloss Level 1 (flat), Level 2 (velvet), or Level 3 (eggshell) paint, glazed coating, textured coating, or wall covering.
 - b. Where above listed surfaces are to be finished with textured decorative treatments, wall covering, paneling, or wall guard.
 - c. Remaining locations, unless noted otherwise.
- H. Glass Mat, Water Resistant Backing Panels:
 - 1. Finish according to manufacturer's written instructions.
- I. Cementitious Backer Units:
 - 1. Finish according to manufacturer's written instructions.
- J. Repairs:
 - 1. After painter has applied primer to wallboard surfaces, repair and refinish defective areas.
 - 2. If wallboard is damaged, or surfaces are roughened, repair or replace.

3.9 FIRE AND SMOKE WALL IDENTIFICATION

- A. Identify walls indicated on Drawings as having a required fire or smoke rating.
 - 1. Follow guidelines set in applicable Building Code.
 - 2. Permanently identify rating and type of barrier with stencil and paint in contrasting, 3 IN 75 MM high letters in a manner acceptable to authority having jurisdiction.
 - 3. Text for fire and smoke barriers: “x HOUR FIRE AND/OR SMOKE BARRIER—PROTECT ALL OPENINGS”.

3.10 FIELD QUALITY CONTROL

- A. Radiation Shielding Testing:
 - 1. Radiation shielding will be tested by Owner’s registered radiation physicist.
 - 2. Notify Owner’s radiation physicist when shielding installation is complete to perform a visual inspection.
 - 3. Upon completion of radiology equipment installation, perform tests and radiation survey
 - a. Comply with requirements of ASTM F2547.
 - b. Conduct leakage tests under direction of Owner’s radiation physicist.
 - c. Test elements forming radiation shielding.
- B. Testing Results:
 - 1. Exposure levels shall not exceed those specified in Radiation Shielding Report.
- C. Perform corrective work that inspection reports indicate does not comply with specified requirements.
- D. Retest locations where system is found to be deficient following repair.
- E. Submit certified reports to Owner.

3.11 PROTECTION

- A. Protect installed wallboard from water damage during construction.
- B. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.
- C. Remove and replace panels that are wet, moisture damaged, and mold damaged.
 - 1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
 - 2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.
- D. Prior to finishing, walls shall be inspected for visible mold growth.
 - 1. Replace affected portions.

END OF SECTION

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SECTION 09 77 61
FIBERGLASS REINFORCED PLASTIC (FRP) PANELS

PART 1 - GENERAL

1.1 SUMMARY

- A. Furnish labor, materials, tools, equipment, and services for Fiberglass Reinforced Plastic Panels, as indicated, in accordance with provisions of Contract Documents.
- B. Completely coordinate with work of other trades.

1.2 QUALITY ASSURANCE

- A. ASTM Standards:
 - 1. ASTM D570 Standard Test Method for Water Absorption of Plastics
 - 2. ASTM E84 Standard Test Method for Surface Burning Characteristics of Building Materials

1.3 SUBMITTALS

- A. Product Data:
 - 1. Manufacturer's literature indicating material, installation instructions and fire test information in compliance with specifications.
- B. Samples:
 - 1. Two 12 IN 300 x 300 MM square pieces of each pattern and color as specified on Drawing Finish Schedule.
- C. Contract Closeout Information:
 - 1. Maintenance data:
 - a. See Section 01 33 04.
 - 2. Interior finish fire performance data:
 - a. Provide for each finish material and type specified:
 - 1) Manufacturer's printed information including:
 - a) Photograph.
 - 2) Proof of purchase.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Fiberglass Reinforced Plastic Panels:
 - 1. Base:
 - a. Crane Composites.
 - 2. Optional:
 - a. Marlite.
 - b. Glasteel.
 - c. Kal-Lite.
 - d. Nudo.
 - e. Graham.
- B. Other manufacturers desiring approval comply with Section 01 25 13.

2.2 MATERIALS

- A. Class A Fiberglass Reinforced Plastic (FRP) Wall and Ceiling Panels:
 - 1. For use on walls and ceilings, see Room Finish Schedule for locations.
 - 2. Panel thickness:
 - a. 0.09 IN 2.3 MM.

3. Barcol hardness not less than 30.
 4. Interior finish rating: Class A (I) when tested in accord with ASTM E84:
 - a. Flame spread: Less than 25.
 - b. Smoke developed: Less than 450.
 5. Water absorption no greater than 0.35 PCT at 24HRS at 77 DEGF 25 DEGC in accordance with ASTM D570.
 6. Identify boards by manufacturer's standard marking on reverse side of panel.
 7. Embossed finish.
 8. Color: White.
 9. Adhesive:
 - a. Compatible with panels and substrate.
 - b. As recommended by panel manufacturer.
 10. Base product: Fire-X Glasbord by Crane Composites.
- B. Moldings:
1. Manufacturer's standard extruded vinyl trim.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Verify suitability of substrate to accept installation.
- B. Correct unsatisfactory conditions.
- C. Start of installation indicates acceptance of responsibility for performance.

3.2 INSTALLATION

- A. Install in accordance with manufacturer's recommendations and approved shop drawings.
- B. Install moldings to panels prior to erection.
 1. Apply moldings to panel edges.
 2. Apply silicone sealant to manufacturer's recommendations.
- C. Apply adhesive full coverage at panel back.

3.3 CLEANING

- A. Remove excessive sealant and adhesive with cleaner recommended by panel manufacturer.
- B. Clean entire surface prior to closeout.

END OF SECTION

SECTION 09 91 10
ARCHITECTURAL PAINTING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Surface Preparation.
 - 2. Field application of:
 - a. Architectural Coatings.
 - b. Special Coatings.
 - c. Stains and varnishes.
 - d. Any other coating, thinner, accelerator, inhibitor, etc., specified or required as part of a complete System specified in this Specification Section.
 - 3. Environmental controls for field application of coatings.
- B. Related Specification Sections include but are not necessarily limited to:
 - 1. Division 00 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
 - 2. Division 01 - General Requirements.
 - 3. Division 03 - Concrete.
 - 4. Section 08 11 00 - Metal Doors and Frames.
 - 5. Section 09 29 00 - Gypsum Board.
 - 6. Section 09 96 00 - High Performance Industrial Coatings.

1.2 QUALITY ASSURANCE

- A. Referenced Standards:
 - 1. ASTM International (ASTM):
 - a. D523, Standard Test Method for Specular Gloss.
 - b. D4258, Standard Practice for Surface Cleaning Concrete for Coating.
 - c. D4259, Standard Practice for Abrading Concrete.
 - d. D4261, Standard Practice for Surface Cleaning Concrete Unit Masonry for Coating.
 - e. D4262, Standard Test Method for pH of Chemically Cleaned or Etched Concrete Surfaces.
 - f. D4263, Standard Test Method for Indicating Moisture in Concrete by the Plastic Sheet Method.
 - g. F1869, Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride.
 - h. E84, Standard Test Method for Surface Burning Characteristics of Building Materials.
 - 2. National Fire Protection Association (NFPA):
 - a. 101, Life Safety Code.
 - 3. Steel Door Institute/American National Standards Institute (SDI/ANSI):
 - a. A250.10, Test Procedure and Acceptance Criteria For Prime Painted Steel Surfaces for Steel Doors and Frames.
 - 4. The Society for Protective Coatings (SSPC):
 - a. SP 1, Solvent Cleaning.
 - b. SP 2, Hand Tool Cleaning.
 - c. SP 3, Power Tool Cleaning.
 - d. SP 16, Brush-off Blast Cleaning of Non-Ferrous Metals.
 - 5. The Society for Protective Coatings/NACE International (SSPC/NACE):
 - a. SP 6/NACE No. 3, Commercial Blast Cleaning.
 - b. SP 7/NACE No. 4, Brush-off Blast Cleaning.
 - c. SP 13/NACE No. 6, Surface Preparation of Concrete.
 - 6. United States Environmental Protection Agency (EPA).

- B. Miscellaneous:
 - 1. Coating used in all corridors and stairways shall meet requirements of NFPA 101 and ASTM E84.

1.3 DEFINITIONS

- A. Installer or Applicator:
 - 1. Installer or applicator is the person actually installing or applying the product in the field at the Project site.
 - 2. Installer and applicator are synonymous.
- B. Approved Factory Finish: Finish on a product in compliance with the finish specified in the Specification Section where the product is specified.
- C. Exposed Exterior Surface:
 - 1. Exterior surface which is exposed to view.
 - 2. Exterior surface which is exposed to weather but not necessarily exposed to view.
- D. Finished Area:
 - 1. An area that is listed in or has finish called for on Room Finish Schedule.
 - 2. An area that is indicated on Drawings to be painted.
- E. Gloss Range:
 - 1. Specular gloss measured in accordance with ASTM D523:
 - a. Flat: Below 15, at 60 DEG.
 - b. Eggshell: Between 20 and 35, at 60 DEG.
 - c. Semi-gloss: Between 35 and 70, at 60 DEG.
 - d. Gloss: More than 70, at 60-degrees.
- F. Paint includes the following:
 - 1. Architectural paints (AP) include: Acrylic latex or alkyd enamel coatings.
 - 2. Special coatings (SC) include: Water-based pigmented resin particles suspended in a acrylic latex solution.
 - 3. Stains and varnish include: Alkyd stain and polyurethane varnish.

1.4 SUBMITTALS

- A. Shop Drawings:
 - 1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
 - 2. Product technical data including:
 - a. Acknowledgement that products submitted meet requirements of standards referenced.
 - b. Manufacturer's surface preparation instructions.
 - c. Manufacturer's application instructions.
- B. Samples:
 - 1. Manufacturer's full line of colors for Engineer's preliminary color selection.
 - 2. Gloss samples.
 - 3. After preliminary color selection by Engineer provide two (2) 8 by 10 IN samples of each final color and sheen selected.
- C. Informational Submittals:
 - 1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
 - 2. Test results.
 - 3. Applicator's daily records:
 - a. Submit daily records at end of each week in which painting work is performed unless requested otherwise by Engineer's on-site representative.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver in original containers, labeled as follows:
 - 1. Name or type number of material.
 - 2. Manufacturer's name and item stock number.
 - 3. Contents, by volume, of major constituents.
 - 4. Warning labels.
 - 5. VOC content.
- B. Store materials in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 DEGF.

1.6 PROJECT CONDITIONS

- A. Verify that atmosphere in area where painting is to take place is within paint manufacturer's acceptable temperature, humidity and sun exposure limits.
 - 1. Provide temporary heating, shade and/or dehumidification as required to bring area within acceptable limits.
 - a. Provide temporary dehumidification equipment properly sized to maintain humidity levels required by paint manufacturer.
 - b. Provide clean heat with heat exchanger type equipment sufficient in size to maintain temperature on a 24 HR basis.
 - 1) Vent exhaust gases to exterior environment.
 - 2) No exhaust gases shall be allowed to vent into the space being painted or any adjacent space.
 - 2. Do not apply coatings in snow, rain, fog or mist.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Provide products from a single manufacturer to the greatest extent practicable.
- B. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
 - 1. Architectural paints:
 - a. Benjamin Moore & Co.
 - b. PPG IdeaScapes.
 - c. Pratt & Lambert.
 - d. Sherwin-Williams.
 - e. Tnemec, Inc.
 - 2. Special coatings:
 - a. Master Coating Technologies, Inc. - Zolatone.
 - b. Dryvit Systems, Inc.
 - 3. Stains and varnish:
 - a. Benjamin Moore & Co.
 - b. PPG IdeaScapes.
 - c. Pratt & Lambert.
 - d. Sherwin-Williams.
- C. No like, equivalent or "or-equal" item [or substitution] is permitted.
- D. Submit request for substitution in accordance with Specification Section 01 25 13.

2.2 MATERIALS

A. General:

1. For unspecified materials such as thinner, provide manufacturer's recommended products.
2. Unless noted otherwise, products listed are manufactured by the manufacturer listed below.
 - a. Products of other manufacturers will be considered for use provided that the product:
 - 1) Is of the same generic formulation.
 - 2) Has comparable application requirements.
 - 3) Meets the same VOC levels or better.
 - 4) Provides the same finish and color options.
3. Coatings shall comply with the VOC limits of EPA
4. Colors:
 - a. Colors and gloss will be selected from the manufacturer's complete offering, including special colors and premium offerings.

B. Architectural Paints:

1. Product List:

Generic Description	Product
Acrylic Primer	PPG Pure Performance 9-900
Acrylic Latex	PPG Pure Performance 9-100/9-300/9-500 Series
Acrylic Gloss	PPG Speedhide 6-8534 Series
Dry-Fall Primer	Tnemec Series V115 Uni-Bond DF
Epoxy Barrier Coat	Tnemec Series 135 Chembuild
Fluoropolymer	Tnemec Series 1070V/1071V/1072V Fluoronar
HDP Acrylic	Tnemec Series 1028/1029 Enduratone
Organic Zinc Primer	Tnemec Series 94-H2O Hydro-Zinc
Polycarbamide	Tnemec Series 740/750 UVX
Waterborne Acrylate	Tnemec Series 156 Enviro-Crete

2.3 PAINT SYSTEMS:

A. General:

1. Refer to Specification Section 09 96 00 for:
 - a. Items in corrosive or highly corrosive environments.
 - b. Items subject to immersion service.
 - c. Items subject to exterior exposure.
 - d. Any other locations where High Performance Industrial Coatings (HPIC) are required.

B. Schedule:

Substrate	Prime Coat ¹	Intermediate Coat(s) ¹	Finish Coat ¹
Concrete	Concrete Filler/Surfer as necessary to fill all voids and depressions	100 to 200 SQFT/GAL Waterborne Acrylate	100 to 200 SQFT/GAL Waterborne Acrylate
Galvanized Steel Railings	4.0 to 6.0 MIL Epoxy Barrier Coat	2.5 to 3.5 MIL Polycarbamide Gloss	2.5 to 3.5 MIL Polycarbamide Gloss
Hollow Metal - Interior	4.0 to 5.0 MIL DFT Epoxy Barrier Coat	2.0 to 3.0 MIL HDP Acrylic ²	2.0 to 3.0 MIL HDP Acrylic ²

Substrate	Prime Coat ¹	Intermediate Coat(s) ¹	Finish Coat ¹
Hollow Metal - Exterior	4.0 to 5.0 MIL DFT Epoxy Barrier Coat	2.5 to 3.5 MIL Polycarbamide ²	2.5 to 3.5 MIL Polycarbamide ²
Gypsum Board scheduled to receive "PT"	300 to 400 SQFT/GAL Acrylic Primer	300 to 400 SQFT/GAL Acrylic Latex ²	300 to 400 SQFT/GAL Acrylic Latex ²

1. Application rates (SF/GAL) shown are for unthinned materials.
2. Sheen as scheduled or selected.
3. For steel elements to receive fireproofing, see Specification Section 07 81 00.

PART 3 - EXECUTION

3.1 ITEMS TO BE PAINTED

- A. Exterior surfaces, including but not limited to:
 1. Concrete:
 - a. Where indicated on Drawings.
 2. Miscellaneous ferrous metal surfaces:
 - a. Items specifically noted on Drawings to be painted.
 3. Doors and frames:
 - a. Hollow metal doors and frames.
 - b. Hollow metal window frames.
- B. Interior Areas:
 1. Refer to Room Finish Schedule on Drawings.
 - a. If space is scheduled to be painted, paint all appurtenant surfaces within the space unless specifically noted otherwise.
 - b. Provide coating manufacturer's recommended bonding primer.
 - c. Appurtenant surfaces include but are not limited to:
 - 1) Columns, beams, bracing and similar components.
 - 2) Underside of roof or floor decks above.
 - 3) Conduit, boxes, covers and supports.
 - 4) Ductwork, duct insulation and duct supports.
 - 5) Piping, pipe insulation and jacketing.
 - 6) Miscellaneous ferrous metal surfaces.
 2. Concrete walls and columns.
 3. Doors and frames:
 - a. Hollow metal doors and frames
 - b. Hollow metal window frames.
 - c. Four-fold industrial doors.
 - d. Sectional overhead doors.

3.2 ITEMS NOT TO BE PAINTED

- A. General: Do not paint items listed in this Article, unless noted otherwise.
- B. Items with Approved Factory Finish: These items may require repair of damaged painted areas or painting of welded connections.
- C. Electrical equipment.
- D. Moving parts of mechanical and electrical units where painting would interfere with the operation of the unit.
- E. Code labels, equipment identification or rating plates and similar labels, tagging and identification.
- F. Contact surfaces of friction-type structural connections.

- G. Aluminum Surfaces Except:
 - 1. Where specifically shown in the Contract Documents.
 - 2. Where in contact with concrete.
 - 3. Where in contact with dissimilar metals.
 - 4. Appurtenant surfaces as described in the ITEMS TO BE PAINTED article.
- H. Fiberglass Surfaces Except:
 - 1. Fiberglass piping where specifically noted to be painted.
 - 2. Piping supports where specifically noted to be painted.
 - 3. Appurtenant surfaces as described in the ITEMS TO BE PAINTED article.
- I. Galvanized steel items, unless specifically noted to be painted.
- J. Architectural finishes:
 - 1. Exterior concrete indicated to receive another finish.
 - 2. Precast concrete surfaces, unless specifically indicated to be painted.
 - 3. Standing and running trim.
 - 4. Fiberglass fabrications.
 - 5. Anodized aluminum.
 - 6. PVDF coated metals.
 - 7. Factory finished doors and frames.
 - 8. Aluminum windows, curtainwall and storefront framing systems.
 - 9. Finish hardware.
 - 10. Glass and glazing.
 - 11.
 - 12. Acoustical materials.
 - 13. Building specialties.
 - 14. Louvers.
 - 15. Pipe insulation and jacketing.
 - 16. Standing seam metal roof, fascia, trim, soffit and accessories.

3.3 EXAMINATION

- A. Concrete (Other than surface indicated to be painted by Section 0996 00):
 - 1. Test pH of surface to be painted in accordance with ASTM D4262.
 - a. If surface pH is not within paint manufacturer's required acceptable range, use methods acceptable to paint manufacturer as required to bring pH within acceptable range.
 - b. Retest pH until acceptable results are obtained.
 - 2. Verify that moisture content of surface to be painted is within paint manufacturer's recommended acceptable limits.
 - a. Test surface to be coated in accordance with ASTM D4263 to determine the presence of moisture.
 - 1) If moisture is detected, test moisture content of surface to be coated in accordance with ASTM F1869.
 - 2) Provide remedial measures as necessary to bring moisture content within paint manufacturer's recommended acceptable limits.
 - 3) Retest surface until acceptable results are obtained.

3.4 PREPARATION

- A. General:
 - 1. Prepare surfaces to be painted in accordance with paint manufacturer's instructions and this Specification Section unless noted otherwise in this Specification Section.
 - a. Where discrepancy between paint manufacturer's instructions and this Specification Section exists, the more stringent preparation shall be provided unless approved otherwise, in writing, by the Engineer.
 - 2. Remove all dust, grease, oil, compounds, dirt and other foreign matter which would prevent bonding of paint to surface.

3. Adhere to manufacturer's recoat time surface preparation requirements.
 - a. Surfaces that have exceeded paint manufacturer's published recoat time and/or have exhibited surface chalking shall be prepared prior to additional paint in accordance with manufacturer's published recommendations.
- B. Protection:
1. Protect surrounding surfaces not to be coated.
 2. Remove and protect hardware, accessories, plates, fixtures, finished work, and similar items; or provide ample in-place protection.
 3. Protect code labels, equipment identification or rating plates and similar labels, tagging and identification.
- C. Prepare and paint before assembly all surfaces which are inaccessible after assembly.
- D. Existing Surfaces:
1. Wherever existing work is cut, patched or modified; repair and repaint to match new work.
 2. Where a wall or ceiling is disturbed and patched, paint entire wall or ceiling.
- E. Ferrous Metal:
1. Complete fabrication, welding or burning before beginning surface preparation.
 - a. Chip or grind off flux, spatter, slag or other laminations left from welding.
 - b. Remove mill scale.
 - c. Grind smooth rough welds and other sharp projections.
 2. Solvent clean in accordance with SSPC SP 1 to remove all dust, grease, oil, compounds, dirt and other foreign matter.
 3. Exterior exposure:
 - a. Commercial blast clean in accordance with SSPC SP 6/NACE No. 3.
 4. Interior exposure:
 - a. Hand tool cleaning in accordance with SSPC SP 2 and/or power tool cleaning in accordance with SSPC SP 3.
- F. Hollow Metal:
1. Solvent clean in accordance with SSPC SP 1 to remove all dust, grease, oil, compounds, dirt and other foreign matter.
 2. Lightly sand primed surfaces with fine grit sandpaper as recommended by hollow metal manufacturer.
- G. Galvanized Steel and Non-ferrous Metals:
1. Solvent clean to remove all dust, grease, oil, compounds, dirt and other foreign matter.
 2. Brush-off blast in accordance with SSPC SP 16 or hand tool cleaning in accordance with SSPC SP 2 to remove surface contaminants.
- H. Gypsum Wallboard:
1. Repair minor irregularities left by finishers.
 2. Avoid raising nap of paper face on gypsum wallboard.
 3. Verify moisture content is less than 8 PCT before painting.
 4. After application of prime coat and between subsequent coats, inspect surface and repair holes, dents, irregularities or other defects as necessary to provide a smooth, uniform finish.
- I. Concrete:
1. Cure for minimum of 28 days.
 2. Clean in accordance with ASTM D4258.
 - a. Remove all soil, grease, oil, or other surface contaminants.
 3. Grind fins and protrusions in accordance with ASTM D4259, flush to plane of wall.
 4. Abrasive blast in accordance with ASTM D4259 and SSPC SP 13/NACE No. 6.
 - a. Remove all laitance, efflorescence, scabbing and other foreign matter.
 - b. Provide minimum concrete surface profile CSP 3 per ICRI 310.2.
 5. Test pH and moisture content in accordance with EXAMINATION article in this specification section.

6. Repair tie holes, voids, bugholes or other surface defects as necessary to provide smooth, uniform surface.

3.5 APPLICATION

A. General:

1. Thin, mix and apply paints in accordance with manufacturer's installation instructions.
 - a. Where discrepancy exists between manufacturer's instructions and this Specification Section, the more stringent requirement shall apply.
 - b. When materials have been thinned, adjust application rates as necessary to achieve film coverage indicated in Part 2 for unthinned materials.
 - c. Backroll spray applied paints.
2. Temperature and weather conditions:
 - a. Do not paint surfaces when surface temperature is below 50 DEGF unless product has been formulated specifically for low temperature application and application is approved in writing by Engineer and paint manufacturer's authorized representative.
 - b. Avoid painting surfaces exposed to hot sun.
 - c. Do not paint on damp surfaces.
3. Apply materials under adequate illumination.
4. Evenly spread to provide full, smooth coverage.
 - a. All paint systems are "to cover."
 - 1) When color or undercoats show through, apply additional coats until paint film is of uniform finish and color.
 - b. Finished paint system shall be uniform and without voids, bugholes, holidays, laps, brush marks, roller marks, runs, sags or other imperfections.
5. If so directed by Engineer, do not apply consecutive coats until Engineer has had an opportunity to observe and approve previous coats.
6. Work each application of material into corners, crevices, joints, and other difficult to work areas.
7. When painting rough surfaces, hand brush and backroll paint to work into all recesses.
8. Smooth out runs or sags immediately, or remove and recoat entire surface.
9. Allow preceding coats to dry before recoating.
 - a. Recoat within time limits specified by paint manufacturer.
 - b. If recoat time limits have expired re-prepare surface in accordance with paint manufacturer's printed recommendations.
10. Allow coated surfaces to cure prior to allowing traffic or other work to proceed.
11. Finish colors not otherwise indicated shall be selected by Engineer from paint manufacturer's complete offering.

B. Fillers, surfacers or patching compounds:

1. Provide fillers, surfacers or patching compounds in accordance with manufacturer's recommendations and as specified herein as necessary to provide a smooth, defect free substrate.

C. Prime Coat Application:

1. Prime all surfaces indicated to be painted.
 - a. Apply prime coat in accordance with paint manufacturer's written instructions and as written in this Specification Section.
2. Ensure field-applied paints are compatible with factory-applied paints or existing coatings.
 - a. Employ services of coating manufacturer's qualified technical representative.
 - 1) Certify through material data sheets.
 - 2) Perform test patch.
 - b. If field-applied coating is found to be not compatible, require the coating manufacturer's technical representative to recommend, in writing, product to be used as barrier coat, thickness to be applied, surface preparation and method of application.

- c. At Contractor's option, coatings may be removed, surface re-prepared, and new coating applied using a appropriate paint system listed in the MATERIALS Article, Paint Systems paragraph of this Specification Section.
 - 1) All damage to surface as result of coating removal shall be repaired to original condition or better by Contractor at no additional cost to Owner.
 - 3. Special coatings prime coat application:
 - a. Prime new gypsum board surfaces using sealer as recommended by manufacturer.
 - 1) Apply at rate per manufacturer's recommendation.
 - b. Prime and fill new concrete using sealer coat as recommended by manufacturer followed by modified epoxy filler as specified.
 - c. Prime filled concrete and masonry surfaces with primer at rates and as recommended by manufacturer.
 - 4. Touch up damaged primer coats prior to applying finish coats.
 - a. Restore primed surface equal to surface before damage.
- D. Finish Coat Application:
- 1. Apply finish coats in accordance with paint manufacturer's written instructions and in accordance with this Specification Section.
 - 2. Touch up damaged finish coats using same application method and same material specified for finish coat.
 - a. Prepare damaged area in accordance with the PREPARATION Article of this Specification Section.
 - 3. Hollow metal frames and doors:
 - a. Finish coats shall be spray applied only.
 - b. Finish edges same as faces of doors.
 - 4. Varnish:
 - a. Apply first coat of varnish: Gloss.
 - 1) Allow to dry a minimum of 48 HRS.
 - b. Apply second and third coats of varnish: Satin.
 - 1) Allow a minimum of 48 HRS between each coat.
 - c. Lightly sand between coats as required and remove dust.

3.6 FIELD QUALITY CONTROL

- A. Application Deficiencies:
 - 1. Surfaces showing runs, laps, brush marks, telegraphing of surface imperfections or other defects will not be accepted.
 - 2. Surfaces showing evidence of fading, chalking, blistering, delamination or other defects due to improper surface preparation, environmental controls or application will not be accepted.
- B. Provide protection for painted surfaces.
 - 1. Surfaces showing soiling, staining, streaking, chipping, scratches, or other defects will not be accepted.
- C. Maintain Daily Records:
 - 1. Record the following information during application of each coat of paint applied:
 - a. Date, starting time, end time, and all breaks taken by painters.
 - b. For exterior painting:
 - 1) Sky condition.
 - 2) Wind speed and direction.
 - c. Air temperature.
 - d. Relative humidity.
 - e. Moisture content and surface temperature of substrate prior to each coat.
 - f. Provisions utilized to maintain work area within manufacturer's recommended application parameters including temporary heating, ventilation, cooling, dehumidification and provisions utilized to mitigate wind blown dust and debris from contaminating the wet paint film.

- g. Record environmental conditions, substrate moisture content and surface temperature information not less than once every four (4) hours during application.
 - 1) Record hourly when temperatures are below 50 DEGF or above 100 DEGF.
- 2. Record the following information daily for the paint manufacturer's recommended curing period:
 - a. Date and start time of cure period for each item or area.
 - b. For exterior painting:
 - 1) Sky conditions.
 - 2) Wind speed and direction.
 - c. Record environmental conditions not less than once every 12 HRS.
 - 1) Record once every 4 HRS when ambient temperature is below 35 DEGF.
 - d. Provisions utilized to protect each item or area and to maintain areas within manufacturer's recommended curing parameters.
- 3. Format for daily record to be computer generated.
- D. Measure surface temperature of items to be painted with surface temperature gage specifically designed for such.
- E. Measure substrate humidity with humidity gage specifically designed for such.
- F. Provide wet paint signs.

3.7 CLEANING

- A. Clean paint spattered surfaces.
 - 1. Use care not to damage finished surfaces.
- B. Remove masking, adhesive residue or other foreign materials.
- C. Upon completion of painting, replace hardware, accessories, plates, fixtures, and similar items.
- D. Remove surplus materials, scaffolding, and debris.

3.8 COLOR SCHEDULE

Color Tag	Manufacturer	Color Number	Color Name	Sheen
PT- 1	PPG	To Be Selected by Engineer	To Be Selected by Engineer	Eggshell
PT-2	PPG	To Be Selected by Engineer	To Be Selected by Engineer	Semi-Gloss

END OF SECTION

SECTION 09 96 00
HIGH PERFORMANCE INDUSTRIAL COATINGS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
1. High performance industrial coatings (HPIC).
 2. Any other coating, thinner, accelerator, inhibitor, etc., specified or required as part of a complete System specified in this Specification Section.
 3. Minimum surface preparation requirements.
- B. Related Specification Sections include but are not necessarily limited to:
1. Division 00 - Procurement and Contracting Requirements.
 2. Division 01 - General Requirements.
 3. Section 01 61 03 - Equipment - Basic Requirements.
 4. Division 23 - Heating, Ventilating, and Air-Conditioning (HVAC).
 5. Division 26 - Electrical.
 6. Division 40 - Process Interconnections.
 7. Section 40 05 00 - Pipe and Pipe Fittings - Basic Requirements.

1.2 QUALITY ASSURANCE

- A. Referenced Standards:
1. ASTM International (ASTM):
 - a. B499, Standard Test Method for Measurement of Coating Thicknesses by the Magnetic Method: Nonmagnetic Coatings on Magnetic Basis Metals.
 - b. D3359, Standard Test Methods for Rating Adhesion by Tape Test.
 - c. D4258, Standard Practice for Surface Cleaning Concrete for Coating.
 - d. D4259, Standard Practice for Abrading Concrete.
 - e. D4261, Standard Practice for Surface Cleaning Concrete Masonry Units for Coating.
 - f. D4262, Standard Test Method for pH of Chemically Cleaned or Etched Concrete Surfaces.
 - g. D4263, Standard Test Method for Indicating Moisture in Concrete by the Plastic Sheet Method.
 - h. D4414, Standard Practice for Measurement of Wet Film Thickness by Notch Gages.
 - i. D4541, Standard Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers.
 - j. D6132, Standard Test Method for Nondestructive Measurement of Dry Film Thickness of Applied Organic Coatings Using an Ultrasonic Gage.
 - k. D6677, Standard Test Method for Evaluating Adhesion by Knife.
 - l. D7091, Standard Practice for Nondestructive Measurement of Dry Film Thickness of Nonmagnetic Coatings Applied to Ferrous Metals and Nonmagnetic, Nonconductive Coatings Applied to Non-Ferrous Metals.
 - m. D7234, Standard Test Method for Pull-Off Adhesion Strength of Coatings on Concrete Using Portable Pull-Off Adhesion Testers.
 - n. E337, Standard Test Method for Measuring Humidity with a Psychrometer (the Measurement of Wet- and Dry-Bulb Temperatures).
 - o. F1869, Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride.
 - p. F2170, Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes.
 2. Environmental Protection Agency (EPA).

3. International Concrete Repair Institute (ICRI):
 - a. 310.2, Selecting and Specifying Concrete Surface Preparation for Sealers, Coatings, Polymer Overlays, and Concrete Repair.
 4. NACE International (NACE).
 5. National Association of Pipe Fabricators (NAPF):
 - a. 500-03, Surface Preparation Standard for Ductile Iron Pipe and Fittings in Exposed Locations Receiving Special External Coatings and/or Special Internal Linings:
 - 1) 500-03-04, Abrasive Blast Cleaning for Ductile Iron Pipe.
 - 2) 500-03-05, Abrasive Blast Cleaning for Cast Ductile Iron Fittings.
 6. NSF International (NSF).
 - a. 61, Drinking Water System Components - Health Effects.
 7. The Society for Protective Coatings (SSPC):
 - a. PA 2, Procedure for Determining Conformance to Dry Coating Thickness Requirements.
 - b. SP 1, Solvent Cleaning.
 - c. SP 2, Hand Tool Cleaning.
 - d. SP 3, Power Tool Cleaning.
 - e. SP 16, Brush-off Blast Cleaning of Coated and Uncoated Galvanized Steel, Stainless Steels, and Non-Ferrous Metals.
 8. The Society for Protective Coatings/NACE International (SSPC/NACE):
 - a. SP 5/NACE No. 1, White Metal Blast Cleaning
 - b. SP 6/NACE No. 3, Commercial Blast Cleaning.
 - c. SP 7/NACE No. 4, Brush-off Blast Cleaning.
 - d. SP 10/NACE No. 2, Near-White Blast Cleaning.
 - e. SP 13/NACE No. 6, Surface Preparation of Concrete.
- B. Qualifications:
1. Coating manufacturer's technical representative shall be a NACE Certified Coatings Inspector, Level 3 minimum.
 2. Applicators shall have minimum of 10 years of experience in application of similar products on similar project.
 - a. Provide references for minimum of three different projects completed in last five years with similar scope of work.
 - b. Include name and address of project, size of project in value (coating) and contact person.
 3. NACE inspector shall be NACE Certified Coatings Inspector Level 3 minimum and shall have minimum of five years of experience of conducting inspections and tests as indicated in this Specification Section.
- C. Miscellaneous:
1. Furnish coating through one manufacturer unless noted otherwise.
- D. Deviation from specified MIL thickness or product type is not allowed without written authorization of Engineer.
- E. Material shall not be thinned unless approved, in writing, by coating manufacturer's technical representative.

1.3 DEFINITIONS

- A. Applicator:
1. Applicator is the person actually installing or applying the product in the field, at the Project site, or at an approved shop facility.
- B. Approved Factory Finish: Finish on a product in compliance with the finish specified in the Specification Section where the product is specified or in Specification Section 01 61 03.
- C. Appurtenant Surface: Accessory or auxiliary surface attached to or adjacent to a surface indicated to be coated.

- D. Corrosive Environment:
 - 1. Immersion in or subject to:
 - a. Condensation, spillage or splash of a corrosive material such as water, wastewater or chemical solution.
 - b. Exposure to corrosive caustic or acidic agent, chemicals, chemical fumes, chemical mixture, or solutions.
 - c. For purposes of this Specification Section, corrosive environments include:
 - 1) Exterior areas not otherwise identified as highly corrosive.
 - 2) Piping galleries.
 - 3) Surfaces within 2 FT of high water level.
 - 4) Chemicals storage and feed areas:
- E. Exterior Atmosphere or Surface: Outdoor atmosphere or surface exposed to weather and/or direct sunlight.
- F. Finished Area: A room or area that is listed in or has finish called for on Room Finish Schedule or is indicated on Drawings to be coated.
- G. Holiday:
 - 1. A void, crack, thin spot, foreign inclusion, or contamination in the coating that significantly lowers the dielectric strength of the coating.
 - 2. May also be identified as a discontinuity or pinhole.
- H. HPIC: High performance industrial coatings.
 - 1. Epoxies, urethanes, vinyl ester, waterborne vinyl acrylic emulsions, acrylates, silicones, alkyds, acrylic emulsions and any other coating listed as a HPIC.
- I. Interior Atmosphere or Surface: Indoor atmosphere or surface not exposed to weather and/or direct sunlight.
- J. Immersion Service:
 - 1. Any surface immersed in water or some other liquid.
 - 2. Surface of any pipe, valve, or any other component of the piping system subject to frequent wetting.
 - 3. Surfaces within two feet above high water level in water bearing structures.
- K. Piping System: Pipe, valves, fittings and accessories.
- L. Surface Hidden from View:
 - 1. Within pipe chases.
 - 2. Between top side of ceilings and underside of floor or roof structures above.
- M. Vapor Space: Interior space within tankage, closed structures, or similar elements that is above the low liquid line and subject to the accumulation of fumes, vapor and/or condensation.

1.4 SUBMITTALS

- A. Shop Drawings:
 - 1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
 - 2. Applicator experience qualifications.
 - a. No submittal information will be reviewed until Engineer has received and approved applicator qualifications.
 - 3. Certification that High Performance Coating Systems proposed for use have been reviewed and approved by a NACE Certified Coatings Inspector employed by the coating manufacturer.
 - a. Submittals not including this certification will be returned without review.
 - 4. Product technical data including:
 - a. Acknowledgement that products submitted meet requirements of standards referenced.
 - b. Manufacturer's surface preparation instructions.

- c. Manufacturer's application instructions.
 - 1) Manufacturer's standard details, including but not limited to penetrations, transitions, and terminations for:
 - a) High-build coatings on concrete.
 - b) Other special conditions as applicable.
 - d. If products being used are manufactured by Company other than listed in the MATERIALS Article of this Specification Section, provide complete individual data sheet comparison of proposed products with specified products including:
 - 1) Application procedure.
 - 2) Coverage rates.
 - 3) Certification that product is designed for intended use and is equal or superior to specified product.
 - e. Contractor's written plan of action for containing airborne particles created by blasting operation and location of disposal of spent contaminated blasting media.
 - f. Coating manufacturer's recommendation on abrasive blasting.
 - g. Coating manufacturer's technical representative's written statement attesting that applicator has been instructed on proper preparation, mixing and application procedures for coatings specified.
 - h. Manufacturer's recommendation for universal barrier coat.
 - i. Manufacturer's recommendation for providing temporary or supplemental heat or dehumidification or other environmental control measures.
5. Results of discontinuity testing indicating any corrective action taken.
 6. Manufacturer's statement regarding applicator instruction on product use.
- B. Samples:
1. Manufacturer's full line of colors for Engineer's preliminary color selection.
 2. After preliminary color selection by Engineer provide two, 3 x 5 IN samples of each final color selected.
- C. Informational Submittals:
1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
 2. Approval of application equipment.
 3. Applicator's daily records:
 - a. Submit daily records at end of each week in which coating work is performed unless requested otherwise by Engineer's on-site representative.
 4. Certification that coating systems requiring holiday detection testing are free of pinholes or other material defects.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver in original containers, labeled as follows:
1. Name or type number of material.
 2. Manufacturer's name and item stock number.
 3. Contents, by volume, of major constituents.
 4. Warning labels.
 5. VOC content.
- B. Store materials in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 DEGF.

1.6 PROJECT CONDITIONS

- A. Pre-application Conference:
1. Prior to commencement of surface preparation or coating application, the Contractor shall convene a pre-application conference with all affected parties, including but not limited to: the applicator, coating manufacturer's technical representative, Owner's representative, and Engineer's representative(s).

2. The meeting shall discuss all aspects of the Project including but not limited to:
 - a. Schedule.
 - b. Material storage and handling.
 - c. Examination of surfaces to be coated.
 - d. Protection of surfaces not to be coated.
 - e. Surface preparation.
 - f. Coating application:
 - 1) Environmental conditions for a application of coatings.
 - 2) Temporary environmental controls.
 - g. Field quality control requirements:
 - 1) Manufacturer's technical representative responsibilities.
 - 2) Contractor performed testing.
 - a) Instrumentation requirements.
 - b) Frequency of testing.
 - c) Record keeping.
 - 3) NACE inspector performed testing.
- B. Verify that atmosphere in area where coating is to take place is within coating manufacturer's acceptable temperature, humidity and sun exposure limits.
1. Provide temporary heating, shade and/or dehumidification as required to bring area within acceptable limits.
 - a. Provide temporary dehumidification equipment properly sized to maintain humidity levels required by coating manufacturer.
 - b. Provide clean heat with heat exchanger type equipment sufficient in size to maintain temperature on a 24 HR basis.
 - 1) Vent exhaust gases to exterior environment.
 - 2) No exhaust gases shall be allowed to vent into the space being coated or any adjacent space.
 2. Do not apply coatings in snow, rain, fog or mist.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
1. High Performance Industrial Coatings:
 - a. Carboline Protective Coatings.
 - b. PPG.
 - c. The Sherwin-Williams Company.
 - d. Tnemec.
 - e. AkzoNobel.
 - f. Raven (Digester Concrete Interior Coating)
- B. Submit request for substitution in accordance with Specification Section 01 25 13.
- C. "Or-Equal" Submittals:
1. Materials by other manufacturers are acceptable provided that they are established as being compatible with and of equal quality to the coatings of the manufacturers listed.
 2. Provide satisfactory documentation from the proposed "or-equal" manufacturer that proposed materials meets or exceeds the following:
 - a. Is of the same generic resin.
 - b. Requires comparable surface preparation.
 - c. Has comparable application requirements.
 - d. Meets the same VOC levels or better.
 - e. Provides the same finish and color options.
 - f. Is suitable for the intended service.

- g. Resistance to abrasion and physical damage.
 - h. Resistance to chemical attack.
 - i. Resistance to UV exposure.
 - j. Ability to recoat in future.
 - k. Dry film thickness per coat.
 - 1) Where manufacturer's product data sheet indicates a minimum MIL thickness per coat that is greater than specified herein, MIL thickness for entire coating system shall be increased proportionately.
 - l. Minimum and Maximum time between coats.
 - m. Compatibility with other coatings.
 - n. Temperature limitations in service and during application.
 - o. Type and quality of recommended undercoats and topcoats.
 - p. Ease of application.
 - q. Ease of repairing damaged areas.
 - r. Stability of colors.
3. The cost of all testing and analyzing of the proposed substitute materials shall be borne by the CONTRACTOR.

2.2 MATERIALS

- A. Coatings used for interior finishes shall meet the requirements of the building code and NFPA 101.
- B. Coatings shall comply with the VOC limits of EPA.
- C. For unspecified materials such as thinner, provide manufacturer's recommended products.
- D. High Performance Industrial Coatings:

COATING CODE	GENERIC DESCRIPTION	MANUFACTURER	
		TNEMEC	SHERWIN WILLIAMS
AAE	Acrylic/Acrylate Emulsion	Series 180 WB Tneme-Crete	Cement Plex 875
AREL	Abrasion-Resistant Epoxy Lining	Series 435 Perma-Glaze	Duraplate 5900
CRM	Cementitious Repair Mortar	Series 217 MortarCrete	Cemtec Silatec MSM
CRU	Corrosion Resistant Urethane	Series 290 CRU	Polylon HP
DFA	Dry-fall Acrylic	Series 115 Uni-Bond DF	DFA Dry Fall Acrylic
EBF	Epoxy Block Filler	Series 1254 Epoxoblock WB	Kem Cati Coat HS
ESF	Epoxy Surfacer/Filler	Series 215 Surfacing Epoxy	Steel Seam FT 910
EMM	Epoxy Modified Cementitious Mortar	Series 218 MortarClad	Duraplate 2300
EF	Epoxy Flooring	Series 237 Power-Tread	GP3746
GFRE	Glass Flake Reinforced Epoxy	Series 142	Sher-Glass FF
HREM	H2S-Resistant Epoxy Mortar	Series 434 Perma-Shield H ₂ S	Duraplate 5900 Mortar

COATING CODE	GENERIC DESCRIPTION	MANUFACTURER	
		TNEMEC	SHERWIN WILLIAMS
HU	Hybrid Urethane	Series 740 UVX	Acrolon Ultra
MIO	MIO Polyurethane	Series 1 Omnithane	Corothane 1 MIO
MPE	Multi-Purpose Epoxy	Series N69 Hi-Build Epoxoline II	Macropoxy 646
MTEP	Moisture-Tolerant Epoxy Primer	Series 201 Epoxoprime	Corobond 100
SCE	Secondary Containment Epoxy	Series 237SC Chembloc	Cor Cote HP
SCEP	Secondary Containment Epoxy Primer	Series 206SC Chembloc	GP3552
STEP	Surface-Tolerant Epoxy Primer	Series 135 Chembuild	Macropoxy 646
UHSE	Ultra-High Solids Epoxy (NSF 61)	Series 22 Epoxoline	Duraplate UHS
VEP	Vinyl Ester Primer	Series 251SC Chembloc	Corobond Vinyl Ester Primer
VESC	Vinyl Ester Secondary Containment	Series 252SC Chembloc	Cor Cote VEN FF
ZRU	Zinc-Rich Urethane	Series 94-H ₂ O Hydro-Zinc	Corothane 1 Galvapak Zinc

E. High Temperature Coatings:

COATING CODE	GENERIC DESCRIPTION	MANUFACTURER		
		PPG	TNEMEC	SHERWIN WILLIAMS
HTZRP	High Temperature Zinc Rich Primer	Dimetcote 9 Series	Series 1505 Endura-Heat ZR	Zinc Clad II Plus

2.3 COATING SYSTEMS:

A. The following tables indicate coating systems by material and environment, unless a specific application is indicated.

Environment/ Application	Surface Preparation	Prime Coat	Intermediate Coats	Finish Coat
Ferrous Metals (Structural & Miscellaneous Metals)				
Interior atmospheric	SSPC-SP 6/ NACE No. 3	3.0 to 4.0 MIL MPE	3.0 to 4.0 MIL MPE	3.0 to 4.0 MIL MPE
Interior atmospheric (corrosive environment)	SSPC-SP 10/ NACE No. 2, min. 2 MIL anchor profile	2.5 to 3.5 MIL ZRU	3.0 to 4.0 MIL MPE	3.0 to 4.0 MIL MPE

Environment/ Application	Surface Preparation	Prime Coat	Intermediate Coats	Finish Coat
Immersion - Wastewater	SSPC-SP 10/ NACE No. 2	3.0 to 4.0 MIL MPE		12 to 16 MIL GFRE
Immersion - Wastewater (abrasion resistant)	SSPC-SP 10/ NACE No. 2 min. 3 MIL anchor profile	15 to 20 MIL AREL		15 to 20 MIL AREL
Immersion - non NSF	SSPC-SP 10/ NACE No. 2	3.0 to 4.0 MIL MPE	3.0 to 4.0 MIL MPE	3.0 to 4.0 MIL MPE
Exterior atmospheric	SSPC-SP 6/ NACE No. 3	2.5 to 3.5 MIL ZRU	3.0 to 5.0 MIL MPE	2.5 to 3.5 MIL HU
Galvanized Steel				
Interior atmospheric	SSPC-SP 16	4.0 to 6.0 MIL STEP		2.0 to 3.0 MIL MPE
Immersion - non NSF	SSPC-SP 16	4.0 to 6.0 MIL STEP	2.0 to 3.0 MIL MPE	2.0 to 3.0 MIL MPE
Exterior atmospheric	SSPC-SP 16	4.0 to 6.0 MIL STEP		2.5 to 3.5 MIL HU
Field cut pipe threads	SSPC-SP 3	4.0 to 6.0 MIL STEP	Coat per exposure above	Coat per exposure above
Non Ferrous Metals, including piping				
Dissimilar Materials Protection	SSPC-SP 2	4.5 to 5.5 MIL MPE		
Interior atmospheric	SSPC-SP 2	3.0 to 4.0 MIL MPE		3.0 to 4.0 MIL MPE
Immersion - Wastewater	SSPC-SP 16	3.0 to 4.0 MIL MPE		5.0 to 6.0 MIL MPE
Immersion - Wastewater (abrasion resistant)	SSPC-SP 16			40 to 45 MIL AREL
Immersion - non NSF	SSPC-SP 16	3.0 to 4.0 MIL MPE		5.0 to 6.0 MIL MPE
Exterior atmospheric	SSPC-SP 2	4.0 to 6.0 MIL MPE		2.5 to 3.5 MIL HU
Ferrous Piping				
Interior atmospheric	SSPC-SP 6/ NACE No. 3	2.5 to 3.5 MIL ZRU	3.0 to 4.0 MIL MPE	3.0 to 4.0 MIL MPE
Immersion - Wastewater	SSPC-SP 10/ NACE No. 2	3.0 to 4.0 MIL MPE		12 to 16 MIL GFRE
Immersion - Wastewater (abrasion resistant)	SSPC-SP 10/ NACE No. 2, min 3 MIL anchor profile	15 to 20 MIL AREL		15 to 20 MIL AREL

Environment/ Application	Surface Preparation	Prime Coat	Intermediate Coats	Finish Coat
Immersion - non NSF	SSPC-SP 5/ NACE No.1	3.0 to 4.0 MIL MPE	3.0 to 4.0 MIL MPE	3.0 to 4.0 MIL MPE
Exterior atmospheric	SSPC-SP 10/ NACE No. 2	2.5 to 3.5 MIL ZRU	3.0 to 4.0 MIL MPE	2.5 to 3.5 MIL HU
Ductile Iron Piping				
Interior atmospheric	Pipe: NAPF 500-03-04 Fittings: NAPF 500-03-05	3.0 to 4.0 MIL MPE	3.0 to 4.0 MIL MPE	3.0 to 4.0 MIL MPE
Immersion - Wastewater	Pipe: NAPF 500-03-04 Fittings: NAPF 500-03-05	3.0 to 4.0 MIL MPE		12 to 16 MIL GFRE
Immersion - Wastewater (abrasion resistant)	Pipe: NAPF 500-03-04 Fittings: NAPF 500-03-05	15 to 20 MIL AREL		15 to 20 MIL AREL
Immersion - non NSF	Pipe: NAPF 500-03-04 Fittings: NAPF 500-03-05	3.0 to 4.0 MIL MPE	3.0 to 4.0 MIL MPE	3.0 to 4.0 MIL MPE
Exterior atmospheric	Pipe: NAPF 500-03-04 Fittings: NAPF 500-03-05	3.0 to 4.0 MIL MPE	3.0 to 4.0 MIL MPE	2.5 to 3.5 MIL HU

Environment/ Application	Surface Preparation	Filler/Surfacers	Prime Coat	Intermediate Coat(s)	Finish Coat
Concrete*					
Walls, ceilings, and appurtenant surfaces Interior atmospheric	SSPC-SP 13/ NACE No. 6 ICRI CSP 5	ESF and/or EMM as necessary to fill holes and depressions	250 to 300 SQFT/GAL MPE		250 to 300 SQFT/GAL MPE
Interior floors	SSPC-SP 13/ NACE No. 6 ICRI CSP 5	ESF as necessary to fill holes and depressions	175 to 225 SQFT/GAL EF clear	200 to 250 SQFT/GAL EF pigmented	200 to 250 SQFT/GAL EF pigmented
			broadcast slip-resistant aggregate into wet intermediate coat on walking surfaces		
Interior Safety Striping	SSPC-SP 13/ NACE No. 6 ICRI CSP 3	ESF and/or EMM as necessary to fill holes and depressions			6.0 to 8.0 MIL EF Pigmented

Environment/ Application	Surface Preparation	Filler/Surfacer	Prime Coat	Intermediate Coat(s)	Finish Coat
Interior - Secondary Containment	SSPC-SP 13/ NACE No. 6 ICRI CSP 5	ESF and/or EMM as necessary to fill holes and depressions	6.0 to 8.0 MIL MTEP	60 to 80 MIL SCEP Fiberglass mat Saturated with 8.0 to 12 MILS SCE	10 to 12 MIL SCE
Immersion - non NSF	SSPC-SP 13/ NACE No. 6 ICRI CSP 5	1/16 to 1/4 IN EMM			16 to 20 MIL UHSE
Immersion - Wastewater (Abrasion Resistant)	SSPC-SP 13/ NACE No. 6 ICRI CSP 5	1/16 to 1/4 IN EMM	1/8 IN HREM		15 to 25 MIL AREL
Exterior atmospheric Corrosive Environment	SSPC-SP 13/ NACE No. 6 ICRI CSP 5	ESF and/or EMM as necessary to fill holes and depressions	150 to 175 SQFT/GAL AAE		150 to 175 SQFT/GAL AAE
Exterior - Secondary Containment	SSPC-SP 13/ NACE No. 6 ICRI CSP 5	ESF and/or EMM as necessary to fill holes and depressions	6.0 to 8.0 MIL MTEP	60 to 80 MIL SCEP Fiberglass mat Saturated with 8.0 to 12 MILS SCE	10 to 12 MIL SCE 20. to 3.0 MIL CRU

* For repair of deteriorated existing concrete, provide additional surface preparation as specified in PREPARATION article in this Specification Section.

Environment/ Application	Surface Preparation	Filler/Surfacer	Prime Coat	Intermediate Coat(s)	Finish Coat
CMU*					
Interior atmospheric	Refer to PART 3	100 to 150 SQFT/Gal EBF	175 to 200 SQFT/Gal MPE		175 to 200 SQFT/Gal MPE
Exterior atmospheric Corrosive Environment	Refer to PART 3	100 to 150 SQFT/Gal EBF	175 to 200 SQFT/Gal MPE		275 to 300 SQFT/Gal HU
Exterior atmospheric Non-Corrosive Environment	Refer to Specification Section 09 91 10 Architectural Painting				

B. * Coverage rates indicated are based on smooth-face normal weight CMU. Provide increased coverage rates in accordance with manufacturer's recommendations for more porous surfaces.

2.4 DIGESTER INTERIOR CONCRETE COATING SYSTEMS:

A. The following coating systems for all interior concrete above the elevations shown in the drawings for Digester 4 are:

1. Raven 405 System:
 - a. Blast to remove all laitance to sound concrete to a minimum CSP3.
 - b. Apply three 5 mil applications of 155 or 175 primer.
 - c. Surface profile shall be CSP 3-6, 120 mils DFT of Raven 405.
 - d. If surface profile of CSP 7 or greater, 180 mils DFT minimum back roll/trowel to fill depressions.

2. Sherwin Williams System:
 - a. Blast to remove all laitance to sound concrete to a minimum CSP3.
 - b. Surface profile shall be CSP 3-5, Sherwin Williams Dura-Plate 6000 at 120 mils DFT, minimum.
 - c. If surface profile of CSP 5 or greater, coat areas greater than CSP 5 to fill areas with coating and then coat all surfaces to a minimum of 120 mils DFT.

PART 3 - EXECUTION

3.1 ITEMS TO BE COATED

- A. Exterior Surfaces, including but not limited to:
 1. Concrete:
 - a. Components of concrete tankage:
 - 1) Walls, columns, beams:
 - a) Coat from 1 FT below low water level to top of component.
 - 2) Troughs, launders, weirs.
 - 3) Underside of concrete walkways within 2 FT of high water level.
 - b. Secondary containment enclosures.
 - c. Chemical fill stations.
 - 1) Paving where indicated on Drawings.
 - 2) Spill containment sumps.
 2. Concrete masonry:
 - a. Where indicated on Drawings.
 3. Piping, valves, fittings, hydrants and supports:
 - a. As scheduled in Specification Section 4005 00.
 4. Ferrous metal tankage.
 5. Ferrous metal process equipment.
 - a. Equipment bridges.
 - b. Gates and operators.
 6. Structural steel:
 - a. Columns, beams and bracing.
 - b. Field welded connections of factory coated structural steel.
 7. Miscellaneous ferrous metal surfaces:
 - a. Items specifically noted on Drawings to be coated.
 8. Miscellaneous galvanized steel surfaces:
 - a. Pipe Bollards.
 - b. Embed Plates.
 - c. Loose lintels.
 - d. Steel components of concrete lintels.
 - e. Items specifically noted on Drawings to be coated.
 9. Appurtenant surfaces attached to or adjacent to a surface indicated to be coated:
 - a. Conduit, boxes, covers and supports.
- B. Interior Areas:
 1. Refer to Room Finish Schedule on Drawings.
 - a. If space is scheduled to be coated, coat all appurtenant surfaces within the space unless specifically noted otherwise. Appurtenant surfaces include but are not limited to:
 - 1) Columns.
 - 2) Equipment pads.
 - 3) Equipment supports.
 - 4) Underside of roof or floor decks above:
 - a) Including semi-exposed or concealed from view unless noted otherwise.
 - 5) Conduit, boxes, covers and supports.
 - 6) Miscellaneous ferrous metal surfaces.

2. Concrete:
 - a. Components of concrete tankage:
 - 1) Walls, columns, beams:
 - a) Coat from 1 FT below low water level to top of component.
 - 2) Troughs, launders, weirs.
 - 3) Underside of concrete walkways within 2 FT of high water level.
 - b. Chemical storage areas:
 - c. Chemical storage areas:
 - 1) Flooring where scheduled or indicated on Drawings.
 - 2) Secondary containment enclosures.
3. Piping, valves, fittings, hydrants and supports:
 - a. Do not coat piping scheduled to be insulated.
4. Ferrous metal tankage.
5. Ferrous metal process equipment.
 - a. Equipment bridges.
 - b. Gates and operators.
 - c. Items specifically noted on Drawings to be coated.
6. Miscellaneous galvanized steel surfaces:
 - a. Pipe Bollards.
 - b. Embed Plates.
 - c. Loose lintels.
 - d. Steel components of concrete lintels.
 - e. Seismic angles at masonry partitions.
 - f. Items specifically noted on Drawings to be coated.
7. Safety Striping:
 - a. Equipment Pads: Coat vertical face and return 3 IN onto horizontal surface of pad.
 - b. Pipe supports, columns, piers and similar vertical elements: Coat embedded galvanized steel armoring angles.
 - c. As shown on Drawings.

3.2 ITEMS NOT TO BE COATED

- A. General: Do not coat items listed in this Article, unless noted otherwise.
- B. Items with Approved Factory Finish: These items may require repair of damaged coated areas or coating of welded connections.
- C. Electrical Equipment.
- D. Moving parts of mechanical and electrical units where coating would interfere with the operation of the unit.
- E. Code labels, equipment identification or rating plates and similar labels, tagging and identification.
- F. Contact surfaces of friction-type structural connections.
- G. Stainless Steel Surfaces, except:
 1. Dissimilar metals in immersion service.
 2. Piping where specifically noted to be coated.
 3. Banding as required to identify piping.
- H. Aluminum Surfaces, except:
 1. Where specifically shown in the Contract Documents.
 2. Where in contact with concrete.
 3. Where in contact with dissimilar metals.
 4. Appurtenant surfaces as described in the ITEMS TO BE COATED article.
- I. Fiberglass Surfaces, except:
 1. Fiberglass piping where specifically noted to be coated.

2. Piping supports where specifically noted to be coated.
 3. Appurtenant surfaces as described in the ITEMS TO BE COATED article.
- J. Mechanical piping scheduled to be insulated.
- K. Interior of Pipe, Ductwork, and Conduits.
1. See Division 23 for ductwork.
 2. See Division 40 for pipe linings.
- L. Galvanized Steel Items, unless specifically noted to be coated.
- M. Architectural Finishes:
1. Exterior concrete indicated to receive another finish.
 2. Precast concrete surfaces, unless specifically indicated to be coated.
 3. Prefinished masonry surfaces:
 - a. Pre-colored masonry (exterior face).
 - 1) Interior face shall be coated where scheduled.
 - b. Burnished (ground face) concrete masonry.
 - c. Prefaced masonry.
 - d. Face brick.
 - e. Glass masonry.
 4. Plastic laminate.
 5. Solid surface material.
 6. Standing and running trim.
 7. Fiberglass fabrications.
 8. Anodized aluminum.
 9. PVDF coated metals.
 10. Factory finished doors and frames.
 11. Aluminum windows, curtainwall and storefront framing systems.
 12. Finish hardware.
 13. Glass and glazing.
 14. Ceramic, porcelain, quarry tile or natural stone.
 15. Acoustical materials.
 16. Building specialties.
 17. Louvers.
 18. Casework and countertops.
 19. Pipe insulation and jacketing.
 20. Standing seam metal roof, fascia, trim, soffit and accessories.

3.3 EXAMINATION

- A. Concrete:
1. Test pH of surface to be coated in accordance with ASTM D4262.
 - a. If surface pH is not within coating manufacturer's required acceptable range, use methods acceptable to coating manufacturer as required to bring pH within acceptable range.
 - b. Retest pH until acceptable results are obtained.
 2. Verify that moisture content of surface to be coated is within coating manufacturer's recommended acceptable limits.
 - a. Test surface to be coated in accordance with ASTM D4263 to determine the presence of moisture.
 - 1) If moisture is detected, test moisture content of surface to be coated in accordance with ASTM F1869 or ASTM F2170.
 - 2) Provide remedial measures as necessary to bring moisture content within coating manufacturer's recommended acceptable limits.
 - 3) Retest surface until acceptable results are obtained.
- B. Concrete Unit Masonry:
1. Test pH of surface to be coated in accordance with ASTM D4262.

- a. If surface pH is not within coating manufacturer's required acceptable range, use methods acceptable to coating manufacturer as required to bring pH within acceptable limits.
- b. Retest pH until acceptable results are obtained.
2. Verify that moisture content of surface to be coated is within coating manufacturer's recommended acceptable limits.
 - a. Test surface to be coated in accordance with ASTM D4263 to determine the presence of moisture.
 - 1) If moisture is detected, test moisture content of surface to be coated in accordance with ASTM F1869.
 - 2) Provide remedial measures as necessary to bring moisture content within coating manufacturer's recommended acceptable limits.
 - 3) Retest surface until acceptable results are obtained.

3.4 PREPARATION

A. General:

1. Prepare surfaces to be coated in accordance with coating manufacturer's instructions and this Specification Section unless noted otherwise in this Specification Section.
 - a. Where discrepancy between coating manufacturer's instructions and this Specification Section exists, the more stringent surface preparation shall be provided unless approved otherwise, in writing, by the Engineer.
2. Remove all dust, grease, oil, compounds, dirt and other foreign matter which would prevent bonding of coating to surface.
3. Adhere to manufacturer's recoat time surface preparation requirements.
 - a. Surfaces that have exceeded coating manufacturer's published recoat time and/or have exhibited surface chalking shall be prepared prior to additional coating in accordance with manufacturer's published recommendations.
 - 1) Minimum SSPC-SP 7/ NACE No. 4 unless otherwise approved by Engineer.

B. Protection:

1. Protect surrounding surfaces not to be coated.
2. Remove and protect hardware, accessories, plates, fixtures, finished work, and similar items; or provide ample in-place protection.
3. Protect code labels, equipment identification or rating plates and similar labels, tagging and identification.

C. Prepare and coat before assembly all surfaces which are inaccessible after assembly.

D. Ferrous Metal:

1. Prepare ductile iron pipe in accordance with pipe manufacturer's recommendations and NAPF.
 - a. All piping, pumps, valves, fittings and any other component used in the water piping system that requires preparation for coating shall be prepared in accordance with requirements for immersion service.
 - b. Prepare all areas requiring patch coating in accordance with recommendations of manufacturer and NAPF.
 - c. Remove bituminous coating per piping manufacturer, coating manufacturer and NAPF recommendations.
 - 1) The most stringent recommendations shall apply.
2. Complete fabrication, welding or burning before beginning surface preparation.
 - a. Chip or grind off flux, spatter, slag or other laminations left from welding.
 - b. Remove mill scale.
 - c. Grind smooth rough welds and other sharp projections.
3. Solvent clean in accordance with SSPC-SP 1.
4. Restore surface of field welds and adjacent areas to original surface preparation.

E. Galvanized Steel and Non-ferrous Metals:

1. Solvent clean in accordance with SSPC-SP 1 followed by brush-off blast clean in accordance with SSPC-SP 16 to remove zinc oxide and other foreign contaminants.
 - a. Provide uniform 1 MIL profile surface.
- F. Concrete:
1. Cure for minimum of 28 days.
 2. Concrete surfaces shall be cleaned in accordance with ASTM D4258.
 3. Abrasive blast concrete surfaces in accordance with ASTM D4259 and SSPC-SP 13/ NACE No. 6.
 - a. Provide profile per ICRI 301.2 as listed in MATERIALS article of this Specification Section.
 4. Test pH and moisture content in accordance with EXAMINATION article in this Specification Section.
- G. Concrete Masonry:
1. Cure for minimum of 28 days.
 2. Remove all mortar spatters and protrusions.
 3. Clean concrete masonry in accordance with Specification ASTM D4261.
 4. Test pH and moisture content in accordance with EXAMINATION article in this Specification Section.
- H. Preparation by Abrasive Blasting:
1. Schedule the abrasive blasting operation so blasted surfaces will not be wet after blasting and before coating.
 2. Provide compressed air for blasting that is free of water and oil.
 - a. Provide accessible separators and traps.
 3. Protect nameplates, valve stems, rotating equipment, motors and other items that may be damaged from blasting.
 4. All abrasive-blasted ferrous metal surfaces shall be inspected immediately prior to application of coatings.
 - a. Inspection shall be performed to determine cleanliness and profile depth of blasted surfaces and to certify that surface has been prepared in accordance with these Specifications.
 5. Perform additional blasting and cleaning as required to achieve surface preparation required.
 - a. Re-blast surfaces not meeting requirements of these Specifications.
 - b. Prior to coating, re-blast surfaces allowed to set overnight and surfaces that show rust bloom.
 - c. Surfaces allowed to set overnight or surfaces which show rust bloom prior to coating shall be re-inspected prior to coating application.
 6. Profile depth of blasted surface: Not less than 1 MIL or greater than 2 MILS unless required otherwise by coating manufacturer.
 7. Ensure abrasive blasting operation does not result in embedment of abrasive particles in coating.
 8. Confine blast abrasives to area being blasted.
 - a. Provide shields of polyethylene sheeting or other such barriers to confine blast material.
 - b. Plug pipes, holes, or openings before blasting and keep plugged until blast operation is complete and residue is removed.
 9. Abrasive blasting media may be recovered, cleaned and reused providing Contractor submits, for Engineer's review, a comprehensive recovery plan outlining all procedures and equipment proposed in reclamation process.
 10. Properly dispose of blasting material contaminated with debris from blasting operation.
- I. All Plastic Surfaces:
1. Sand using 80-100 grit sandpaper to scarify surfaces.

3.5 APPLICATION

A. General:

1. Thin, mix and apply coatings by brush, roller, or spray in accordance with manufacturer's installation instructions.
 - a. Application equipment must be inspected and approved in writing by coating manufacturer.
 2. Temperature and weather conditions:
 - a. Do not coat surfaces when surface temperature is below 50 DEGF unless product has been formulated specifically for low temperature application and application is approved in writing by Engineer and coating manufacturer's technical representative.
 - b. Avoid coating surfaces exposed to hot sun.
 - c. Do not coat damp surfaces.
 - d. Apply coating to concrete or masonry surfaces in descending temperatures, in accordance with coating manufacturer's application instructions.
 3. Apply materials under adequate illumination.
 4. Provide complete coverage to MIL thickness specified.
 - a. Thickness specified is dry MIL thickness.
 5. Evenly spread to provide full, smooth coverage.
 - a. All coating systems are "to cover."
 - 1) In situations of discrepancy between manufacturer's square footage coverage rates and MIL thickness, MIL thickness requirements govern.
 - b. When color or undercoats show through, apply additional coats until coating is of uniform finish and color.
 - c. Finished coating system shall be uniform and without voids, bugholes, holidays, laps, brush marks, roller marks, runs, sags or other imperfections.
 6. If so directed by Engineer, do not apply consecutive coats until Engineer has had an opportunity to observe and approve previous coats.
 7. Work each application of material into corners, crevices, joints, and other difficult to work areas.
 8. Provide coating manufacturer's recommended details at all terminations, penetrations, embedments, cracks, joints and changes in substrate direction.
 9. Avoid degradation and contamination of blasted surfaces and avoid inter-coat contamination.
 - a. Clean contaminated surfaces before applying next coat.
 - b. Intercoat surface cleanliness shall be inspected and approved by the Engineer prior to application of each coat.
 10. Smooth out runs or sags immediately, or remove and recoat entire surface.
 11. Allow preceding coats to dry before recoating.
 - a. Recoat within time limits specified by coating manufacturer.
 - b. If recoat time limits have expired re-prepare surface in accordance with coating manufacturer's printed recommendations.
 12. Allow coated surfaces to cure prior to allowing traffic or other work to proceed.
 13. Coat all aluminum in contact with dissimilar materials.
 14. When coating rough surfaces which cannot be backrolled sufficiently, hand brush coating to work into all recesses provided that the maximum DFT is not exceeded.
 15. Backroll surfaces if coatings are spray applied.
- B. Employ services of coating manufacturer's technical representative to ensure that field-applied coatings are compatible with factory-applied or existing coatings.
1. Certify through material data sheets.
 2. Perform test patch.
 - a. Prepare existing coating surface to receive specified coating system.
 - b. Apply coating to a minimum 1 SQFT area and allow to cure in accordance with manufacturer's recommendations.
 - c. Evaluate adhesion to existing coating:
 - 1) Concrete or Masonry substrates: ASTM D4541.
 - 2) All other substrates: ASTM D6677 and ASTM D3359 (X-cut method).

3. If field-applied coating is found to be not compatible, require the coating manufacturer's technical representative to recommend, in writing, product to be used as barrier coat, thickness to be applied, surface preparation and method of application.
 - a. Perform test patch as described above.
 4. At Contractor's option, coatings may be removed, surface re-prepared, and new coating applied using a appropriate coating system listed in the MATERIALS Article, Coating Systems paragraph of this Specification Section.
 - a. All damage to surface as result of coating removal shall be repaired to original condition or better by Contractor at no additional cost to Owner.
- C. Prime Coat Application:
1. Apply structural steel and miscellaneous steel prime coat in the factory.
 - a. Finish coats shall be applied in the Shop.
 - b. Prime coat referred to here is prime coat as indicated in this Specification.
 - 1) Prime coating applied in factory (shop) as part of Fabricator's standard rust inhibiting and protection coating is not acceptable as replacement for specified prime coating.
 - c. Application of all factory-applied coatings(s) on structural steel and miscellaneous steel and steel joist shall be continually observed and certified by NACE coatings inspector.
 2. Prime all surfaces indicated to be coated.
 - a. Apply prime coat in accordance with coating manufacturer's written instructions and as written in this Specification Section.
 3. Prime ferrous metals embedded in concrete to minimum of 1 IN below exposed surfaces.
 4. Apply zinc-rich primers while under continuous agitation.
 5. Brush or spray bolts, welds, edges and difficult access areas with primer prior to primer application over entire surface.
 6. Touch up damaged primer coats prior to applying finish coats.
 - a. Restore primed surface equal to surface before damage.
 7. All surfaces of steel lintels and steel components of concrete lintels used in wall construction shall be completely coated with both prime and finish coats prior to placing in wall.
- D. Finish Coat Application:
1. Apply finish coats in accordance with coating manufacturer's written instructions and in accordance with this Specification Section; manufacturer instructions take precedent over these Specifications.
 2. Touch up damaged finish coats using same application method and same material specified for finish coat.
 - a. Prepare damaged area in accordance with the PREPARATION Article of this Specification Section.

3.6 DIGESTER INTERIOR COATINGS APPLICATION

A. ITEMS TO BE COATED

1. Miscellaneous ferrous metal surfaces:
 - a. Items specifically noted on Drawings to be coated.
2. Interior Areas:
 - a. Refer to Digester Interior Areas to be coated as shown on the Drawings.
 - b. If space is scheduled to be coated, coat all appurtenant surfaces within the space unless specifically noted otherwise. Appurtenant surfaces include but are not limited to:
 - 1) Columns.
 - 2) Beams
 - 3) Walls
 - 4) Underside of roof or floor decks above:
 - a) Including semi-exposed or concealed from view unless noted otherwise.
 - 5) Conduit, boxes, covers and supports.
 - 6) Miscellaneous ferrous metal surfaces.

- c. Concrete:
 - 1) Components of concrete tankage:
 - 2) Walls, columns, underside of roof (ceiling), beams:
 - a) Coat interior surfaces including underside of roof (ceiling), walls and appurtenances to below low water level as shown on the Drawings.
 - d. Piping, valves, fittings, hydrants and supports:
 - e. Ferrous metal process equipment.
 - f. Other items specifically noted on Drawings to be coated.
- 3. Stripe Coating:
 - 4. Prior to applying surface coating, stripe coat all areas that have an intersection angle of 120 degrees or less. Fill all voids at corners prior to coating application

3.7 COLOR CODING

- A. Color code piping in accordance with the SCHEDULE Article of this Specification Section.

3.8 FIELD QUALITY CONTROL

- A. Application Deficiencies:
 - 1. Surfaces showing runs, laps, brush marks, telegraphing of surface imperfections or other defects will not be accepted.
 - 2. Surfaces showing evidence of fading, chalking, blistering, delamination or other defects due to improper surface preparation, environmental controls or application will not be accepted.
 - a. Epoxy surfaces showing evidence of chalking or amine blush shall be prepared and recoated as follows:
 - 1) Solvent clean surfaces in accordance with SSPC-SP1 and a abrasive blast in accordance with SSPC-SP7/ NACE No. 4.
 - 2) Recoat with intermediate and finish coats in accordance with coating system specified herein.
- B. Provide protection for coated surfaces.
 - 1. Surfaces showing soiling, staining, streaking, chipping, scratches, or other defects will not be accepted.
- C. Contractor Performed Testing:
 - 1. Provide ongoing testing and inspection, including but not limited to the following:
 - a. Measurement and recording of environmental conditions as specified herein.
 - b. Measurement and recording of substrate conditions as specified herein.
 - c. Thickness Testing:
 - 1) Wet film thickness during application in accordance with ASTM D4414.
 - 2) Dry Film Thickness (DFT) in accordance with SSPC-PA 2.
 - 3) Engineer may measure coating thickness at any time during project to assure conformance with these Specifications.
 - d. Bond Strength:
 - 1) Bond strength testing will be required by the Engineer or Owner where there is reason to suspect the integrity of the coating system.
 - 2) Measure bond strength of the coating in accordance with:
 - a) Steel substrate: ASTM D4541.
 - b) Concrete substrate ASTM D7234.
 - 3) The number of test sites and locations to be tested shall be determined by the Engineer or Owner after application of coating. The Contractor will apply the dollies, perform the tests and repair the coating in the presence of the Engineer or Owner.
 - a) For each test that fails, two additional tests shall be performed in the adjacent area.
 - b) Further bond tests may be performed to determine the extent of potentially deficient bonded areas at no additional cost to the Owner.

- 4) Repairs shall be made by applicator in strict accordance with manufacturer's recommendations. Any coated areas that do not pass the bond strength tests shall be removed and replaced at the expense of the Contractor.

D. NACE inspection:

1. The Owner reserves the right to retain a NACE Level 3 coating inspector to perform observation, inspection and testing as deemed necessary to document the quality of the Work.
 - a. All work shall be done to the satisfaction of the Owner's inspector.
 - b. Any portion of the coating that does not satisfactorily pass the inspection and testing requirements shall be repaired or replaced by the Contractor at no additional cost to the Owner.
 - c. Additional testing and/or inspection may be done at the discretion of the Owner.
 - 1) The Contractor will provide all equipment, materials, and labor to perform the testing.
2. Inspection, testing or observation by the Owner's inspector shall not relieve the Contractor of responsibility for surface preparation, inspection or quality control specified herein.

E. Instrumentation:

1. Provide instrumentation as necessary to measure and record atmospheric and substrate conditions, including but not limited to:
 - a. Dry Film Thickness Gauge:
 - 1) Ultrasonic: ASTM D6132.
 - 2) Magnetic: ASTM B499.
 - b. Wet Film Thickness Gauge: ASTM D4414.
 - c. Sling Psychrometer: ASTM E337.
 - d. Surface Temperature Gauge.
 - e. Anemometer.
 - f. Moisture Meter.
 - g. Adhesion test apparatus:
 - 1) Steel: ASTM D4541.
 - 2) Concrete: ASTM D7234.

F. Maintain Daily Records:

1. Record the following information during application:
 - a. Date, starting time, end time, and all breaks taken by applicators.
 - b. Air temperature.
 - c. Relative humidity.
 - d. Dew point.
 - e. Moisture content and pH level of concrete or masonry substrates prior to coating.
 - f. Surface temperature of substrate.
 - g. Provisions utilized to maintain work area within manufacturer's recommended application parameters including temporary heating, ventilation, cooling, dehumidification and provisions utilized to mitigate wind-blown dust and debris from contaminating the wet coating.
 - h. For exterior coating, also record:
 - 1) Sky condition.
 - 2) Wind speed and direction.
 - i. Record environmental conditions, substrate moisture content and surface temperature information not less than once every 4 HRS during application.
 - 1) Record hourly when temperatures are below 50 DEGF or a bove 100 DEGF.
2. Record the following information daily for the coating manufacturer's recommended curing period:
 - a. Date and start time of cure period for each item or area.
 - b. For exterior coating, also record:
 - 1) Sky conditions.
 - 2) Wind speed and direction.

- 3) Air temperature.
 - a) Dry Bulb.
 - b) Wet Bulb.
 - 4) Relative humidity.
 - 5) Dew point.
 - 6) Surface temperatures.
 - c. Record environmental conditions not less than once every 4 HRS.
 - 1) Record hourly when temperatures are below 50 DEGF or above 100 DEGF.
 - d. Provisions utilized to protect each item or area and to maintain areas within manufacturer's recommended curing parameters.
3. Format for daily record to be computer generated.
- G. Provide wet paint signs.

3.9 CLEANING

- A. Clean coating spattered surfaces.
 - 1. Use care not to damage finished surfaces.
- B. Upon completion of coating, replace hardware, accessories, plates, fixtures, and similar items.
- C. Remove surplus materials, scaffolding, and debris.

3.10 COLOR SCHEDULE

- A. Pipe Bollards: 02SF Safety Yellow.

3.11 SUPPLEMENTAL INFORMATION

- A. The following submittals are attached as supplemental information to this specification section requirements.
- B. Contractor shall submit the following information at the time of Bid and as a submittal during construction:
 - 1. Exhibit A Painting Contractor Questionnaire (To be submitted with Bid and Shop Drawing Submittals)
 - 2. Exhibit B-Coating Manufacturers Certification

END OF SECTION

EXHIBIT A
PAINTING CONTRACTOR QUESTIONNAIRE
(TO BE SUPPLIED WITH BID AND SHOP DRAWING SUBMITTALS)

Contractor Name: _____

Address: _____

Telephone: _____

Contact: _____

INSTRUCTIONS TO CONTRACTOR: LIST EQUIPMENT AND PERSONNEL TO BE ASSIGNED TO THIS PROJECT IF YOU ARE THE SUCCESSFUL BIDDER.

I. COMPRESSED AIR

A. Air Compressors

1. Manufacturer _____

Type: Screw _____ Piston _____ Rotary _____

Flow Rate _____ CFM Pressure _____ PSI

How Many _____

2. Manufacturer _____

Type: Screw _____ Piston _____ Rotary _____

Flow Rate _____ CFM Pressure _____ PSI

How Many _____

B. Compressed Air Surge Tanks

1. Size _____ Cu. Ft. (7.48 Gal = 1.0 Cu. Ft.)

2. Size _____ Cu. Ft.

C. Compressed Air Oil Filters

1. Size _____ Sq. Ft. of Filter Area

2. Size _____ Sq. Ft. of Filter Area

3. Size _____ Sq. Ft. of Filter Area

4. Size _____ Sq. Ft. of Filter Area

- D. Compressed Air Dryers
1. Refrigeration Type – How Many _____
 Size _____ CFM Design Flow Rate
 _____ BTU/Hr. (12,000 BTU/Hr. = 1.0 Ton)
 2. Desiccant Type – How Many _____
 Size _____ Cubic Feet.

- E. Compressed Air Hose
1. Length _____ Ft. Dia _____ Inches
 2. Length _____ Ft. Dia _____ Inches
 3. Length _____ Ft. Dia _____ Inches
 4. Length _____ Ft. Dia _____ Inches
 5. Length _____ Ft. Dia _____ Inches

II. SAND BLAST EQUIPMENT

- A. Sand Blast Hose
1. Length _____ Ft. Dia _____ Inches
 2. Length _____ Ft. Dia _____ Inches
 3. Length _____ Ft. Dia _____ Inches

- B. Sand Blast Nozzles
1. Size _____ Inside Dia. Type- venturi or straight: No. Units: _____
 2. Size _____ Inside Dia. Type- venturi or straight: No. Units: _____
 3. Size _____ Inside Dia. Type- venturi or straight: No. Units: _____
 4. Size _____ Inside Dia. Type- venturi or straight: No. Units: _____

- C. Sand Blast Post
1. Size _____ Cu. Ft. No. Units _____
 2. Size _____ Cu. Ft. No. Units _____
 3. Size _____ Cu. Ft. No. Units _____

D. Deadman Controls - No. Units _____

E. Air Fed Sandblast Hoods – No Units _____

III. COATING OR PAINT APPLICATION EQUIPMENT

A. Airless Paint Pumps

- 1. Mfg. _____ Ratio _____ Flow _____ GPM
- 2. Mfg. _____ Ratio _____ Flow _____ GPM
- 3. Mfg. _____ Ratio _____ Flow _____ GPM

B. Airless Spray Guns

- 1. Mfg. _____ No Units _____
- 2. Mfg. _____ No Units _____

C. Power Paint Mixers

- 1. Air Driven Propeller Type – No. Units _____
- 2. Paint Can Shaker Type – No. Units _____

D. Air Spray Paint Pots

- 1. Size _____ Gal with Powermiser? YES or NO No. Units _____
- 2. Size _____ Gal with Powermiser? YES or NO No. Units _____

E. Air Spray Paint Guns

- 1. Mfg. _____ No Units _____
- 2. Mfg. _____ No Units _____

F. Solvent Vapor Respirators – No. Units _____

IV. VENTILATORS

A. Type _____ FAN or AIR HORN CFM _____

B. Type _____ FAN or AIR HORN CFM _____

C. Type _____ FAN or AIR HORN CFM _____

V. DEHUMIDIFICATION EQUIPMENT

- A. Mfg. _____ No. Units _____ Unit Capacity _____
- B. Mfg. _____ No. Units _____ Unit Capacity _____
- C. Mfg. _____ No. Units _____ Unit Capacity _____

VI. VACUUM RECOVERY EQUIPMENT

- A. Mfg. _____ No. Units _____ Amt. Of Recovery/Hr. _____
- B. Mfg. _____ No. Units _____ Amt. Of Recovery/Hr. _____
- C. Mfg. _____ No. Units _____ Amt. Of Recovery/Hr. _____

VII. PERSONNEL

- A. Foreman – Name _____ (attach resume)
- B. Lead Applicator – Name _____ (attach resume)
- C. Number of Sandblasters _____
- D. Number of Coaters _____
- F. Number of Helpers _____

VIII. EXPERIENCE IN PAINT AND COATING FOR OTHER MUNICIPAL WASTEWATER PROJECTS. LIST PREVIOUS PAINT AND COATING JOBS. SHOW MUNICIPAL CONTACT NUMBER, NAME OF MUNICIPAL'S INSPECTOR(S) ON JOB AND BRIEF DESCRIPTION OF ITEMS COATED.

**EXHIBIT B
COATING MANUFACTURERS CERTIFICATION**

Coating Manufacturer's Name: _____

Address: _____

Telephone: _____

Contact: _____

The below named coating applicator has attended our instruction/school for the application of the below listed coatings and is an acceptable coating contractor.

Coatings: _____

Coating Contractor: _____

Printed Name of Authorized Coating Manufacturer's Representative

Signature of Authorized Coating Manufacturer's Representative

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DIVISION 10

SPECIALTIES



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SECTION 10 14 00
IDENTIFICATION DEVICES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Tag, tape and stenciling systems for equipment, piping, valves, pumps, ductwork and similar items.
 - 2. Hazard and safety signs.
- B. Related Specification Sections include but are not necessarily limited to:
 - 1. Division 00 - Procurement and Contracting Requirements.
 - 2. Division 01 - General Requirements.

1.2 QUALITY ASSURANCE

- A. Referenced Standards:
 - 1. American Society of Mechanical Engineers (ASME):
 - a. A13.1, Scheme for the Identification of Piping Systems.
 - 2. The International Society of Automation (ISA).
 - 3. National Electrical Manufacturers Association/American National Standards Institute (NEMA/ANSI):
 - a. Z535.1, Safety Color Code.
 - b. Z535.2, Environmental and Facility Safety Signs.
 - c. Z535.3, Criteria for Safety Symbols.
 - d. Z535.4, Product Safety Signs and Labels.
 - 4. National Fire Protection Association (NFPA):
 - a. 70, National Electrical Code (NEC).
 - b. 704, Standard System for the Identification of Hazards of Materials for Emergency Response.
 - 5. Occupational Safety and Health Administration (OSHA):
 - a. 29 CFR 1910.145, Specification for Accident Prevention Signs and Tags.

1.3 SUBMITTALS

- A. Shop Drawings:
 - 1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
 - 2. Product technical data including:
 - a. Catalog information for all identification systems.
 - b. Acknowledgement that products submitted meet requirements of standards referenced.
 - 3. Identification register, listing all items in PART 3 of this Specification Section to be identified, type of identification system to be used, lettering, location and color.
 - 4. Schedule of Hazard and Safety Signage indicating text and graphics.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
 - 1. W.H. Brady Co.
 - 2. Panduit.
 - 3. Seton.
 - 4. National Band and Tag Co.

5. Carlton Industries, Inc.

B. Submit request for substitution in accordance with Specification Section 01 25 13.

2.2 MANUFACTURED UNITS

A. Type A1 - Round Metal Tags:

1. Materials:
 - a. Aluminum or stainless steel.
 - b. Stainless steel shall be used in corrosive environments.
2. Size:
 - a. Diameter: 1-1/2 IN minimum.
 - b. Thickness: 0.035 IN (20 GA) minimum.
3. Fabrication:
 - a. 3/16 IN minimum mounting hole.
 - b. Legend: Stamped and filled with black coloring.
4. Color: Natural.

B. Type A2 - Rectangle Metal Tags:

1. Materials: Stainless steel.
2. Size:
 - a. 3-1/2 IN x 1-1/2 IN minimum.
 - b. Thickness: 0.036 IN (20 GA) minimum.
3. Fabrication:
 - a. 3/16 IN minimum mounting hole.
 - b. Legend: Stamped and filled with black coloring.
4. Color: Natural.

C. Type A3 - Metal Tape Tags:

1. Materials: Aluminum or stainless steel.
2. Size:
 - a. Width 1/2 IN minimum.
 - b. Length as required by text.
3. Fabrication:
 - a. 3/16 IN minimum mounting hole.
 - b. Legend: Embossed.
4. Color: Natural.

D. Type B1 - Square Nonmetallic Tags:

1. Materials: Fiberglass reinforced plastic.
2. Size:
 - a. Surface: 2 x 2 IN minimum.
 - b. Thickness: 100 MILS.
3. Fabrication:
 - a. 3/16 IN mounting hole with metal eyelet.
 - b. Legend: Preprinted and permanently embedded and fade resistant.
4. Color:
 - a. Background: Manufacturer standard or as specified.
 - b. Lettering: Black.

E. Type B2 - Nonmetallic Signs:

1. Materials: Fiberglass reinforced or durable plastic.
2. Size:
 - a. Surface: As required by text.
 - b. Thickness: 60 MILS minimum.
3. Fabrication:
 - a. Rounded corners.
 - b. Drilled holes in corners with grommets.

- c. Legend: Preprinted, permanently embedded and fade resistant for a 10 year minimum outdoor durability.
 - 4. Color:
 - a. Background: Manufacturer standard or as specified.
 - b. Lettering: Black.
 - 5. Standards for OSHA signs: NEMA/ANSI Z535.1, NEMA/ANSI Z535.2, NEMA/ANSI Z535.3, NEMA/ANSI Z535.4, OSHA 29 CFR 1910.145.
- F. Type C - Laminated Name Plates:
 - 1. Materials: Phenolic or DR (high impact) acrylic.
 - 2. Size:
 - a. Surface: As required by text.
 - b. Thickness: 1/16 IN.
 - 3. Fabrication:
 - a. Outdoor rated and UV resistant when installed outdoors.
 - b. Two layers laminated.
 - c. Legend: Engraved through top lamination into bottom lamination.
 - d. Two drilled side holes, for screw mounting.
 - 4. Color: Black top surface, white core, unless otherwise indicated.
- G. Type D - Self-Adhesive Tape Tags and Signs:
 - 1. Materials: Vinyl tape or vinyl cloth.
 - 2. Size:
 - a. Surface: As required by text.
 - b. Thickness: 5 MILS minimum.
 - 3. Fabrication:
 - a. Indoor/Outdoor grade.
 - b. Weather and UV resistant inks.
 - c. Permanent adhesive.
 - d. Legend: Preprinted.
 - e. Wire markers to be self-laminating.
 - 4. Color: White with black lettering or as specified.
 - 5. Standards for OSHA signs: NEMA/ANSI Z535.1, NEMA/ANSI Z535.2, NEMA/ANSI Z535.3, NEMA/ANSI Z535.4, OSHA 29 CFR 1910.145.
- H. Type E - Heat Shrinkable Tape Tags:
 - 1. Materials: Polyolefin.
 - 2. Size: As required by text.
 - 3. Fabrication:
 - a. Legend: Preprinted.
 - 4. Color: White background, black printing.
- I. Type F - Underground Warning Tape:
 - 1. Materials: Polyethylene.
 - 2. Size:
 - a. 6 IN wide (minimum).
 - b. Thickness: 3.5 MILS.
 - 3. Fabrication:
 - a. Legend: Preprinted and permanently imbedded.
 - b. Message continuous printed.
 - c. Tensile strength: 1750 PSI.
 - 4. Color: As specified.
- J. Type G - Stenciling System:
 - 1. Materials:
 - a. Exterior type stenciling enamel.
 - b. Either brushing grade or pressurized spray can form and grade.
 - 2. Size: As required.

3. Fabrication:
 - a. Legend: As required.
 4. Color: Black or white for best contrast.
- K. Snap-Around Labeling System:
1. Material:
 - a. Interior/Exterior Conditions
 - b. Pipe Temperature Range (-40F to 248F)
 2. Over-laminated polyester construction
 3. Size: As Required
 4. Fabrication:
 - a. Legend: As Required and shown (refer to Pipe Schedule and Abbreviations)
 5. Color: Meet ANSI Guidelines
 6. Manufacturer: Seton, or equal.
- L. Underground Tracer Wire:
1. Materials:
 - a. Wire:
 - 1) 12 GA AWG.
 - 2) Solid.
 - b. Wire nuts: Waterproof type.
 - c. Split bolts: Brass.

2.3 ACCESSORIES

- A. Fasteners:
1. Bead chain: #6 brass, aluminum or stainless steel.
 2. Plastic strap: Nylon, urethane or polypropylene.
 3. Screws: Self-tapping, stainless steel.
 4. Adhesive, solvent activated.

2.4 MAINTENANCE MATERIALS

- A. Where stenciled markers are provided, clean and retain stencils after completion and include in extra stock, along with required stock of paints and applicators.

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION

- A. Install identification devices at specified locations.
- B. All identification devices to be printed by mechanical process, hand printing is not acceptable.
- C. Attach tags to equipment with sufficient surface or body area with solvent activated adhesive applied to back of each tag.
- D. Attach tags with 1/8 IN round or flat head screws to equipment without sufficient surface or body area, or porous surfaces.
 1. Where attachment with screws should not or cannot penetrate substrate, attach with plastic strap.
- E. Single items of equipment enclosed in a housing or compartment to be tagged on outside of housing.
 1. Several items of equipment mounted in housing to be individually tagged inside the compartment.
- F. Tracer Wire:
 1. Attach to pipe at a maximum of 10 FT intervals with tape or tie-wraps.
 2. Continuous pass from each valve box and above grade at each structure.
 3. Coil enough wire at each valve box to extend wire a foot above the ground surface.

4. 1,000 FT maximum spacing between valve boxes.
5. If split bolts are used for splicing, wrap with electrical tape.
6. If wire nuts are used for splicing, knot wire at each splice point leaving 6 IN of wire for splicing.
7. Use continuous strand of wire between valve box where possible.
 - a. Continuous length shall be no shorter than 100 FT.

3.2 SCHEDULES

- A. Hazard and Safety Signage:
 1. Permit Required Confined Space signage:
 - a. Tag Type: Type B2 - Nonmetallic Signs.
 - b. Fastener: Screw or adhesive.
 - c. Size: 10 IN x 14 IN.
 - d. Location: Field located as directed by Engineer or Owner.
 - 1) Allowance: Provide 16 signs.
 - e. Legend:
 - 1) OSHA Danger sign.
 - 2) Description of hazard: "PERMIT REQUIRED CONFINED SPACE DO NOT ENTER".
 2. Miscellaneous OSHA hazard signage:
 - a. Tag Type: Type B2 - Nonmetallic Signs.
 - b. Fastener: Screw or adhesive.
 - c. Size: 10 IN x 14 IN.
 - d. Location: Field located as directed by Engineer or Owner.
 - 1) Allowance: Provide 10] OSHA Danger, Caution, Safety Instruction or Biohazard signs as directed by Engineer or Owner.
 - e. Legend:
 - 1) Description of hazard shall be determined by Engineer or Owner.
 - 2) Provide international graphic symbology where indicated.
 3. No Smoking Signage:
 - a. Tag Type: Type B2 - Nonmetallic Signs.
 - b. Fastener: Screw or adhesive.
 - c. Size: 10 IN x 14 IN.
 - d. Location: On the doors entering into the rooms with flammable gas or other material requiring No Smoking signage, as indicated on the Drawings.
 - e. Location: Field located as directed by Owner.
 - 1) Allowance: Provide 4 "NO SMOKING" signs.
 - f. Legend: "NO SMOKING" with international graphic symbology, adhering to the International Fire Code.
 4. Hazardous Material Identification Signage:
 - a. Tag Type: Type B2 - Nonmetallic Signs.
 - b. Fastener: Screw or adhesive.
 - c. Size (NFPA Diamond): Per NFPA 704, 10" minimum.
 - d. Size (Hazardous Material name, with concentration % where applicable): 2 IN minimum letters, directly below corresponding NFPA Diamond.
 - e. Location: On the doors entering into the rooms with Hazardous Material and on the tanks or storage containers of Hazardous Materials.
 - f. Location: Field located as directed by Engineer or Owner.
 - 1) Allowance: Provide 8 NFPA 704 Diamond signs.
 - 2) Allowance: Provide 8 for Hazardous Material Name.
 - g. Legend:
 - 1) NFPA 704 Diamond hazard numbers: As directed by Engineer or Owner appropriate for the Hazardous Material.
 - 2) Hazardous Material name: As directed by Engineer.

B. Process Systems:

1. General:
 - a. Provide arrows and markers on piping.
 - 1) At 20 FT maximum centers along continuous lines.
 - 2) At changes in direction (route) or obstructions.
 - 3) At valves, risers, "T" joints, machinery or equipment.
 - 4) Where pipes pass through floors, walls, ceilings, cladding assemblies and like obstructions provide markers on both sides.
 - b. Position markers on both sides of pipe with arrow markers pointing in flow direction.
 - 1) If flow is in both directions use double headed arrow markers.
 - c. Apply tapes and stenciling in uniform manner parallel to piping.
2. Trenches with piping:
 - a. Tag type: Type F - Underground Warning Tape
 - b. Location: Halfway between top of piping and finished grade.
 - c. Letter height: 1-1/4 IN minimum.
 - d. Natural gas or digester gas:
 - 1) Color: Yellow with black letters.
 - 2) Legend:
 - a) First line: "CAUTION CAUTION CAUTION"
 - b) Second line: "BURIED GAS LINE BELOW"
 - e. Potable water:
 - 1) Color: Blue with black letters.
 - 2) Legend:
 - a) First line: "CAUTION CAUTION CAUTION"
 - b) Second line: "BURIED WATER LINE BELOW"
 - f. Storm and sanitary sewer lines:
 - 1) Color: Green with black letters.
 - 2) Legend:
 - a) First line: "CAUTION CAUTION CAUTION"
 - b) Second line: "BURIED SEWER LINE BELOW"
 - g. (Nonpotable) water piping, except 3 IN and smaller irrigation pipe:
 - 1) Color: Green with black letters.
 - 2) Legend:
 - a) First line: "CAUTION CAUTION CAUTION"
 - b) Second line: "BURIED NONPOTABLE WATER LINE BELOW"
 - h. Chemical feed piping (e.g., chlorine solution, polymer solution, caustic solution, etc.):
 - 1) Color: Yellow with black letters.
 - 2) Legend:
 - a) First line: "CAUTION CAUTION CAUTION"
 - b) Second line: "BURIED CHEMICAL LINE BELOW"
 - i. Other piping (e.g., compressed air, irrigation, refrigerant, heating water, etc.):
 - 1) Color: Yellow with black letters.
 - 2) Legend:
 - a) First line: "CAUTION CAUTION CAUTION"
 - b) Second line: "BURIED PIPE LINE BELOW"
3. Yard valves, buried, with valve box and concrete pad:
 - a. Tag type: Type A2 - Rectangle Metal Tags.
 - b. Fastener: 3/16 IN x 7/8 IN plastic screw anchor with 1 IN #6 stainless steel pan head screw.
 - c. Legend:
 - 1) Letter height: 1/4 IN minimum.
 - 2) Valve designation as indicated on the Drawings (e.g., "V-xxx").
4. Valves and slide gates:
 - a. Tag type:
 - 1) Outdoor locations: Type B1 - Square Nonmetallic Tags.

- 2) Indoor noncorrosive:
 - a) Type A1 - Round Metal Tags.
 - b) Type B1 - Square Nonmetallic Tags.
- 3) Indoor corrosive:
 - a) Stainless steel Type A1 - Round Metal Tags.
 - b) Type B1 - Square Nonmetallic Tags.
- b. Fastener:
 - 1) Type A1: Chain of the same material.
 - 2) Type B1: Stainless steel chain.
- c. Color: Per ASME A13.1 corresponding to the piping system.
- d. Legend:
 - 1) Letter height: 1/4 IN minimum.
 - 2) Valve designation as indicated on the Drawings (e.g., "V-xxx").
5. Process equipment (e.g., pumps, pump motors, blowers, air compressors, bar screens, clarifier drive mechanism, etc.):
 - a. Tag type:
 - 1) Type B2 - Nonmetallic Signs.
 - 2) Type D - Self-Adhesive Tape Tags and Signs.
 - 3) Type G - Stenciling System.
 - b. Fastener:
 - 1) Self.
 - 2) Screws.
 - 3) Adhesive.
 - c. Legend:
 - 1) Letter height: 1/2 IN minimum.
 - 2) Equipment designation as indicated on the Drawings (e.g., "Primary Sludge Pump P-xxx").
6. Piping systems:
 - a. Tag type:
 - 1) Outdoor/Interior locations: Type K – Snap-Around Labeling System.
 - b. Fastener: Self.
 - c. Color: Per ANSI and ASME A13.1.
 - d. Legend:
 - 1) Letter height: Manufacturers standard for the pipe diameter.
 - 2) Mark piping in accordance with ASME A13.1.
 - 3) Use piping designation as indicated on the Drawings.
 - 4) Arrow: Single arrow.
7. Process tanks (over 1000 GAL) and basins, (e.g., chemical storage, clarifiers, trickling filters, digesters, etc.):
 - a. Tag type:
 - 1) Type B2 - Nonmetallic Signs.
 - 2) Type G - Stenciling System.
 - b. Fastener:
 - 1) Screw.
 - 2) Self.
 - c. Location as directed by Owner.
 - d. Legend:
 - 1) Letter height: 4 IN minimum.
 - 2) Equipment designation as indicated on the Drawings (e.g., "Clarifier CL-xxx").
8. Tanks (less than 1000 GAL) (e.g., break tanks, chemical tanks, hydro-pneumatic tanks, air receivers, etc.):
 - a. Tag type:
 - 1) Type D - Self-Adhesive Tape Tags and Signs.
 - 2) Type G - Stenciling System.
 - b. Fastener: Self.

- c. Legend:
 - 1) Letter height: 2 IN minimum.
 - 2) Equipment designation as indicated on the Drawings (e.g., "Polymer Storage Tank TNK- xxx")
- 9. Equipment that starts automatically:
 - a. Tag type:
 - 1) Type B2 - Nonmetallic Signs.
 - 2) Type D - Self-Adhesive Tape Tags and Signs.
 - b. Fastener:
 - 1) Type B2 - Screw or adhesive.
 - 2) Type D - Self.
 - c. Size: 5 IN x 7 IN
 - d. Location: Equipment name.
 - e. Legend:
 - 1) OSHA Warning Sign.
 - 2) Description of Warning: "THIS MACHINE STARTS AUTOMATICALLY".
- C. Instrumentation Systems:
 - 1. Instrumentation Equipment (e.g., flow control valves, primary elements, etc.):
 - a. Tag type:
 - 1) Outdoor locations: Type B1 - Square Nonmetallic Tags.
 - 2) Indoor noncorrosive:
 - a) Type A1 - Round Metal Tags.
 - b) Type B1 - Square Nonmetallic Tags.
 - 3) Indoor corrosive:
 - a) Stainless steel Type A1 - Round Metal Tags.
 - b) Type B1 - Square Nonmetallic Tags.
 - b. Fastener:
 - 1) Type A1: Chain of the same material.
 - 2) Type B1: Stainless steel chain.
 - c. Legend:
 - 1) Letter height: 1/4 IN minimum.
 - 2) Equipment ISA designation as indicated on the Drawings (e.g., "FIT-xxx").
 - 2. Enclosure for instrumentation and control equipment, (e.g., PLC control panels, etc.):
 - a. Tag type: Type C - Phenolic Name Plates.
 - b. Fastener: Screws.
 - c. Legend:
 - 1) Letter height: 1/2 IN minimum.
 - 2) Equipment name (e.g., "PLC CONTROL PANEL PCP-xxx").
 - 3. Components inside equipment enclosure, (e.g., PLC's, control relays, contactors, and timers):
 - a. Tag type: Type D - Self-Adhesive Tape Tags.
 - b. Fastener: Self.
 - c. Legend:
 - 1) Letter height: 3/16 IN minimum.
 - 2) Description or function of component (e.g., "PLC-xxx" or "CR-xxx").
 - 4. Through enclosure door mounted components (e.g., selector switches, controller digital displays, etc.):
 - a. Tag type: Type C - Phenolic Name Plates.
 - b. Fastener: Screws.
 - c. Legend:
 - 1) Letter height: 1/4 IN minimum.
 - 2) Component ISA tag number as indicated on the Drawings (e.g., "HS-xxx").

- D. HVAC Systems:
1. General:
 - a. Provide arrows and markers on ducts.
 - 1) At 20 FT maximum centers along continuous lines.
 - 2) At changes in direction (route) or obstructions.
 - 3) At dampers, risers, branches, machinery or equipment.
 - 4) Where ducts pass through floors, walls, ceilings, cladding assemblies and like obstructions provide markers on both sides.
 - b. Position markers on both sides of duct with arrow markers pointing in flow direction.
 - 1) If flow is in both directions use double headed arrow markers.
 - c. Apply tapes and stenciling in uniform manner parallel to ducts.
 2. HVAC Equipment (e.g., unit heaters, exhaust fans, air handlers, etc.):
 - a. Tag type:
 - 1) Type B2 - Nonmetallic Signs.
 - 2) Type C - Phenolic Name Plates.
 - b. Fastener: Screws.
 - c. Legend:
 - 1) Letter height: 1 IN minimum.
 - 2) Equipment designation as indicated on the Drawings (e.g., "EF-xxx").
 3. Ductwork:
 - a. Tag type:
 - 1) Type D - Self-Adhesive Tape Tags and Signs.
 - 2) Type G - Stenciling System.
 - b. Fastener: Self.
 - c. Legend:
 - 1) Letter height: 1 IN minimum.
 - 2) Description of ductwork, (e.g., "AIR SUPPLY").
 - 3) Arrows: Single arrow.
 4. Enclosure for instrumentation and control equipment, (e.g., fan control panels, etc.):
 - a. Tag type: Type C - Phenolic Name Plates.
 - b. Fastener: Screws.
 - c. Legend:
 - 1) Letter height: 1/2 IN minimum.
 - 2) Equipment designation as indicated on the Drawings (e.g., "FAN CONTROL PANEL FCP-xxx").
 5. Wall mounted thermostats:
 - a. Tag type: Type D - Self-Adhesive Tape Tags and Signs.
 - b. Fastener: Self.
 - c. Legend:
 - 1) Letter height: 3/16 IN minimum.
 - 2) Description of equipment controlled (e.g., "UH-xxx" or AHU-xxx").
 6. Components inside equipment enclosure, (e.g., controller's, control relays, contactors, and timers):
 - a. Tag type: Type D - Self-Adhesive Tape Tags and Signs.
 - b. Fastener: Self.
 - c. Legend:
 - 1) Letter height: 3/16 IN minimum.
 - 2) Description or function of component (e.g., "CR-xxx").
 7. Through enclosure door mounted equipment (e.g., selector switches, controller digital displays, etc.):
 - a. Tag type: Type C - Phenolic Name Plates.
 - b. Fastener: Screws.

- c. Legend:
 - 1) Letter height: 1/4 IN minimum.
 - 2) Component tag number as indicated on the Drawings or as defined by contractor (e.g., "HS-xxx").
- E. Electrical Systems:
1. Trenches with ductbanks, direct-buried conduit, or direct-buried wire and cable.
 - a. Tag type: Type F - Underground Warning Tape.
 - b. Letter height: 1-1/4 IN minimum.
 - c. Location:
 - 1) Where trench is 12 IN or more below finished grade: In trench 6 IN below finished grade.
 - 2) Where trench is less than 12 IN below finished grade: In trench 3 IN below finished grade.
 - d. Electrical power (e.g., low and medium voltage):
 - 1) Color: Red with black letters.
 - 2) Legend:
 - a) First line: "CAUTION CAUTION CAUTION".
 - b) Second line: "BURIED ELECTRIC LINE BELOW".
 - e. Communications (e.g., telephone, instrumentation, LAN, SCADA):
 - 1) Color: Orange with black letters.
 - 2) Legend:
 - a) First line: "CAUTION CAUTION CAUTION".
 - b) Second line: "BURIED COMMUNICATION LINE BELOW".
 2. Switchgear, switchboards, and motor control centers:
 - a. Tag type: Type C - Phenolic Name Plates.
 - b. Fastener: Screws.
 - c. Main equipment legend:
 - 1) Letter height:
 - a) First line: 1 IN minimum.
 - b) Subsequent lines: 3/8 IN minimum.
 - 2) First line: Equipment name (e.g., "MAIN SWITCHBOARD MSBxxx").
 - 3) Second line:
 - a) Source of power (e.g., "FED FROM MCCxxx LOCATED IN ROOM xxx").
 - b) Include the building name or number if the source is in another building.
 - 4) Third line: System voltage and phase (e.g., "480/277 V, 3PH").
 - 5) Fourth line: Date installed (e.g., "INSTALLED JULY 20xx").
 - d. Main and feeder device legend:
 - 1) Letter height: 3/8 IN minimum.
 - 2) Description of load (e.g., "MAIN DISCONNECT", "PUMP Pxxx" or "PANELBOARD HPxxx").
 3. Panelboards and transformers:
 - a. Tag type: Type C - Phenolic Name Plates.
 - b. Fastener: Screws.
 - c. Legend:
 - 1) Letter height:
 - a) First line: 3/8 IN minimum.
 - b) Subsequent lines: 3/16 IN minimum.
 - 2) First line: Equipment name (e.g., "PANELBOARD LPxxx" or "TRANSFORMER Txxx").
 - 3) Second line (panelboards only): System voltage and phase (e.g., "208/120V, 3PH").
 - 4) Third line:
 - a) Source of power (e.g., "FED FROM MCCxxx LOCATED IN ROOM xxx").
 - b) Include the building name or number if the source is in another building.
 - 5) Fourth line: Date installed (e.g., "INSTALLED JULY 20xx").

4. Transfer switches:
 - a. Tag type: Type C - Phenolic Name Plates.
 - b. Fastener: Screws.
 - c. Legend:
 - 1) Letter height:
 - a) First line: 3/8 IN minimum.
 - b) Subsequent lines: 3/16 IN minimum.
 - 2) First line: Equipment name (e.g., "AUTOMATIC TRANSFER SWITCH ATsxxx").
 - 3) Second line: Normal source of power (e.g., "NORMAL SOURCE FED FROM MCCxxx").
 - 4) Third line: Emergency source of power (e.g., "EMERGENCY SOURCE FED FROM SGENxxx").
 - 5) Fourth line: Date installed (e.g., "INSTALLED JULY 20xx").
5. Safety switches, separately mounted circuit breakers and motor starters, VFD's, etc.:
 - a. Tag type: Type C - Phenolic Name Plates.
 - b. Fastener: Screws.
 - c. Legend:
 - 1) Letter height: 1/4 IN minimum.
 - 2) First line: Description of load equipment is connected to (e.g., "PUMP Pxxx").
 - 3) Second line:
 - a) Source of power (e.g., "FED FROM MCCxxx LOCATED IN ROOM xxx").
 - b) The source of power room number is only required when there are multiple electrical rooms, if the source is in another building, the building name or number shall be used.
6. Enclosure for instrumentation and control equipment, (e.g., lighting control panels, etc.):
 - a. Tag type: Type C - Phenolic Name Plates.
 - b. Fastener: Screws.
 - c. Legend:
 - 1) Letter height: 1/2 IN minimum.
 - 2) Equipment name (e.g., "LIGHTING CONTROL PANEL LCPxxx").
7. Components inside equipment enclosures (e.g., circuit breakers, fuses, control power transformers, control relays, contactors, timers, etc.):
 - a. Tag type: Type D - Self-Adhesive Tape Tags and Signs.
 - b. Fastener: Self.
 - c. Legend:
 - 1) Letter height: 3/16 IN minimum.
 - 2) Description or function of component (e.g., "M-xxx", "CR-xxx" or "TR-xxx").
8. Through enclosure door mounted equipment (e.g., selector switches, controller digital displays, etc.):
 - a. Tag type: Type C - Phenolic Name Plates.
 - b. Fastener: Screws.
 - c. Legend:
 - 1) Letter height: 1/4 IN minimum.
 - 2) Component tag number as indicated on the Drawings or as defined by contractor (e.g., "HS-xxx").
9. Conductors in control panels and in pull or junction boxes where multiple circuits exist.
 - a. Tag type: Type D - Self-Adhesive Tape Tags.
 - b. Fastener: Self.
 - c. Tag conductor at both ends.
 - d. Legend:
 - 1) Letter height: 1/8 IN minimum.
 - 2) Circuit number or wire number as scheduled on the Drawings or as furnished with the equipment.

10. Conductors in handholes and manholes.
 - a. Tag type: Type A3 - Metal Tape Tags.
 - b. Fastener: Nylon strap.
 - c. Tag conductor at both ends.
 - d. Legend:
 - 1) Letter height: 1/8 IN minimum.
 - 2) Circuit number or wire number as scheduled on the Drawings.
11. Grounding conductors associated with grounding electrode system in accordance with the following:
 - a. Tag type: Type D - Self-Adhesive Tape Tags.
 - b. Fastener: Self.
 - c. Legend:
 - 1) Letter height: 1/8 IN minimum.
 - 2) Function of conductor (e.g., "MAIN BONDING JUMPER", "TO GROUND RING", "TO MAIN WATER PIPE").
12. Arc Flash Hazard Warning Label for switchboards, panelboards, industrial control panels and motor control centers:
 - a. Tag type: Type D - Self-Adhesive Tape Signs.
 - b. Fastener: Self.
 - c. Legend: Per NFPA 70. Refer to Section 26 2800 for information to include on label.
13. Entrances to electrical rooms:
 - a. Tag type: Type B2 - Nonmetallic Signs.
 - b. Fastener: Screw or adhesive.
 - c. Size: 5 IN x 7 IN.
 - d. Location: Each door to room.
 - e. Legend:
 - 1) OSHA Danger Sign.
 - 2) Description of Danger: "HIGH VOLTAGE, AUTHORIZED PERSONNEL ONLY".
14. Equipment where more than one voltage source is present:
 - a. Tag type:
 - 1) Type B2 - Nonmetallic Signs.
 - 2) Type D - Self-Adhesive Tape Signs.
 - b. Fastener:
 - 1) Screw or adhesive.
 - 2) Self.
 - c. Size: 1-3/4 IN x 2-1/2 IN.
 - d. Location: Exterior face of enclosure or cubical.
 - e. Legend:
 - 1) OSHA Danger Sign.
 - 2) Description of Danger: "MULTIPLE VOLTAGE SOURCES".

END OF SECTION

SECTION 10 14 23
SIGNAGE

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Room identification signs.
 - 2. Other identification signs:
 - a. Fire and/or smoke barrier identification signs.
 - 3. Aluminum letters.
- B. Related Specification Sections include but are not necessarily limited to:
 - 1. Division 00 - Procurement and Contracting Requirements.
 - 2. Division 01 - General Requirements.
 - 3. Section 10 14 00 - Identification Devices.

1.2 QUALITY ASSURANCE

- A. Referenced Standards:
 - 1. Americans with Disabilities Act (ADA):
 - a. Accessibility Guidelines for Buildings and Facilities (ADAAG).
 - 2. ASTM International (ASTM):
 - a. B26, Standard Specification for Aluminum-Alloy Sand Castings.

1.3 DEFINITIONS

- A. Authority Having Jurisdiction (AHJ): Building official, fire chief, fire marshal or other individual having statutory authority.
- B. Wet and/or Corrosive Areas: For the purposes of this Specification Section, the following rooms or areas are considered wet and/or corrosive:
 - 1. Pump rooms.
 - 2. Truck loading boxes.
 - 3. Process equipment rooms.

1.4 SUBMITTALS

- A. Shop Drawings:
 - 1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
 - 2. Product technical data including:
 - a. Acknowledgement that products submitted meet requirements of standards referenced.
 - b. Manufacturer's installation instructions.
 - c. Color charts for Engineer's color selection.
 - 1) Color selection shall be made from manufacturer's complete color line including all premium and special colors.
 - 3. Schedule of all signs indicating text and graphics.
 - 4. Layout drawings of all signage showing size, letter style, text, border, finish, and installation detail.
 - a. Provide drawings for:
 - 1) Room exit, and stair identification signs.
 - 2) Fire and/or smoke barrier identification signs.
 - 3) Aluminum letters.

- B. Samples:
 - 1. Room, exit, and stair identification signs.
 - 2. Fire and/or smoke barrier identification signs.
 - 3. Aluminum letters.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
 - 1. Room, exit and stair identification signs:
 - a. ASE - Architectural Signs and Engraving.
 - b. ASI Signage Innovations.
 - c. Best Sign Systems.
 - d. Mohawk Sign Systems.
 - e. Nelson-Harkins.
 - f. Southwell Co.
 - g. Stamprite Supersine Identification Specialists.
 - 2. Fire and/or smoke barrier identification signs:
 - a. Brady.
 - b. Panduit.
 - c. Seton.
 - d. Carlton Industries.
 - 3. Aluminum letters:
 - a. A R K Ramos Manufacturing Co., Inc.
 - b. ASI Signage Innovations.
 - c. Leeds Architectural Letters.
 - d. Metal Arts.
 - e. Metallic Arts.
 - f. The Southwell Co.
- B. Submit request for substitution in accordance with Specification Section 01 25 13.

2.2 MATERIALS

- A. Room, Exit, and Stair Identification Signs:
 - 1. Interior:
 - a. Dry, non-corrosive areas: Melamine plastic suitable for raised lettering and Braille.
 - b. Wet and/or corrosive areas: Aluminum or fiberglass suitable for raised lettering and Braille.
 - 2. Exterior: Aluminum or fiberglass suitable for raised lettering and Braille.
- B. Fire and/or Smoke Barrier Identification Signs:
 - 1. Stenciling system.
- C. Aluminum Letters:
 - 1. Cast aluminum ASTM B26.
 - 2. For machine cut letters, provide aluminum of appropriate alloy and hardness.

2.3 FABRICATION

- A. Room and Exit Identification Signs:
 - 1. General:
 - a. Raised text, border and graphics.
 - 1) Minimum 1/32 IN height.
 - 2) Provide international graphic symbology for all toilet, locker and shower rooms or combinations thereof, and for unisex toilet rooms and stairs.
 - 3) Provide handicap symbol on all signs for rooms meeting handicap requirements.

- b. Grade 2 Braille.
 - c. Finish: Eggshell.
 - 1) Color: To be selected.
 - d. Text:
 - 1) Typeface: Sans Serif.
 - 2) Size: Minimum 3/4IN high.
 - e. Text as indicated in the SCHEDULES Article in PART 3 of this Specification Section.
 - f. Exterior signs shall be rated for exterior use.
 - g. All signs shall comply with requirements of ADA Washington state or local authority, if appropriate.
- B. Fire and/or Smoke Barrier Identification Signs:
- 1. Self-adhesive tape tags and signs:
 - a. Materials: Vinyl tape or vinyl cloth.
 - 1) Indoor/Outdoor grade.
 - 2) Weather and UV resistant inks.
 - 3) Permanent adhesive.
 - b. Size:
 - 1) Surface: As required by text.
 - 2) Thickness: 5 MILS minimum.
 - c. Color: White with black lettering.
 - 2. Typeface: Helvetica Medium.
 - 3. Text Size:
 - a. Height: 3 IN minimum.
 - b. Stroke: 3/8 IN minimum.
 - c. Text: As indicated in the SCHEDULES Article in PART 3 Fabrication:
- C. Hazard Communication Signage (NFPA and OSHA signage): See Specification Section 10 14 00.
- D. Aluminum Letters:
- 1. General:
 - a. Cast aluminum, machine cut or laser cut aluminum.
 - b. Finish: Anodized.
 - c. Color: Clear.
 - d. Mounting:
 - 1) 1 IN projected.
 - 2) Provide stainless steel mounting studs.
 - e. Text: As indicated in the SCHEDULES Article in PART 3.
 - 2. Letters:
 - a. Typeface: Match existing facility signage.
 - b. Size:
 - 1) Height: Match existing facility signage.
 - 2) Stroke: 1/2 IN minimum.
 - c. Depth: 3/8 IN.
 - 3. Provide true angles, crisp corners and straight edges with no burrs or pitting in the surface.
- E. Site Signs:

2.4 MAINTENANCE MATERIALS

- A. Where stenciled markers are provided, clean and retain stencils after completion and include in extra stock, along with required stock of paints and applicators.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Room Identification Signs:
1. Install signs using foam tape for interior signs and stainless steel screws (minimum of two) for exterior signs.
 - a. Stainless steel screws shall be painted to match sign color.
 2. Mounting Locations:
 - a. Tactile characters on signs shall be located 48 IN minimum above the finished floor or ground surface, measured from the baseline of the lowest tactile character and 60 IN maximum above the finish floor or ground surface, measured from the baseline of the highest tactile character.
 - b. Where a tactile sign is provided at a door, the sign shall be located alongside the door at the latch side. Where a tactile sign is provided at double doors with one active leaf, the sign shall be located on the inactive leaf. Where a tactile sign is provided at double doors with two active leaves, the sign shall be located to the right side of the right hand door. Where there is no wall space at the latch side of a single door or at the right side of double doors, signs shall be located on the nearest adjacent wall.
 - c. Signs containing tactile characters shall be located so that a clear floor space of 18 IN minimum by 18 IN minimum, centered on the tactile characters, is provided beyond the arc of any door swing between the closed position and 45 degree open position.
 3. Interior and exterior signs identifying permanent rooms and spaces shall comply with ADA Washington state or local authority, if appropriate.
- B. Fire and/or Smoke Barrier Identification Signs:
1. Provide marking and identification in compliance with building code.
 2. Locate in accessible concealed floor, floor-ceiling, or attic spaces.
 3. Locate within 15 FT of the end of each wall or partition and at intervals not exceeding 30 FT horizontally.
- C. Aluminum Letters:
1. Install letters where indicated on Drawings.
 2. Mount to walls with 1 IN projection in accordance with manufacturer's instructions.

3.2 SCHEDULES

- A. Room and Exit Identification Signs:

BUILDING LOCATION	MOUNTING	VERBIAGE	REMARKS
MECHANICAL BUILDING			
DOOR 01	INTERIOR	EXIT, SLUDGE HEATING & PUMP ROOM AUTHORIZED PERSONNEL ONLY	2, 3
DOOR 02A	INTERIOR	EXIT, SLUDGE THICKENING ROOM AUTHORIZED PERSONNEL ONLY	2, 3
DOOR 02B	EXTERIOR	SLUDGE THICKENING ROOM AUTHORIZED PERSONNEL ONLY, EXIT	2, 3
DOOR 02	EXTERIOR	ENTRANCE	1, 2
DOOR 30	INTERIOR	EXIT, STAIR	1, 2, 3,
DOOR 31	INTERIOR	UNISEX RESTROOM	3
DOOR 32	INTERIOR	STORAGE	3

BUILDING LOCATION	MOUNTING	VERBIAGE	REMARKS
DOOR 33A	EXTERIOR	BOILER ROOM AUTHORIZED PERSONNEL ONLY	2
DOOR 33B	INTERIOR	BOILER ROOM AUTHORIZED PERSONNEL ONLY	2
DOOR 34	INTERIOR	ELECTRICAL ROOM AUTHORIZED PERSONNEL ONLY	2
OH DOOR S1	INTERIOR	TRUCK LOADING	1
OH DOOR S2	INTERIOR	TRUCK LOADING	1
DIGESTER 4			
SIDE ACCESS HATCH	EXTERIOR	CONFINED SPACE ENTRY	4
REMARKS: 1. Provide Universal Graphic Symbology. 2. Mount adjacent to pull side of door. 3. Mount adjacent to push side of door. 4. Verify exact verbiage with AHJ prior to fabricating signage			

B. Fire and/or Smoke Barrier Identification Signs:

ASSEMBLY	VERBIAGE
Fire Walls	3 HR FIRE WALL - PROTECT ALL OPENINGS
Fire Barriers	2 HR FIRE BARRIER - PROTECT ALL OPENINGS

1. Indicate hourly rating of assembly.
2. Verify exact verbiage with AHJ prior to fabricating signage.

C. Aluminum Letters:

1. As indicated on the Drawings.

END OF SECTION

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SECTION 10 28 13
TOILET AND BATH ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Toilet and bath accessories.
- B. Related Specification Sections include but are not necessarily limited to:
 - 1. Division 00 - Procurement and Contracting Requirements.
 - 2. Division 01 - General Requirements.

1.2 QUALITY ASSURANCE

- A. Referenced Standards:
 - 1. Americans with Disabilities Act (ADA):
 - a. Accessibility Guidelines for Buildings and Facilities (ADAAG).
 - 2. ASTM International (ASTM):
 - a. A269/A269M, Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service.
 - b. A480/A480M, Standard Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet, and Strip.

1.3 SUBMITTALS

- A. Shop Drawings:
 - 1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
 - 2. Product technical data including:
 - a. Acknowledgement that products submitted meet requirements of standards referenced.
 - b. Manufacturer's installation instructions.
 - c. Manufacturer's recommendation on fasteners.
 - 3. Schedule of items being provided for each room. Reference rooms using room number designated on Drawings.
 - 4. Catalog cut sheet of each item proposed.
- B. Contract Closeout Information:
 - 1. Operation and Maintenance Data:
 - a. See Specification Section 01 33 04 for requirements for the mechanics, administration, and the content of Operation and Maintenance Manual submittals.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products in manufacturer's original packaging.
- B. Store materials in a dry, conditioned location, until ready for installation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Product numbers scheduled are manufactured by Bobrick.
- B. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
 - 1. American Specialties, Inc.
 - 2. Bobrick Washroom Equipment, Inc.

3. Bradley.

C. Submit request for substitution in accordance with Specification Section 01 25 13.

2.2 MATERIALS

A. Toilet Accessories:

1. General: ASTM A480/A480M, stainless steel.
2. Grab bars: ASTM A269/A269M, stainless steel.

B. Anchoring Devices:

1. Stainless steel.

2.3 FABRICATION

A. Toilet Accessories:

1. General:
 - a. Satin finish.
 - b. Items shall meet design requirements of ADA.
2. Grab bars:
 - a. Concealed mounting.
 - b. 3 IN DIA flange.
 - c. 1-1/2 IN OD.
 - d. Peened finish on gripping surface.

B. Anchoring Devices:

1. Designed to withstand minimum concentrated load of 250 LB applied at any point on grab bar.

PART 3 - EXECUTION

3.1 PREPARATION

A. Verify adequate backing has been provided in wall or toilet partition.

3.2 INSTALLATION

A. Install in accordance with manufacturer's instruction and in accordance with ADA.

B. Install in locations indicated on Drawings.

C. Mount all items using manufacturer's recommended anchorage devices for the substrate to which the accessory is to be mounted.

3.3 SCHEDULE

A. See Drawings for locations.

B. Model numbers indicated are Bobrick, unless noted otherwise.

1. TA-1: NOT USED.
2. TA-2: Toilet Tissue Dispenser (double non-controlled) - B-2740.
3. TA-3: Toilet Seat Cover Dispenser - B-221 (surface mounted), 250 sheets.
4. TA-4: Feminine Napkin-Tampon Dispenser - B-2706 (surface mounted).
5. TA-5: Feminine Napkin Disposal - B-270.
6. TA-6: Paper Towel Dispenser - B-262.
7. TA-7: Waste Receptacle - B-279.
8. TA-8: Liquid Soap Dispenser - B-2112.
9. TA-9: Mop and Broom Rack - B-223 x 36 IN.
10. TA-10: NOT USED.
11. TA-11: NOT USED.
12. TA-12: Mirror - B-290 x size indicated on Drawings.
13. TA-13: NOT USED.

14. TA-14: Metal Shelf - B-295 x 24 IN.
15. TA-15: NOT USED.
16. TA-16: NOT USED.
17. TA-17: NOT USED.
18. TA-18: Grab Bar - B-6806.99 x length indicated on Drawings.

END OF SECTION

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SECTION 10 44 33
FIRE PROTECTION SPECIALTIES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Portable fire extinguishers.
- B. Related Specification Sections include but are not necessarily limited to:
 - 1. Division 00 - Procurement and Contracting Requirements.
 - 2. Division 01 - General Requirements.
 - 3. Section 05 50 00 - Metal Fabrications.

1.2 QUALITY ASSURANCE

- A. Referenced Standards:
 - 1. Americans with Disabilities Act (ADA):
 - a. 2010 ADA Standards for Accessible Design.
 - 2. National Fire Protection Association (NFPA):
 - a. 10, Standard for Portable Fire Extinguishers.
 - 3. Underwriters Laboratories, Inc. (UL):
 - a. 8, Water Based Agent Fire Extinguishers.
 - b. 154, Carbon Dioxide Fire Extinguishers.
 - c. 299, Dry Chemical Fire Extinguishers.
 - d. 626, Water Fire Extinguishers.
 - e. 711, Rating and Fire Testing of Fire Extinguishers.
 - f. 2129, Halocarbon Clean Agent Fire Extinguishers.

1.3 DEFINITIONS

- A. Authority Having Jurisdiction (AHJ): Building official, fire chief, fire marshal or other individual having statutory authority.

1.4 SUBMITTALS

- A. Shop Drawings:
 - 1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
 - 2. Product technical data including:
 - a. Acknowledgement that products submitted meet requirements of standards referenced.
 - b. Manufacturer's installation instructions.
 - c. Ratings and classification of extinguishers.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver and install filled and charged extinguishers just prior to building occupancy.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
 - 1. Fire extinguishers:
 - a. Amerex Corporation.
 - b. Ansul – Tyco Fire Protection Products.
 - c. Badger Fire Protection.

- d. United Technologies - Kidde.
- e. Buckeye Fire Equipment.
- 2. Fire extinguisher signs:
 - a. Seton.
 - b. Compliance Signs.
 - c. Safety Sign.

B. Submit request for substitution in accordance with Specification Section 01 25 13.

2.2 MANUFACTURED UNITS

- A. Fire Extinguisher (FEXT):
 - 1. Steel bodied, all metal top (head) and valves.
 - 2. Multi-purpose dry chemical extinguisher with hose and nozzle.
 - 3. Provide one listed 10 LB. 4A-60BC extinguisher for each fire extinguisher location (FEXT) indicated on Drawings.
 - 4. Finish: Red with epoxy finish coat.
- B. Wall Brackets:
 - 1. Bracket type to fit specified extinguisher.
 - 2. Furnish bracket for each extinguisher not in cabinet.
 - 3. Bracket to be finished in red or black enamel.
- C. Fire Extinguisher Signage:
 - 1. Single faced: SETON #21999.
 - 2. Double faced: SETON #22001.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install products in accordance with manufacturer's instructions and NFPA 10.
 - 1. Install units with extinguisher top not over 48 IN above floor.
 - 2. Install wall brackets to concrete or masonry substrate with self-tapping concrete anchors.
 - a. See Specification Section 03 15 19.
- B. Fire extinguisher locations shown on Drawings are approximate locations.
 - 1. Verify all extinguisher mounting locations with the AHJ.
- C. Provide "FIRE EXTINGUISHER" sign for each extinguisher location.
 - 1. Provide single or double faced sign to provide optimum visibility for extinguisher location.

END OF SECTION

SECTION 10 73 16
ALUMINUM CANOPIES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Prefabricated aluminum canopies (for covered walkways).
- B. Related Specification Sections:
 - 1. Division 00 - Procurement and Contracting Requirements.
 - 2. Division 01 - General Requirements.

1.2 QUALITY ASSURANCE

- A. Referenced Standards:
 - 1. American Architectural Manufacturers Association (AAMA):
 - a. 611, Voluntary Standards for Anodized Architectural Aluminum.
 - b. 2603, Voluntary Specification, Performance Requirements and Test Procedures for Pigmented Organic Coatings on Aluminum Extrusions and Panels.

1.3 SUBMITTALS

- A. Shop Drawings:
 - 1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
 - 2. Product technical data including:
 - a. Acknowledgement that products submitted meet requirements of standards referenced.
 - 3. Connections.
 - 4. Foundation details.
 - 5. Manufacturer's standard load tables.
 - 6. Design calculations prepared and signed by an Engineer registered in the State where project is located.
 - 7. Foundation loads and reactions for all design load cases and column locations.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
 - 1. E.L. Burns.
 - 2. Dittmer.
 - 3. Perfection.
 - 4. Mapes Panels.
 - 5. Superior Metal.
 - 6. Peachtree Protective Covers.
 - 7. Mapes Architectural Canopies.
- B. Submit request for substitution in accordance with Specification Section 01 25 13.

2.2 MATERIALS

- A. Structural Framing System:
 - 1. All extruded aluminum system, aluminum alloy 6063-T6.
 - a. Yield: 31,000 PSI.
 - b. Ultimate strength: 35,000 PSI.

- 2. Radius-cornered aluminum tubular extrusions of sizes shown on the Drawings.
- B. Deck and Fascia:
 - 1. Extruded aluminum alloy 6063-T6.
 - 2. Size and profile as shown on the Drawings.
- C. Fasteners:
 - 1. Deck: Manufacturer's standard.
 - 2. Trim: Aluminum rivets.
- D. Finish:
 - 1. Bents:
 - a. Clear anodized: AAM10C22A31, Architectural Class II, comply with AAMA 611.
 - b. Bronze anodized: AAM10C22A44, Architectural Class I, comply with AAMA 611.
 - c. Thermo-set enamel:
 - 1) AAC12C42R1, comply with AAMA 2603.
 - 2) Color:
 - d. Fluoropolymer coating:
 - 1) 70 PCT PVDF resin based fluoropolymer, AAC12C42R1, custom color as selected by Architect/Engineer.
 - 2. Deck:
 - a. Bronze anodized: AAM10C22A44, Architectural Class I, comply with AAMA 611.
 - b. Thermo-set enamel:
 - 1) AAC12C42R1, comply with AAMA 2603.
 - 2) Color: To Be Selected by Engineer
 - c. Fluoropolymer coating:
 - 1) 70 PCT PVDF resin based fluoropolymer, AAC12C42R1, custom color as selected by Architect/Engineer.
 - 3. Fascia/Gutter:
 - a. Clear anodized: AAM10C22A31, Architectural Class II, comply with AAMA 611.
 - b. Bronze anodized: AAM10C22A44, Architectural Class I, comply with AAMA 611.
 - c. Thermo-set enamel:
 - 1) AAC12C42R1, comply with AAMA 2603.
 - 2) Color: To Be Selected By Engineer
 - d. Fluoropolymer coating:
 - 1) 70 PCT PVDF resin based fluoropolymer, AAC12C42R1, custom color as selected by Architect/Engineer.
- E. Grout:
 - 1. One part portland cement, three parts masonry sand.
 - 2. 2,000 LBS per square inch (13.8 MPa) compressive strength.
- F. Foam block-outs: Rigid foam blocks sized as required for column embedment depth and shape.

2.3 PERFORMANCE AND DESIGN REQUIREMENTS

- A. Design Loads:
 - 1. Comply with building code for site location.
 - 2. Collateral loads: Additional loads imposed by other materials or systems identified in Contract Documents.
- B. Structural Design:
- C. Expansion and Contraction:
 - 1. Roof deck and fascia shall be designed with a maximum of one end of each member fastened rigidly.
 - a. All other fasteners shall allow movement of deck and fascia.
 - 2. Deck and fascia shall be designed to allow movement for temperature changes of at least 200 DEGF.

2.4 FABRICATION AND MANUFACTURE

- A. Bents:
 - 1. Columns and beams heliarc welded together to form one-piece rigid bents.
 - 2. Columns shall allow grouting of columns into foundation.
 - a. Ends of columns coated to prevent electrolytic reactions with concrete foundations.
 - 3. Provide beam ties at every other deck projection.
 - 4. Water shall drain into gutters.
 - a. Downspouts shall carry water from gutters to grade level discharge.
- B. Deck:
 - 1. Interlocking, self-flashing joints.
 - a. Joints fastened at 8 IN OC.
 - 2. Cambered to neutralize deflection and to provide drainage.
 - 3. Slope toward gutter.
- C. Fascia:
 - 1. Manufacturer's standard.
 - 2. Allow for expansion and contraction.
- D. Gutters and Downspouts:
 - 1. Manufacturer's standard.
 - 2. Watertight and secured.
 - 3. Drain in a way from existing structures.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine footings in which bents will be set.
 - 1. Verify footing locations and elevations comply with the Shop Drawings.
- B. Examine building surfaces to which canopy will connect.
- C. Coordinate with responsible trade to perform corrective work on unsatisfactory footings or surfaces.
- D. Commencement of Work by installer is acceptance of existing conditions.

3.2 ERECTION

- A. Erect protective covers in accordance with manufacturer's installation instructions.
- B. Set bents plumb, straight, and true to line, adequately braced to maintain position until grout has cured.
- C. Keep aluminum surfaces from direct contact with ferrous metal or other incompatible materials by applying one coat of zinc chromate primer.
 - 1. Follow with two coats of aluminum paint.
 - 2. In lieu of aluminum paint, one coat of high-build bituminous paint applied to 1/16 IN (1.6 MM) thickness may be used.

3.3 CLEANING

- A. Clean surfaces soiled by Work as recommended by manufacturer.
- B. Remove surplus materials and debris from the site.

3.4 PROTECTION

- A. Protect finished aluminum surfaces from damage due to subsequent construction operations.

END OF SECTION

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DIVISION 11

EQUIPMENT



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SECTION 11 24 26
SAFETY TIE-BACKS

PART 1 - GENERAL

1.1 SUMMARY

- A. Furnish labor, materials, tools, equipment, and services for Safety Tie-Backs, as indicated, in accordance with provisions of Contract Documents.
- B. Completely coordinate with work of other trades.

1.2 DESCRIPTION

- A. Description of system:
 - 1. Design, fabrication, and installation of safety tie-backs anchored to roof structure for purpose of window washing and general building maintenance including:
 - a. Single eye safety tiebacks.
 - b. Signage indicating safe usage and restrictions.
 - c. Instructional materials.
 - 2. Design and locate anchors to provide accessibility to windows for purpose of cleaning, building maintenance, or both, with conventionally rigged window washing equipment.
 - 3. Provide soffit mounted anchors, wall mounted anchors, or both, to access windows which are difficult to reach from above due to adjacent soffits and other projecting overhangs.
 - 4. Coverage shall include following areas:
 - a. Individual windows, ribbon windows and curtain wall glass which is not easily reachable by ladder from grade.

1.3 QUALITY ASSURANCE

- A. Manufacturer Qualifications:
 - 1. Manufacturer minimum five (5) years' experience in design, fabrication and installation of similar size and scope systems.
 - 2. Manufacturer to carry specific liability insurance for products and completed systems in amount of \$10,000,000.00 to protect against product and system failure.
- B. Installer Qualifications:
 - 1. Installer minimum five (5) years' experience in installation of similar systems, or approved by manufacturer.
 - 2. Welding to be executed by certified welders in accordance with AWS requirements.
- C. Occupational Safety and Health Administration (OSHA):
 - 1. 1910, Subpart D Walking and Working Surfaces
 - 2. Appendix C to 1910 Subpart I Personal Fall Arrest Systems
 - 3. OSHA Ruling on Window Cleaning by Boatswain's Chair.
 - 4. 1910.66, Subpart F Powered Platforms
- D. American Institute of Steel Construction (AISC):
 - 1. AISC S342L-1993, with Supplements Load and Resistance Factor Design Specification for Structural Steel Buildings.
 - 2. AISC Manual of Steel Construction, Allowable Stress Design.
- E. Aluminum Association (AA):
 - 1. AA ADM-1 Aluminum Design Manual; Aluminum Association
- F. American Welding Society (AWS):
 - 1. AWS D1.1-2000 Structural Welding Code - Steel.
 - 2. AWS D1.2-2000 Structural Welding Code - Aluminum.

- G. American National Standards Institute (ANSI)/International Window Cleaning Association (IWCA):
 - 1. ANSI/IWCA I-14.1 Window Cleaning Safety Standard
- H. American Society of Mechanical Engineers:
 - 1. ASME A120.1 Safety Requirements for Powered Platforms for Building Maintenance

1.4 SUBMITTALS

- A. See Section 01 33 00 for requirements.
- B. Product Data:
 - 1. For each type of material and accessory.
- C. Shop Drawings:
 - 1. Showing anchorage locations and details.
- D. Project Information:
 - 1. Manufacturer's installation instructions and recommendations.
 - 2. Manufacturer Certificate of liability insurance.
 - 3. Drawings showing proposed rigging arrangements which might be used to reach windows, including boatswain's chair, drop-stage and/or other methods.
- E. Contract Closeout Information:
 - 1. Structural calculations for Window Washing System indicating design conforms to specified design criteria, sealed by the Specialty Structural Engineer.
 - a. Submit concurrent with Shop Drawings.
 - 2. Operating Procedures Outline:
 - a. Include elements in both pictorial and written form to instruct employees in safe use of roof supported building maintenance equipment and window cleaning procedures.
 - 3. Warranty.

1.5 WARRANTY

- A. Manufacturer five year warranty against failure and replacement of components.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Safety Tie-backs:
 - 1. Base:
 - a. Pro-Bel Enterprises Limited.
 - 2. Optional:
 - a. Boston Anchor.
 - b. Guardian Fall Protection.
 - c. High Rise Systems Inc.
 - d. Hysafe.
 - e. MIO Mechanical Corp.
 - f. Spider Staging.
 - g. Summit Anchor Company.
 - h. Swing Stage.
 - i. Tractel Incorporated.
- B. Other manufacturers desiring approval comply with Section 01 61 00.

2.2 DESIGN CRITERIA

- A. Provide Safety Tie-Backs engineered to support dead, live, and lateral (wind or seismic) loads indicated.
 - 1. Include headers and reinforcing members around openings.
 - 2. Required details defining method of fastening throughout system and attachments to supporting primary structure included in engineering requirement.
- B. Comply with California Administrative Code, Title 22 and Title 24.
- C. Design system to support 5000 LBS minimum load applied to each anchor.
 - 1. Compatible with current window washing practices and standards.
 - 2. Locations shown on Drawings are conceptual.
 - 3. Actual locations are to be determined by designer of system.

2.3 MATERIALS

- A. Design roof anchorage system including locations and details required to meet listed codes and requirements.
- B. Locations shown on Drawings are conceptual.
- C. Actual locations as determined by equipment supplier in Shop Drawings, but shall comply with following:
 - 1. Locate anchors with direct attachment to structural concrete or steel members.
 - a. Through-slab connections not allowed.
 - 2. Proposed locations are subject to final approval by Architect.
- D. Standards for components:
 - 1. Exposed structural stainless steel: Type 304, with a yield strength of 42 KSI.
 - 2. Non-Exposed structural components: ASTM A36, Type 350W with yield strength of 50 KSI for Hollow Structural Steel and 42 KSI for Plate Steel and other sections.
 - 3. Galvanizing: ASTM A123.
 - 4. Cold-Rolled Sections: ASTM A500 with yield strength of 55 KSI.
 - 5. Fastening devices: ASTM A325 or Type 304 stainless steel.
- E. Provide anchorage components fabricated of materials compatible with substrates to which welded or otherwise attached.
- F. Flashing and Counterflashing:
 - 1. Specified in Section 076200.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Correct unsatisfactory conditions.
- B. Start of work constitutes acceptance of conditions and responsibility for performance.

3.2 INSTALLATION/ERECTION

- A. Install components required to be attached to or connected with structure.
- B. Coordinate as required.
- C. Install in accord with manufacturer's instructions and approved shop drawings.
- D. No through-wall style anchors may be used unless approved by Architect.
- E. Install top of safety tie-back at 6 IN minimum above adjacent roofing height, taking into account insulation thickness at each tie-back location.

- F. Flashing:
 - 1. Specified in Section 07 62 00.
- G. Where contact is made between dissimilar materials, protect to prevent corrosion.
- H. Coordinate components indicated to be installed on other affected building components with those supplier, installers, or both.
- I. Retouch damaged galvanizing.
- J. Design components for attachment directly to structural steel members.

3.3 FIELD QUALITY CONTROL

- A. Check welds to structure.
- B. Verify water integrity of flashings, with roofer.

END OF SECTION



DIVISION 22

PLUMBING



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SECTION 22 20 00
PLUMBING FIXTURES AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Plumbing fixtures, trim, and equipment.
- B. Related Specification Sections include but are not necessarily limited to:
 - 1. Division 00 - Procurement and Contracting Requirements.
 - 2. Division 01 - General Requirements.
 - 3. Section 01 61 03 - Equipment - Basic Requirements.
 - 4. Section 40 05 00 - Pipe and Pipe Fittings - Basic Requirements.

1.2 QUALITY ASSURANCE

- A. Referenced Standards:
 - 1. Americans with Disabilities Act (ADA):
 - a. Accessibility Guidelines for Buildings and Facilities (ADAAG).
 - 2. American Society of Heating, Refrigerating and Air Conditioning Engineers/Illuminating Engineering Society of North America (ASHRAE/IESNA):
 - a. 90.1 IP, Energy Standard for Buildings Except Low-Rise Residential Buildings.
 - 3. American Society of Mechanical Engineers (ASME):
 - a. A112.19.3, Stainless Steel Plumbing Fixtures (Designed for Residential Use).
 - 4. American Society of Sanitation Engineers (ASSE):
 - a. 1011, Performance Requirements for Hose Connection Vacuum Breaker.
 - 5. Canadian Standards Association (CSA).
 - 6. NSF International (NSF).
 - 7. Underwriters Laboratories, Inc. (UL).

1.3 SUBMITTALS

- A. Shop Drawings:
 - 1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
 - 2. See Specification Section 01 61 03 and Specification Section 40 05 00.
 - 3. Color selection charts for Owner color selection.
 - 4. Fabrication and/or layout drawings:
 - a. Layout plan(s) showing dimensions, elevations, etc.
 - b. Details showing connections, installation, rough-in locations, etc.
 - 5. Product technical data including:
 - a. Acknowledgement that products submitted meet requirements of standards referenced.
 - b. Manufacturer's installation instructions.
 - c. Chemical-resistance data.
- B. Contract Closeout Information:
 - 1. Operation and Maintenance Data:
 - a. See Specification Section 01 33 04 for requirements for the mechanics, administration, and the content of Operation and Maintenance Manual submittals.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
1. Plumbing fixtures (vitreous china):
 - a. American Standard.
 - b. Crane.
 - c. Kohler.
 - d. Eljer.
 2. Premolded mop sinks:
 - a. Powers - Fiat.
 - b. Standard - Elsmar Granite Co.
 - c. Williams.
 - d. Florestone.
 3. Water closet seats:
 - a. Church.
 - b. Beneke.
 4. Lavatory fittings:
 - a. American Standard.
 - b. Chicago Faucets.
 - c. Kohler.
 - d. Sloan.
 5. Mop sink fittings:
 - a. American Standard.
 - b. Chicago Faucets.
 - c. Kohler.
 6. Flush valves:
 - a. Sloan.
 - b. Zurn.
 - c. Delany.
 7. Drains, roof drains, carriers, and shock absorbers:
 - a. Wade.
 - b. Josam.
 - c. Zurn.
 - d. Smith.
 8. Trap primer:
 - a. Precision Plumbing Products.
 9. Water hose:
 - a. B.F. Goodrich
 - b. Boston Industrial Hose
 10. Hose reels:
 - a. Hannay and Son, Inc.
 - b. Aeromative Mfg Co.
 11. Hose bibs:
 - a. Elkhart.
 12. Hydrants:
 - a. Wade.
 - b. Josam.
 - c. Smith.
 13. Domestic water heater:
 - a. A. O. Smith.
 - b. Ruud.
 - c. Rheem.
 - d. State.

14. Reduced pressure backflow preventer:
 - a. Watts.
 - b. Febco.
 - c. Clayton.
 15. Hose racks:
 - a. Strahman Valves, Inc., Model HR-100.
 16. Prefabricated trench drain system:
 - a. ACO Drain, Inc.
 - b. Poly Drain, Inc.
 - c. L.M. Scofield Company.
 17. Tepid water delivery system:
 - a. Hubbell.
 - b. Lawler.
- B. Submit request for substitution in accordance with Specification Section 01 25 13.

2.2 MANUFACTURED UNITS

- A. Plumbing Fixtures: (Vitreous China):
 1. Water closet (WC): Refer to schedule on Plans.
 2. Lavatory (L): Refer to Schedule on Plans.
- B. Sinks (S):
 1. Mop sink (MS): Refer to Schedule on Plans.
- C. Carriers:
 1. Closets (wall hung):
 - a. Wade W-330 or 340 for vertical stacks.
 - b. Wade W-310, 4 IN for horizontal lines.
 2. Lavatories: Wade W-520 series.
- D. Drains, Roof Drains and Downspout Nozzle:
 1. Floor drain (FD): Refer to Schedules on Plans.
 2. Prefabricated Trench Drain
 - a. Grating: Heavy Duty cast iron rated for 56,000 lb rubber tire wheel loads.
 - b. Grating Frame: Galvanized Steel
- E. Traps:
 1. Floor and equipment drains:
 - a. Same material and coating as the piping system.
 - b. 3 IN minimum seal.
 2. Fixture drains:
 - a. 2 IN minimum seal.
 - b. Cast brass.
 - c. Chrome plated.
 - d. Size as required.
 3. Ventilation housing drains: Extra-deep seal sufficient to maintain seal against static pressure maintained in fan housing.
- F. Trap Primer:
 1. Body:
 - a. All brass construction.
 - b. 1/2 IN male NPT inlet.
 - c. 1/2 IN female NPT outlet.
 - d. Stainless steel debris screen.
 - e. Brass piston.
 - f. Trap primer distribution:
 - 1) Up to 4 traps.
 - 2) 2 IN copper body.

3) Brass outlet.

G. Cleanouts (CO):

1. Cleanouts for cast iron pipe:
 - a. Tapped extra heavy cast iron ferrule.
 - b. Calked into cast iron fittings.
 - c. Extra heavy brass neoprene seal screw plug with solid hexagonal nut.
2. Cleanouts for steel pipe: Extra heavy brass screw plug in drainage fittings.
3. Access housing with a adjustable anchor flange and secured scoriated cast: Wade W-3800-MF.
4. Cleanouts turning out through walls and up through floor shall be made by long sweepells or "y" and 1/8 bends with plugs and face or deck plates to conform to architectural finish in room.
 - a. Where definite finish is not indicated, wall plates shall be chrome-plated cast-brass and floor plates polished brass.
5. Code:
 - a. Provide cleanouts of same size as pipe up to 4 IN and not less than 4 IN for larger pipes.
 - b. Close access openings for concealed cleanouts with flush floor or flush wall cover plates or flush ceiling access panels.
 - c. Provide wall plates with chrome plated cast-brass round cleanout cover with flanged ring.
 - d. Provide screws which match cover plate material.
6. Cleanouts installed in floor with ceramic tile, concrete, or Terrazzo finish: Wade W-6000-U.
7. Cleanouts installed in finished rooms flush with wall: Wade W-8480-S stainless steel.
8. Cleanouts installed in completely accessible pipe chases or where piping is exposed do not require special covers.
9. Cleanouts in floating floors: Wade 8300-MF housing and cover with 8550 cleanout body and closure plug or Smith 4250 or 4260 Series housing and cover with 4280 or 4290 Series cleanout body and closure plug.

H. Water Hose:

1. Furnish six 50-foot lengths of 1 IN rubber water hose and one 50-foot length of 3/4 IN rubber hose.
2. Provide with brass male and female NST hose thread couplings to fit hose nozzles and hose valves specified.

I. Hose Bibb (HB-1):

1. 1 IN cast brass, adjustable, combination fog straight stream nozzles.
2. Nozzles shall have female NST hose thread.

J. Hydrants (WH):

1. Wall hydrant:
 - a. Non-freeze.
 - b. Integral vacuum breaker.
 - c. Nylon seat.
 - d. 3/4 IN hose connection.
 - e. 3/4 IN inlet connection.
 - f. Length as recommended by manufacturer for wall thickness.
 - g. Type:
 - 1) WH-1 (exposed) Wade [8600].
 - 2) WH-2 (wall box) Wade [8600].
2. Yard hydrant (YH):
 - a. Non-freeze.
 - b. Galvanized casing.
 - c. Bury depth per Specification Section 4005 00.

- d. Brass mechanism.
 - e. Type: YH-1 (post type, aluminum housing wheel operating handle, 1-1/2 IN inlet and 1 IN hose connection) Wade W-8610.
 - f. Casing guard.
- K. Hose Racks:
- 1. Stainless steel.
 - 2. 3/4 IN hose capacity: 50 FT.
- L. Domestic Water Heater (DWH):
- 1. Electric tank type:
 - a. Size and capacity as scheduled.
 - b. UL listed.
 - c. Internal surfaces:
 - 1) Glass-lined with alkaline borosilicate composition fused-to-steel.
 - 2) Provide magnesium rods rigidly supported for cathodic protection.
 - d. Low watt density heating elements with zinc-plated copper sheath.
 - 1) Provide thermostat with each element, high temperature cutoff and temperature and pressure relief valve.
 - e. Insulate tank with vermin-proof glass fiber insulation or equal.
 - f. Heavy gage steel jacket with baked enamel finish.
 - g. Warranty against corrosion for three year period.
 - h. Provide water heaters meeting ASHRAE/IESNA 90.1 IP for energy efficiencies.
- M. Reduced Pressure Backflow Preventer:
- 1. Backflow preventers consist of two check valves, test cocks and relief valve, all assembled as an integral unit.
 - 2. Reduced pressure backflow preventers Watts 909.
 - 3. Backflow preventer to have threaded ends in sizes through 2 IN, flanged 2-1/2 IN and larger.
 - 4. Pressure loss through backflow preventer not exceeding 14 PSI at design flow.
 - 5. Provide air gap and pipe discharge to within 6 IN of finished floor.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Cross Connection: Do not install any plumbing components that will provide a cross connection between potable and non-potable or drainage systems.
- B. Fixtures:
- 1. Install fixtures at locations indicated on Drawings and in compliance with local Codes.
 - 2. Connect plumbing supply, drain and vent line sizes as shown on Drawings.
 - 3. Set proper grounds to form secure base for each fixture and rigid setting.
 - 4. Install fixtures except water closets with water supply above rim and with Code approved backflow preventers.
 - 5. Seal fixture joints abutting walls and floors with silicone sealant.
 - 6. Connect exposed traps and supply pipes for fixtures and equipment to rough piping systems at wall, unless otherwise specified.
- C. Drains:
- 1. Install drains at locations indicated on Drawings and in compliance with local Codes.
 - 2. In quarry tile floors:
 - a. 24 x 24 IN 6 LB lead sheet clamped to drain.
 - b. Set 1-1/2 IN above structural slab for mortar set and 1/2 IN for thin set.
 - 3. In uncovered concrete slabs:
 - a. Install at the low points of surface areas to be drained or as indicated.
 - b. Set tops of drains flush with the finished floor.

- c. Install drain flashing collar or a flange so that no leakage occurs between the drain and the adjoining surfaces.
 - d. Maintain the integrity of waterproof membranes, where penetrated.
- D. Yard Hydrants:
 - 1. Install plumb.
 - 2. Provide concrete around pipe as shown on Drawing.
 - 3. For buried applications, install Schedule 80 PVC drainage nipple sized to match drain port as provided by manufacturer.
 - a. Extend nipple into crushed rock.
 - 4. For applications at elevated slabs, provide 1/2 IN Schedule 80 PVC from drain port to drain.
- E. Hose Racks:
 - 1. Adjacent to hose bibbs, top of rack 36 IN above finished floor or grade.
 - 2. Concrete or masonry walls: Mount with 5/8 IN x 2-1/2 IN stainless steel expansion anchors.
 - 3. Handrail:
 - a. Bolt hose rack to 24 IN x 24 IN x 1/4 IN aluminum plate with 5/8 IN stainless steel bolts.
 - b. Attach to handrail with 3/8 IN stainless steel through bolt at each corner of the plate.
 - 4. Pedestal:
 - a. Bolt hose rack to 24 IN to 24 IN x 1/4 IN aluminum plate with 5/8 IN stainless steel bolts.
 - b. Attach to pedestal with two, 1/2 IN stainless steel bolts through handrail.
- F. Hose Bibbs:
 - 1. Install 36 IN above finished floor.
 - 2. In exterior locations, provide interior isolation valve.
- G. Shock Absorbers:
 - 1. Install on hot and cold water lines adjacent to each battery of fixtures or other equipment where indicated on Drawings.
 - 2. Size as recommended by manufacturer for length of pipe served.
 - 3. Locations having two fixtures or less, install capped air chamber 12 IN long on hot and cold water runouts to each fixture, same size as runout.
 - 4. Runouts to hose bibbs and wall hydrants do not require air chambers.
 - 5. Install units vertically on top of pipe or as detailed on the Drawings.
- H. Cleanouts:
 - 1. Install cleanouts:
 - a. Above floor in each vertical riser that connects to horizontal branch below floor.
 - b. At test tee to receive proper test plugs in each vertical riser at least every other floor.
 - c. As required by local Code.
- I. Wall Plates and Escutcheons: Install as specified in Specification Section 40 05 00 or this Specification Section.
- J. Water Heater:
 - 1. Install all water heaters in accordance with details, manufacturer's recommendations, and applicable Codes.
 - 2. For units located on concrete pads, plumb level and orient to allow access to the controls, elements and other items requiring service.
 - 3. Connect hot and cold water piping to the unit with line-size, isolation valves and dielectric unions.
 - 4. Start up the unit and adjust all controls for proper temperature control and maximum efficiency.
- K. Reduce Pressure Backflow Preventer: Install on water lines as required by Code.

3.2 FIELD QUALITY CONTROL

- A. Test piping and fixtures for leaks per Specification Section 40 05 00.

END OF SECTION

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DIVISION 23

HEATING, VENTILATING, AND AIR
CONDITIONING (HVAC)



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SECTION 23 05 93
HVAC SYSTEMS - BALANCING AND TESTING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Adjusting, balancing, and testing of all heating, ventilating and air conditioning (HVAC) systems, including the following systems:
 - a. Air distribution and exhaust systems.
 - b. Air moving equipment.
 - c. Circulating water systems, including pumps.
 - d. Control systems.
 - e. Heating system.
- B. Related Sections include but are not necessarily limited to:
 - 1. Division 00 - Procurement and Contracting Requirements.
 - 2. Division 01 - General Requirements.
 - 3. Section 23 09 00 - Instrumentation and Control for HVAC Systems.
 - 4. Section 23 31 00 - HVAC - Ductwork.
 - 5. Section 23 34 00 - HVAC - Fans.
 - 6. Section 23 80 00 - HVAC - Equipment.

1.2 QUALITY ASSURANCE

- A. Referenced Standards:
 - 1. Associated Air Balance Council (AABC):
 - a. National Standards for Total System Balance.
 - 2. American Industrial Hygiene Association (AIHA):
 - a. Z9.5, Laboratory Ventilation.
 - 3. American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE):
 - a. HVAC Systems and Equipment Handbook, Chapter entitled "Testing, Adjusting, and Balancing".
 - 4. National Environmental Balancing Bureau (NEBB):
 - a. Procedural Standards for Testing Adjusting Balancing of Environmental Systems.
- B. Qualifications:
 - 1. Work of this Section to be accomplished by an independent testing and balancing firm certified by one (1) of the following:
 - a. Associated Air Balance Council (AABC).
 - b. National Environmental Balancing Bureau (NEBB).
 - c. Other certification entity approved by Engineer.
 - 2. The independent firm shall not be the same firm as the firm installing the HVAC equipment, nor under contract to the firm installing the equipment.

1.3 SUBMITTALS

- A. Shop Drawings:
 - 1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
 - 2. Certifications:
 - a. Letter stating the name and qualifications of the firm proposed.
 - b. Evidence that relevant subcontractors have been notified of the requirement to coordinate balance and test elements in the work with the testing and balancing firm.

3. Report forms:
 - a. Procedures and forms to be used in calibrating of test instruments, balancing systems, and recording and reporting test data.
- B. Informational Submittals:
 1. Completed test reports and data forms upon completion of installation, balance and testing of HVAC systems.
 - a. Insert recorded information on report forms required by specifications and approved for use on project.
 - b. Additional written verification and other related information clearly identifying project, date and specifics of verification.
 - c. Utilize report forms similar to those shown in Section V of AABC Standard.
 - d. Provide forms typed and signed by the testing and balancing firm.

PART 2 - PRODUCTS - (NOT USED)

PART 3 - EXECUTION

3.1 PREPARATION

- A. Secure approved Shop Drawings of all HVAC equipment.
- B. Procedures and Forms:
 1. Submit procedures and forms to be used in calibration of test instruments, balancing systems, and recording and reporting test data.
 2. Obtain approval before beginning balancing and testing.
- C. Do not begin balancing and testing until HVAC systems are complete and in full working order.
 1. Place HVAC systems into full operation and continue their operation during each working day of balancing and testing.
- D. Provide qualified heating and ventilating Engineer(s) to supervise and perform balancing and testing.
- E. Review design Drawings, specifications, approved Shop Drawings and other related items to become thoroughly acquainted with the design of HVAC systems.
- F. Check all installed systems against Contract Drawings, Specifications and Shop Drawings to see that system is installed as required.
 1. Report deficiencies to the Engineer.
 2. Report deficiencies to Contractor for remedial action including providing corrective measures required in the function of any part of system to complete balancing.
- G. Make necessary adjustments as required to balance the systems.

3.2 FIELD QUALITY CONTROL

- A. Balance and Test Air Systems:
 1. Adjust equipment RPM to design requirements.
 2. Report motor full load amperes.
 3. Obtain design CFM at fans.
 - a. Make pitot tube traverse of main supply and exhaust ducts within 5 PCT.
 4. Test and record system static pressures, suction and discharge.
 5. Obtain design CFM for recirculated air.
 6. Obtain design CFM outside air.
 7. Test and record entering air temperatures, (DB, heating and cooling).
 8. Test and record leaving air temperatures, (DB, heating and cooling).
 9. Test and record leaving air temperatures, (WB, cooling).
 10. Adjust dampers in supply, exhaust and return air ducts to design CFM.

11. Test diffusers, grilles, and registers as follows:
 - a. Adjust to comply with design requirements within 10 PCT.
 - b. Identify location and area of each.
 - c. Adjust face velocity to establish required CFM.
 - 1) Retest after initial adjustments.
 - d. Adjust to minimize drafts and to ensure uniform air distribution in all areas.
 12. Identify and list size, type and manufacturer of diffusers, grilles, registers, and HVAC equipment.
 - a. Use manufacturer's ratings on equipment to make required calculations.
 13. Adjust and assure that the operation of automatically operated dampers are as specified.
 - a. Check and calibrate controls.
 14. Prepare and submit reports.
- B. Balance and Test Water Systems:
1. Phase 1:
 - a. Complete air balance before beginning actual water balance.
 - b. Open valves to full open position.
 - 1) Close coil bypass stop valves.
 - 2) Set mixing valve to full coil flow.
 - c. Check operation of relief valves.
 - d. Examine water in system and determine if water has been treated and cleaned.
 - 1) Clean strainers before and after balancing.
 - e. Check pump rotation.
 - f. Check expansion tanks to determine they are not air bound and system is completely full of water.
 - g. Check air vents at high points of water systems and determine all are installed and operating correctly.
 - h. Set temperature controls so coils are calling for full heating.
 - 1) This should close automatic bypass valves.
 - 2) Utilize same procedure when balancing chilled water coils, set on call for full cooling.
 - i. Check operation of automatic bypass valves.
 2. Phase 2:
 - a. Set pumps to proper flow delivery.
 - b. Adjust and record waterflow at system entrance.
 - c. Adjust and record waterflow through pumps.
 - d. Check and record water entering temperatures and return water temperatures at system entrance.
 - 1) Set to correct design temperatures.
 - e. Check water temperatures at inlet side of cooling and heating coils.
 - 1) Record rise or drop of temperatures from source.
 - f. Proceed to balance each chilled water and hot water coil.
 - g. Upon completion of flow readings and adjustments at coils, mark settings and record data.
 3. Phase 3:
 - a. After adjustments to coils are made, recheck settings at pumps and readjust if required.
 - b. Install pressure gauges on coil, read pressure drop through coil at set flow rate.
 - 1) Set pressure drop across bypass valve to match coil full flow pressure drop to prevent unbalanced flow conditions when coils are on full bypass.
 - c. Check and record the following items at each cooling heating element:
 - 1) Inlet water temperatures.
 - 2) Leaving water temperatures.
 - 3) Pressure drop of each coil.
 - 4) Pressure drop across bypass valve.
 - 5) Pump operating suction and discharge pressures and final TDH.
 - 6) Water metering device readings.

- d. List mechanical specifications of pumps.
- e. Record rated and actual running amperage of pump motor.
- f. Prepare and submit report.

END OF SECTION

SECTION 23 09 00

INSTRUMENTATION AND CONTROL FOR HVAC SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Instrumentation and control for HVAC systems.
 - 2. Temperature control.
 - 3. Ventilation control.
 - 4. Heating control.
 - 5. Control wiring.
 - 6. Panels and accessories.
 - 7. Miscellaneous.
- B. Related Specification Sections include but are not necessarily limited to:
 - 1. Division 00 - Procurement and Contracting Requirements.
 - 2. Division 01 - General Requirements.
 - 3. Section 10 14 00 - Identification Devices.
 - 4. Section 01 61 03 - Equipment - Basic Requirements.
 - 5. Section 23 31 00 - HVAC - Ductwork.
 - 6. Section 23 80 00 - HVAC - Equipment.
 - 7. Section 26 05 19 - Wire and Cable - 600 Volt and Below.
 - 8. Section 26 05 33 - Raceways and Boxes.
 - 9. Section 40 61 13 - Process Control Systems General Requirements.

1.2 QUALITY ASSURANCE

- A. See Specification Section 01 61 03.
- B. Referenced Standards:
 - 1. ASTM International (ASTM):
 - a. D1693, Standard Test Method for Environmental Stress-Cracking of Ethylene Plastics.
 - 2. The International Society of Automation (ISA):
 - a. S5.1, Instrumentation Symbols and Identification.
 - b. S5.4, Standard Instrument Loop Diagrams.
 - 3. National Electrical Manufacturers Association (NEMA):
 - a. 250, Enclosures for Electrical Equipment (1000 Volts Maximum).
 - 4. National Fire Protection Association (NFPA):
 - a. 70, National Electrical Code (NEC).
 - 5. Underwriters Laboratories, Inc. (UL).
- C. Miscellaneous:
 - 1. Controls to be in compliance with Specification Section 2605 00 for NEMA and NFPA 70 enclosure class requirements unless noted or specified otherwise.
 - 2. Unless specifically noted otherwise, components of systems shall be industrial duty suitable for moist, corrosive environments.

1.3 SYSTEM DESCRIPTION

- A. Work shall be provided as an integrated operating system.
- B. Provide a complete system of automatic temperature control, thermostats, relays, valves, damper operators and other associated controls and appurtenances required to maintain minimum conditions described in detail herein and on Drawings, together with thermometers, gauges and other accessory equipment.

1. Assemble control system with complete system of wiring and air piping to fulfill requirements of the Contract Documents.
- C. Install system using competent mechanics under direct supervision of control manufacturer.
- D. Controls, as set out in "Sequence of Operation," are designed to illustrate operating functions only.
1. Control sequence shall be considered supplementary to "Sequence of Operation".
 2. These minimum specified items, and any additional controls, not indicated but required to meet performance as outlined in the Contract Documents, shall be furnished and installed at no additional cost to Owner to make a complete system.
- E. Sequence of Operation - General:
1. Sequence of operation indicated illustrates basic operating functions only.
 2. Review Drawings and submit complete installation data, including minor details, to provide proper operation in his proposal.
 3. Where an item differs from specifications, control manufacturer shall submit manufacturer's recommendations subject to Engineer's approval.
 4. Solids Handling Building, 510:
 - a. Four air handlers provide continuous ventilation to the building to reduce classification in the building to Class 1, Division 2.
 - 1) ASU-8001, ASU-8002, ASU-8003, and ASU-8004 supply fans shall run continuously subject to smoke detection in the supply air ducts.
 - 2) Exhaust fan EF-510-01 shall run when ASU-8003 is running.
 - 3) Heating system:
 - a) When the outside air temperature is below 50 DegF the associated circulation pumps shall run.
 - b) Each control valve shall modulate to maintain the room temperature as set at the room thermostats, initial setting 45 DegF (adj.).
 - 4) Alarms:
 - a) Provide fan failure alarms to the SCADA system if the fan is not running.
 - b) See additional requirements in the I&C section for required NFPA 820 alarms.
 - 5) Smoke detection:
 - a) Provide supply system smoke detection per NFPA 90A and shut down the associated supply fan when smoke is detected.
 - b. Exhaust fan EF-8004 shall run continuously.
 5. Mechanical Building, 560:
 - a. One supply fan, SF-560-01, and exhaust fan, EF-560-01, provide code required ventilation to the Mechanical Building to reduce the classification to Unclassified from Class 1, Division 2, Group D.
 - 1) These fan shall run continuously and provide an alarm to the SCADA system when flow is not maintained.
 - 2) Smoke detection in the supply and return fans shall stop the associated fans.
 - b. Unit heaters in each room will provide heating as required to maintain integral thermostat setpoints, initial setpoint 40 DegF.
 - c. The electrical room has a ductless split system air conditioner that is controlled by controls provided by the manufacturer.
 - d. The electrical room also has a positive pressurization unit that provides outside air to the room and has local controls by the manufacturer.

1.4 SUBMITTALS

- A. Shop Drawings:
1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
 2. Wiring diagrams showing point to point termination with auxiliary interlocks for each item in each control loop.
 3. Information on equipment proposed for use including corrosion protection.

- B. Quality Control Submittals:
 - 1. Secure from equipment manufacturers, detailed and complete control and power wiring diagrams, word descriptions of controls provided as part of the HVAC equipment or equipment interfaced or interlocked thereto, and submit with equipment manufacturer's submittals.
 - a. Provide the above information to control manufacturer.
- C. Contract Closeout Information:
 - 1. Operation and Maintenance Data:
 - a. See Specification Section 01 33 04 for requirements for the mechanics, administration, and the content of Operation and Maintenance Manual submittals.

1.5 PROJECT CONDITIONS

- A. Unless stated otherwise, the environment and air streams will include varying concentrations of the following chemical components:
 - 1. H₂SO₄ - Sulfuric acid.
 - 2. NH₃ - Ammonia.
 - 3. Cl₂ - Chlorine.
 - 4. H₂S - Hydrogen sulfide.
 - 5. HCl - Hydrochloric acid.
 - 6. Condensation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
 - 1. Manufacturer's catalog numbers hereinafter are for reference to type, style, dimension, related items and to establish a standard of quality.
 - a. Reference to a manufacturer's number hereinafter does not imply full compliance to these Specifications.
 - 2. Instrumentation and control systems:
 - a. Honeywell.
 - b. Johnson Control Co.
- B. Submit request for substitution in accordance with Specification Section 01 25 13.

2.2 EQUIPMENT

- A. Dampers:
 - 1. Refer to Specification Section 23 31 00.
- B. Damper Operators:
 - 1. Provide operators of proper size and number to secure true throttling or two-position action as required.
 - 2. Furnish damper operators for installation inside ductwork and attached to frame of damper, or installed outside ductwork and connected to extended shaft as required.
 - 3. Provide operators for outside air, spring-loaded with sufficient power to assure tight closing of dampers on fan shutdown or in the fail safe position indicated by "Sequence of Controls."
 - 4. Provide pneumatic operators with aluminum bodies and stainless steel shafts, low friction non-corrosive shaft bearings, piston-type operators with rolling type neoprene diaphragm, and universal mounting bracket.
 - 5. Electric operators:
 - a. Provide operators:
 - 1) Fully immersed in oil gear train.
 - 2) Enclosed in closed cast aluminum housing.

- b. As an alternate to 5.a.: Provide operators in NEMA 4X enclosure, Belimo ZS-300.
 - c. Provide damper operators with integral spring return motor springs to make controls fail safe in position specified under "Sequence of Controls."
 - d. Provide fully modulating operators from proportional electric controllers.
 - e. Provide end switches or proportioning controllers permitting simultaneous operation or interlocking with other equipment.
 - f. Provide separate electrical circuits for damper operators with no more than four operators on a circuit.
6. Coordinate with dampers provided:
 - a. Provide damper operators that are rated for the required torque.
 - b. If single damper operator can not meet torque requirement, provide sectional dampers to match operator torque.
 7. Use of electric operators shall be limited to small dampers in those applications where it is impractical to provide pneumatic operators and are to be approved by the Engineer.
 8. Ensure coordination to provide for the installation of tight closing dampers low leakage type (6 CFM per square foot at 4 IN WC pressure across damper) with compatible dampers, damper operators and related controls.

C. Motor-Operated Valves:

1. Valves shall have modulating plugs and contoured disc type inner valve construction to ensure modulation of flow and shut-off features as the application demands.
2. Furnish valves 2 IN and smaller with high grade bronze bodies with screwed ends.
 - a. Reducers and fittings necessary to install smaller than pipe size valves shall be furnished and installed under applicable piping sections.
3. Furnish valves 2-1/2 IN and larger with iron bodies with flanged ends.
 - a. Rate valves at a maximum fluid pressure of 125 PSI, and a maximum fluid temperature of 350 DEGF.
 - b. Valves to be sized in accordance with flow capacity and pressure drop indicated.

FLUID	INLET PRESSURE	DIFFERENTIAL PRESSURE
Heating water	25 PSIG	5 to 10 FT

4. Furnish valves for heating water with equal percentage modulating plugs and renewable composition discs.
 - a. Coil valves shall be molded rubber diaphragm type.
 - b. Valves 2 IN and smaller shall be screwed.
 - c. Valves 2-1/2 IN and larger shall be flanged.
 - d. Valve bodies suitable for 125 PSIG WP.
 - e. Provide three-way mixing or diverting valves as indicated or as the application demands.

D. Valve Operators:

1. Provide operators of proper size and number to secure true throttling or two-position action as required.
2. Provide electric operators rated for area classifications shown on the Electrical drawings.
3. Provide electric operators with fully immersed in oil gear train, in tightly closed cast aluminum housing.
 - a. Provide valve linkage.

E. Electric Control Instruments:

1. Provide stainless steel sensing elements type thermostats with liquid filled, compensated thermal systems so that equally spaced dial graduations are possible over entire range.
 - a. Make thermal systems field detachable with averaging or plain bulbs as installation conditions dictate.

- b. Provide sensing elements minimum of 60 IN in length and suitable for operation from -30 to 300 DEGF.
 - c. Provide reverse acting on-off type thermostats for controlling ventilating fans.
 - d. Provide multiple stage thermostats where designated in Paragraph "Sequence of Operation".
2. Provide transformers for supplying current to control equipment operating at less than 120 V and where required by manufacturer's automatic control system design capable of supplying 125 PCT of energy requirements of equipment connected for not less than 1 HR.
 - a. Enclose transformers in UL listed cabinets with conduit connections.
 - b. Provide fused disconnect switches on both primary and secondary sides.
 3. Provide low limit electric thermostats of two-position type with 20 FT bulb and manual reset.
 - a. Shall be capable of opening thermostat circuit if any 1 FT section of bulb is subjected to a temperature below thermostat setting.
 - b. Each thermostat shall have two circuits, one to shut down fan, another for a alarm.
 - c. Install all freeze-stats to override starter circuits regardless of position.
 - d. For corrosive environments provide thermostats with stainless steel sensing elements.
 - 1) Ensure element is installed to sense coldest point should stratification occur.
 4. Provide each thermostat with an accurate red-reading thermometer sensing temperature outside of enclosure.
 5. Label thermostat with identification tag of HVAC equipment controlled using phenolic nameplate in accordance with Specification Section 10 14 00.
- F. Industrial Controllers:
1. Provide control instruments, devices, and incidentals of industrial process control quality capable of producing the outlined performances.
 2. Controller shall be capable of receiving both pneumatic and analog electric systems.
 3. Electronic (and electric) controller shall have three control mode capabilities of proportional rate (time), and dead band within following minimum performance and application criteria:
 - a. Setpoint adjustment: 0 to 110 PCT of span.
 - b. Repeatability: Setpoint repeats within +0.1 PCT of span.
 - c. Dead band: 1 PCT of span, standard.
 - d. Rate: 5 to 30 seconds adjustable.
 - e. Response level: 50 milliseconds for a step change of 1 PCT of span beyond setpoints.
 - f. Output: SPDT relay contacts, 5 amps at 117 VAC noninductive.
 4. Controller shall be capable of remote setpoint adjustment, permanently mounted in air flow control panel unless otherwise indicated.
 5. Provide each controller with instruments (pressure gages, milliammeters, voltmeters, etc.) to indicate magnitude of output signal in both medium of signal (psig, mA, volt DC, etc.) and percentage of full output signal.
 6. Recording controllers:
 - a. Where recording controllers are required by "Sequence of Controls," they shall be 10 IN chart, 24 HR or 30-day charts (field selection), with one, two, or three pens as listed in control sequence.
 - b. Pens shall have capillary ink supply and cartridge type ink supply.
 - c. Recorders shall operate on 110 V power supply.
 - d. Optional 4 IN strip chart recorders may be used with the strip traveling vertically.
- G. Static Pressure Gages:
1. Install gages on control panel for each system.
 - a. One gage shall serve each filter while others shall serve as a check on system.
 - b. Gages shall be Magnahelic by Dwyer 2000 ASF, flush mounted with signal flag for filter gage.
 - c. Install static pressure tips as scheduled under control panel indication points.
 - d. Static pressure ranges:
 - 1) Filter (cartridge): 0 to 2.0 IN WC.

2) Air-handling systems: 0 to 10.0IN WC (one per a ir-handling unit).

H. Local Temperature Control Panel, ECP-510-01:

1. Panel shall be floor or wall-mounted and be sized to accommodate electrical switches, protective devices (except electrical switches and devices furnished as an integral part of air handling unit).
2. Mount indicating controllers or receiver-controllers, , switching relays, ammeters and other accessory items on local sub-panels set in vicinity of equipment to be served.
 - a. Where two similar items of equipment, such as pumps, are installed adjacent to each other a single panel may be used to contain all instruments.
3. Fully compensated capillaries connected to instruments shall be of sufficient length to allow them to be run between equipment and placed in such a position so that they will not obstruct service of equipment or become damaged.
4. Miniature milliamper meters for electronic temperature transmission may be used.
5. Manufacture panels in one of the following manners:
 - a. NEMA electrical panel boxes with windows.
 - b. Install gauges flush mounted in swing out panel behind window with instruments and other control items located inside enclosures behind panel.
 - 1) Refer to Paragraph "Corrosion Protection."
6. Mount all relays, , pressure switches, etc., on rear inside of enclosure.
 - a. Tag each instrument corresponding to symbols used on control diagrams.
7. Temperatures, pressures, equipment operation, and related items shall be continuously indicated on panels.
8. Temperature control panel shall indicate the following for ASU-8001, ASU-8002, ASU-8003, and ASU-8004:
 - a. Supply fan run status.
 - b. Room temperature.
 - c. Discharge air temperature.
 - d. (Common) Outside air temperature.
 - e. Circulation pump run status.
9. Temperature control panel shall indicate the following for EF-510-01:
 - a. Supply fan run status.
10. Temperature control panel shall include an equipment call relay output contact to the Motor Control Center for the following:
 - a. ASU-8001
 - b. ASU-8002
 - c. ASU-8003
 - d. ASU-8004
 - e. EF-510-01

2.3 FABRICATION

A. Corrosion Protection:

1. Protect metal parts of controls, instrumentation and related items from corrosive atmosphere by either protective coatings or select materials.
 - a. Aluminum and stainless steel require no further protection.
2. Provide NEMA 4X fiberglass control enclosures with tempered glass windows and vapor tight gaskets, illustrated in Hoffman Bulletin A-50, for protection of controls from corrosive environment.
 - a. Install control instruments inside enclosure and extend remote stainless steel sensing elements through enclosure wall.
 - b. Provide vaportight seals for penetrations of enclosure.
3. Provide in each enclosure industrial corrosion inhibitors, Hoffman Corrosion Inhibitors, as illustrated in Hoffman's technical Bulletin HCI.
4. Protect metal accessory items such as mounting brackets and fasteners not stainless steel, fiberglass or aluminum by epoxy or phenolic coatings.
5. Protect electric motor operator with corrosion inhibitors inside enclosure.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Comply with requirements of Specification Section 26 05 19 and Specification Section 26 05 33.
- B. Identification: See Specification Section 10 14 00.
- C. Connect control devices to perform functions indicated and perform in required sequence.
- D. Use remote element temperature transmitters for points of temperature transmitters for points of temperature measurement occurring in air ducts or shafts, or in mechanical piping system.
- E. Use remote element pressure transmitters of panel-mounted pressure gauges.
- F. Where continuous indication of space temperature is on local control panels, install a thermostat and a temperature transmitter side by side.
 - 1. Pipe continuous indication signal to a receiver on panel.
 - 2. A resistance element or thermocouple signal may be used with continuous indicating meter, calibrated in degrees Fahrenheit.
- G. In general, locate thermostats for room control immediately inside door, above light switch, unless shown otherwise.
 - 1. Where light switch is in an entryway to room, locate thermostat on wall within room so it is capable of sensing true space conditions.
 - 2. Prior to installation, coordinate thermostat location with Engineer.
- H. Mount local control panels adjacent to equipment served.
- I. Where a temperature indicating gage is used at the panel, a pressure gage indicating transmitter signal is not required.
- J. Provide appropriate type continuous reading indicator for each controller, transmitter and transducer.
 - 1. Mount in-line or tapped on controller.
 - 2. Mount at local control panel.
- K. Gages with flexible hose terminating with hypodermic needle may be used for checking control system.
 - 1. Do not substitute for in-line gages.
- L. Locate panels so visual observation and adjustment can be accomplished from floor level.

END OF SECTION

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SECTION 23 21 00
HYDRONIC SPECIALTIES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Hydronic specialties.
- B. Related Sections include but are not necessarily limited to:
 - 1. Division 00 - Procurement and Contracting Requirements.
 - 2. Division 01 - General Requirements.
 - 3. Section 01 61 03 - Equipment - Basic Requirements.
 - 4. Section 23 09 00 - Instrumentation and Control for HVAC Systems.
 - 5. Section 23 05 93 - HVAC Systems - Balancing and Testing.

1.2 QUALITY ASSURANCE

- A. Referenced Standards:
 - 1. American National Standards Institute (ANSI).
 - 2. American Society of Mechanical Engineers (ASME).
 - 3. ASTM International (ASTM):
 - a. A159, Standard Specification for Automotive Gray Iron Coating.
 - b. B36, Standard Specification for Brass Plate, Sheet, Strip and Rolled Bar.
 - c. B62, Standard Specification for Composition Bronze or Ounce Metal Castings.
 - d. B85, Standard Specification for Aluminum-Alloy Die Castings.
 - e. B99, Standard Specification for Copper-Silicon Alloy Wire for General Purposes.
 - f. B371, Standard Specification for Copper-Zinc-Silicon Alloy Rod.
 - g. B584, Standard Specification for Copper Alloy Sand Castings for General Applications.
 - 4. Expansion Joint Manufacturer's Association (EJMA).
 - 5. National Electrical Manufacturers Association (NEMA).
 - 6. Society of Automotive Engineers (SAE).

1.3 SUBMITTALS

- A. Shop Drawings:
 - 1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
 - 2. See Specification Section 01 61 03.
 - 3. Product technical data including:
 - a. Acknowledgement that products submitted meet requirements of standards referenced.
 - b. Manufacturer's installation instructions.
 - c. Manufacturer's catalog cuts and technical information.
 - d. Pump curves.
 - 4. Certifications.
 - 5. Test reports.
- B. Contract Closeout Information:
 - 1. Operation and Maintenance Data:
 - a. See Specification Section 01 33 04 for requirements for the mechanics, administration, and the content of Operation and Maintenance Manual submittals.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
1. Tank fittings:
 - a. Bell and Gossett; Modle ATFL
 2. Flow measuring devices and meters:
 - a. Aeroquip.
 - b. Barco.
 - c. Dieterich Standard Corp.
 3. Hydronic water pumps:
 - a. Bell and Gossett.
 4. Expansion joints:
 - a. Flexonics Div.
 - b. Zallea Brothers, Inc.
 - c. Pathway Bellows, Inc.
 5. Flexible connections:
 - a. Flexonics Div.
 - b. Barco.
 - c. Anaconda Metal Hose.
 6. Heating water coil circulation pumps:
 - a. Bell and Gossett.
- B. Submit request for substitution in accordance with Specification Section 01 25 13.

2.2 EQUIPMENT

- A. Manual Air Relief Vents:
1. Type: Class 150 bronze gate with rising stem and solids wedge.
 2. Material:
 - a. Bonnet, body and wedge: Bronze ASTM B62.
 - b. Packing nut and packing gland: Bronze ASTM B62 or ASTM B584 alloy C84400.
 - c. Stem: Silicon Bronze ASTM B371 Alloy C69400 or ASTM B99 alloy C65100 H04.
 - d. Hand wheel: Aluminum ASTM B85 Alloy A03800.
 - e. Hand wheel nut; 150 PSI steam at 406 DEGF minimum.
 3. Design limitations: 150 PSI steam at 406 DEGF minimum.
 4. Relief tubing: K copper.
 5. Size: As required.
- B. Tank Fittings:
1. Body: Cast iron.
 2. Tubes: Copper and copper plated.
 3. Vent tube plug: Brass.
 4. Ball check: Stainless steel.
 5. Design pressures: 125 PSI minimum.
- C. Water Flow Measuring Devices:
1. Venturi type (non-corrosive areas).
 - a. Material:
 - 1) Bronze to 3 In DIA.
 - 2) Cast steel for 4 In or larger.
 - b. Connections:
 - 1) NPT to 3 IN or larger.
 - 2) Flanged for 4 IN or larger.
 - c. Minimum length: 1.6 x pipe diameter.
 - d. Accuracy: +1 PCT.

- 1) Accuracy obtained with as little as five (5) pipe diameters of straight pipe upstream and two (2) pipe diameters downstream.
 - e. Two (2) sensing taps, nipples, shut-off valves, and quick connect couplings.
 - f. Body rating: ANSI 150LB minimum.
 - 2. Pivot type (corrosive areas).
 - a. Material: 316 stainless steel.
 - b. Permanent pressure loss to system: 5 IN water of head on sizes over 1-1/2 IN, maximum.
 - c. Impact port size:
 - 1) Pipes 2 to 5 IN: 0.125 IN ID minimum.
 - 2) Pipes 4 IN or larger: 0.281 IN ID minimum.
 - d. Nominal 1/4 IN flare safety shut-off instrument valves.
 - e. Accuracy: +2 PCT of actual valve.
 - f. Repeatability: +2 PCT of actual valve.
 - g. Maximum temperature rating in water: 300 DEGF.
 - h. Maximum pressure rating in water: 500 PSIG.
- D. Hydronic Water Pumps:
 - 1. Type: Centrifugal, single-stage, in-line suction and discharge, base mounted.
 - 2. Material:
 - a. Volute: Cast iron ASTM A159.
 - b. Impeller:
 - 1) AA sizes: Brass, ASTM B36.
 - 2) A, F sizes: Cast bronze, ASTM B584
 - c. Pump shaft: Steel, SAE 1144.
 - d. Seal assembly:
 - 1) Housing: Brass.
 - 2) Bellows: Buna-N.
 - 3) Ring: Carbon.
 - 4) Spring: 304 stainless steel.
 - 5) Seat: Ceramic.
 - 6) Seat gasket: Buna-N
 - e. Volute gasket: Cellulose fiber.
 - f. Companion flanges:
 - 1) 1 to 1-1/2 IN: Formed steel.
 - 2) 2 IN: Cast iron, ASTM A159.
 - g. Shaft sleeve: Copper alloy 110 or aluminum bronze, ASTM B584.
 - h. See Hydronic Water Pumps Schedule
- E. Expansion Joints:
 - 1. For piping 2-1/2 IN or smaller.
 - a. Type: Bellows.
 - b. Material:
 - 1) Bellows: Two-ply stainless steel.
 - 2) Shrouds and end fittings: Carbon steel.
 - c. Stroke: 1-3/4 IN compression, 1/4 IN extension minimum.
 - d. Maximum operating temperature: 750 DEGF.
 - e. Maximum working pressure: 175 PSI.
 - f. Maximum test pressure: 250 PSI.
 - g. Fittings: NPT.
 - 2. For piping 3 IN or larger:
 - a. Type: Controlled flexing bellows.
 - b. Material:
 - 1) Bellows: Stainless steel.
 - 2) Carrier rings and fittings: Steel.
 - c. Maximum transverse travel: 7-1/2 IN.

- d. Temperature limits: -20 to 850 DEGF.
 - e. Allowable pressure: Vacuum to 300 PSI.
 - f. Fittings: Flanged.
- F. Pipe Guides:
- 1. Type: System consisting of a spider which rigidly attaches to pipe and is housed in a sleeve which can be rigidly anchored.
 - 2. Material: Steel.
- G. Flexible Connectors:
- 1. Type: Flexible corrugated single braid hose.
 - 2. Material: Stainless steel.
 - 3. Maximum working pressure 150 PSIG.
 - 4. Maximum test pressure: 250 PSIG.
 - 5. Normal burst pressure: 650 PSIG minimum.
 - 6. Fittings:
 - a. For sizes up to 2-1/2 IN DIA: NPT.
 - b. For sizes 3 IN or larger: Flanged.
- H. Floor Drain:
- 1. Cast iron construction
 - 2. Square ductile iron half grate
 - 3. Sediment bucket
 - 4. Heavy duty traffic rated
 - 5. Single seated valve plugs
 - 6. Center guided trim
 - 7. Linear flow characteristics
 - 8. 125 LB ANSI flanges
 - 9. Electric temperature transmitter, 120V: See Paragraph 3.2
 - 10. Valve schedule: See Paragraph 3.2
- I. Heating Water Circulation Pumps:
- 1. Type: Centrifugal, single-stage, in-line, close coupled.
 - 2. Material:
 - a. Volute: Cast iron ASTM A159.
 - b. Impeller:
 - 1) Cast iron, ASTM A159.
 - c. Pump shaft: Stainless steel.
 - d. Seal assembly:
 - 1) Housing: Stainless steel.
 - 2) Bellows: Buna-N.
 - 3) Ring: Carbon.
 - 4) Spring: 304 stainless steel.
 - 5) Seat: Ceramic.
 - 6) Seat gasket: Buna-N.
 - e. Volute gasket: Cellulose fiber.
 - f. Companion flanges:
 - 1) 1 to 1-1/2 IN: Formed steel.
 - 2) 2 IN: Cast iron, ASTM A159.
 - g. Shaft sleeve: Copper alloy 110 or aluminum bronze, ASTM B584.
 - h. Motor:
 - 1) Rated for Class 1, Division 2, Group D locations.
 - i. Performance as scheduled.

2.3 FABRICATION

- A. Fabricate pumps complete with motor and pump as one (1) unit.

2.4 SOURCE QUALITY CONTROL

- A. Pump Impeller Trimming:
1. Trim impellers to a diameter to provide design flow to each terminal with minimum pump power consumption for each pump.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install hydronic specialty items where indicated or required.
- B. Install at high point in closed water systems and at high point of coil headers an automatic relief vent.
1. Install shut-off valve ahead of each vent.
 2. Extend relief tubing from vent to drip pan or drain.
- C. Install flexible connectors at pump suction and discharge and where indicated.
- D. Install pipe guides in accordance with EJMA Standards.
1. Space at 4 and 14 pipe diameters from expansion joints.
 2. Install at expansion loops as indicated.

3.2 SCHEDULES

A. Hydronic Water Pumps Schedule

Equipment No.	Description/Location	Inlet (inch)	Outlet (inch)	Flow (gpm)	TDH (ft)	HP	V, Phase
PMP-510-05	Boiler Circulation Pump	4	4	305	36	5	480, 3
PMP-510-06	Primary Hot Water Circulation Pump 1	4	4	350	60	10	480, 3
PMP-510-07	Primary Hot Water Circulation Pump 2	4	4	350	60	10	480, 3
PMP-510-08	Heat Exchanger Circulation Pump 1	3	3	150	13	3/4	480, 3
PMP-510-09	Heat Exchanger Circulation Pump 2	3	3	150	13	3/4	480, 3

END OF SECTION

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SECTION 23 31 00
HVAC - DUCTWORK

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. HVAC ductwork and accessories.
- B. Related Specification Sections include but are not necessarily limited to:
 - 1. Division 00 - Procurement and Contracting Requirements.
 - 2. Division 01 - General Requirements.
 - 3. Section 08 90 00 - Louvers and Vents.
 - 4. Section 01 61 03 - Equipment - Basic Requirements.
 - 5. Section 23 09 00 - Instrumentation and Control for HVAC Systems.

1.2 QUALITY ASSURANCE

- A. Referenced Standards:
 - 1. American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE):
 - a. 52, Method of Testing Air Conditioning Devices Used in General Ventilation for Removing Particulate Matter.
 - 2. National Fire Protection Association (NFPA).
 - 3. Sheet Metal and Air Conditioning Contractors' National Association (SMACNA):
 - a. Ducted Electric Heat Guide for Air Handling Systems.
 - b. HVAC Duct Construction Standards - Metal and Flexible.
 - 4. Underwriters Laboratory, Inc. (UL):
 - a. 555, Standard for Safety Fire Damper and Ceiling Fire Damper.
 - b. 555S, Standard for Safety Leakage Rated Dampers for Use in Smoke Control Systems.
 - c. Building Materials Directory.
- B. Qualifications:
 - 1. Fabricator: Firms regularly engaged in the manufacture of the specific product, of type, size required, whose products have been in use in similar service for not less than three years.
 - 2. Installers: Firm with at least five years installation experience on products similar to that required for this Project.

1.3 DEFINITIONS

- A. Installer or Applicator:
 - 1. Installer or applicator is the person actually installing or applying the product in the field at the Project site.
 - 2. Installer and applicator are synonymous.

1.4 SUBMITTALS

- A. Shop Drawings:
 - 1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
 - 2. See Specification Section 01 61 03.
 - 3. Efficiency ratings per ASHRAE 52 for factory built and assembled filter units.
 - 4. Scaled ductwork drawings (1/4 IN equals 1 FT) showing duct and accessory layout and support.

- B. Contract Closeout Information:
 - 1. Operation and Maintenance Data:
 - a. See Specification Section 01 33 04 for requirements for the mechanics, administration, and the content of Operation and Maintenance Manual submittals.
- C. Miscellaneous Submittal:
 - 1. Documentation of qualifications for fabricators and installers.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
 - 1. Transverse joints (factory fabricated aluminum):
 - a. Ductmate Industries, Inc.
 - 2. Flexible ducts:
 - a. Thermaflex.
 - b. Condu-flex.
 - c. Glass-flex.
 - 3. Turning vanes:
 - a. Ductmate Industries, Inc.
 - b. Duro Dyne.
 - c. SEMCO Incorporated.
 - d. Ward Industries, Inc.
 - 4. Flexible duct connections:
 - a. Vent Fabrics.
 - b. Duro Dyne.
 - 5. Flexible connector thrust restraint:
 - a. Mason WB.
 - 6. Access doors in ductwork:
 - a. Vent Fabrics.
 - b. American Warming.
 - 7. Backdraft dampers:
 - a. Air Balance.
 - b. Ruskin.
 - c. American Warming.
 - 8. Grilles and registers:
 - a. Anemostat.
 - b. Carnes.
 - c. Titus.
 - 9. Air filters:
 - a. American Air Filter.
 - b. Farr.
 - c. Continental.
 - 10. Manual (volume) dampers:
 - a. Air Balance.
 - b. Ruskin.
 - c. American Warming.
 - 11. Duct sealers:
 - a. Durkee-Atwood.
 - b. Unitec McGill.
 - c. Benjamin Foster.
 - d. Design Polymerics.

12. Temperature control and automatic dampers:

- a. Air Balance.
- b. Ruskin.
- c. American Warming.

B. Submit request for substitution in accordance with Specification Section 01 25 13.

2.2 COMPONENTS

A. Duct and Fittings (Metallic):

1. Materials:

- a. 3003 H-14 aluminum alloy:
 - 1) Comply with ASTM B209.

2. Fabrication (aluminum):

- a. Minimum sheet material thickness:
 - 1) Ducts with largest side or diameter to 30 IN: 0.05 IN thick.
 - 2) Ducts with largest side or diameter greater than 30 IN: 0.08 IN thick.
- b. Utilize SMACNA HVAC Duct Construction Standards for minimum of 2 IN water gage static pressure for the minimum sheet material thickness specified herein.
 - 1) Heavier gage sheet material may be used with associated reinforcement as an alternate to minimum thickness specified.
 - 2) Lighter gage sheet material with associated reinforcement shall not be used as an alternate to minimum thickness specified.
- c. Longitudinal seams:
 - 1) 0.050 material:
 - a) Pittsburgh seam.
 - b) Continuously welded.
 - 2) 0.080 material: Continuously welded.
- d. Continuously weld seams on factory assembled units.
- e. Transverse joints (Alternate A):
 - 1) SMACNA T-22 companion flange.
 - 2) Gasketed.
 - 3) Rigidity class:
 - a) Ducts with largest side or diameter to 30 IN: SMACNA Class D (1-1/2 x 1-1/2 x 1/8 IN angles).
 - b) Ducts with largest side or diameter greater than 30 to 54 IN: SMACNA Class H (2-1/2 x 2-1/2 x 3/16 IN angles).
- f. Transverse joints (Alternate B):
 - 1) Materials and fabrication:
 - a) Angles: Aluminum.
 - (1) Ductmate 35.
 - b) Corners: Aluminum.
 - (1) Ductmate DC 35.
 - c) Snap cleats: Aluminized or stainless steel.
 - d) Gaskets: Closed cell neoprene.
 - e) Bolts: Stainless steel.
 - f) Sheet metal screws: Self-drilling stainless steel with unthreaded section under head.
 - 2) Fabrication:
 - a) Rigidity class: SMACNA Class H.
 - b) 3/8 IN DIA x 1 IN bolts.

B. Supports and Hangers:

1. Materials (for aluminum duct):

- a. Support angles: Aluminum or stainless steel, minimum 1-1/2 by 1-1/2 by 1/4 angle.
- b. Hanger rods: Stainless steel.
- c. Anchors: Stainless steel wedge type.

2. Fabrication: Trapeze type units.
 3. Strap hangers are not allowed.
- C. Turning Vanes:
1. Materials: Same as duct.
 2. Fabrication:
 - a. Fabricate double vane units.
 - b. Pressure drop through elbows: Maximum 20 PCT of velocity pressure.
- D. Flexible Connections:
1. Materials: Hypalon, double coated closely woven glass fabric.
 2. Fabrication: Withstand 4.5 IN water column, positive and negative pressure.
- E. Access Doors:
1. Materials:
 - a. Inner panel, out panel and frame: Same as duct.
 - b. Gaskets: Closed cell neoprene.
 - c. Insulation: 1 LB density fiberglass.
 - d. Hinges: Stainless steel.
 - e. Latches:
 - 1) Aluminum-zinc alloy.
 - 2) Outside lever handle.
 - 3) Adjustable spacer.
 - 4) Beveled inside flange.
 - 5) Studs:
 - a) Minimum 3/8 IN DIA stud for doors up to 24 IN wide x 48 IN high.
 - b) Minimum 1/2 IN DIA stud for doors larger than 24 x 48 IN.
 2. Fabrication:
 - a. Provide four-side continuous gaskets.
 - b. Utilize continuous piano hinges.
 - c. Latches required:
 - 1) 12 IN in any direction: One.
 - 2) Up to 18 x 18 IN: Two.
 - 3) Up to 24 x 48 IN: Two with inside handles.
 - 4) Up to 24 x 72 IN: Three with inside handles.
 - 5) Minimum door size: 12 x 12 IN.
- F. Volume Extractors:
1. Materials (for aluminum duct):
 - a. Mounting bracket: 0.071 IN aluminum.
 - b. Movement bar: 0.080 IN aluminum.
 - c. Blades: 0.050 IN aluminum.
 2. Fabrication:
 - a. Gang operated parallel blade, fully adjustable.
 - b. Minimum two manually operated adjustment arms.
 - c. Rotating shaft: Minimum 3/8 IN SQ.
- G. Drain Pan:
1. Materials: Aluminum.
 2. Fabrication: 0.080 IN.
- H. Air Grille and Register Assembly:
1. Materials:
 - a. Assembly: Extruded aluminum.
 - b. Gaskets: Sponge rubber.
 2. Fabrication:
 - a. Supply registers: Two sets individually adjustable louvers.
 - b. Exhaust and return registers: 45 DEG deflection front blades.

- c. Dampers: Key-operated opposed blade.
 - d. Screws, duct collars, and transitions as required.
 - e. Finish:
 - 1) Manufacturer's standard factory applied finish.
 - 2) Color: White.
- I. Roof-Mounted Hoods:
- 1. Materials:
 - a. Hood: Aluminum.
 - b. Screen: Expanded aluminum.
 - 2. Fabrication:
 - a. Type indicated on Drawings.
 - b. 0.080 IN thick material.
 - c. Insulated.
 - d. 85 PCT free area bird screen.
 - e. Design to withstand 30 LBS/SQFT snow load and 100 MPH winds.
- J. Air Filter Enclosure:
- 1. Housing:
 - a. Factory fabricated.
 - b. Aluminum.
 - c. Bracing to eliminate racking.
 - d. Two-side access doors.
 - 2. Access doors:
 - a. Aluminum.
 - b. Replaceable positive sealing latches.
 - c. Replaceable hinges.
 - d. Neoprene door gasket.
 - e. Holding frame to door gasket: Polyurethane foam.
 - 3. Tracks:
 - a. Field adjustable.
 - b. Anodized extruded aluminum.
 - c. Polypropylene seal between holding frame and track.
 - 4. Holding frame:
 - a. Aluminum or stainless steel.
 - b. Multiple fastener lances.
 - c. Polyurethane foam gasket.
 - 1) Internally.
 - 2) Frame sides.
 - d. Accommodate nominal 24 x 24 IN or 12 x 24 IN filters without modifications to frame or housing.
- K. Air Filters:
- 1. Materials:
 - a. Holding frame: Aluminum.
 - 2. Fabrication:
 - a. Factory built and assembled unit.
 - b. Efficiency rating as per ASHRAE 52.
 - c. 2 IN thickness minimum.
 - d. Efficiency: MERV 8.
 - e. Air velocity: 450 FPM maximum.
 - f. Clean pressure drop: 0.2 IN WG maximum.
 - g. Size, capacity, and type: As indicated on Drawings.
- L. Temperature Control, Automatic and Manually (Volume) Operated Dampers:
- 1. Material:
 - a. Body: 6063 T5 aluminum.

- b. Seal blade edge: Extruded vinyl.
- 2. Fabrication:
 - a. Frame thickness: 0.125 IN minimum.
 - b. Provide flanged connections.
 - c. Blades:
 - 1) Two-position damper: Parallel blade.
 - 2) Mixing and volume damper: Opposed blade.
 - 3) Airfoil shape.
 - 4) Maximum 6 IN width.
 - d. Linkage: Concealed in frame.
 - e. Axles: 1/2 IN plated steel hex.
 - f. Bearings: Molded synthetic.
 - g. Seals:
 - 1) Jamb: Flexible compression type.
 - h. Control shaft: Removable, 1/2 IN DIA.
 - i. Air leakage (4 FT SQ damper) at 4 IN WG pressure: 99 CFM maximum.
 - j. Motors for motor operated damper: See Specification Section 23 09 00.
 - k. Provide outboard support for operator linkage where damper motor is to be installed outside of duct.
 - l. Provide stainless steel locking quadrants for manual (volume) dampers.
 - m. Provide fold out operator mounting bracket where damper motor is to be installed on face of damper or inside duct.
 - n. Finish: 215 R1 anodized.
- M. Duct sealer:
 - 1. NFPA rating of "Non-Combustible".
 - 2. Flame spread rating: 25 or lower, in dry condition.
 - 3. Smoke developed rating: 50 or lower, in dry condition.
 - 4. Resistant to water and water vapors.
 - 5. Comply with UL 181.
 - 6. Pressure rupture rating: 16 IN WG, minimum.
- N. Louvers: See Specification Section 08 90 00.

2.3 MAINTENANCE MATERIALS

- A. Extra Materials:
 - 1. Furnish Owner with the following extra materials:
 - a. 12 complete filter media changes for each filter unit.
 - b. Filter media used during construction is in addition to this requirement.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. See Specification Section 01 61 03.
- B. Metal Ductwork:
 - 1. Install with longitudinal seams sealed for zero leakage.
 - a. For welded seams, submit sample for approval by Engineer.
 - 2. Install gaskets at each transverse joint and fasten sections together with bolts.
 - a. Tighten for zero leakage.
 - 3. Install supports and hangers with anchors in accordance with SMACNA HVAC Duct Construction Standards.
 - 4. Install turning vanes in square elbows:
 - a. Unsupported vane length not to exceed 48 IN.
 - b. Position vanes at proper angle to meet specified pressure drop.

5. Install flexible connections at fans:
 - a. Locate as close as possible to fan.
 - b. Allow 1 IN of slack to prevent vibration transmission.
 - c. Install thrust restraints across connectors.
 6. Install access doors where indicated on Drawings and at smoke and fire damper in accordance with NFPA requirements.
 7. Volume extractors:
 - a. Install at supply registers, grilles, diffusers and supply branch connections from ducts.
 - b. Provide branch duct extensions into main duct above and below extractor when branch duct is narrower than main duct.
- C. Flexible Ductwork:
1. Install in concealed areas between: low velocity duct work and diffusers, return air grilles or exhaust outlets and ducts.
 2. Use low loss fittings for connection to duct.
 3. Connect to metal duct collars by means of non-combustible synthetic rubber sealing compound and stainless steel drawband.
 4. Install with maximum length of 3 FT and no change in direction.
- D. Drain Pans:
1. Install at fan coil cooling coils, control valves above finished ceilings and at other sources of moisture.
 2. Install metal tubing at drain and terminate above floor drain, equipment drain and as shown on Drawings.
- E. Dampers:
1. Install where indicated on Drawings of sizes shown.
 2. Install fire and smoke dampers in ductwork passing through 1 HR or higher fire-rated construction.
 - a. Install in wall and floor openings utilizing steel sleeves, angles and other materials following practices required to provide installation in accordance with local building codes.
- F. Air Grille and Register Assemblies:
1. Install where shown on Drawings of size and capacities scheduled on Drawings.
 2. Install prime painted grilles and registers in areas where duct work is concealed.
 - a. Field paint to match adjacent surface finish.
- G. Roof-mounted Hoods: Install where shown on Drawings.
- H. Air Filters:
1. Install where shown on Drawings of size and capacity scheduled on Drawings.
 2. Do not operate equipment during construction without filters.

END OF SECTION

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SECTION 23 34 00

HVAC - FANS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Heating, ventilating, and cooling equipment.
- B. Related Specification Sections include but are not necessarily limited to:
 - 1. Division 00 - Procurement and Contracting Requirements.
 - 2. Division 01 - General Requirements.
 - 3. Section 01 61 03 - Equipment - Basic Requirements.
 - 4. Section 23 05 93 - HVAC Systems - Balancing and Testing.
 - 5. Section 23 09 00 - Instrumentation and Control for HVAC Systems.
 - 6. Section 23 31 00 - HVAC - Ductwork.

1.2 QUALITY ASSURANCE

- A. Referenced Standards:
 - 1. Air Movement and Control Association (AMCA).
 - a. AMCA Publication 203 "Field Performance Measurement of Fan Systems".
 - b. ANSI/AMCA 210 "Laboratory Methods of Testing Fans for Aerodynamic Performance Rating".
 - 2. Air Conditioning and Refrigeration Institute (ARI).
 - 3. American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE):
 - a. HVAC Applications Handbook, Chapter entitled "Sound and Vibration Control."
 - b. 20, Methods of Testing for Rating Remote Mechanical-Draft Air-Cooled Refrigerant Condensers.
 - c. 52.2, Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size.
 - 4. Canadian Standards Association (CSA).
 - 5. National Electrical Manufacturers Association (NEMA):
 - a. 250, Enclosures for Electrical Equipment (1000 Volts Maximum).
 - 6. National Fire Protection Association (NFPA):
 - a. 70, National Electrical Code (NEC).
 - 7. National Roofing Contractors Association (NRCA).
 - 8. Underwriters Laboratories, Inc. (UL):
 - a. 507, Standard for Electric Fans.
- B. Miscellaneous:
 - 1. Gage thickness specified herein shall be manufacturer's standard gage for steel and Brown and Sharpe gage for non-ferrous metals.
 - 2. Corrosion protection of equipment to be as specified herein.

1.3 SUBMITTALS

- A. Shop Drawings:
 - 1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
 - 2. Product technical data including:
 - a. Acknowledgement that products submitted meet requirements of standards referenced.
 - b. Manufacturer's installation instructions.
 - c. Wiring diagrams.
 - d. Control diagrams.
 - e. Manufacturer's catalog cuts and technical data.

- f. Corrosion-protection information.
 - g. Fan curves.
 - h. Sound data.
 - i. Vibration isolation.
 - j. Performance data on all equipment.
3. Certifications:
- a. Provide certification of thickness of corrosion-protection coating.
 - b. Fan systems have been tested in accordance with AMCA Standard 210 or 260, and are licensed to bear the AMCA Certified Ratings Seal.
- B. Factory Performance test for any fan having a flow rate greater than 1,000 CFM and/or a total static pressure rating equal to or greater than 1.5 IN WC.
- 1. Pursuant to AMCA Publication 203 or 210 with no plus tolerances on Power and no minus tolerances on flow or pressure.
- C. Contract Closeout Information:
- 1. Operation and Maintenance Data:
 - a. See Specification Section 01 33 04 for requirements for the mechanics, administration, and the content of Operation and Maintenance Manual submittals.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
- 1. Vibration isolation assemblies:
 - a. Mason.
 - b. Vibration Mounting and Controls Co.
 - c. Vibro-Acoustics.
 - 2. Corrosion-protective coatings:
 - a. Heresite and Chemical Co.; "Heresite."
 - b. Aero-Marine Engineering, Inc.
 - 3. In-line centrifugal fans - tube axial fans:
 - a. New York Blower.
 - b. Aerovent.
 - 4. Roof-mounted centrifugal exhaust fans:
 - a. Loren Cook.
 - b. Greenheck.
 - c. PennBarry Ventilator Co., Inc.
- B. Submit request for substitution in accordance with Specification Section 01 25 13.

2.2 GENERAL

- A. All Manufactured Units:
- 1. Comply with Specification Section 01 61 03.
 - 2. Factory wired and assembled.
 - 3. Use fasteners made of same material as unit.
 - 4. Fabricate motor assemblies and unit housings with vibration isolation assemblies:
 - a. Type: As per Table 47, Chapter 48, ASHRAE HVAC Applications Handbook.
- B. All manufactured units shall be constructed with corrosion-resistant materials or have corrosion-resistant coating.
- 1. Type:
 - a. Corrosion-resistant materials:
 - 1) Aluminum.
 - 2) Stainless steel.
 - 3) FRP.

- b. Corrosion-resistant coating:
 - 1) Phenolic-based coating.
 - 2) 3 MIL minimum dry thickness, air-dried coating, for surfaces exposed to temperatures less than 150 DEGF.
 - 3) 5 MIL baked-on coating for heat transfer surfaces and surfaces exposed to temperatures greater than 150 DEGF.
 - 4) Factory applied.
 - 5) Provide factory certification of application.

2.3 MANUFACTURED UNITS

A. In-Line Centrifugal Fans:

- 1. General:
 - a. Belt or direct drive as indicated.
 - b. Corrosion resistant construction.
- 2. Housing:
 - a. Aluminum construction.
 - b. Inlet bell.
 - c. Bolted gasketed access door located on three sides.
- 3. Fan Wheel:
 - a. Ventrifugal type, aluminum construction.
 - b. Backward inclined or airfoil blades.
 - c. Statically and dynamically balanced.
- 4. Bearings:
 - a. Bearings shall be fixed to the fan shaft using concentric mounting locking collars. Set screws are not allowed.
 - b. Self-aligning, extra heavy duty type ball or roller bearings with regreaseable lubrication and extended lube lines.
- 5. Motor:
 - a. See Specification Section 01 61 03.
 - b. Belt Drive Units:
 - 1) Driver and driven sheaves:
 - a) Keyed hub type.
 - b) Drive sheaves: Fixed pitch diameter.
 - c) Driver:
 - (1) Shipped with variable pitch diameter sheave.
 - (2) Fixed pitch diameter size based on approved test and balance reports.
 - d) V-belt drives sized for 150 PCT motor horsepower.
 - 2) Automatic drive belt tensioner.
 - c. Adjustable motor base.
- 6. Flanged inlet and outlet.
- 7. Accessories:
 - a. OSHA belt guard.
 - b. Cam type access door.
 - c. Extended grease links and fittings.
 - d. Spark-resistant construction:
 - 1) Type A: All parts in air stream are aluminum or non-ferrous construction.
 - 2) Type B: Aluminum wheel and aluminum rub ring where the fan shaft passes through the housing.
- 8. Size and capacity as scheduled on Drawings.

B. Roof-Mounted Centrifugal Exhaust Fans:

- 1. AMCA certified.
- 2. Non-overloading horsepower capability.
- 3. Materials:
 - a. Top cap: Spun aluminum.
 - b. Wheel and inlet shroud: Aluminum.

- c. Baffle: Aluminum.
- d. Base: One-piece aluminum.
- e. Drive assembly supports: Steel.
- f. Drive shaft: Solid stainless steel.
- g. Minimum 10 GA motor mounting plate.
- 4. Backward inclined blades.
- 5. Tapered inlet shroud.
- 6. Statically and dynamically balanced wheel.
- 7. Bearings:
 - a. Cast iron pillow blocks.
 - b. Concentric bearing locking collar for drive shafts 1 IN and larger.
 - 1) SKF "ConCentra."
 - 2) Dodge "D Lock."
 - c. Regreaseable.
 - d. 200,000 HR average life.
 - e. 5-to-1 load capability to actual load ratio.
- 8. Weathertight compartment for motor and drives.
 - a. Separated from airstream.
- 9. Motor:
 - a. See Specification Section 01 61 03.
 - b. Belt Drive Units:
 - 1) Driver and driven sheaves:
 - a) Keyed hub type.
 - b) Drive sheaves: Fixed pitch diameter.
 - c) Driver:
 - (1) Shipped with variable pitch diameter sheave.
 - (2) Fixed pitch diameter size based on approved test and balance reports.
 - d) V-belt drives sized for 150 PCT motor horsepower.
 - 2) Automatic drive belt tensioner.
 - c. Direct Drive Units:
 - 1) Keyed hub type.
 - d. Vibration isolated drive assembly.
- 10. Accessories:
 - a. Prefabricated insulated aluminum roof curb.
 - b. Backdraft damper: See Specification Section 23 31 00.
 - c. Bird screen.
 - d. Extended grease lines and fittings.
 - e. Spark-resistant construction:
 - 1) Type A: All parts in air stream are aluminum or non-ferrous construction.
 - 2) Type B: Aluminum wheel and an aluminum rub ring where the fan shaft passes through the housing.
- 11. Size and capacity as scheduled on Drawings.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install in accordance with Specification Section 01 61 03.
- B. Install fixed pitched drive sheave after sheave has been sized based on accepted test and balance report.
- C. Do not operate fans for any purpose until ductwork is clean, filters are in place, bearings lubricated and fan has been test run under observation.

3.2 FIELD QUALITY CONTROL

- A. Comply with Specification Section 23 05 93.

3.3 ADJUSTING

- A. Install new filters on units which have been running prior to a cceptance of Project.

END OF SECTION

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SECTION 23 52 00
COMBINATION BOILER HEAT EXCHANGER

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Combination Boiler and Heat Exchanger.
- B. Related Sections include but are not necessarily limited to:
 - 1. Division 00 - Procurement and Contracting Requirements.
 - 2. Division 01 - General Requirements.
 - 3. Section 01 61 03 - Equipment - Basic Requirements.
 - 4. Section 23 09 00 - Instrumentation and Control for HVAC Systems.
 - 5. Section 40 67 00 - Control System Equipment Panels and Racks
 - 6. Section 40 61 13 - Process Control Systems General Requirements.

1.2 QUALITY ASSURANCE

- A. Referenced Standards:
 - 1. American Society of Mechanical Engineers (ASME):
 - a. Boiler and Pressure Vessel Code (Latest Edition).
 - 2. FM Global (FM).
 - 3. Industrial Risk Insurers (IRI).
 - 4. National Fire Protection Association (NFPA).
 - 5. Underwriters Laboratories, Inc. (UL).
 - 6. State of Washington Boiler Code 2019.
 - 7. Factory Mutual, GE-GAP, ASME CSD-1

1.3 SUBMITTALS

- A. Shop Drawings:
 - 1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
 - 2. See Specification Section 01 61 03.
 - 3. Product technical data including:
 - a. Acknowledgement that products submitted meet requirements of standards referenced.
 - b. Manufacturer's installation instructions.
 - c. Boiler information to include:
 - 1) Net boiler output capacity in BTUH.
 - 2) Total heat transfer surface in SQFT.
 - 3) Water content in LBS.
 - 4) Auxiliary power requirements in kWh.
 - 5) Operational efficiency.
 - 6) Combustion space (furnace volume) in CUFT.
 - 7) Combustion air and venting requirement.
 - d. Layout showing dimensions, elevations, etc.
 - e. Control wiring diagrams.
 - f. Fuel train layout.
- B. Contract Closeout Information:
 - 1. Operation and Maintenance Data:
 - a. See Specification Section 01 33 04 for requirements for the mechanics, administration, and the content of Operation and Maintenance Manual submittals.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
 - 1. Combination Heater Heat Exchanger:
 - a. Basis of Design: Evoqua model 756
 - b. Or Approved Equal
- B. Submit request for substitution in accordance with Specification Section 01 25 13.

2.2 GENERAL

- 1. The boiler shall be mounted on a heavy steel frame with integral forced draft burner and burner controls.

2.3 COMBINATION HEATER HEAT EXCHANGER

- A. ASME code constructed for 30 PSI maximum water working pressure (200 DEGF max.).
- B. Design Requirements:
 - 1. Specific design requirements related to this project include:

- a. Number of units: 1
- b. Minimum boiler output: 750,000 BTU/hr
- c. Minimum sludge heating capacity: 750,000 BTU/hr
- d. Sludge recirculation flow: 350 GPM
- e. Digester operating temperature: 98° F (35° C)
- f. Site elevation above sea level: 778 ft
- g. System utilization: Digester heating.

- 2. Boiler section

- a. Minimum output capacity: 750,000 BTU/hr
- b. Maximum working pressure: 30 psi
- c. Minimum fired surface: 165.3 ft² (Includes furnace tube, water cooled return back and fire tubes).
- d. Boiler shall be a two-pass furnace tube type incorporating a water cooled return back.
- e. No refractory or non-water cooled steel surfaces shall be allowed in areas of flame impingement or in the path of hot gases.
- f. The exhaust breeching and return back shall be readily removable for access to fire tubes.
- g. A flame inspection port shall be provided in the water cooled return back.
- h. Access hand holes and water bath drain shall be provided in the front plate.
- i. The boiler shall be provided with a boiler water pressure gauge and an ASME pressure relief valve.

- 3. Heat exchanger section

- a. Minimum sludge heating capacity: 750,000 BTU/hr
- b. Sludge recirculation flow: 350 GPM
- c. Maximum Pressure Drop: 5.1 ft at 350 gpm
- d. Sludge tube diameter: 6 inches
- e. Sludge inlet and outlet flange size: 6 inches
- f. Minimum sphere tubes shall pass: 5-1/2 inch dia
- g. Exterior heated surface of tubes: 83 ft²

C. Fuel:

1. Primary: Wet corrosive digester gas at 8 IN water column at inlet to gas train.
2. Secondary: Natural gas at 5 psig inlet pressure. Natural gas should be piped to the natural gas train inlet. Maximum pressure is 20" W.C. at the inlet to this gas train.
3. Burner and Fuel Piping
 - h. The fuel burning equipment shall include the necessary accessories for burning either digester gas having a heat content of approximately 650 BTU/ft³ and a specific gravity of 0.8, natural gas having a heat content of 1,000 BTU/ft³ or a mixture of the two gases.
 - i. The burner shall be able to operate on digester gas until the inlet pressure at the unit drops to 2 inches of water column, at which point natural gas shall automatically be blended to make up the deficiency, ensuring the maximum utilization of available digester gas. The use of a gas booster pump to meet this requirement will not be permitted.
 - j. The fuel piping system shall include digester and natural gas adjustable throttling valves, digester and natural gas shutoff valves, digester gas and natural gas pressure regulators, two (2) motorized gas valves, low pressure check valve, pilot regulator, pilot solenoid valve, and pilot line shutoff valve.
 - k. Digester and natural gas shall be ignited by a proven pilot. A 6,000 volt ignition transformer shall be provided at the burner.
4. Burner Performance for Primary Gas
 - a. Burner shall meet the following NO_x requirements and shall be based on the average concentrations of gaseous constituents in 2.3C.4.b.
 - 1) NO_x < or = 100 ppm @ 3% O₂
 - b. Average concentration of gaseous constituents
 - 1) Oxygen 0.97 %
 - 2) Nitrogen 3.6 %
 - 3) Carbon Dioxide 36 %
 - 4) Methane 59 %
 - 5) Carbon Monoxide < 0.10 %

D. Insulation and Protective Covering:

1. The shell and internal framework shall be painted with Tnemec #140 Primer before insulation is installed. The shell shall be insulated with a minimum of 2 inches of fiberglass having a density of 0.60 pounds and an "R" factor of 3.33/inch. The insulated sides shall be protected by removable 14 gauge sheet steel covering.
2. The top of the unit shall be protected by a removable 10 gauge plate. The entire exterior surface of the unit shall be shop cleaned and factory finish painted with Tnemec #135-1243 Gray Aluminum Chembuild (minimum of 7 to 9 mils dry film thickness).

E. Burner:

1. Type: Induced draft fan combination digester gas and natural gas.
 - a. Electronic ignition.
2. Induced Draft Fan:
 - a. Capacity: Designed for operation to 1,000 ft above sea level.
 - b. Belt driven
 - c. Belt and motor area enclosed in a removable housing.
 - d. Air proving switch

- e. Open drip proof motor
- F. Water Circulating Pump:
 - 1. Open drip proof motor. A flow control valve shall be provided to prevent gravity flow through each pump. Each pump's discharge shall be arranged to produce turbulent transverse circulation across the sludge tubes.
- G. Compression Tank
 - 1. A carbon steel compression tank shall be supplied with the unit. The tank shall have a 100 gallon capacity and shall be furnished with a water level gauge glass, 2" boiler water connection, 1/2" drain valve, and a factory finish paint.
 - 2. The tank shall have ASME construction.
 - 3. A water makeup line with pressure reducing valve and bypass shall be provided on the heater.
- H. Accessories:
 - 1. ASME rated relief valve.
 - 2. Low water cut off and alarm.
 - 3. Thermocouples.
 - 4. Dual gas trains.
 - 5. Manually and automatically operated gas selector switches.
 - 6. Digester gas valve suitable for wet and corrosive digester gas.
 - a. Material for orifices, gas control devices, and gas safety devices in direct contact with digester gas: Stainless steel, aluminum trim or other approved steel.
 - b. Body materials: Cast aluminum or stainless steel.
 - 7. Gas pressure gages.
 - a. Digester gas gages to have stainless steel Bourbon tube.
 - 8. Gas cocks with lubricated plug cocks and operating handles.
 - 9. Gas piping meeting NFPA recommendations.
 - 10. Flame Check valves and Varc flame arrester shall be provided by the contractor or the gas safety equipment supplier.
- I. Provide permanent observation port for observation of both pilot and main flame.

2.4 STACK AND BREECHING

- A. Stack (provided and installed by contractor):
 - 1. Type: Factory-built modular, suitable for continuous operation at 1000 DEGF UL listed.
 - 2. Construction:
 - a. Double wall.
 - b. Inner liner: 20 GA, 304 stainless steel.
 - c. Annular space: 1 IN high temperature insulating material to maintain "man-safe" temperature limitation of 150 DEGF.
 - d. Outer shell:
 - 1) 20 GA, 304 stainless steel.
 - 2) Top section and velocity cone to be 304 stainless steel.
 - e. Liner joint: Overlapping tabbed end V-bands, sealed with silicone sealant.
 - 3. Exhaust temperature: 450 DEGF.
 - 4. Inside diameter: 12 IN. Refer to manufacturer's installation instructions for specific requirements. Verify exact flue pipe size requirements with the equipment supplier.
 - 5. Applicable prefabricated sections:
 - a. Base drain section with cleanout and base support.
 - b. Straight sections.
 - c. 90-degree tee.
 - d. 45-degree elbow.
 - e. Variable length section.
 - f. Full angle ring.
 - g. Flashing and counter flashing.

- h. Velocity cone.
- 6. Height: As indicated on Drawings.
- 7. The exhaust stack shall be located through the roof and directly above the heater blower discharge.
- 8. An exhaust stack temperature gauge to monitor exhaust gas shall be provided (100F-800F)
- 9. Insulate flue pipe with exterior blanket insulation to be supplied by the equipment manufacturer.
- 10. Once outside the building, wrap exhaust with water-repellant pre-formed (or field formed with v-grooves) mineral wool insulation rated to withstand heat from direct contact with exterior of exhaust line and rated for outdoor use. Insulation joints exposed to weather shall be sealed against water intrusion with a luminum heat tape rated for outdoor use on exhaust systems. Mineral wool insulation system and heat tape must be rated to 1,200 DEGF. Heat tape 1,200 DEGF rating may be for intermittent heat exposure.

2.5 CONTROL PANEL

- A. The electrical control panel shall contain a burner controller, circuit breaker and magnetic starter for the induced draft fan motor, controls for hot water bath recirculation pumps, and digester temperature controls. Controls shall be mounted and wired with rigid conduit and flexible watertight connectors in accordance with NEC. The electrical control panel shall be mounted on the side of the unit so as not to interfere with access to the burner, return breech, sludge tubes, or gas piping. The control panel shall have a NEMA 12 enclosure with dual swing-out doors. The doors shall be lockable with disconnect switch and handle to ensure the doors are closed during operation.
- B. Starters and circuit breakers for digester recirculation pumps shall be provided in the motor control center.
- C. The following labeled switches and indicating lamps shall be provided on control panel doors:
 - 1. Sludge heater hand/off/auto switch.
 - 2. Constant water bath on/off switch.
 - 3. Exhaust fan continuous/intermittent switch.
 - 4. Sludge recirculation pump continuous/intermittent switch.
 - 5. Low boiler water indicator lamp.
 - 6. Flame failure alarm horn, alarm horn silencer, and flame failure indicator lamp.
- D. Tagged outlets shall be provided for:
 - 1. The main power supply: 480 volt, 3-phase, 60 hertz.
 - 2. The normally open contact to the magnetic starter for the raw sludge pump to ensure operation of a selected digester recirculation pump when the raw sludge pump is operating.
 - 3. The control circuit supply, single-phase, 60 hertz, 115 volt AC.
- E. An isolated common alarm circuit shall be provided for remote annunciation of the following:
 - 1. Induced draft fan fail.
 - 2. Flame failure.
 - 3. Low boiler water.
- F. The panel shall include a flame safeguard and programming controller with transistorized amplifier listed by Underwriters Laboratories (UL) and approved by Canadian Standards Association (CSA), Industrial Risk Insurers (IRI), and Factory Mutual (FM). The controller shall provide a minimum of 30 second pre-purge and 15 second post-purge of the combustion chamber. An infra-red scanning device shall sense pilot and main flame presence. The burner controller shall, upon flame failure, automatically close the main fuel and pilot valves within 4

seconds and sound an audible alarm in addition to lighting a visual indicator. The burner controller shall, after an interruption of power, automatically recycle upon resumption of power.

- G. Digester temperature control shall be provided as follows:
1. Manual control of digester temperature shall be permitted by the hand/off/auto switch mounted on the control panel.
 2. Automatic control of digester temperature within plus or minus ½ °F shall be by means of a sensor located at the sludge inlet of the unit. The water circulation pumps for sludge heating and burner equipment shall be automatically controlled by the temperature of the sludge passing the sensor at the sludge inlet. A 24 hr. repeating cycle time switch shall be provided for periodic starting of digester recirculation pump with controls arranged such that the recirculation pump will continue to operate until the digester heating requirements are satisfied or shall stop after a short cycle in case heat is not required by the digester.
- H. Digital temperature indicators with a range from shall be mounted on the face of the control panel. The sludge temperature indicators shall be connected to sensors located in the sludge inlet and outlet of the heat exchanger. The water bath temperature indicator shall be connected to a sensor located in the boiler water bath through the rear tube sheet. Each sensor shall be provided with a mounting socket to enable the removal of the sensor without draining the sludge tubes or water bath, respectively.
- I. The following safety controls shall be provided:
1. Operating temperature controller with high/low set points.
 2. High temperature shutdown with manual reset.
 3. Low water cutoff switch.
 4. Air proving switch with time delay on exhaust breech to shut down boiler in event of induced draft fan failure.
 5. Two (2) E-Stop Buttons for room entrance way.
- J. Induced Draft Fan System
1. All air for combustion shall be provided by an induced draft fan connected to the boiler exhaust breech. The fan shall be designed to maintain a negative pressure of at least 1-inch water column in the furnace throughout boiler operation to prevent the leakage of combustion products to the surrounding room and to permit dependable operation at the low digester gas pressures listed herein. Burner mounted fans or forced draft burners will not be permitted. The induced draft fan shall have a capacity in excess of the maximum air requirements for combustion.
 2. The induced draft fan shall draw air in at the burner inlet and at the top of the exhaust breech. The burner inlet shall permit adjustment of combustion air volume and the exhaust stack inlet shall allow a adjustment of negative furnace pressure.
 3. The induced draft fan shall be belt driven to permit field adjustment of the air capacity. The drive belts and open drip proof motor shall be enclosed in a removable housing.
 4. An exhaust gas temperature gauge shall be provided on the exhaust stack.

2.6 FABRICATION AND MATERIALS

- A. The boiler fire tubes shall be .095 inches (2.4 mm) wall SA-178 GR "A" steel boiler tubes. In order to facilitate tube replacement, the boiler tubes shall be rolled and flared in place. Fire tubes welded in place will not be acceptable.
- B. The furnace tube shall be ASME SA53/SA106 Grade B steel, minimum 16 inches outer diameter (OD), with a minimum wall thickness of 0.375 inch.
- C. All plates in contact with fire or hot gases (except the exhaust breech) shall be of ASME SA516 Grade 70 steel, with a minimum thickness of 5/16 inch. Provide tube sheets with a minimum 5/8 inch thickness.
- D. The heat exchanger shall be located immediately adjacent to boiler. Designs with the heat exchanger mounted below the boiler, thus raising the boiler and limiting its access, will not be allowed.
- E. Sludge tubes shall be Schedule 40 steel pipe meeting the requirements of ASTM SA53/SA106 Grade B.
- F. Sludge tubes shall be held in place by exterior multiple gasket joints, incorporating a cast iron gasket following ring. The following ring shall have a groove around its interior surface with a weep hole. Sludge or boiler water which leaks through the gaskets shall be collected by this groove and passed through the weep hole. Any leakage shall be exposed to atmospheric pressure.
- G. Sludge tubes shall be connected by removable cast iron return bends. Sludge inlet and outlet connections shall be cast iron flanges meeting ANSI B16.1, 125 pound template. Sludge return bends and inlet and outlet connections shall be designed for removal without draining the water bath. Fabricate using all welded integral construction.
- H. Fabricate completely assembled with burner, accessories except gas trains, breeching, and stacks, insulated, with skid type base.
 - 1. Furnish with minimum two (2) lifting lugs.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install where indicated on Drawings.
- B. Install gas train as approved on shop drawings.
 - 1. Install check valve in natural gas line.
 - 2. Install check valve, digester gas valve, and Varc flame arrester in digester gas line.
 - 3. Install separate pilot gas cock, gas pressure regulator, and pilot safety shut off gas valves on ignition gas supply.
- C. Install vents which extend to exterior of building on both natural gas and digester gas pressure regulators.
- D. Install manually operated gas valve located downstream of automatically operated motorized gas valves on each gas train.
- E. Install leak petcock gauges and gage cocks between manually and automatically operated gas valves.
- F. Wire Burner Fan for Pre-Purge Operation:
 - 1. Provide manual restart of burner in event of shutdown due to flame failure.
 - 2. Coordinate with Section 406113.

- G. Install automatic starter with thermal overload protection on motors.
 - 1. Interlock starter to prevent burner operation when overload relays are tripped.
- H. Install stacks where indicated on Drawings in accordance with approved shop drawings.
 - 1. Seal joints and cover with draw bands.
 - 2. Guy wire to roof structure.
 - 3. Flash penetrations through roof.
- I. Install breeching from smoke outlet into stack.
 All connections shall be airtight. Each gas regulator that is placed in the fuel lines must have its top side vented to the atmosphere for correct operation. Do not use copper or plastic tubing. Iron pipe or stainless steel tubing is recommended. Refer to manufacturer's installation instructions for specific requirements.
- J. Compression tank provided by the equipment manufacturer shall be piped according to the manufacturer's installation instructions.
- K. Sludge piping shall be adequately supported as to not transmit excessive loading to the digester heater sludge connections. The sludge tubes should be vented of all trapped air via the petcock provided on the sludge outlet flange. Refer to manufacturer's installation instructions for specific requirements.
- L. The discharge from the ASME pressure relief valve must be piped to a location where there will be no danger of scalding attendants. The pipe size shall not be less than the size of the valve outlet. If an elbow is used in the piping, it shall be placed as close to the relief valve as possible, transmitting no stress to the relief valve. The pipe shall go directly to the floor drain and shall not connect to other piping, unless the cross sectional area is one and one half times the total cross sectional area of the relief valve outlet(s). No shut off valve is allowed on the piping between the relief valve and the atmosphere. Refer to manufacturer's installation instructions for additional requirements.
- M. The discharge stacks, vents, or outlet parts of all pressure relieving and pressure limiting devices shall be located so that gas is safely discharged to the outdoors. Discharge stacks or vents shall be designed to prevent the entry of water, insects, or other foreign material that could cause blockage.
- N. Install the boiler on a 4" minimum thickness concrete pad. Maintain service clearance. Refer to manufacturer's installation instructions for specific requirements.
- O. Heater/heat exchanger equipment to be installed in strict conformance with the approved shop drawings, the supplier's recommendations, and the requirements of the ASME Boiler and Pressure Vessel Code. Installation shall be coordinated and interfaced with other digester equipment and accessories.

3.2 FIELD QUALITY CONTROL

- A. The heater heat exchanger shall be completely pre-assembled and fire tested at the factory. The unit shall be ready for immediate mounting on floor or simple foundation and ready for attachment of water, fuel, electrical, vent, and blowdown connections.
- B. Boiler and burner manufacturer's factory trained service representative, or representatives, to spend a minimum of five (5) working days (Monday through Friday) at site to supervise and inspect the following tasks:
 - 1. Boil out and wash out.
 - 2. Adjusting firing equipment.
 - 3. Boiler performance demonstration.
 - a. 120 HRS (minimum) over complete operating range using designed fuels.
 - 4. Two days classroom instruction of Owner's personnel.

3.3 WARRANTY

- A. All equipment is to be guaranteed against defects in materials and/or workmanship for a period of 12 months from date of start-up or 18 months from date of shipment, whichever comes first.

3.4 SHOP TESTS

- A. A packaged boiler must receive factory tests to check the construction, controls, and operation of the unit. All tests may be witnessed by the purchaser, if desired.
- B. Start-up Service
 - 1. After boiler installation is completed, the manufacturer shall provide the services of a field representative for starting the unit and training the operator at no additional costs.
 - a. A factory-approved and authorized start-up report shall be submitted to the customer/user at the time of start-up.

END OF SECTION

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SECTION 23 80 00
HVAC - EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Heating, ventilating, and cooling equipment.
- B. Related Specification Sections include but are not necessarily limited to:
 - 1. Division 00 - Procurement and Contracting Requirements.
 - 2. Division 01 - General Requirements.
 - 3. Section 01 61 03 - Equipment - Basic Requirements.
 - 4. Section 23 05 93 - HVAC Systems - Balancing and Testing.
 - 5. Section 23 09 00 - Instrumentation and Control for HVAC Systems.
 - 6. Section 23 31 00 - HVAC - Ductwork.

1.2 QUALITY ASSURANCE

- A. Referenced Standards:
 - 1. Air Movement and Control Association (AMCA).
 - 2. Air Conditioning and Refrigeration Institute (ARI).
 - 3. American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE):
 - a. HVAC Applications Handbook, Chapter entitled "Sound and Vibration Control."
 - b. 20, Methods of Testing for Rating Remote Mechanical-Draft Air-Cooled Refrigerant Condensers.
 - c. 52.2, Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size.
 - 4. Canadian Standards Association (CSA).
 - 5. National Electrical Manufacturers Association (NEMA):
 - a. 250, Enclosures for Electrical Equipment (1000 Volts Maximum).
 - 6. National Fire Protection Association (NFPA):
 - a. 70, National Electrical Code (NEC).
 - 7. National Roofing Contractors Association (NRCA).
 - 8. Underwriters Laboratories, Inc. (UL):
 - a. 507, Standard for Electric Fans.
- B. Miscellaneous:
 - 1. Gage thickness specified herein shall be manufacturer's standard gage for steel and Brown and Sharpe gage for non-ferrous metals.
 - 2. Corrosion protection of equipment to be as specified herein.

1.3 SUBMITTALS

- A. Shop Drawings:
 - 1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
 - 2. Fabrication and/or layout drawings.
 - 3. Product technical data including:
 - a. Acknowledgement that products submitted meet requirements of standards referenced.
 - b. Manufacturer's installation instructions.
 - c. Wiring diagrams.
 - d. Control diagrams.
 - e. Manufacturer's catalog cuts and technical data.
 - f. Corrosion-protection information.
 - g. Fan curves.

- h. Sound data.
- i. Vibration isolation.
- j. Control description.
- k. Performance data on all equipment.
- 4. Certifications:
 - a. Provide certification of thickness of corrosion-protection coating.
- B. Contract Closeout Information:
 - 1. Operation and Maintenance Data:
 - a. See Specification Section 01 33 04 for requirements for the mechanics, administration, and the content of Operation and Maintenance Manual submittals.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
 - 1. Vibration isolation assemblies:
 - a. Mason.
 - b. Vibration Mounting and Controls Co.
 - c. Vibro-Acoustics.
 - 2. Corrosion-protective coatings:
 - a. Heresite and Chemical Co.; "Heresite."
 - b. Aero-Marine Engineering, Inc.
 - 3. Unit heater - electric:
 - a. Brasch.
 - b. Chromalox.
 - c. QMark.
 - 4. Air-handling unit with coils:
 - a. BASX.
 - b. Xetex.
 - c. Nortek.
 - 5. Unitary split system heat pump:
 - a. Daikin AC.
 - b. Mitsubishi Electric.
 - c. Sanyo.
 - 6. Positive pressurization unit:
 - a. Purafil.
- B. Submit request for substitution in accordance with Specification Section 01 25 13.

2.2 GENERAL

- A. All Manufactured Units:
 - 1. Comply with Specification Section 01 61 03.
 - 2. Factory wired and assembled.
 - 3. Use fasteners made of same material as unit.
 - 4. Fabricate motor assemblies and unit housings with vibration isolation assemblies:
 - a. Type: As per Table 47, Chapter 48, ASHRAE HVAC Applications Handbook.
- B. All manufactured units shall be constructed with corrosion-resistant materials or have corrosion-resistant coating.
 - 1. Type:
 - a. Corrosion-resistant materials:
 - 1) Aluminum.
 - 2) Stainless steel.
 - 3) FRP.

- b. Corrosion-resistant coating:
 - 1) Phenolic-based coating:
 - 2) 3 MIL minimum dry thickness, air-dried coating, for surfaces exposed to temperatures less than 150 DEGF.
 - 3) 5 MIL baked-on coating for heat transfer surfaces and surfaces exposed to temperatures greater than 150 DEGF.
 - 4) Factory applied.
 - 5) Provide factory certification of application.

2.3 MANUFACTURED UNITS

A. Equipment Coils:

- 1. Heating and cooling coils - water:
 - a. ARI certified.
 - b. Material:
 - 1) Aluminum with a luminum fins.
 - c. Fin spacing: Per schedule.
 - d. Minimum standard operating limit: 200 PSI.
 - e. Equip with vent and drain connections.
 - f. Size and capacity as scheduled on Drawings.

B. Unit Heater - Electric:

- 1. Type: Horizontal.
- 2. UL listed for non-rated areas.
- 3. Material:
 - a. Cabinet: 18 GA steel.
 - b. Heating elements: Copper-clad steel.
- 4. Fan motors:
 - a. See Specification Section 01 61 03.
 - b. Built-in automatic reset overload protection.
- 5. Dynamically balanced fan.
- 6. Built-in automatic reset cutout protection.
- 7. Accessories:
 - a. Mounting bracket.
 - b. 40 to 90 DEGF, 5 DEGF differential internal thermostat.
- 8. Electrical, fan motor, and airflow data as scheduled on Drawings.

C. Unit Heater - Electric:

- 1. UL listed, corrosion-resistant washable.
- 2. Material:
 - a. Fan: Non-sparking aluminum.
 - b. Heater case: Stainless steel.
 - c. Heating Monel fin tube.
 - d. Junction box: NEMA 4X.
- 3. Fan motor:
 - a. See Specification Section 01 61 03.
 - b. Built-in overload protection.
- 4. Louvered outlet grille.
- 5. Rear grille.
- 6. Built-in over temperature protection.
- 7. Accessories:
 - a. Mounting bracket: Stainless steel.
 - b. Factory wired and mounted thermostat.
 - 1) Temperature range; 40-80 DegF.

D. Air-Handling Unit with Coils:

- 1. ARI certified.
- 2. UL listed.

3. Corrosion resistant.
4. Rated for Class 1, Division 2, Group D location.
5. Unit Construction:
 - a. Fabricate unit with 16 GA channel posts and panels secured with mechanical fasteners.
 - 1) Seal all panels, access doors, and ship sections with permanently applied bulb-type gasket.
 - 2) Loose shipped gasketing is not allowed.
 - b. Construct panels and access doors as a 2 IN nominal thick; thermal broke double wall assembly, injected with foam insulation for an R-value of not less than R-13.
 - 1) Construct the outer panel and the inner liner of a luminum or stainless steel.
 - c. Panel deflection:
 - 1) Do not exceed L/240 ratio at 125 PCT of design static pressure, maximum positive or negative 8 IN of static pressure.
 - 2) Measure deflection at the midpoint of the panel height.
 - d. Casing leakage rate: Do not exceed 0.5 CFM per square foot of cabinet area at 6 IN of negative static pressure or 5 IN of positive static pressure.
 - e. Module to module assembly:
 - 1) Provide an overlapping, full perimeter, insulated, internal splice joint sealed with bulb type gasketing on both mating modules to minimize on-site labor and meet indoor air quality standards.
 - f. Entire unit: Provide a 4 IN full perimeter base rail for structural rigidity and condensate trapping.
 - g. Access doors:
 - 1) Flush mounted to cabinetry, with minimum of two, 6 IN long stainless steel piano-type hinges, latch and full size (4.5 IN minimum) handle assembly (provide inspection window for fan section).
 - 2) Swing outward for unit sections under negative pressure (inward for unit sections under positive pressure).
 - 3) Provide a secondary latch to relieve pressure and prevent injury upon access on doors limited from swinging inward (such as side access filter sections) on positive pressure sections.
 - h. Construct drain pans from stainless steel with cross break and double sloping pitch to drain connection.
 - 1) Provide drain pans under cooling coil section.
 - 2) Drain connection centerline: A minimum of 3 IN above the base rail to aid in proper condensate trapping.
 - 3) Drain connections that protrude from the base rail are not acceptable.
 - 4) There must be a full 2 IN thickness of insulation under drain pan.
6. Fan section:
 - a. Fans:
 - 1) Double-width, double-inlet, multiblade centrifugal type.
 - 2) Statically and dynamically balanced.
 - 3) Solid shafts.
 - 4) Airfoil fans.
 - 5) Die formed fan housing.
 - 6) 200,000 HR grease lubricated ball-bearings.
7. Motors: See Specification Section 01 61 03.
8. V-belts and drives sized for 150 PCT motor capacity.
9. Heating coil section:
 - a. Water: See paragraph(s) in Article 2.3, Equipment Coils.
10. Filter section:
 - a. Filters: See Specification Section 23 31 00.
 - b. Non-insulated cabinet.
 - c. Access doors for filter removal.
11. Type: Draw through.

12. Size and capacity as scheduled on Drawings.
- E. Unitary Split System Air Conditioner:
1. General:
 - a. Provide ductless split system air conditioner with matched indoor and outdoor sections. Provide indoor section with condensate pump and integral filter.
 2. Outdoor Unit:
 - a. Casing and frame:
 - 1) Casing: Heavy gage galvanized steel, factory painted.
 - 2) Fan grill: ABS plastic.
 - 3) Removable end panel for access to components and connections.
 - b. Compressors:
 - 1) Modulating scroll type, with five-year non-prorated warranty.
 - 2) Suction and discharge service valves.
 - 3) Thermal overload protection.
 - c. Refrigeration circuit:
 - 1) Sight glass.
 - 2) Filter dryer.
 - 3) Manual shut-off valve.
 - 4) High pressure relief valve.
 - d. Compressor isolators.
 - e. Condenser coils:
 - 1) Nominal 3/8 IN OD seamless copper mechanically bonded to corrugated aluminum fins.
 - 2) Factory leak tested at 315 PSIG under water.
 - f. Condenser fans:
 - 1) Direct drive.
 - 2) Propeller type.
 - g. Condenser fan motors:
 - 1) Heavy duty, inherently protected, non-reversing.
 - 2) Permanently lubricated bearings.
 - 3) Integral rain shield.
 3. Indoor unit:
 - a. Type: Wall mounted.
 - b. Materials:
 - 1) Casing: Heavy gage steel.
 - 2) Framework: Steel angle.
 - 3) Pan insulation: Foam-in-place insulation.
 - c. Evaporator fans:
 - 1) Double-width, double-inlet centrifugal type.
 - 2) Forward curved or airfoil.
 - 3) Solid steel shafts.
 - 4) Permanently lubricated bearings.
 - d. Fan motors:
 - 1) Direct drive.
 - 2) Permanently lubricated bearings.
 - e. Filter section:
 - 1) Filters: Washable.
 - 2) Access doors for filter removal.
 - f. Evaporator coil:
 - 1) Aluminum fin on copper tubing.
 - g. Drain pan:
 - 1) Mastic-coated.
 - 2) Threaded drain connections.

- h. Accessories:
 - 1) Pre-charged refrigerant lineset.
 - 2) Condensate pump with minimum 33" lift.
 - 3) Wall thermostat/ controller.
 - 4. Size and capacity as scheduled on Drawings.
- F. Positive Pressurization Unit:
- 1. Self contained.
 - 2. Pressurization air as scheduled.
 - 3. Total delivered air with recirculation as scheduled.
 - 4. Vertical configuration.
 - 5. Four (4) stages of air purification.
 - a. First stage: ASHRAE 20, 20-25 PCT removal filter.
 - b. Second stage: Media modules filled with 50 LBS of media.
 - c. Third stage: Same as second.
 - d. Fourth stage: JFL-90, 90 PCT removal.
 - 6. Materials:
 - a. Unit: 14 GA cold rolled steel.
 - b. Modules: Perforated aluminum sheets.
 - c. Stage supports: Aluminum track with sealing material.
 - 7. Blower:
 - a. Location: Between second and third stage.
 - b. Wheel: Backward curved, aluminum.
 - c. VFD drive.
 - d. Motor: See Specification Section 01 61 03.
 - 8. Module media:
 - a. Pelletized.
 - b. Activated alumina impregnated with a minimum of 12 PCT sodium permanganate.
 - c. 100 LB of media shall remove 14 LB hydrogen sulfide; 14 PCT minimum by weight.
 - d. Inorganic.
 - e. Non-toxic.
 - f. Non-flammable.
 - g. Shall not support bacterial or fungal growth.
 - 9. Media performance certification (manufacturer's responsibility):
 - a. Performed by laboratory of Owner's (Engineer's) choice.
 - b. Test procedure: Pass moist (85 PCT RH) air containing 10 (\pm 1) ppm hydrogen sulfide gas at a rate of 2900 ML per minute through a 1.0 IN diameter by 6.0 IN deep uniformly packed bed.
 - c. Test shall run continuous for 48 HRS.
 - d. During test down stream concentration of hydrogen sulfide shall never exceed 0.05 PPM.
 - 10. Gages:
 - a. Outside air flow.
 - b. Room pressure.
 - c. Pressure differential across first stage.
 - d. Pressure differential across final stage.
 - 11. Size and capacity as scheduled on Drawings.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install in accordance with Specification Section 01 61 03.
- B. Install fixed pitched drive sheave after sheave has been sized based on accepted test and balance report.

3.2 FIELD QUALITY CONTROL

A. Comply with Specification Section 23 05 93.

3.3 ADJUSTING

A. Install new filters on units which have been running prior to acceptance of Project.

END OF SECTION

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DIVISION 26

ELECTRICAL



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SECTION 26 05 00
ELECTRICAL - BASIC REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Basic requirements for electrical systems.
- B. Related Specification Sections include but are not necessarily limited to:
 - 1. Division 00 - Procurement and Contracting Requirements.
 - 2. Division 01 - General Requirements.
 - 3. Division 03 - Concrete.
 - 4. Division 26 - Electrical.
 - 5. Section 01 61 03 - Equipment - Basic Requirements.
 - 6. Section 03 15 19 - Anchorage to Concrete.
 - 7. Section 10 14 00 - Identification Devices.
 - 8. Section 26 05 19 - Wire and Cable - 600 Volt and Below.
 - 9. Section 26 05 33 - Raceways and Boxes.

1.2 QUALITY ASSURANCE

- A. Referenced Standards:
 - 1. American Institute of Steel Construction (AISC):
 - a. Steel Construction Manual.
 - 2. American National Standards Institute (ANSI).
 - 3. ETL Testing Laboratories (ETL).
 - 4. Institute of Electrical and Electronics Engineers, Inc. (IEEE):
 - a. C2, National Electrical Safety Code (NEC).
 - 5. National Fire Protection Association (NFPA):
 - a. 70, National Electrical Code (NEC).
 - b. 70E, Standard for Electrical Safety in the Workplace.
 - 6. National Electrical Manufacturers Association (NEMA):
 - a. 250, Enclosures for Electrical Equipment (1000 Volts Maximum).
 - b. ICS 6, Industrial Control and Systems Enclosures.
 - 7. Underwriters Laboratories, Inc. (UL).
- B. Products to be listed by a Nationally Recognized Testing Laboratory (NRTL) in accordance with applicable product standards.
 - 1. Where UL test procedures have been established for the product type, use UL or ETL approved electrical equipment and provide with the UL or ETL label.
 - 2. Applicable product standards including, but not limited to, ANSI, FM, IEEE, NEMA and UL.
 - 3. NRTL includes, but is not limited to, CSA Group Testing and Certification (CS), FM Approvals LLC (FM), Intertek Testing Services NA, Inc. (ETL), and Underwriters Laboratories, Inc. (UL).

1.3 DEFINITIONS

- A. For the purposes of providing materials and installing electrical work the following definitions shall be used.
 - 1. Outdoor area: Exterior locations where the equipment is normally exposed to the weather and including below grade structures, such as vaults, manholes, handholes and in-ground pump stations.
 - 2. Architecturally finished interior area: Offices, laboratories, conference rooms, restrooms, corridors and other similar occupied spaces.

3. Non-architecturally finished interior area: Pump, chemical, mechanical, electrical rooms and other similar process type rooms.
4. Highly corrosive and corrosive area: Areas identified on the Drawings where there is a varying degree of spillage or splashing of corrosive materials such as water, wastewater or chemical solutions; or chronic exposure to corrosive, caustic or acidic agents, chemicals, chemical fumes or chemical mixtures.
5. Hazardous areas: Class I, II or III areas as defined in NFPA 70.
6. Shop fabricated: Manufactured or assembled equipment for which a UL test procedure has not been established.
7. Electrical Subcontractor:
 - a. Employed by the Contractor.
 - b. Responsible for coordination, installation, connections, testing, etc. of motor control equipment and all other electrical equipment required for the Project.
 - c. Qualified personnel with the Electrical Subcontractor shall be the only personnel authorized to perform work in existing and/or new electrical equipment/gear.

1.4 SYSTEM DESCRIPTION

- A. Maintain Plant Operation:
 1. All existing equipment must be operational prior to beginning the phased construction.
 - a. Coordinate with the Owner's operations and maintenance staffs to verify that they have equipment operational and construction can proceed.
 - b. Comply with the requirements of 01 3000 and 01 14 16.
- B. Execution of this Contract will involve replacement of existing equipment.
 1. The Contractor is responsible for coordinating with the Engineer and the Owner on which equipment shall remain in service, or which shall have a limited downtime, and to schedule his work accordingly.
 2. Temporary equipment and wiring, installed in accordance with the NFPA 70, may be used if necessary to maintain operation or to limit downtime.
 3. Under no circumstances shall equipment be taken out of service without the Owner's permission.
 4. Comply with requirements of Specification Sections 01 3000 and 01 14 16.
- C. Provide fully-functioning systems in compliance with National Electrical Code (NEC), manufacturer's instruction, performance requirements specified or shown in the contract Documents, and modifications resulting from reviewed shop drawings and field coordinated drawings.
- D. Provide power and control wiring to HVAC equipment per manufacturer installation instructions (such as supply fans, exhaust fans, unit heaters, chillers, boiler, air handling units, Field Equipment Controllers, etc.) as shown in the electrical drawings and as required for complete, fully-functional system. Provide coordination. Provide local equipment disconnects. Provide local and remote control stations as shown on control diagrams and as required for a fully functional system.
- E. Provide complete power distribution systems including raceways, wiring, and power supply to all equipment shown.
 1. Includes design of required raceways and wiring where only the electrical device is in the Contract Documents.
- F. Provide complete interior lighting system including all lighting equipment, raceways, wiring, lighting controls, and switching equipment:
 1. Includes design of required raceways and wiring.
 2. Only the fixtures, circuits, and switching schemes are shown in the Contract Documents.
 3. Fixture locations are approximate and shall be field adjusted as practical to avoid interferences with piping, cable tray, HVAC equipment, ductwork, etc.

- G. Provide complete exterior lighting system including all lights, building exterior lighting equipment, and switching equipment:
 - 1. Includes design of required raceways and wiring.
 - 2. Only the fixtures, circuits, and switching schemes are shown in the Contract Documents.
 - 3. For each exterior, surface-mounted light near a canopy, install the fixture under the canopy, sheltered from weather and drips. Similarly located receptacles shall be similarly located and protected.
- H. Site duct banks penetrate structure walls in various locations on the Contract Drawings. Coordinate these penetrations with other construction disciplines and submit a sketch for review of each duct bank penetration. Submit for review prior to construction.
- I. Where electrical equipment (such as control panels, control stations, etc.) is installed underneath piping, provide appropriately-sized drip shields.
- J. Provide a local disconnect switch for each field-mounted instrument transmitter with a 120Vac power source.

1.5 SUBMITTALS

- A. Shop Drawings:
 - 1. See Specification Section 01 33 00 for requirements for the mechanics and administration of submittal process.
 - 2. See Specification Section 01 61 03 and individual specification sections for submittal requirements for products defined as equipment.
 - 3. General requirements:
 - a. Provide manufacturer's technical information on products to be used, including product descriptive bulletin.
 - b. Include data sheets that include manufacturer's name and product model number.
 - 1) Clearly identify all optional accessories.
 - c. Acknowledgement that products are NRTL listed or are constructed utilizing NRTL recognized components.
 - d. Manufacturer's delivery, storage, handling and installation instructions.
 - e. Product installation details.
 - f. Short Circuit Current Rating (SCCR) nameplate marking per NFPA 70, include any required calculations.
 - g. See individual specification sections for any additional requirements.
 - 4. Documentation of Electrical Subcontractor qualifications.
 - 5. Fabrication and/or layout drawings:
 - a. Concrete and reinforcing steel, per Division 03 requirements.
- B. Operation and Maintenance Manuals:
 - 1. See Specification Section 01 33 04 for requirements for:
 - a. The mechanics and administration of the submittal process.
 - b. The content process of Operation and Maintenance Manuals.
- C. When a Specification Section includes products specified in a nother Specification Section, each Specification Section shall have the required Shop Drawing transmittal form per Specification Section 01 33 00 and all Specification Sections shall be submitted simultaneously.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. See Specification Section 01 65 50.
- B. Protect nameplates on electrical equipment to prevent defacing.

1.7 AREA DESIGNATIONS

- A. Designation of an area will determine the NEMA rating of the electrical equipment enclosures, types of conduits and installation methods to be used in that area.
 - 1. Outdoor areas:
 - a. Wet.
 - b. Also, corrosive and/or hazardous when specifically designated on the Drawings or in the Specifications.
 - 2. Indoor areas:
 - a. Dry.
 - b. Also, wet, corrosive and/or hazardous when specifically designated on the Drawings or in the Specifications.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with the Contract Documents, refer to specific Electrical Specification Sections and specific material paragraphs below for acceptable manufacturers.
- B. Submit request for substitution in accordance with Specification Section 01 25 13.
- C. Provide all components of a similar type by one (1) manufacturer.

2.2 MATERIALS

- A. Electrical Equipment Support Pedestals and/or Racks:
 - 1. Manufacturers:
 - a. Modular strut:
 - 1) Unistrut Building Systems.
 - 2) B-Line by Eaton.
 - 3) Globe Strut.
 - 4) Superstrut by Thomas & Betts.
 - 2. Material requirements:
 - a. Modular strut:
 - 1) Galvanized steel: ASTM A123/123M or ASTM A153/A153M.
 - 2) Stainless steel: AISI Type 316.
 - 3) PVC coated galvanized steel: ASTM A123/A123M or ASTM A153/A153M and 20 MIL PVC coating.
 - b. Mounting plates:
 - 1) Galvanized steel: ASTM A36/A36M steel with galvanizing per ASTM A123/A123M.
 - c. Mounting hardware:
 - 1) Galvanized steel.
 - 2) Stainless steel.
 - d. Anchorage per Specification Section 03 15 19.
 - e. Concrete and reinforcing steel: See Division 03 specifications.
- B. Equipment pads (interior and exterior):
 - 1. Concrete and reinforcing steel: See Division 03 specifications.
- C. Field touch-up of galvanized surfaces.
 - 1. Zinc-rich primer.
 - a. One coat, 3.0 MILS, ZRC by ZRC Products.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install and wire all equipment, including prepurchased equipment, and perform all tests necessary to assure conformance to the Drawings and Specification Sections and ensure that equipment is ready and safe for energization.
- B. Install equipment in accordance with the requirements of:
 - 1. NFPA 70.
 - 2. IEEE C2.
 - 3. The manufacturer's instructions.
 - 4. Specification Section 2605 48 for seismic bracing of suspended components and equipment anchorage.
- C. In general, conduit routing is not shown on the Drawings.
 - 1. The Contractor is responsible for routing all conduits including those shown on one-line and control block diagrams and home runs shown on floor plans.
 - 2. Conduit routings and stub-up locations that are shown are approximate; exact routing to be as required for equipment furnished and field conditions.
 - 3. Conduit routing shall be surface mounted except where shown on the Drawings or where approved by the Engineer. The Contractor shall develop plan sheets showing proposed routing, circuiting, etc. Where power circuits are proposed to be installed in duct bank, Contractor shall provide calculations showing the derating of the cable ampacities and the proposed new cable sizing. Calculations shall be software driven by SKM, AmpCalc, or equivalent.
- D. When complete branch circuiting is not shown on the Drawings:
 - 1. A homerun indicating panelboard name and circuit number will be shown and the circuit number will be shown adjacent to the additional devices (e.g., light fixture and receptacles) on the same circuit.
 - 2. The Contractor is to furnish and install all conduit and conductors required for proper operation of the circuit.
 - 3. The indicated homerun conduit and conductor size shall be used for the entire branch circuit.
 - 4. See Specification Section 2605 19 for combining multiple branch circuits in a common conduit.
- E. Do not use equipment that exceed dimensions or reduce clearances indicated on the Drawings or as required by the NFPA 70.
- F. Install equipment plumb, square and true with construction features and securely fastened.
- G. Install electrical equipment, including pull and junction boxes, minimum of 6 IN from process, gas, air and water piping and equipment.
- H. Install equipment so it is readily accessible for operation and maintenance, is not blocked or concealed and does not interfere with normal operation and maintenance requirements of other equipment.
- I. Device Mounting Schedule:
 - 1. Unless indicated otherwise on the Drawings, mounting heights are as indicated below:
 - a. Light switch (to center): 46 IN.
 - b. Receptacle in architecturally finished areas (to center): 18 IN.
 - c. Receptacle on exterior wall of building (to center): 18 IN.
 - d. Receptacle in non-architecturally finished areas (to center): 46 IN.
 - e. Telephone outlet in architecturally finished areas (to center): 18 IN.
 - f. Telephone outlet for wall-mounted phone (to center): 46 IN.
 - g. Safety switch (to center of operating handle): 54 IN.
 - h. Separately mounted motor starter (to center of operating handle): 54 IN.

- i. Pushbutton or selector switch control station (to center): 46 IN.
 - j. Panelboard (to top): 72 IN.
- J. Avoid interference of electrical equipment operation and maintenance with structural members, building features and equipment of other trades.
 - 1. When it is necessary to adjust the intended location of electrical equipment, unless specifically dimensioned or detailed, the Contractor may make adjustments of up to 6 IN in equipment location with the Engineer's approval.
 - 2. When it is necessary to adjust the intended location of electrical equipment, unless specifically dimensioned or detailed, the Contractor may make adjustments in equipment locations in accordance with the following without obtaining the Engineer's approval:
 - a. 1 FT at grade, floor and roof level in any direction in the horizontal plane.
 - b. 1 FT for equipment other than lighting at ceiling level in any direction in the horizontal plane.
 - c. 1 FT for lighting fixtures at ceiling level in any direction in the horizontal plane.
 - d. 1 FT on walls in a horizontal direction within the vertical plane.
 - e. Changes in equipment location exceeding those defined above require the Engineer's approval.
- K. Provide electrical equipment support system per the following area designations:
 - 1. Dry areas:
 - a. Galvanized system consisting of galvanized steel channels and fittings.
 - b. Stainless steel anchors, nuts and hardware.
 - c. Field touch-up cut ends and scratches of galvanized components with the specified primer during the installation, before rust appears.
 - 2. Wet areas:
 - a. Galvanized system consisting of galvanized steel channels and fittings.
 - b. Stainless steel anchors, nuts and hardware.
 - c. Field touch-up cut ends and scratches of galvanized components with the specified primer during the installation, before rust appears.
 - 3. All outdoor areas:
 - a. Stainless steel system consisting of stainless steel channels and fittings, anchors, nuts, and hardware.
 - b. Provide a aluminum or stainless steel back panels, sun shields, etc for mounting of equipment.
 - 4. Corrosive areas:
 - a. Stainless steel system consisting of stainless steel channels and fittings, nuts and hardware.
 - 5. Highly corrosive areas:
 - a. PVC coated steel system consisting of PVC coated steel channels and fittings with stainless steel nuts and hardware.
- L. Provide all necessary anchoring devices and supports rated for the equipment load based on dimensions and weights verified from approved submittals, or as recommended by the manufacturer.
 - 1. See Specification Section 03 15 19.
 - 2. Do not cut, or weld to, building structural members.
 - 3. Do not mount safety switches or other equipment to equipment enclosures, unless enclosure mounting surface is properly braced to accept mounting of external equipment.
- M. Provide non-metallic corrosion resistant spacers to maintain 1/4 IN separation between metallic equipment and/or metallic equipment supports and mounting surface in wet areas, on below grade walls and on walls of liquid containment or processing areas such as Basins, Clarifiers, Digesters, Reservoirs, etc.
- N. Do not place equipment fabricated from a aluminum in direct contact with earth or concrete.

- O. Screen or seal all openings into equipment mounted outdoors to prevent the entrance of rodents and insects.
- P. Do not use materials that may cause the walls or roof of a building to discolor or rust.
- Q. Identify electrical equipment and components in accordance with Specification Section 10 14 00.
- R. Provide field markings and/or documentation of available short-circuit current (available fault current) and related information for equipment as required by the NFPA 70 and other applicable codes.
- S. Provide equipment or control panels with Short Circuit Current Rating (SCCR) labeling as required by NFPA 70 and other applicable codes.
 - 1. Determine the SCCR rating by one of the following methods:
 - a. Method 1: SCCR rating meets or exceeds the available fault current of the source equipment when indicated on the Drawings.
 - b. Method 2: SCCR rating meets or exceeds the source equipment's Amp Interrupting Current (AIC) rating as indicated on the Drawings.
 - c. Method 3: SCCR rating meets or exceeds the calculated available short circuit current at the control panel.
 - 2. The source equipment is the switchboard, panelboard, motor control center or similar equipment where the equipment or control panel circuit originates.
 - 3. For Method 3, provide calculations justifying the SCCR rating. Utilize source equipment available fault current or AIC rating as indicated on the Drawings.

3.2 FIELD QUALITY CONTROL

- A. Verify exact rough-in location and dimensions for connection to electrified equipment, provided by others.
 - 1. See Specification Section 01 73 20 for openings and penetrations in structures.
- B. Replace equipment and systems found inoperative or defective and re-test.
- C. Cleaning:
 - 1. See Specification Section 01 74 00.
- D. The protective coating integrity of support structures and equipment enclosures shall be maintained.
 - 1. Repair galvanized components utilizing a zinc rich paint.
 - 2. Repair painted components utilizing touch up paint provided by or approved by the manufacturer.
 - 3. Repair PVC coated components utilizing a patching compound, of the same material as the coating, provided by the manufacturer of the component.
 - 4. Repair surfaces which will be inaccessible after installation prior to installation.
 - 5. See Specification Section 26 05 33 for requirements for conduits and associated accessories.
- E. Replace nameplates damaged during installation.
- F. Perform tests in the presence of the Engineer.
 - 1. Schedule tests with the Engineer.
 - 2. Present required certificates of testing or review to the Engineer upon completion of the tests.

3.3 DEMONSTRATION

- A. Demonstrate equipment in accordance with Specification Section 01 75 00.

END OF SECTION

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SECTION 26 05 19

WIRE AND CABLE - 600 VOLT AND BELOW

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
1. Material and installation requirements for:
 - a. Building wire.
 - b. Power cable.
 - c. Control cable.
 - d. Shielded VFD cable.
 - e. Instrumentation cable.
 - f. Fiber optic cable.
 - g. Wire connectors.
 - h. Insulating tape.
 - i. Pulling lubricant.
- B. Related Specification Sections include but are not necessarily limited to:
1. Division 00 - Procurement and Contracting Requirements.
 2. Division 01 - General Requirements.
 3. Section 26 05 00 - Electrical - Basic Requirements.
 4. Section 26 08 13 - Acceptance Testing.

1.2 QUALITY ASSURANCE

- A. Referenced Standards:
1. Institute of Electrical and Electronics Engineers, Inc. (IEEE):
 - a. 1202, Standard for Flame-Propagation Testing of Wire and Cable.
 2. Insulated Cable Engineers Association (ICEA):
 - a. S-58-679, Standard for Control Cable Conductor Identification.
 3. National Electrical Manufacturers Association (NEMA):
 - a. ICS 4, Industrial Control and Systems: Terminal Blocks.
 4. National Electrical Manufacturers Association/Insulated Cable Engineers Association (NEMA/ICEA):
 - a. WC 57/S-73-532, Standard for Control Cables.
 - b. WC 70/S-95-658, Power Cables Rated 2000 Volts or Less for the Distribution of Electrical Energy.
 5. National Fire Protection Association (NFPA):
 - a. 70, National Electrical Code (NEC).
 - b. 70E, Standard for Electrical Safety in the Workplace.
 - c. 262, Standard Method of Test for Flame Travel and Smoke of Wires and Cables for Use in Air-Handling Spaces.
 6. Telecommunications Industry Association/Electronic Industries Alliance (TIA/EIA):
 - a. 598-C, Optical Fiber Cable Color Coding.
 7. Telecommunications Industry Association/Electronic Industries Alliance/American National Standards Institute (TIA/EIA/ANSI):
 - a. 568, Commercial Building Telecommunications Cabling Standard.
 8. Underwriters Laboratories, Inc. (UL):
 - a. 44, Standard for Safety Thermoset-Insulated Wires and Cables.
 - b. 467, Standard for Safety Grounding and Bonding Equipment.
 - c. 486A, Standard for Safety Wire Connectors and Soldering Lugs for use with Copper Conductors.
 - d. 486C, Standard for Safety Splicing Wire Connections.
 - e. 510, Standard for Safety Polyvinyl Chloride, Polyethylene and Rubber Insulating Tape.

- f. 1277, Standard for Safety Electrical Power and Control Tray Cables with Optional Optical-Fiber Members.
- g. 1581, Standard for Safety Reference Standard for Electrical Wires, Cables, and Flexible Cords.
- h. 2250, Standard for Safety Instrumentation Tray Cable.

1.3 DEFINITIONS

- A. Cable: Multi-conductor, insulated, with outer sheath containing either building wire or instrumentation wire.
- B. Instrumentation Cable:
 - 1. Multiple conductor, insulated, twisted or untwisted, with outer sheath.
 - 2. The following are specific types of instrumentation cables:
 - a. Analog signal cable:
 - 1) Used for the transmission of low current (e.g., 4-20mA DC) or low voltage (e.g., 0-10 VDC) signals, using No. 16 AWG and smaller conductors.
 - 2) Commonly used types are defined in the following:
 - a) TSP: Twisted shielded pair.
 - b) TST: Twisted shielded triad.
 - b. Digital signal cable: Used for the transmission of digital signals between computers, PLC's, RTU's, etc.
- C. Power Cable: Multi-conductor, insulated, with outer sheath containing building wire, No. 8 AWG and larger.
- D. Shielded VFD Cable: Multi-conductor, insulated, with shield, drain wire and building wires, No. 12 and larger.
- E. Control Cable: Multi-conductor, insulated, with outer sheath containing building wires, No. 14, No. 12 or No. 10 AWG.
- F. Building Wire: Single conductor, insulated, with or without outer jacket depending upon type.

1.4 SUBMITTALS

- A. Shop Drawings:
 - 1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
 - 2. Product technical data:
 - a. Provide submittal data for all products specified in PART 2 of this Specification Section.
 - b. See Specification Section 26 05 00 for additional requirements.
 - 3. Miscellaneous:
 - a. Cable pulling plan and data.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. See Specification Section 26 05 00.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
 - 1. Building wire, power and control cable:
 - a. Aetna Insulated Wire.
 - b. Alpha wire.
 - c. Cerrowire.
 - d. Encore Wire Corporation.

- e. General Cable.
- f. Okonite Company.
- g. Southwire Company.
- 2. Shielded VFD cable:
 - a. Belden Inc.
 - b. General Cable.
 - c. Okonite Company.
 - d. Olfex Wire and Cable, Inc.
 - e. Priority Wire and Cable (Prysmian).
 - f. Rockbestos-Surprenant Cable Corp.
 - g. Southwire Company.
- 3. Instrumentation cable:
 - a. Analog cable:
 - 1) Alpha wire.
 - 2) Belden Inc.
 - 3) General Cable.
- 4. Wire connectors:
 - a. Burndy Corporation.
 - b. Buchanan.
 - c. Ideal.
 - d. Ilsco.
 - e. 3M Co.
 - f. Teledyne Penn Union.
 - g. Thomas and Betts.
 - h. Phoenix Contact.
- 5. Insulating and color coding tape:
 - a. 3M Co.
 - b. Plymouth Bishop Tapes.
 - c. Red Seal Electric Co.

B. Submit request for substitution in accordance with Specification Section 01 25 13.

2.2 MANUFACTURED UNITS

- A. Building Wire:
 - 1. Conductor shall be copper with 600 V rated insulation.
 - 2. Conductors shall be stranded, except for conductors used in lighting and receptacle circuits which may be stranded or solid.
 - 3. Surface mark with manufacturer's name or trademark, conductor size, insulation type and UL label.
 - 4. When exposed to sunlight, UL listed and marked as sunlight resistant.
 - 5. Conform to NEMA/ICEA WC 70/S-95-658 and UL 44 for type XHHW-2 insulation.
- B. Power Cable:
 - 1. Conductor shall be copper with 600 V rated insulation.
 - 2. Surface mark with manufacturer's name or trademark, conductor size, insulation type and UL label.
 - 3. Conform to NEMA/ICEA WC 70/S-95-658 and UL 44 and UL 1277 for type XHHW-2 insulation with an overall PVC jacket.
 - 4. Number of conductors as required, including a bare ground conductor.
 - 5. Individual conductor color coding:
 - a. ICEA S-58-679, Method 4.
 - b. See PART 3 of this Specification Section for additional requirements.
 - 6. When exposed to sunlight, UL listed and marked as sunlight resistant.
 - 7. Conform to NFPA 70 Type TC.

- C. Control Cable:
1. Conductor shall be copper with 600 V rated insulation.
 2. Surface mark with manufacturer's name or trademark, conductor size, insulation type and UL label.
 3. Conform to NEMA/ICEA WC 57/S-73-532 and UL 44 and UL 1277 for type XHHW-2 insulation with an overall PVC jacket.
 4. Number of conductors as required, provided with or without bare ground conductor of the same AWG size.
 - a. When a bare ground conductor is not provided, an additional insulated conductor shall be provided and used as the ground conductor (e.g., 6/c No. 14 w/g and 7/c No. 14 are equal).
 5. Individual conductor color coding:
 - a. ICEA S-58-679, Method 1, Table E-2.
 - b. See PART 3 of this Specification Section for additional requirements.
 6. When exposed to sunlight, UL listed and marked as sunlight resistant.
 7. Conform to NFPA 70 Type TC.
- D. Electrical Equipment Control Wire:
1. Conductor shall be copper with 600 V rated insulation.
 2. Conductors shall be stranded.
 3. Surface mark with manufacturer's name or trademark, conductor size, insulation type and UL label.
 4. Conform to UL 44 for Type SIS insulation.
 5. Conform to UL 83 for Type MTW insulation.
- E. Shielded VFD Cable:
1. Conductor shall be copper, stranded with 600 V rated insulation.
 2. Surface mark with manufacturer's name or trademark, conductor size, insulation type and UL label.
 3. Cables No. 1 AWG and less:
 - a. Conform to NEMA/ICEA WC 70/S-95-658 and UL 44 and UL 1277 for type RHW-2 or XHHW-2 insulation with an overall PVC jacket.
 - b. Shielding: 85 PCT tinned copper braid, full size tinned copper drain wire and 100 PCT foil shield.
 - c. Number of conductors: 3 PH and 1 full size ground.
 4. Cables No. 12 through 750 kcmil:
 - a. Conform to NEMA/ICEA WC 70/S-95-658 and UL 44 type XHHW-2 insulation.
 - b. Shielding: Continuous corrugated copper-free aluminum sheath covered with a PVC jacket.
 - c. Number of conductors: 3 PH and 3 equally spaced ground conductors.
 5. Individual conductor color coding:
 - a. ICEA S-58-679, Method 4.
 - b. See PART 3 of this Specification Section for additional requirements.
 6. When installed exposed outdoors, UL listed and marked as sunlight resistant.
 7. For continuously corrugated cable, use manufacturer approved fittings.
 8. Conform to NFPA 70, Type TC.
- F. Instrumentation Cable:
1. Surface mark with manufacturer's name or trademark, conductor size, insulation type and UL label.
 2. Analog cable:
 - a. Tinned copper conductors.
 - b. 600 V PVC insulation with PVC jacket.
 - c. Twisted with 100 PCT foil shield coverage with drain wire.
 - d. Six (6) twists per foot minimum.
 - e. When exposed to sunlight, UL listed and marked as sunlight resistant.
 - f. Individual conductor color coding: ICEA S-58-679, Method 1, Table E-2.

- g. Conform to NFPA 262 and NFPA 70 Type ITC.
- 3. Digital cable:
 - a. As recommended by equipment (e.g., PLC, RTU) manufacturer.
 - b. Horizontal voice and data cable:
 - 1) Category 6 per TIA/EIA/ANSI 568.
 - 2) Cable shall be label-verified.
 - 3) Cable jacket shall be factory marked at regular intervals indicating verifying organization and performance level.
 - 4) Conductors: No. 24 AWG solid untinned copper.
 - 5) Rated CMP per NFPA 70.
 - c. Conform to NFPA 262 and NFPA 70 Type ITC.
- G. Fiber Optic Cable:
 - 1. Design and fabrication - Multi-mode:
 - a. Type:
 - 1) Indoor: Tight buffered or loose tube with a dry gel water blocking system.
 - 2) Outdoor: Loose tube with a wet or dry gel water blocking system.
 - b. Number of fibers: As indicated on the Drawings.
 - c. Fiber size: 62.5/125 micrometer (core diameter/cladding diameter).
 - d. Glass fiber core.
 - e. Step index.
 - f. Maximum attenuation:
 - 1) At 850 nm: 3.75 dB/km.
 - 2) At 1300 nm: 1.5 dB/km.
 - g. Minimum bandwidth:
 - 1) At 850 nm: 160 MHz/km.
 - 2) At 1300 nm: 500 MHz/km.
 - h. Maximum tensile load:
 - 1) Installation: 225 LBS.
 - 2) Long term: 67 LBS.
 - i. Cable jacket material:
 - 1) In rigid steel conduit: PVC, or polyethylene.
 - 2) In plenum or riser: Flame retardant material, PVC not allowed.
 - a) Plenum applications: Cable materials shall pass NFPA 262 requirements.
 - b) Riser applications: Cable materials shall pass UL 1666 requirements.
 - 3) In cable tray: Polyethylene or equivalent; PVC not allowed.
 - a) Meet vertical flame tray test requirements of NFPA 262.
 - j. Cables shall be listed and marked in accordance with the requirements of NFPA 70.
 - k. Optical fiber cable type utilized shall be in accordance with NFPA 70.
 - l. Utilize LC type connectors:
 - 1) Tip material: Ceramic or ceramic/glass composite.
 - 2) Utilize connectors which do not require adhesive, epoxy, or polish.
 - 2. Design and fabrication - Single-mode:
 - a. Type:
 - 1) Outdoor: Loose tube with a wet or dry gel water blocking system.
 - b. Number of fibers: As indicated on the Drawings.
 - c. Fiber size: Non-dispersion shifted, 9/125 micrometer (core diameter/cladding diameter).
 - d. Glass fiber core.
 - e. Step index.
 - f. Maximum attenuation:
 - 1) At 850 nm: 0.5 dB/km.
 - 2) At 1300 nm: 0.4 dB/km.
 - g. Minimum bandwidth:
 - 1) At 850 nm: 160 MHz/km.
 - 2) At 1300 nm: 500 MHz/km.

- h. Maximum tensile load:
 - 1) Installation: 600 LBS.
 - 2) Long term: 200 LBS.
 - i. Cable jacket material:
 - 1) In conduit: PVC, or polyethylene.
 - j. Cables shall be listed and marked in accordance with the requirements of NFPA 70.
 - k. Optical fiber cable type utilized shall be in accordance with NFPA 70.
 - l. Fiber shall conform to TIA/EIA 492AAAA Class IVa.
 - m. Fiber color code shall conform to TIA/EIA 598-C.
 - n. Utilize FC type connectors:
 - 1) Tip material: Ceramic or ceramic/glass composite.
 - 2) Utilize connectors which do not require adhesive, epoxy, or polish.
- H. Wire Connectors:
- 1. Twist/screw on type:
 - a. Insulated pressure or spring type solderless connector.
 - b. 600 V rated.
 - c. Ground conductors: Conform to UL 486C and/or UL 467 when required by local codes.
 - d. Phase and neutral conductors: Conform to UL 486C.
 - 2. Compression and mechanical screw type:
 - a. 600 V rated.
 - b. Ground conductors: Conform to UL 467.
 - c. Phase and neutral conductors: Conform to UL 486A.
 - 3. Terminal block type:
 - a. High density, screw-post barrier-type with white center marker strip.
 - b. 600 V and ampere ratings as required, for power circuits.
 - c. 600 V, 20 ampere rated for control circuits.
 - d. Conform to NEMA ICS 4 and UL 486A.
- I. Insulating and Color Coding Tape:
- 1. Pressure sensitive vinyl.
 - 2. Premium grade.
 - 3. Heat, cold, moisture, and sunlight resistant.
 - 4. Thickness, depending on use conditions: 7, 8.5, or 10 MIL.
 - 5. For cold weather or outdoor location, tape must also be all-weather.
 - 6. Color:
 - a. Insulating tape: Black.
 - b. Color coding tape: Fade-resistant color as specified herein.
 - 7. Comply with UL 510.
- J. Pulling Lubricant: Cable manufacturer's standard containing no petroleum or other products which will deteriorate insulation.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Permitted Usage of Insulation Types:
- 1. Type XHHW-2:
 - a. Building wire and power and control cable in all indoor and outdoor areas and below grade.
 - 2. Type SIS and MTW:
 - a. For the wiring of control equipment within control panels and field wiring of control equipment within switchgear, switchboards, motor control centers.
- B. Shielded VFD Cable:
- 1. For wiring between a VFD and motor.

C. Conductor Size Limitations:

1. Feeder and branch power conductors shall not be smaller than No. 12.
2. Control conductors shall not be smaller than No. 14 AWG.
3. Instrumentation conductors shall not be smaller than No. 16 AWG unless otherwise indicated on the Drawings.

D. Color Code All Wiring as Follows:

1. Building wire:

	240 V, 208 V, 240/120 V, 208/120 V	480 V, 480/277 V
Phase 1	Black	Brown
Phase 2	Red *	Orange
Phase 3	Blue	Yellow
Neutral	White	White or Gray
Ground	Green	Green

* Orange when it is a high leg of a 120/240 V Delta system.

- a. Conductors No. 6 AWG and smaller: Insulated phase, neutral and ground conductors shall be identified by a continuous colored outer finish along its entire length.
- b. Conductors larger than No. 6 AWG:
 - 1) Insulated phase and neutral conductors shall be identified by one of the following methods:
 - a) Continuous colored outer finish along its entire length.
 - b) 3 IN of colored tape applied at the termination.
 - 2) Insulated grounding conductor shall be identified by:
 - a) Continuous green outer finish along its entire length.
 - 3) The color coding shall be applied at all accessible locations, including but not limited to: Junction and pull boxes, wireways, manholes and handholes.
2. Power cables ICEA S-58-679, Method 4 with:
 - a. Phase and neutral conductors identified with 3 IN of colored tape, per the Table herein, applied at the terminations.
 - b. Ground conductor: Bare.
3. Shielded VFD cable ICEA S-58-679, Method 4 with:
 - a. Phase conductors identified with 3 IN of colored tape, per the Table herein, applied at the terminations.
 - b. Ground conductor: Green color insulation or bare.
4. Control cables ICEA S-58-679, Method 1, Table E-2:
 - a. When a bare ground is not provided, one of the colored insulated conductors shall be re-identified by stripping the insulation from the entire exposed length or using green tape to cover the entire exposed length.
 - b. When used in power applications the colored insulated conductors used as phase and neutral conductors may have to be re-identified with 3 IN of colored tape, per the Table herein, applied at the terminations.

E. Install all wiring in raceway unless otherwise indicated on the Drawings.

F. Feeder, branch, control and instrumentation circuits shall not be combined in a raceway, cable tray, junction or pull box, except as permitted in the following:

1. Where specifically indicated on the Drawings.
2. Where field conditions dictate and written permission is obtained from the Engineer.
3. Control circuits shall be isolated from feeder and branch power and instrumentation circuits but combining of control circuits is permitted.
 - a. The combinations shall comply with the following:
 - 1) 12 VDC, 24 VDC and 48 VDC may be combined.

- 2) 125 VDC shall be isolated from all other AC and DC circuits.
- 3) AC control circuits shall be isolated from all DC circuits.
- 4. Instrumentation circuits shall be isolated from feeder and branch power and control circuits but combining of instrumentation circuits is permitted.
 - a. The combinations shall comply with the following:
 - 1) Analog signal circuits may be combined.
 - 2) Digital signal circuits may be combined but isolated from analog signal circuits.
- 5. Multiple branch circuits for similar loads may be combined in a common raceway, such as multiple lighting circuits or multiple receptacle circuits or other 120Vac circuits. Do not combine lighting and receptacle circuits.
 - a. Do not combine control device circuits with lighting or receptacle circuits.
 - b. Contractor is responsible for making the required adjustments in conductor and raceway size, in accordance with all requirements of the NFPA 70, including but not limited to:
 - 1) Up sizing conductor size for required ampacity de-ratings for the number of current carrying conductors in the raceway.
 - 2) The neutral conductors may not be shared.
 - 3) Up sizing raceway size for the size and quantity of conductors.
- G. Ground the drain wire of shielded instrumentation cables at one end only.
 - 1. The preferred grounding location is at the load (e.g., control panel), not at the source (e.g., field mounted instrument).
- H. Splices in 480V circuits are not permitted.
- I. Splices in 120/208V circuits are not permitted except lighting and receptacles branch circuits.
- J. Splices and terminations for the following circuit types shall be made in the indicated enclosure type using the indicated method.
 - 1. Branch power circuits:
 - a. Device outlet boxes (lighting and receptacles):
 - 1) Twist/screw on type connectors.
 - b. Junction and pull boxes and wireways:
 - 1) Twist/screw on type connectors for use on No. 8 and smaller wire.
 - 2) Compression, mechanical screw or terminal block or terminal strip type connectors for use on No. 6 AWG and larger wire.
 - c. Motor terminal boxes:
 - 1) Twist/screw on type connectors for use on No. 10 AWG and smaller wire.
 - 2) Insulated mechanical screw type connectors for use on No. 8 AWG and larger wire.
 - d. Manholes or handholes:
 - 1) Twist/screw on type connectors pre-filled with epoxy for use on No. 8 AWG and smaller wire.
 - 2) Watertight compression or mechanical screw type connectors for use on No. 6 AWG and larger wire.
 - 2. Control circuits:
 - a. Junction and pull boxes: Terminal block type connector.
 - b. Manholes or handholes: Twist/screw on type connectors pre-filled with epoxy.
 - c. Control panels and motor control centers: Terminal block or strips provided within the equipment or field installed within the equipment by the Contractor.
 - 3. Instrumentation circuits can be spliced where field conditions dictate and written permission is obtained from the Engineer.
 - a. Maintain electrical continuity of the shield when splicing twisted shielded conductors.
 - b. Junction and pull boxes: Terminal block type connector.
 - c. Control panels and motor control centers: Terminal block or strip provided within the equipment or field installed within the equipment by the Contractor.

4. Non-insulated compression and mechanical screw type connectors shall be insulated with tape or hot or cold shrink type insulation to the insulation level of the conductors.
- K. Insulating Tape Usage:
1. For insulating connections of No. 8 AWG wire and smaller: 7 MIL vinyl tape.
 2. For insulating splices and taps of No. 6 AWG wire or larger: 10 MIL vinyl tape.
 3. For insulating connections made in cold weather or in outdoor locations: 8.5 MIL, all weather vinyl tape.
- L. Color Coding Tape Usage: For color coding of conductors.
- M. Fiber Optic Cable:
1. Unless indicated otherwise, install all fiber optic cable in conduit.
 - a. In cable trays, the cable(s) shall be installed in an innerduct that is placed in the tray for protection of the cable.
 2. Splicing:
 - a. Optical fibers shall not be spliced.
 3. Utilize dust tight wall-mounted interconnect center to provide the following:
 - a. Interconnect fiber optic cable to jumper cable assemblies for connection to the opto-electronic interface.
 4. Where exposed to contact with electric light or power conductors, the noncurrent carrying metallic members (if applicable) of optical fiber cables entering buildings shall be grounded as close to the point of entrance as practicable in accordance with NFPA 70.
 5. Install cables in accordance with the requirements of NFPA 70.

3.2 FIELD QUALITY CONTROL

- A. Acceptance Testing:
1. See Specification Section 2608 13.
 2. For Category 6 cable, provide testing to confirm compliance with TIA568. Provide signed testing forms.
- B. Test installed fiber optic cable system to verify the following:
1. Continuity of all installed fibers and associated connectors.
 2. Maximum attenuation requirements of specification are not exceeded.

END OF SECTION

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SECTION 26 05 26
GROUNDING AND BONDING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Material and installation requirements for grounding and bonding system(s).
- B. Related Specification Sections include but are not necessarily limited to:
 - 1. Division 00 - Procurement and Contracting Requirements.
 - 2. Division 01 - General Requirements.
 - 3. Section 10 14 00 - Identification Devices.
 - 4. Section 26 05 00 - Electrical - Basic Requirements.
 - 5. Section 26 05 19 - Wire and Cable - 600 Volt and Below.
 - 6. Section 26 05 33 - Raceways and Boxes.
 - 7. Section 26 08 13 - Acceptance Testing.

1.2 QUALITY ASSURANCE

- A. Referenced Standards:
 - 1. ASTM International (ASTM):
 - a. B8, Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft.
 - 2. Institute of Electrical and Electronics Engineers, Inc. (IEEE):
 - a. 837, Standard for Qualifying Permanent Connections Used in Substation Grounding.
 - 3. National Fire Protection Association (NFPA):
 - a. 70, National Electrical Code (NEC).
 - b. 70E, Standard for Electrical Safety in the Workplace.
 - 4. Underwriters Laboratories, Inc. (UL):
 - a. 467, Grounding and Bonding Equipment.
- B. Assure ground continuity is continuous throughout the entire Project.

1.3 SUBMITTALS

- A. Shop Drawings:
 - 1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
 - 2. Product technical data.
 - a. Provide submittal data for all products specified in PART 2 of this Specification Section.
 - b. See Specification Section 26 05 00 for additional requirements.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
 - 1. Ground rods and bars and grounding clamps, connectors and terminals:
 - a. ERICO by Pentair.
 - b. Harger Lightning & Grounding.
 - c. Burndy by Hubbell.
 - d. Blackburn by Thomas & Betts.

2. Exothermic weld connections:
 - a. ERICO by Pentair - Cadweld.
 - b. Harger Lightning & Grounding - Ultra weld.
 - c. Burndy by Hubbell - Thermoweld.
 - d. FurseWELD by Thomas & Betts.
3. Prefabricated composite test stations:
 - a. Armocast Products Company.
 - b. MacLean Highline.
 - c. Quazite by Hubbell

2.2 COMPONENTS

- A. Wire and Cable:
 1. Bare conductors: Soft drawn stranded copper meeting ASTM B8.
 2. Insulated conductors: Color coded green, per Specification Section 2605 19.
- B. Conduit: As specified in Specification Section 2605 33.
- C. Ground Bars:
 1. Solid copper:
 - a. 1/4 IN thick.
 - b. 2 or 4 IN wide.
 - c. 24 IN long minimum in main service entrance electrical rooms, 12 IN long elsewhere.
 2. Predrilled grounding lug mounting holes.
 3. Stainless steel or galvanized steel mounting brackets.
 4. Insulated standoffs.
- D. Ground Rods:
 1. 5/8 IN x 10 FT.
 2. Copper-clad:
 - a. 10 MIL minimum uniform coating of electrolytic copper molecularly bonded to a rigid steel core.
 - b. Corrosion resistant bond between the copper and steel.
 - c. Hard drawn for a scar-resistant surface.
- E. Grounding Clamps, Connectors and Terminals:
 1. Mechanical type:
 - a. Standards: UL 467.
 - b. High copper alloy content.
 2. Compression type for interior locations:
 - a. Standards: UL 467.
 - b. High copper alloy content.
 - c. Non-reversible.
 - d. Terminals for connection to bus bars shall have two bolt holes.
- F. Exothermic Weld Connections:
 1. Copper oxide reduction by aluminum process.
 2. Molds properly sized for each application.
- G. Prefabricated Composite Material Test Stations:
 1. Body and cover: Fiberglass reinforced polymer concrete conforming to all test provisions of SCTE 77.
 2. Minimum load ratings: SCTE 77 Tier 15.
 3. Open bottom.
 4. Stackable design as required for 3 FT depth.
 5. Cover:
 - a. Engraved legend of "GROUND".
 - b. Lay-in non-bolt down.
 6. Size: 12 IN round or 12 IN square.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General:

1. Install products in accordance with manufacturer's instructions.
2. Size grounding conductors and bonding jumpers in accordance with NFPA 70, Article 250, except where larger sizes are indicated on the Drawings.
3. Remove paint, rust, or other non-conducting material from contact surfaces before making ground connections. After connection, apply manufacturer's approved touch-up paint to protect metallic surface from corrosion.
4. Where ground conductors pass through floor slabs or building walls provide nonmetallic sleeves and install sleeve per Specification Section 01 73 20.
 - a. Seal the sleeve interior to stop water penetration.
5. Do not splice grounding electrode conductors except at ground rods utilizing exothermic type connections.
6. Install ground rods and grounding electrode conductors in undisturbed, firm soil.
 - a. Provide excavation required for installation of ground rods and conductors.
 - b. Use driving studs or other suitable means to prevent damage to threaded ends of sectional rods.
 - c. Connect conductors to ground rods with exothermic weld only.
 - d. Provide sufficient slack in conductor to prevent conductor breakage during backfill or due to ground movement.
 - e. Backfill excavation completely, thoroughly tamping to provide good contact between backfill materials and ground rods and conductors.
7. Do not use exothermic welding if it will damage the structure the grounding conductor is being welded to.

B. Grounding Electrode System:

1. Provide a grounding electrode system in accordance with NFPA 70, Article 250 and as indicated on the Drawings.
 - a. All grounding electrode conductors terminate on a main ground bar located adjacent to the service entrance equipment.
2. Grounding electrode conductor terminations:
 - a. Ground bars mounted on wall: Use a two-hole compression type conductor terminal and bolt it to the ground bar with two bolts.
 - b. Ground bars in electrical equipment: Use compression type conductor terminal and bolt it to the ground bar.
 - c. Piping systems: Use mechanical type connections.
 - d. Building steel, below grade and encased in concrete: Use exothermic weld.
 - e. Building steel, above grade: Use a two-hole compression type conductor terminal and bolt to the steel with two bolts.
 - f. Ground rod: Exothermic weld, unless otherwise specified.
 - g. At all above grade terminations, the conductors shall be labeled per Specification Section 10 14 00.
3. Ufer grounding system (New Mechanical Building):
 - a. Ufer consists of ground rods placed a minimum of 5 FT from foundation and a conductor, at least 20 ft. in length, looped in the structure foundation in compliance with NEC article 250.52(A)(3) Concrete Encased Electrode.
 - b. Place ground rods 2 FT-6 IN below grade.
 - c. Bond conductor to rebar every 50 FT.
 - d. Provide ground rods connected to the conductor at all 90 DEG corners in the foundation and at an additional location so that the maximum distance between ground rods does not exceed 50 FT.
 - e. Grounding conductor: Bare conductor, size as indicated on the Drawings.

- f. Ground rod test stations:
 - 1) Provide where indicated on the Drawings.
 - 2) Grounding conductors connected to ground rod with removable ground clamps.
- C. Supplemental Grounding Electrode:
 - 1. Provide the following grounding in addition to the equipment ground conductor supplied with the feeder conductors whether or not shown on the Drawings.
 - a. See Grounding Electrode System paragraph for conductor termination requirements.
 - 2. Equipment support rack and pedestals mounted outdoors:
 - a. Connect metallic structure to a ground rod.
 - b. Grounding conductor: #6 AWG minimum.
- D. Other Bonding Requirements:
 - 1. Other metal piping:
 - a. Connect in a daisy chain or radial fashion: Metallic piping.
- E. Low Voltage Transformer Separately Derived Grounding System:
 - 1. Ground separately mounted step-down transformers XO terminal to one of the following:
 - a. Power ground bar PGB-3 in Electrical Room.
 - 2. Ground step-down transformer integrally mounted in motor control center to motor control center ground bus.
- F. Raceway Bonding/Grounding:
 - 1. Install all metallic raceway so that it is electrically continuous.
 - 2. Provide an equipment grounding conductor in all raceways with insulation identical to the phase conductors, unless otherwise indicated on the Drawings.
 - 3. NFPA 70 required grounding bushings shall be of the insulating type.
 - 4. Provide double locknuts at all panels.
 - 5. Bond all conduits, at entrance and exit of equipment, to the equipment ground bus or lug.
 - 6. Provide bonding jumpers if conduits are installed in concentric knockouts.
 - 7. Make all metallic raceway fittings and grounding clamps tight to ensure equipment grounding system will operate continuously at ground potential to provide low impedance current path for proper operation of overcurrent devices during possible ground fault conditions.
- G. Equipment Grounding:
 - 1. Ground all utilization equipment with an equipment grounding conductor.
 - 2. Grounding conductor insulation shall be identical to phase conductor insulation.
 - a. Where green-colored insulation is not available, green electrical tape shall be applied to all equipment grounding conductors where exposed, to include, but not be limited to, in manholes and handholes, pull and junction boxes, wireways, and inside equipment enclosures. Tape shall be applied continuously where exposed.
- H. Cable Tray Grounding:
 - 1. Make metal cable tray electrically continuous by one of the following methods:
 - a. Tray sections and fittings suitable for grounding purposes.
 - b. Provide bonding jumpers at discontinuous joints.
 - c. Lay a grounding conductor within the tray for bonding of each individual tray section.
 - 1) Provide a minimum of one ground lug per tray section.
 - 2) Grounding conductor: Insulated #4 AWG minimum with green marking tape every 10 FT.
 - 3) Securely tie the grounding conductor to cable tray every 10 FT. Bond the grounding conductor to the cable tray run a minimum of every 50 FT with a UL listed connector.
 - 2. Bond the tray or tray grounding conductor to every electrical equipment ground bus or telecomm backboard ground bus where conductors terminate.
 - 3. Bond all conduits to the tray that extend the conductors to field equipment.

- I. Manhole and Handhole Grounding:
 - 1. Provide a ground rod and ground bar in each manhole and handhole with exposed metal parts.
 - a. Expose a minimum of 4 IN of the rod above the floor for field connections to the rod.
 - 2. Connect all exposed metal parts (e.g., conduits and cable racks) to the ground rod.
 - 3. Connect any separate bare grounding conductors run underneath ductbanks to the ground rod.
- J. Prefabricated Composite Material Test Station:
 - 1. Place test station on a foundation of compacted 1/4 to 1/2 IN crushed rock or gravel a minimum of 8 IN thick and 6 IN larger than handholes footprint on all sides.
 - 2. Provide concrete encasement ring around test station per manufacturers installation instructions (minimum of 10 IN wide x 12 IN deep).

3.2 FIELD QUALITY CONTROL

- A. Leave grounding system uncovered until observed by Owner.
- B. Acceptance testing:
 - 1. See Specification Section 2608 13.

END OF SECTION

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SECTION 26 05 33
RACEWAYS AND BOXES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
1. Material and installation requirements for:
 - a. Conduits.
 - b. Conduit fittings.
 - c. Conduit supports.
 - d. Wireways.
 - e. Outlet boxes.
 - f. Pull and junction boxes.
- B. Related Specification Sections include but are not necessarily limited to:
1. Division 00 - Procurement and Contracting Requirements.
 2. Division 01 - General Requirements.
 3. Section 26 05 00 - Electrical - Basic Requirements.
 4. Section 26 05 19 - Wire and Cable - 600 Volt and Below.
 5. Section 26 05 43 - Electrical - Exterior Underground.
 6. Section 26 27 26 - Wiring Devices.

1.2 QUALITY ASSURANCE

- A. Referenced Standards:
1. American Iron and Steel Institute (AISI).
 2. ASTM International (ASTM):
 - a. A123/A123M, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
 - b. A153/A153M, Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
 - c. D2564, Standard Specification for Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems.
 - d. E84, Standard Test Method for Surface Burning Characteristics of Building Materials.
 - e. F512, Standard Specification for Smooth-Wall Poly(Vinyl Chloride) (PVC) Conduit and Fittings for Underground Installation.
 3. National Electrical Manufacturers Association (NEMA):
 - a. 250, Enclosures for Electrical Equipment (1000 Volts Maximum).
 - b. RN1, Polyvinyl Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit.
 - c. TC 2, Electrical Polyvinyl Chloride (PVC) Tubing and Conduit.
 - d. TC 3, Polyvinyl Chloride (PVC) Fittings for Use with Rigid PVC Conduit and Tubing.
 - e. TC 14.AG, Aboveground Reinforced Thermosetting Resin Conduit and Fittings.
 - f. TC 14.BG, Belowground Reinforced Thermosetting Resin Conduit and Fittings.
 4. National Electrical Manufacturers Association/American National Standards Institute (NEMA/ANSI):
 - a. C80.1, Electric Rigid Steel Conduit (ERSC).
 - b. OS 1, Sheet-Steel Outlet Boxes, Device Boxes, Covers, and Box Supports.
 5. National Fire Protection Association (NFPA):
 - a. 70, National Electrical Code (NEC).
 - b. 70E, Standard for Electrical Safety in the Workplace.
 6. Underwriters Laboratories, Inc. (UL):
 - a. 1, Standard for Flexible Metal Conduit.
 - b. 6, Electrical Rigid Metal Conduit - Steel.

- c. 50, Enclosures for Electrical Equipment, Non-Environmental Considerations.
- d. 360, Standard for Liquid-Tight Flexible Metal Conduit.
- e. 467, Grounding and Bonding Equipment.
- f. 514A, Metallic Outlet Boxes.
- g. 514B, Conduit, Tubing, and Cable Fittings.
- h. 651, Standard for Schedule 40, 80, Type EB and A Rigid PVC Conduit and Fittings.
- i. 797, Electrical Metallic Tubing - Steel.
- j. 870, Standard for Wireways, Auxiliary Gutters, and Associated Fittings.
- k. 1203, Standard for Explosion-Proof and Dust-Ignition-Proof Electrical Equipment for Use in Hazardous (Classified) Locations. 2420, Belowground Reinforced Thermosetting Resin Conduit (RTRC) and Fittings.
- l. 2515, Aboveground Reinforced Thermosetting Resin Conduit (RTRC) and Fittings.

1.3 SUBMITTALS

- A. Shop Drawings:
 - 1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
 - 2. Product technical data:
 - a. Provide submittal data for all products specified in PART 2 of this Specification.
 - b. See Specification Section 26 05 00 for additional requirements.
 - 3. Fabrication and/or layout drawings:
 - a. Proposed routing of raceways buried under concrete floors and embedded in concrete walls.
 - 1) Identify conduit by tag number of equipment served or by circuit schedule number.
 - b. Proposed routing and details of construction, including raceway and rebar, for raceways embedded in floor slabs, walls and columns.
 - 1) Identify conduit by tag number of equipment served or by circuit schedule number.
 - c. Proposed location and details of construction for openings in slabs and walls for raceway runs.
 - d. Identify dimensional size of pull and junction boxes to be used.
 - e. Proposed routing of exterior raceways and locations of expansion fittings. Provide distance between expansion fittings, back-up data.
 - 1) Identify conduit by tag number of equipment served or by circuit schedule number.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. See Specification Section 26 05 00.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
 - 1. Rigid metal conduits:
 - a. Allied Tube and Conduit.
 - b. Western Tube and Conduit Corporation.
 - c. Wheatland Tube.
 - 2. PVC coated rigid metal conduits:
 - a. Ocal by Thomas & Betts.
 - b. Robroy Industries.
 - 3. Rigid nonmetallic conduit:
 - a. Prime Conduit.
 - b. Cantex, Inc.
 - c. Osburn Associates, Inc.

4. Flexible conduit:
 - a. AFC Cable Systems.
 - b. Anamet, Inc.
 - c. Electri-Flex Company.
 - d. International Metal Hose Company.
 - e. Southwire Company, LLC.
5. Wireway:
 - a. Hoffman Engineering.
 - b. Wiegmann by Hubbell.
 - c. Square D by Schneider Electric.
6. Conduit fittings and accessories:
 - a. Appleton by Emerson Electric Co.
 - b. Carlon by Thomas & Betts.
 - c. Cantex, Inc.
 - d. Crouse-Hinds by Eaton.
 - e. Killark by Hubbell.
 - f. Osburn Associates, Inc.
 - g. O-Z/Gedney by Emerson Electric Co.
 - h. Raco by Hubbell.
 - i. Steel City by Thomas & Betts.
 - j. Thomas & Betts.
7. Support systems:
 - a. Unistrut by Atkore International, Inc.
 - b. B-Line by Eaton.
 - c. Kindorf by Thomas & Betts.
 - d. Minera llac Company.
 - e. CADDY by Pentair.
 - f. Superstrut by Thomas & Betts.
8. Outlet, pull and junction boxes:
 - a. Appleton by Emerson Electric Co.
 - b. Crouse-Hinds by Eaton
 - c. Killark by Hubbell.
 - d. O-Z/Gedney by Emerson Electric Co.
 - e. Steel City by Thomas & Betts.
 - f. Raco by Hubbell
 - g. Bell by Hubbell.
 - h. Hoffman Engineering.
 - i. Wiegmann by Hubbell.
 - j. B-Line by Eaton.
 - k. Adalet.
 - l. RITTAL North America LLC.
 - m. Stahlin by Robroy Enclosures.

B. Submit request for substitution in accordance with Specification Section 01 25 13.

2.2 RIGID METAL CONDUITS

- A. Rigid Galvanized Steel Conduit (RGS):
 1. Mild steel with continuous welded seam.
 2. Metallic zinc applied by hot-dip galvanizing or electro-galvanizing.
 3. Threads galvanized after cutting.
 4. Internal coating: Baked lacquer, varnish or enamel for a smooth surface.
 5. Standards: NFPA 70 Type RMC, NEMA/ANSI C80.1, UL 6.

- B. PVC-Coated Rigid Steel Conduit (PVC-RGS):
 - 1. Nominal 40 MIL Polyvinyl Chloride Exterior Coating:
 - a. Coating: Bonded to hot-dipped galvanized rigid steel conduit conforming to NEMA/ANSI C80.1.
 - b. The bond between the PVC coating and the conduit surface: Greater than the tensile strength of the coating.
 - c. Color shall be gray.
 - 2. Nominal 2 mil, minimum, urethane interior coating.
 - 3. Urethane coating on threads.
 - 4. Conduit: Epoxy prime coated prior to application of PVC and urethane coatings.
 - 5. Female Ends:
 - a. Have a plastic sleeve extending a minimum of one pipe diameter or 2 IN, whichever is less beyond the opening.
 - b. The inside diameter of the sleeve shall be the same as the outside diameter of the conduit to be used with it.
 - 6. Standards: NFPA 70 Type RMC, NEMA/ANSI C80.1, UL 6, NEMA RN 1.

2.3 RIGID NONMETALLIC CONDUIT

- A. Schedules 40 (PVC-40) and 80 (PVC-80):
 - 1. Polyvinyl-chloride (PVC) plastic compound which includes inert modifiers to improve weatherability and heat distribution.
 - 2. Rated for direct sunlight exposure.
 - 3. Fire retardant and low smoke emission.
 - 4. Shall be suitable for use with 90 DEGC wire and shall be marked "maximum 90 DEGC".
 - 5. Standards: NFPA 70 Type PVC, NEMA TC 2, UL 651.

2.4 FLEXIBLE CONDUIT

- A. PVC-Coated Flexible Galvanized Steel (liquid-tight) Conduit (FLEX-LT):
 - 1. Core formed of continuous, spiral wound, hot-dip galvanized steel strip with successive convolutions securely interlocked.
 - 2. Extruded PVC outer jacket positively locked to the steel core.
 - 3. Liquid and vaportight.
 - 4. Standard: NFPA 70 Type LFMC, UL 360.

2.5 WIREWAY

- A. General:
 - 1. Suitable for lay-in conductors.
 - 2. Designed for continuous grounding.
 - 3. Covers:
 - a. Hinged or removable in accessible areas.
 - b. Non-removable when passing through partitions.
 - 4. Finish: Rust inhibiting primer and manufacturer's standard paint inside and out except for stainless steel type.
 - 5. Standards: UL 870, NEMA 250.
- B. Watertight (NEMA 4X rated) Wireway:
 - 1. 14 GA 316 stainless steel bodies and covers without knockouts and 10 GA stainless steel flanges.
 - 2. Cover: Fully gasketed and held in place with captive clamp type latches.
 - 3. Flanges: Fully gasketed and bolted.
- C. Dusttight (NEMA 12 rated) Wireway:
 - 1. 14 GA steel bodies and covers without knockouts and 10 GA steel flanges.
 - 2. Cover: Fully gasketed and held in place with captive clamp type latches.
 - 3. Flanges: Fully gasketed and bolted.

2.6 CONDUIT FITTINGS AND ACCESSORIES

- A. Fittings for Use with RGS:
1. General:
 - a. In hazardous locations listed for use in Class I, Groups C and D locations.
 2. Locknuts:
 - a. Threaded steel or malleable iron.
 - b. Gasketed or non-gasketed.
 - c. Grounding or non-grounding type.
 3. Bushings:
 - a. Threaded, insulated metallic.
 - b. Grounding or non-grounding type.
 4. Hubs: Threaded, insulated and gasketed metallic for raintight connection.
 5. Couplings:
 - a. Threaded straight type: Same material and finish as the conduit with which they are used on.
 6. Unions: Threaded galvanized steel or zinc plated malleable iron.
 7. Conduit bodies (ells and tees):
 - a. Body: Zinc plated cast iron or cast copper free aluminum with threaded hubs.
 - b. Standard and mogul size.
 - c. Cover:
 - 1) Clip-on type with 316 stainless steel screws.
 - 2) Gasketed or non-gasketed galvanized steel, zinc plated cast iron or cast copper free aluminum.
 8. Conduit bodies (round):
 - a. Body: Zinc plated cast iron or cast copper free aluminum with threaded hubs.
 - b. Cover: Threaded screw on type, gasketed, galvanized steel, zinc plated cast iron or cast copper free aluminum.
 9. Sealing fittings:
 - a. Body: Zinc plated cast iron or cast copper free aluminum with threaded hubs.
 - b. Standard and mogul size.
 - c. With or without drain and breather.
 - d. Fiber and sealing compound: UL listed for use with the sealing fitting.
 10. Hazardous location flexible coupling (HAZ-FLEX):
 - a. Liquid tight and arc resistant.
 - b. Electrically conductive so no bonding jumper is required.
 - c. Dry and wet areas:
 - 1) Bronze braided covering over flexible brass core.
 - 2) Bronze end fittings.
 - 3) Zinc-plated steel or malleable iron unions and nipples.
 - d. Corrosive areas:
 - 1) Stainless steel braided covering over flexible stainless steel core.
 - 2) Stainless steel end fittings.
 - 3) Aluminum unions and nipples.
 11. Expansion couplings:
 - a. 2 IN nominal straight-line conduit movement in either direction.
 - b. Galvanized steel with insulated bushing.
 - c. Gasketed for wet locations.
 - d. Internally or externally grounded.
 12. Expansion/deflection couplings:
 - a. 3/4 IN nominal straight-line conduit movement in either direction.
 - b. 30 DEG nominal deflection from the normal in all directions.
 - c. Metallic hubs, neoprene outer jacket and stainless steel jacket clamps.
 - d. Internally or externally grounded.
 - e. Watertight, raintight and concrete tight.
 13. Standards: UL 467, UL 514B, UL 1203.

- B. Fittings for Use with PVC-RGS:
 - 1. The same material and construction as those fittings listed under paragraph "Fittings for Use with RGS" and coated as defined under paragraph "PVC Coated Rigid Steel Conduit (PVC-RGS)."
- C. Fittings for Use with FLEX-LT:
 - 1. Connector:
 - a. Straight or angle type.
 - b. Metal construction, insulated and gasketed.
 - c. Composed of locknut, grounding ferrule and gland compression nut.
 - d. Liquid tight.
 - 2. Standards: UL 467, UL 514B.
- D. Fittings for Use with Rigid Nonmetallic PVC Conduit:
 - 1. Coupling, adapters and conduit bodies:
 - a. Same material, thickness, and construction as the conduits with which they are used.
 - b. Homogeneous plastic free from visible cracks, holes or foreign inclusions.
 - c. Bore smooth and free of blisters, nicks or other imperfections which could damage the conductor.
 - 2. Solvent cement for welding fittings shall be supplied by the same manufacturer as the conduit and fittings.
 - 3. Standards: ASTM D2564, NEMA TC 3, UL 651, UL 514B.
- E. Weather and Corrosion Protection Tape:
 - 1. This tape shall not be permitted to be used as a substitution for PVC-RGS conduit.
 - 2. PVC based tape, 10 mils thick.
 - 3. Protection against moisture, acids, alkalis, salts and sewage and suitable for direct bury.
 - 4. Used with appropriate pipe primer.

2.7 ALL RACEWAY AND FITTINGS

- A. Mark Products:
 - 1. Identify the nominal trade size on the product.
 - 2. Stamp with the name or trademark of the manufacturer.

2.8 OUTLET BOXES

- A. Metallic Outlet Boxes: Not permitted.
- B. Cast Outlet Boxes:
 - 1. Die-cast copper free aluminum with manufacturer's standard finish.
 - 2. Threaded hubs and grounding screw.
 - 3. Styles:
 - a. "FS" or "FD".
 - b. "Bell".
 - c. Single or multiple gang and tandem.
 - d. "EDS" or "EFS" for hazardous locations.
 - 4. Accessories: 40 MIL PVC exterior coating and 2 MIL urethane interior coating.
 - 5. Standards: UL 514A, UL 1203.
- C. See Specification Section 26 27 26 for wiring devices, wall plates and cover plates.

2.9 PULL AND JUNCTION BOXES

- A. NEMA 4X Rated (metallic):
 - 1. Body and cover: 14 GA Type 316 stainless steel.
 - 2. Seams continuously welded and ground smooth.
 - 3. No knockouts.
 - 4. External mounting flanges.
 - 5. Hinged door and stainless steel screws and clamps.
 - 6. Door with oil-resistant gasket.

- B. NEMA 7 Rated:
 1. Copper-free aluminum with manufacturer's standard finish.
 2. Drilled and tapped openings or tapered threaded hub.
 3. Cover bolted-down with stainless steel bolts or threaded cover with neoprene gasket.
 4. External mounting flanges.
 5. Grounding lug.
 6. Accessories: 40 MIL PVC exterior coating and 2 MIL urethane interior coating.
- C. NEMA 12 Rated (Electrical Rooms only):
 1. Body and cover:
 - a. 14 GA steel finished with rust inhibiting primer and manufacturers standard paint inside and out.
 - b. Type 5052 H-32 aluminum, unpainted.
 2. Seams continuously welded and ground smooth.
 3. No knockouts.
 4. External mounting flanges.
 5. Non-hinged cover held closed with captivated cover screws threaded into sealed wells or hinged cover held closed with stainless steel screws and clamps.
 6. Flat door with oil resistant gasket.
- D. Miscellaneous Accessories:
 1. Rigid handles for covers larger than 9 SQFT or heavier than 25 LBS.
 2. Split covers when heavier than 25 LBS.
 3. Weldnuts for mounting optional panels and terminal kits.
 4. Terminal blocks: Screw-post barrier-type, rated 600 volt and 20 ampere minimum.
- E. Standards: NEMA 250, UL 50.

2.10 SUPPORT SYSTEMS

- A. Multi-conduit Surface or Trapeze Type Support and Pull or Junction Box Supports:
 1. Material requirements:
 - a. Stainless steel: AISI Type 316.
- B. Single Conduit and Outlet Box Support Fasteners:
 1. Material requirements:
 - a. Stainless steel.
 - b. PVC coat malleable iron or steel: 20 MIL PVC coating.

2.11 OPENINGS AND PENETRATIONS IN WALLS AND FLOORS

- A. Sleeves, smoke and fire stop fitting through walls and floors:
 1. See Specification Section 01 73 20.

PART 3 - EXECUTION

3.1 RACEWAY INSTALLATION - GENERAL

- A. All conduits shall be surface-mounted.
 1. Contractor may propose conduit installed in concrete floor slabs subject to review by Engineer. Provide proposed routing, spacing, material, etc.
- B. Shall be in accordance with the requirements of:
 1. NFPA 70.
 2. Manufacturer instructions.
- C. Size of Raceways:
 1. Raceway sizes are shown on the Drawings, if not shown on the Drawings, then size in accordance with NFPA 70.

2. Unless specifically indicated otherwise, the minimum raceway size shall be:
 - a. Conduit: 3/4 IN.
 - b. Wireway: 2-1/2 IN x 2-1/2 IN.
- D. Field Bending and Cutting of Conduits:
 1. Utilize tools and equipment recommended by the manufacturer of the conduit, designed for the purpose and the conduit material to make all field bends and cuts.
 2. Do not reduce the internal diameter of the conduit when making conduit bends.
 3. Prepare tools and equipment to prevent damage to the PVC coating.
 4. Degrease threads after threading and apply a zinc rich paint.
 5. Debur interior and exterior after cutting.
- E. Male threads of conduit systems shall be coated with an electrically conductive anti-seize compound.
- F. The protective coating integrity of conduits, fittings, outlet, pull and junction boxes and accessories shall be maintained.
 1. Repair galvanized components utilizing a zinc rich paint.
 2. Repair painted components utilizing touch up paint provided by or approved by the manufacturer.
 3. Repair PVC coated components utilizing a patching compound, of the same material as the coating, provided by the manufacturer of the conduit without exception
 - a. The use of tape is not permitted.
 4. Repair surfaces which will be inaccessible after installation prior to installation.
- G. Remove moisture and debris from conduit before wire is pulled into place.
 1. Pull mandrel with diameter nominally 1/4 IN smaller than the interior of the conduit, to remove obstructions.
 2. Swab conduit by pulling a clean, tight-fitting rag through the conduit.
 3. Tightly plug ends of conduit with tapered wood plugs or plastic inserts until wire is pulled.
- H. Only nylon or polyethylene rope shall be used to pull wire and cable in conduit systems.
- I. Where portions of a raceway are subject to different temperatures and where condensation is known to be a problem, as in cold storage areas of buildings or where passing from the interior to the exterior of a building, the raceway shall be sealed to prevent circulation of warm air to colder section of the raceway.
- J. Seal all conduit and all wall openings (new and existing) from air conditioned electrical rooms. Use pliable sealant. Eliminate all means of air conditioned air leaving the electrical room through these openings.
- K. Fill openings in walls, floors, and ceilings and finish flush with surface.
 1. See Specification Section 01 73 20.
- L. Where conduits emerge from concrete slabs, provide conduit curbs as detailed on the Drawings.
- M. Where spare conduits emerge from concrete near walls, provide conduit curb and extend the conduits a short distance above concrete curb and cap.
- N. Where spare conduits emerge from concrete other than at walls, stub flush with concrete slab with flush plug.
- O. Conduit entering outdoor equipment, or in indoor areas defined as wet, shall enter the bottom of the equipment.
- P. In all air-conditioned electrical rooms, each conduit shall be filled with a pliable sealant after the wiring is installed to maintain the positive pressure within the room. All empty conduits shall be plugged or capped. Where conduit enters the electrical rooms, the spaces around the conduits shall be sealed as specified herein.
- Q. Where conduit terminates at a cable tray system, fit conduit with an insulated bushing.

3.2 RACEWAYROUTING

- A. Raceways shall be routed in the field unless otherwise indicated.
 - 1. Conduit and fittings shall be installed, as required, for a complete system that has a neat appearance and is in compliance with all applicable codes.
 - a. Not all pull boxes are shown on the Drawings. Contractor shall provide a complete raceway system including conduits, boxes, fittings, etc.
 - 2. Run in straight lines parallel to or at right angles to building lines.
 - 3. Do not route conduits:
 - a. Through areas of high ambient temperature or radiant heat.
 - b. In suspended concrete slabs.
 - c. Through beams.
 - d. In any concrete slab unless approved by Engineer.
 - 4. Locate sleeves or conduits penetrating floors, walls, and beams so as not to significantly impair the strength of the construction. Do not place conduit penetrations in columns.
 - 5. Conduit shall not interfere with, or prevent access to, piping, valves, ductwork, or other equipment for operation, maintenance and repair.
 - 6. Provide pull boxes or conduit bodies as needed so that there is a maximum of 360 DEG of bends in the conduit run or in long straight runs to limit pulling tensions.
- B. All conduits within a structure shall be installed exposed except as follows:
 - 1. As indicated on the Drawings.
- C. Maintain minimum spacing between parallel conduit and piping runs in accordance with the following when the runs are greater than 30 FT:
 - 1. Between instrumentation and telecommunication: 1 IN.
 - 2. Between instrumentation and 125 V, 48 V and 24 VDC, 2 IN.
 - 3. Between instrumentation and 600 V and less AC power or control: 6 IN.
 - 4. Between instrumentation and greater than 600 VAC power: 12 IN.
 - 5. Between telecommunication and 125 V, 48 V and 24 VDC, 2 IN.
 - 6. Between telecommunication and 600 V and less AC power or control: 6 IN.
 - 7. Between telecommunication and greater than 600 VAC power: 12 IN.
 - 8. Between 125 V, 48 V and 24 VDC and 600 V and less AC power or control: 2 IN.
 - 9. Between 125 V, 48 V and 24 VDC and greater than 600 VAC power: 2 IN.
 - 10. Between 600 V and less AC and greater than 600 VAC: 2 IN.
 - 11. Between process, gas, air and water pipes: 6 IN.
- D. Conduits shall be installed to eliminate moisture pockets.
 - 1. Where water cannot drain to openings, provide drain fittings in the low spots of the conduit run.
- E. Conduit shall not be routed on the exterior of structures except as specifically indicated on the Drawings.
- F. Where sufficient room exists within the housing of roof-mounted equipment, the conduit shall be stubbed up inside the housing.
- G. Provide all required openings in walls, floors, and ceilings for conduit penetration.
 - 1. See Specification Section 01 73 20.
- H. Conduit embedded in floor slabs (only where approved by Engineer):
 - 1. Where permitted in the Drawings, conduits are permitted to lay on top of the slab granular sub-base material and be encased with the slab.
 - a. See Drawing details for maximum conduit size permitted, spacing requirements, and conduit type.
 - 2. Run in the most direct, practical route.
 - 3. Not to be installed under equipment pads unless approved by Engineer.
 - 4. No crossovers unless approved by the Engineer.
 - 5. Secured in place to prevent movement during the backfill and pour.

- I. Conduit below slab-on-grade: Direct-buried conduits below slab-on-grade shall not be permitted unless approved by Engineer.
 - 1. Provide concrete encasement with reinforcing steel.
- J. Conduits and accessories embedded in concrete where shown on the Contract Drawings:
 - 1. Shall not be considered to replace structurally the displaced concrete except as indicated in the following:
 - a. Size and locate sleeves or conduits passing through floors or walls so as not to significantly impair the strength of the construction.
 - b. Conduit shall not pass through beams.
 - 2. Shall not be larger in outside diameter than one-third the thickness of the slab, column or beam.
 - 3. Shall have a minimum spacing of 3 DIA OC.
 - 4. In reinforced concrete construction:
 - a. Conduit shall not be run in beams.
 - b. Place conduit after reinforcing steel has been laid.
 - c. The reinforcement steel shall not be displaced by the conduit.
 - d. Provide a minimum of 1-1/2 IN of cover over conduit, excluding surface finish.
 - e. Conduits parallel to main reinforcement shall be run near the center of the wall.
 - f. Conduits perpendicular to main reinforcement shall be run midway between wall or slab supports.
- K. Above grade/concrete slab conduits entering outdoor control panels, instrumentation shall enter the enclosures from the side or bottom of the enclosure to a void condensation dripping onto equipment. Where conduits are routed from above, prior to entering the enclosure provide conduit drains.

3.3 RACEWAY APPLICATIONS

- A. Permitted Raceway Types Per Wire or Cable Types:
 - 1. Power wire or cables: All raceway types.
 - 2. Control wire or cables: All raceway types.
 - 3. Instrumentation cables: Metallic raceway except nonmetallic may be used underground.
 - 4. Motor leads from a VFD:
 - a. PVC-RGS or RGS in exposed raceways.
 - b. PVC-RGS in underground installations and ductbank.
 - 5. Telecommunication cables: All raceway types.
- B. Permitted Raceway Types Per Area Designations:
 - 1. Dry areas:
 - a. RGS.
 - 2. Wet areas:
 - a. PVC-RGS.
 - 3. Corrosive areas:
 - a. PVC-RGS.
 - 4. Highly corrosive areas:
 - a. PVC-RGS.
 - 5. NFPA 70 hazardous areas:
 - a. RGS.
 - b. PVC-RGS when required by other area designations.
- C. Permitted Raceway Types Per Routing Locations:
 - 1. In concrete block or brick walls:
 - a. PVC-40.
 - 2. Embedded in poured concrete walls and floors:
 - a. PVC-40.

- b. PVC-RGS when emerging from concrete into areas designated as wet, corrosive or highly corrosive.
 - 1) The vertical elbow shall be PVC-RGS.
 - 2) PVC-RGS shall continue from the top of concrete to 4 FT above the concrete, or when conduits terminate in a pullbox, provide PVC-RGS to the pullbox.
 - 3) RGS wrapped with corrosion protection tape is not permitted at any location.
 - c. PVC-RGS for motor leads from a VFD.
 - 3. Beneath floor slab-on-grade:
 - a. PVC-40.
 - 4. Through floor penetrations, see Specification Section 01 73 20:
 - a. PVC-RGS in areas designated as wet, corrosive or highly corrosive.
 - 1) PVC-RGS shall continue from the top of concrete to 4 FT above the concrete in all locations.
 - 5. Direct buried conduits and ductbanks:
 - a. PVC_RGS.
 - b. 90 DEG elbows for transitions to above grade:
 - 1) PVC-RGS.
 - c. Long sweeping bends greater than 15 DEG:
 - 1) PVC-RGS.
 - 6. Concrete encased ductbanks:
 - a. PVC-40.
 - b. PVC-RGS for motor leads from a VFD.
 - c. 90 degree elbows for transitions to above grade:
 - 1) PVC-RGS.
 - d. Long sweeping bends greater than 15 DEG:
 - 1) RGS for sizes 2 IN and larger.
 - 2) Fiberglass for sizes 2 IN and larger.
 - e. Emerging from underground from the underground vertical elbow to the first equipment termination (i.e. pullbox, MCC, panelboard):
 - 1) PVC-RGS.
 - a) To pullbox.
 - b) To 4 FT above the top of exposed ductbank stub-up when the conduits are not terminated in a pullbox.
- D. FLEX-LT conduits shall be installed as the final conduit connection to light fixtures, dry type transformers, motors, electrically operated valves, instrumentation primary elements, and other electrical equipment that is liable to vibrate.
 - 1. The maximum length shall not exceed:
 - a. 6 FT to light fixtures.
 - b. 3 FT to motors.
 - c. 2 FT to all other equipment.
- E. HAZ-FLEX coupling shall be installed as the final conduit to motors, electrically operated valves, instrumentation primary elements and electrical equipment that is liable to vibrate.
 - 1. The maximum length shall not exceed:
 - a. 3 FT to motors.
 - b. 2 FT to all other equipment.
- F. NEMA 4X Rated Wireway:
 - 1. Surface mounted in areas designated as wet and or corrosive.
- G. NEMA 12 Rated Wireway:
 - 1. Surface mounted in areas designated as dry in architecturally and non-architecturally finished areas.
- H. Underground Conduit: See Specification Section 26 05 43.

3.4 CONDUIT FITTINGS AND ACCESSORIES

- A. Conduit Seals:
 - 1. Installed in conduit systems located in hazardous areas as required by the NFPA 70.
 - 2. The size of the conduit seal shall be such that the cross-sectional area of the seal shall not be smaller in diameter than the corresponding conduit attached to either side of the seal.
 - 3. Fill plug and drain shall be accessible.
 - 4. Pour the conduit seals in a two-step process.
 - a. Pour the seal and leave cover off.
 - b. After seal is dry, inspect for proper sealing, install cover and mark (for example, paint or permanent marker) as complete.
- B. Rigid nonmetallic conduit and fittings shall be joined utilizing solvent cement.
 - 1. Immediately after installation of conduit and fitting, the fitting or conduit shall be rotated 1/4 turn to provide uniform contact.
- C. Install Expansion Fittings:
 - 1. Contractor shall determine the locations of expansion fittings in accordance with the NEC and the manufacturer's recommendations.
 - a. Submittal requirements as specified herein.
 - 2. Where conduits are exposed to the sun and conduit run is greater than 100 FT.
 - 3. Where conduits span structural expansion joints, new and existing structures.
 - 4. Elsewhere as identified on the Drawings.
- D. Install Expansion/Deflection Fittings:
 - 1. Where conduits enter a structure.
 - a. Except electrical manholes and handholes.
 - b. Except where the ductbank is tied to the structure with rebar.
 - 2. Where conduits span structural expansion joints.
 - 3. Elsewhere as identified on the Drawings.
- E. Threaded connections shall be made wrench-tight.
- F. Conduit joints shall be watertight:
 - 1. Where subjected to possible submersion.
 - 2. In areas classified as wet.
 - 3. Underground.
- G. Terminate Conduits:
 - 1. In metallic outlet boxes:
 - a. Conduit hub and locknut.
 - b. Insulated bushing and two locknuts.
 - c. Use grounding type locknut or bushing when required by NFPA 70.
 - 2. In NEMA 12 rated enclosures:
 - a. Watertight, insulated and gasketed hub and locknut.
 - b. Use grounding type locknut or bushing when required by NFPA 70.
 - 3. In NEMA 4 and NEMA 4X rated enclosures:
 - a. Watertight, insulated and gasketed hub and locknut.
 - 4. In NEMA 7 rated enclosures:
 - a. Into an integral threaded hub.
 - 5. When stubbed up through the floor into floor mount equipment:
 - a. With an insulated grounding bushing on metallic conduits.
 - b. With end bells on nonmetallic conduits.
- H. Threadless couplings shall only be used to join new conduit to existing conduit when the existing conduit end is not threaded and it is not practical or possible to cut threads on the existing conduit with a pipe threader.
 - 1. Use of threadless couplings shall be used only where permitted by Engineer.

3.5 CONDUIT SUPPORT

- A. Permitted multi-conduit surface or trapeze type support system per area designations and conduit types:
 - 1. Dry or wet and/or hazardous areas:
 - a. Galvanized system consisting of: Galvanized steel channels and fittings, nuts and hardware and conduit clamps.
 - 2. Corrosive areas:
 - a. Stainless steel system consisting of: Stainless steel channels and fittings, nuts and hardware and conduit clamps.
 - b. PVC coated steel system consisting of: PVC coated galvanized steel channels and fittings and conduit clamps with stainless steel nuts and hardware.
 - 3. Highly corrosive areas:
 - a. PVC coated steel system consisting of: PVC coated galvanized steel channels and fittings and conduit clamps with stainless steel nuts and hardware.
 - 4. Conduit type shall be compatible with the support system material.
 - a. Galvanized steel system may be used with RGS.
 - b. Stainless steel system may be used with RGS and PVC-RGS.
 - c. PVC coated galvanized steel system may be used with PVC-RGS.
- B. Permitted single conduit support fasteners per area designations and conduit types:
 - 1. Dry or wet and/or hazardous areas:
 - a. Material: Stainless steel.
 - b. Types of fasteners: Straps, hangers with bolts, clamps with bolts and bolt on beam clamps.
 - 2. Corrosive areas:
 - a. Material: Stainless steel and PVC coat malleable iron or steel.
 - b. Types of fasteners: Straps, hangers with bolts, clamps with bolts and bolt on beam clamps.
 - 3. Highly corrosive areas:
 - a. Material: PVC coat malleable iron or steel.
 - b. Types of fasteners: Straps, hangers with bolts, clamps with bolts and bolt on beam clamps.
 - 4. Conduit type shall be compatible with the support fastener material.
 - a. Stainless steel system may be used with RGS and PVC-RGS.
 - b. PVC coated fasteners may be used with PVC-RGS.
 - c. Nonmetallic fasteners may be used with PVC-40, PVC-80 and fiberglass.
- C. Conduit Support General Requirements:
 - 1. Maximum spacing between conduit supports per NFPA 70.
 - 2. Support conduit from the building structure.
 - 3. Do not support conduit from process, gas, air or water piping; or from other conduits.
 - 4. Provide hangers and brackets to limit the maximum uniform load on a single support to 25 LBS or to the maximum uniform load recommended by the manufacturer if the support is rated less than 25 LBS.
 - a. Do not exceed maximum concentrated load recommended by the manufacturer on any support.
 - b. Conduit hangers:
 - 1) Continuous threaded rods combined with struts or conduit clamps: Do not use perforated strap hangers and iron bailing wire.
 - c. Do not use suspended ceiling support systems to support raceways.
 - d. Hangers in metal roof decks:
 - 1) Utilize fender washers.
 - 2) Not extend above top of ribs.
 - 3) Not interfere with vapor barrier, insulation, or roofing.

5. Conduit support system fasteners:
 - a. Use stainless steel sleeve-type expansion anchors as fasteners in masonry wall construction.
 - b. Do not use concrete nails and powder-driven fasteners.
 - c. Comply with the requirements of Specification Section 03 41 33 for fasteners in precast-prestressed concrete construction.
 - d. Comply with the requirements of Specification Section 03 15 19 for fasteners in cast-in-place concrete construction.
 - e. Comply with the requirements of Section 26 05 00 for additional fastener material requirements.

3.6 OUTLET, PULL AND JUNCTION BOX INSTALLATION

- A. General:
 1. Install products in accordance with manufacturer's instructions.
 2. See Specification Section 26 05 00 and the Drawings for area classifications.
 3. Fill unused punched-out, tapped, or threaded hub openings with insert plugs.
 4. Size boxes to accommodate quantity of conductors enclosed and quantity of conduits connected to the box.
- B. Outlet Boxes:
 1. Permitted uses of cast outlet boxes:
 - a. Housing of wiring devices surface mounted in non-architecturally finished dry, wet, corrosive, highly corrosive and hazardous areas.
 - b. Pull and junction box surface mounted in non-architecturally finished dry, wet, corrosive and highly corrosive areas.
 2. Mount device outlet boxes where indicated on the Drawings and at heights as scheduled in Specification Section 26 05 00.
 3. Set device outlet boxes plumb and vertical to the floor.
 4. Place barriers between switches in boxes with 277 V switches on opposite phases.
 5. Back-to-back are not permitted.
- C. Pull and Junction Boxes:
 1. Install pull or junction boxes in conduit runs where indicated or required to facilitate pulling of wires or making connections.
 - a. Make covers of boxes accessible.
 2. Permitted uses of NEMA 4X stainless steel metallic enclosure:
 - a. Pull or junction box surface mounted in areas designated as wet and/or corrosive.
 3. Permitted uses of NEMA 7 enclosure:
 - a. Pull or junction box surface mounted in areas designated as Class I hazardous.
 - 1) Provide PVC coating in corrosive and highly corrosive areas when PVC coated conduit is used.
 4. Permitted uses of NEMA 12 enclosure:
 - a. Pull or junction box surface mounted in areas designated as dry.

3.7 FIELD QUALITY CONTROL

- A. Contractor shall provide training to his personnel for the proper handling, cutting, threading, bending, repair and installation of PVC-RGS conduit. Training shall be through a manufacturer's authorized factory representative of the conduit supplied. Contractor shall notify Owner of training session seven days in advance.
- B. Contractor shall provide proper tooling for the installation of PVC-RGS conduit in accordance with the manufacturer's requirements. Tooling will be inspected by Owner throughout the project.
- C. Installed conduit that has damaged the PVC coating material shall be replaced.

END OF SECTION

SECTION 26 05 43
ELECTRICAL - EXTERIOR UNDERGROUND

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Material and installation requirements for:
 - a. Manholes.
 - b. Handhole.
 - c. Underground conduits and ductbanks.
- B. Related Specification Sections include but are not necessarily limited to:
 - 1. Division 00 - Procurement and Contracting Requirements.
 - 2. Division 01 - General Requirements.
 - 3. Division 03 - Concrete.
 - 4. Section 10 14 00 - Identification Devices.
 - 5. Section 26 05 00 - Electrical: Basic Requirements.
 - 6. Section 26 05 26 - Grounding.
 - 7. Section 26 05 33 - Raceways and Boxes.
 - 8. Section 31 23 33 - Trenching, Backfilling and Compacting for Utilities.

1.2 QUALITY ASSURANCE

- A. Referenced Standards:
 - 1. ASTM International (ASTM):
 - a. A536, Standard Specification for Ductile Iron Castings.
 - 2. National Fire Protection Association (NFPA):
 - a. 70, National Electrical Code (NEC).
 - 3. Society of Cable Telecommunications Engineers (SCTE):
 - a. 77, Specifications for Underground Enclosure Integrity.

1.3 DEFINITIONS

- A. Direct-Buried Conduit(s):
 - 1. Individual (single) underground conduit.
 - 2. Multiple underground conduits, arranged in one or more planes, in a common trench.
- B. Concrete Encased Ductbank: An individual (single) or multiple conduit(s), arranged in one or more planes, encased in a common concrete envelope.

1.4 SUBMITTALS

- A. Shop Drawings:
 - 1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
 - 2. Product technical data:
 - a. Provide submittal data for all products specified in PART 2 of this Specification Section.
 - 3. Fabrication and/or layout drawings:
 - a. Provide dimensional drawings of each manhole indicating all specified accessories and conduit entry locations.
 - b. Provide cross-sectioned sketch of each concrete encased ductbank.
 - 1) Dimension spacing between conduits.
 - 2) Dimension concrete envelope and reinforcing, where applicable.
 - 4. Cable pulling calculations and site plans.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
 - 1. Precast manholes and handholes:
 - a. Lister Industries Ltd.
 - b. Oldcastle Enclosure Solutions.
 - c. Jensen Precast and Utility Concrete Products.
 - 2. Manhole and handhole and ductbank accessories:
 - a. Cantex, Inc.
 - b. Condux International, Inc.
 - c. Neenah Enterprises, Inc.
 - d. Prime Conduit.
 - e. Thomas and Betts.
 - f. Underground Devices, Inc.
 - g. Unistrut by Atkore International, Inc.
- B. Submit request for substitution in accordance with Specification Section 01 25 13.

2.2 MANHOLES AND HANDHOLES

- A. Precast Manholes and Handholes:
 - 1. Fiberglass reinforced polymer concrete or steel reinforced cement concrete structures:
 - 2. AASHTO live load rating: H-20 for full deliberate vehicle traffic.
 - 3. Mating edges: Tongue and groove type.
 - 4. Solid bottom with 2 IN diameter ground rod knockout.
 - 5. Solid bottom with a 18 IN x 18 IN or 18 IN DIA French drain just below each manhole and handhole drain sump. Drill hole in the concrete drain sump to allow collected water to drain in French drain below.
 - 6. Gasketed removable top slab with lifting eyes and cast in frame for cover.
 - 7. Cover extension rings as required.
 - 8. Cable pulling eyes opposite all conduit entrances.
 - a. Coordinate exact location with installation contractor.

2.3 CONCRETE MANHOLE AND HANDHOLE ACCESSORIES

- A. Cover and Frame:
 - 1. Manholes:
 - a. Cast ductile iron: ASTM A536.
 - b. AASHTO live load rating: H-20.
 - c. Diameter: 30 IN.
 - d. Cast the legend "ELECTRICAL" or "COMMUNICATIONS" into manhole and handhole covers.
 - 2. Handholes:
 - a. 48 IN x 48 IN (Note: This dimension subject to minor changes based on cover and frame selection).
 - b. Design based on 72 IN depth. Contractor may modify with Engineer's approval.
 - c. Two-panel cover with recessing pulling handles.
 - d. Gasketed and bolted with stainless steel hardware.
 - e. Slip-resistant.
 - f. Stainless steel butt hinges.
 - g. Heavy duty rated.
 - h. Cast the legend "ELECTRICAL" into handhole covers.
- B. Cable Racks and Hooks:
 - 1. Material: Heavy-duty nonmetallic (glass reinforced nylon).
 - 2. Hook loading capacity: 400 LBS minimum.

3. Rack loading capacity: Four hooks maximum.
 4. Hook deflection: 0.25 IN maximum.
 5. Hooks: Length, as required, with positive locking device to prevent upward movement.
 6. Mounding hardware: Stainless steel.
- C. Cable Pulling Irons:
1. 7/8 IN DIA hot-dipped galvanized steel.
 2. 6000 LB minimum pulling load.
- D. Ground Rods and Grounding Equipment: See Specification Section 26 05 26.

2.4 UNDERGROUND CONDUIT AND ACCESSORIES

- A. Concrete and reinforcing steel: See Division 03 Specifications.
- B. Duct Terminators:
1. Window type.
 2. ABS plastic.
 3. Provide for conduit entrance.
 4. Designed for installation into manhole or handhole walls for a watertight seal.
 5. Sufficient space between terminator walls to allow for placement of rebar and concrete.
- C. Conduit: See Specification Section 26 05 33.
- D. Duct Spacers/Supports:
1. High density polyethylene or high impact polystyrene.
 2. Interlocking web or mesh design.
 3. Provide 3 IN minimum spacing between conduits.
 4. Accessories, as required:
 - a. Hold down bars.
 - b. Ductbank strapping.

PART 3 - EXECUTION

3.1 GENERAL

- A. Drawings indicate the intended location of manholes and handholes and routing of ductbanks and direct buried conduit.
1. Field conditions may affect actual routing.
- B. Manhole and Handhole Locations:
1. Approximately where shown on the Drawings.
 2. As required for pulling distances.
 3. As required to keep pulling tensions under allowable cable tensions.
 4. As required for number of bends in ductbank routing.
 5. Shall not be installed in a swale or ditch.
 6. Determine the exact locations after careful consideration has been given to the location of other utilities, grading, and paving.
 7. Locations are to be approved by the Engineer prior to excavation and placement or construction of manholes and handholes.
- C. Install products in accordance with manufacturer's instructions.
- D. Install manholes and handholes in conduit runs where indicated or as required to facilitate pulling of wires or making connections.
- E. Comply with Specification Section 31 23 33 for trenching, backfilling and compacting.

3.2 MANHOLES AND HANDHOLES

- A. Precast Manholes and 48 IN x 48 IN Handholes:
 - 1. For use in vehicular and non-vehicular traffic areas.
 - 2. Construction:
 - a. Grout or seal all joints, per manufacturer's instructions.
 - b. Support cables on walls by cable racks:
 - 1) Provide a minimum of two racks, install symmetrically on each wall of manholes and handholes.
 - a) Provide additional cable racks, as required, so that both ends of cable splices will be supported horizontally.
 - 2) Equip cable racks with adjustable hooks: Quantity of cable hooks as required by the number of conductors to be supported.
 - c. In each manhole and handhole, drive 3/4 IN x 10 FT long copper clad ground rod into the earth with approximately 6 IN exposed above finished floor.
 - 1) Drill opening in floor for ground rod.
 - 2) Connect all metallic components to ground rod by means of #8 AWG minimum copper wire and approved grounding clamps.
 - 3) Connect ground wire installed in duct bank where shown in the duct bank sections.
 - 4) Utilize a ground bar in the manhole or handhole if the quantity of ground wires exceeds three.
 - a) Connect ground bar to ground rod with a #2/0 AWG minimum copper wire.
 - 3. Place manhole or handhole on a foundation of compacted 1/4 to 1/2 IN crushed rock or gravel a minimum of 8 IN thick and 6 IN larger than manholes or handholes footprint on all sides.
 - 4. Install so that the top of cover is 1 IN above finished grade.
 - a. Where existing grades are higher than finished grades, install sufficient number of courses of curved segmented concrete block between top of handhole and manhole frame to temporarily elevate manhole cover to existing grade level.
 - 5. After installation is complete, backfill and compact soil around manholes and handholes.
 - 6. Handhole size:
 - a. As indicated on the Drawings or as required for the number and size of conduits entering or as indicated on the Drawings.
 - b. Minimum floor dimension of 4 FT x 4 FT and minimum depth of 4 FT.
 - 7. Manhole size:
 - a. As indicated on the Drawings or as required for the number and size of conduits entering or as indicated on the Drawings.
 - b. Minimum floor dimension of 6 FT x 6 FT and a minimum depth of 6 FT.

3.3 UNDERGROUND CONDUITS

- A. General Installation Requirements:
 - 1. Ductbank types per location:
 - a. Reinforced concrete ductbank:
 - 1) As indicated in the Contract Documents.
 - b. Concrete encased ductbank:
 - 1) Under roads.
 - 2) Plant process equipment feeders and controls.
 - 3) As indicated in the Contract Documents.
 - c. Direct-buried conduit(s):
 - 1) As indicated in the Contract Documents.
 - 2. Do not place concrete or soil until conduits have been observed by the Engineer.
 - 3. Ductbanks shall be sloped a minimum of 4 IN per 100 FT or as detailed on the Drawings.
 - a. Low points shall be at manholes or handholes.
 - 4. During construction and after conduit installation is complete, plug the ends of all conduits.

5. Provide conduit supports and spacers.
 - a. Place supports and spacers for rigid nonmetallic conduit on maximum centers as indicated for the following trade sizes:
 - 1) 1 IN and less: 3 FT.
 - 2) 1-1/4 to 3 IN: 5 FT.
 - 3) 3-1/2 to 6 IN: 7 FT.
 - b. Securely anchor conduits to supports and spacers to prevent movement during placement of concrete or soil.
 6. Stagger conduit joints at intervals of 6 IN vertically.
 7. Make conduit joints watertight and in accordance with manufacturer's recommendations.
 8. Accomplish underground changes in direction of runs exceeding a total of 15 DEG by long sweep bends having a minimum radius of 25 FT.
 - a. Sweep bends may be made up of one or more curved or straight sections or combinations thereof.
 9. Furnish manufactured elbows at end of runs as the conduit transitions to above grade.
 - a. Minimum radius of 18 IN for conduits less than 3 IN trade size and 36 IN for conduits 3 IN trade size and larger.
 10. Field cuts requiring tapers shall be made with the proper tools and shall match factory tapers.
 11. After the conduit run has been completed:
 - a. Prove joint integrity and test for out-of-round duct by pulling a test mandrel through each conduit.
 - 1) Test mandrel:
 - a) Length: Not less than 12 IN.
 - b) Diameter: Approximately 1/4 IN less than the inside diameter of the conduit.
 - b. Clean the conduit by pulling a heavy duty wire brush mandrel followed by a rubber duct swab through each conduit.
 12. Pneumatic rodding may be used to draw in lead wire.
 - a. Install a heavy nylon cord free of kinks and splices in all unused new ducts.
 - b. Extend cord 3 FT beyond ends of conduit.
 13. Transition from rigid nonmetallic conduit to rigid metallic conduit, per Specification Section 26 05 33, prior to entering a structure or going above ground.
 - a. Except rigid nonmetallic conduit may be extended directly to manholes, handholes, pad mounted transformer boxes and other exterior pad mounted electrical equipment where the conduit is concealed within the enclosure.
 - b. Terminate rigid PVC conduits with end bells.
 - c. Terminate steel conduits with insulated bushings.
 14. Place warning tape in trench directly over ductbanks, direct-buried conduit, and direct-buried wire and cable in accordance with Specification Section 10 14 00.
 15. Placement of conduits stubbing into handholes and manholes shall be located to allow for proper bending radiuses of the cables.
- B. Concrete Encased Ductbank:
1. Ductbank system consists of conduits completely encased in minimum 2 IN of concrete and with separations between different cabling types as required in Specification Section 26 05 33 or as detailed on the Drawings.
 2. Ductbanks containing power conductors shall have one #2/0 bare copper ground located in the lower portion of the ductbank. The ground conductor shall extend into buildings and manholes for connection to ground bar.
 3. Install so that top of concrete encased duct, at any point:
 - a. Is not less than 24 IN below grade.
 - b. Is below pavement sub-grading.
 4. Where identified and for a distance 10 FT either side of the area, the concrete shall be reinforced.
 - a. The reinforcement shall consist of #4 bars and #4 ties placed 12 IN on center, in accordance with Division 03 Specification Sections or as detailed on the Drawings.

- b. Conduit supports to be staggered to minimize weak vertical shear point.
 - 5. Conduit supports shall provide a uniform minimum clearance of 3 IN between the bottom of the trench and the bottom row of conduit.
 - 6. Conduit separators shall provide a uniform minimum clearance of 3 IN between conduits or as required in Specification Section 2605 33 for different cabling types.
- C. Direct-Buried Conduit(s):
- 1. Install so that the top of the uppermost conduit, at any point:
 - a. Is not less than 30 IN below grade.
 - b. Is below pavement sub-grading.
 - 2. Provide a uniform minimum clearance of 3 IN between conduits or as required in Specification Section 2605 33 for different cabling types.
 - a. Maintain the separation of multiple planes of conduits by one of the following methods:
 - 1) Install multilevel conduits with the use of conduit supports and separators to maintain the required separations, and backfill with flowable fill (100 PSI) per Specification Section 31 23 33 or concrete per Division 03 specifications.
 - 2) Install the multilevel conduits one level at a time.
 - a) Each level is backfilled with the appropriate amount of soil and compaction, per Specification Section 31 23 33, to maintain the required separations.
- D. Do not route conduits embedded in concrete structure (e.g., sidewalks, bridge decks) unless specifically located and detailed on Structural Drawings.

3.4 PREPARATION FOR CABLE INSTALLATION IN EXISTING MANHOLES AND DUCTBANKS

- A. Manhole preparation:
- 1. Pump dry any manholes with water in them.
 - 2. Clean all dirt and debris out of the manholes.
 - 3. Provide cable racks in manholes without cable racks:
 - a. Provide a minimum of four racks in each manhole and vaults.
 - 1) Provide additional cable racks, as required, so that both ends of cable splices will be supported horizontally.
 - b. Equip cable racks with adjustable hooks: Quantity of cable hooks as required by the number of conductors to be supported.
- B. In each duct where new cable is to be installed:
- 1. Prove joint integrity and test for out-of-round duct by pulling a test mandrel having a length of not less than 12 IN and a diameter approximately 1/4 IN less than the inside diameter of the conduit through each conduit.
 - 2. Prove integrity and assess any damage of the conduit by pulling a camera through each conduit.
 - 3. Clean the conduit by pulling a heavy duty wire brush mandrel followed by a rubber duct swab through each conduit.
- C. If the camera sent down the conduit to assess the damage locates a damaged section or cannot be pulled through:
- 1. Pull through a 3 IN test mandrel followed by a 4 IN test mandrel.
 - 2. Determine and stake the location for the obstruction.
 - 3. The Engineer will consult with the Engineer to determine if that section of the ductbank will be replaced.
- D. If ductbank repair is required, repair all roads, sidewalks, landscaping, etc., affected by the repair to their original conditions.

3.5 CABLE PULLING CALCULATIONS

- A. Provide cable pulling calculations for all cable and fiber optic cable installed in ductbanks.
 - 1. Calculations shall include, but not be limited to, the following:
 - a. Maximum tension on cable conductors and/or insulation with the cable manufacturer's maximum limits.
 - b. Maximum side wall pressure with the cable manufacturer's maximum limits.
 - c. Jamming.
 - d. Assumptions and supporting data.
 - 2. Site plan sheets showing cable routing and pull points relating to the calculations.
 - 3. Calculations shall be performed using cable pulling software.

END OF SECTION

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SECTION 26 05 48
ELECTRICAL SEISMIC RESTRAINT SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. The design and installation of seismic bracing and anchorage required for electrical equipment, conduit, cable tray, and bus ducts.
- B. Related Specification Sections include but are not necessarily limited to:
 - 1. Division 00 - Procurement and Contracting Requirements.
 - 2. Division 01 - General Requirements.

1.2 QUALITY ASSURANCE

- A. Referenced Standards:
 - 1. American Society of Civil Engineers (ASCE):
 - a. 7, Minimum Design Loads and Associated Criteria for Buildings and Other Structures.
 - 2. ASTM International (ASTM):
 - a. A36/A36M, Standard Specification for Carbon Structural Steel.
 - b. A307, Standard Specification Carbon Steel Bolts, Studs, and Threaded Rod, 60,000 PSI Tensile Strength.
 - c. A500/A500M, Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.
 - d. A588/A588M, Standard Specification for High-Strength Low-Alloy Structural Steel, up to 50 KSI (345 MPa) Minimum Yield Point, with Atmospheric Corrosion Resistance.
 - e. A992/A992M, Standard Specification for Structural Steel Shapes.
 - f. F1554, Standard Specification for Anchor Bolts, Steel, 36, 55, and 105 KSI Yield Strength.
 - 3. Building code:
 - a. International Code Council (ICC):
 - 1) International Building Code and associated standards, 2015 Edition including all amendments, referred to herein as Building Code.
 - b. International Building Code (IBC) – 2015 Edition.
 - c. National Fire Protection Association (NFPA) 5000 Building Construction and Safety Code – 2015 Edition.

1.3 SYSTEM DESCRIPTION

- A. Contractor is responsible for design and installation of seismic bracing and anchorage systems.
- B. Description of Systems:
 - 1. Transverse and longitudinal bracing for seismic forces on suspended electrical systems including conduit, cable tray, bus duct, and equipment.
 - 2. Anchorage of floor and roof mounted electrical equipment.
- C. Seismic Design Requirements:
 - 1. Seismic design criteria: Provide bracing and anchoring for equipment, conduit, cable tray, bus duct, designed, constructed, and installed to resist stresses produced by lateral forces.
- D. Design and install seismic anchorage and bracing for all floor or roof mounted equipment weighing 400 LBS or more and all suspended or wall mounted equipment weighing 20 LBS or more.

- E. The following components are exempt from the requirements of this Specification Section:
 - 1. Electrical components in structures assigned to Seismic Design Category C provided that the importance factor (I_p) is equal to 1.0.
 - 2. Electrical components in Seismic Design Categories D, E, and F where $I_p = 1.0$ and flexible connections between the components and associated conduit are provided and that are mounted at 4 FT (1.22 M) or less above a floor level and weigh 400 LBS (1780 N) or less.
 - 3. Electrical components in Seismic Design Categories D, E, and F weighing 20 LBS (95 N) or less where $I_p = 1.0$ and flexible connections between the components and conduit are provided, or for distribution systems, weighing 5 LBS/FT (7 N/M) or less.
- F. Seismic forces shall be presumed to act through the center of mass of the equipment in a direction that will produce the largest single anchor force.
- G. Installation Inspection:
 - 1. Certify that seismic bracing system installed is in accordance with approved Shop Drawings

1.4 SUBMITTALS

- A. Shop Drawings:
 - 1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
 - 2. Product technical data:
 - a. Seismic control devices.
 - 3. Fabrication and/or layout drawings:
 - a. Layout and mounting detail drawings showing system and proposed brace locations for all systems including pre-engineered systems.
 - b. The specific detail for each type of brace or anchor must be referenced on a plan that identifies the required location.
 - 1) Supplying a book of details without referencing the proper detail to a specific location on a plan is not acceptable.
 - c. Structural calculations for required lateral force level for each component.
 - d. All submittals, including pre-approved systems, shall be signed and sealed by a licensed engineer, licensed in the state in which the project is located.
 - 4. Certifications:
 - a. Certificate that seismic bracing system installed is in accordance with approved Shop Drawings.
 - 5. Test reports:
- B. Contract Closeout Information:
 - 1. Operation and Maintenance Data:
 - a. See Specification Section 01 33 04 for requirements for the mechanics, administration, and the content of Operation and Maintenance Manual submittals.

1.5 PROJECT CONDITIONS

- A. Seismic (Earthquake) Loads: Refer to Section 01 81 10 Wind and Seismic Criteria.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
 - 1. Pre-engineered suspended bracing systems:
 - a. International Seismic Application Technology (ISAT) "Engineered Seismic Bracing of Suspended Utilities".
 - b. Unistrut by Atkore International, Inc.
 - c. TOLCO by Eaton.
 - d. B-Line by Eaton.

2. Custom engineered systems designed using specified criteria and common building materials.
- B. Submit request for substitution in accordance with Specification Section 01 25 13.

2.2 EQUIPMENT ANCHORS AND SUPPORTS

- A. Drilled-in-place concrete anchors shall have an approved ICBO Evaluation Services Report.
- B. Cast-in-place anchors shall comply with ASTM A36, ASTM A307, or ASTM F1554, 36 ksi.
- C. Anchors permanently exposed to weather or corrosive environments shall be stainless steel or hot-dipped galvanized.
- D. Structural steel for supports: ASTM A36, A588, A992 or A500.
- E. Cold formed metal and connection material: Unistrut, or equal.
- F. Any details provided are based on assumed equipment and arrangement.
 1. The Contractor shall be responsible for design and acquiring approval for support and anchorage of equipment and arrangement which varies from equipment and arrangement assumed in detail provided.

PART 3 - EXECUTION

3.1 GENERAL REQUIREMENTS

- A. Every run which requires bracing shall have a minimum of two transverse braces and one longitudinal brace.
 1. A "run" is defined as suspended pipe, conduit, cable tray, bus duct or trapeze rack having a minimum 10 FT straight run length.
- B. Brace spacing shall not exceed the maximum allowable brace spacing as engineered by the manufacturer or custom bracing designer.
- C. Bracing may be omitted from conduit, cable tray and bus duct runs less than 10 FT in length.
- D. Bracing may be omitted from conduit, cable tray and bus duct runs where rod hung supports of less than 12 IN. (305 MM) in length are required.
 1. All unbraced suspended utility systems having 2 IN conduit and larger or systems weighing more than 5 LBS/FT shall be installed with a minimum 6 IN clearance to suspended ceiling vertical hanger wires.
 2. The conduit, cable tray, or bus duct shall be installed such that the lateral motion of the members will not cause damaging impact with other systems or structural members or loss of vertical support.
- E. A longitudinal brace at a 90 DEG change in direction may act as a transverse brace if it is located within 2 FT of the change in direction.
- F. A transverse brace may act as a longitudinal brace if it is located within 2 FT of a change in direction and if the brace arm and anchorage have been sized to meet or exceed the requirements of the longitudinal brace.
- G. When bracing equipment or a utility system that is suspended from an overhead deck, brace back to the overhead deck or to the supporting structure supporting the deck.
 1. Do not brace to another element of the structure which may respond differently during a seismic event.
- H. Obtain approval from the Structural Engineer prior to attaching any brace elements to structural steel or wood framing.

- I. When utilizing cable bracing, tension the cable to remove slack without inducing uplift of the suspended element.
 - 1. Tension seismic bracing system prior to system start-up and adjust if necessary after equipment start-up.
- J. As a general rule, do not mix rigid bracing with cable bracing in the same run.
 - 1. However, once bracing has transitioned a 90 DEG change in run direction, the bracing may switch from rigid to cable or vice versa if required due to a significant change in overhead deck elevation or to provide an implementable bracing scheme in a congested area.
- K. Install brace members at an angle of 45 DEG from horizontal within a tolerance of +2-1/2 DEG or -45 DEG provided the brace length is accounted for in design.
 - 1. Brace angle may be increased to 60 DEG provided the brace spacing is reduced to 1/2 that required for a 45 DEG brace.
- L. Seismic bracing may not pass through a building separation joint.
 - 1. Utility systems that pass through a separation joint must be seismically restrained no greater than 5 FT from the point of connection.
 - 2. Any hardware designed to accommodate seismic movement across the span of the separation joint shall be installed per manufacturer's installation and listing instructions.
- M. With approval of the Structural Engineer, utility systems that are suspended from the overhead deck may be braced to load bearing concrete or CMU (concrete masonry) walls provided that the walls and the overhead decks will respond similarly during a seismic event.
- N. Each layer of a multiple layer trapeze rack shall be braced individually based on the weight of the individual layer.
- O. Conduit, cable tray, or bus duct constructed of non ductile material (plastic or fiberglass), shall have brace spacing reduced to 1/2 of the spacing allowed for ductile materials.
- P. Where brace elements are through-bolted, the mounting hole in the element is to be no more than 1/16 IN in diameter larger than the bolt or threaded rod.
- Q. Seismic braces shall directly brace the support and not the hanger.

3.2 SUSPENDED ELECTRICAL SYSTEMS

- A. Install seismic bracing for all conduit 2-1/2 IN trade size or greater.
- B. All trapeze assemblies supporting conduits, cable trays or bus ducts shall be braced considering the total weight of the elements on the trapeze.
 - 1. For the purposes of calculating weight, all conduits are to be treated as full.
- C. Brace all trapeze racks which support conduit 2-1/2 IN trade size or larger.
 - 1. Brace all other conduit rack, cable tray or bus duct trapezes having a minimum weight in excess of 10 LBS/LF.
 - 2. Include a minimum 10 PCT additional capacity for future additions.
- D. Seismic bracing may be omitted from cable trays, conduit and bus ducts suspended by rod hung supports 12 IN or less in length from the top of the element to the bottom of the structural attachment of the hanger provided lateral motion will not cause damaging impacts to other systems or loss of system vertical support.
- E. For conduit and cable trays:
 - 1. Provide transverse bracing at 40 FT maximum spacing unless otherwise noted.
 - 2. Provide longitudinal bracing at 80 FT maximum spacing unless otherwise noted.
- F. All vertical risers involving conduit 2-1/2 IN in diameter or larger shall include lateral restraint at maximum 30 FT intervals and at the top and bottom of the riser.
- G. Make provisions to eliminate seismic impact between components.

3.3 FLOOR OR ROOF MOUNTED EQUIPMENT

- A. Provide one anchor on each leg or corner.
 - 1. Support with a minimum of three 3/8 IN DIA anchors.
- B. Friction shall be neglected when designing anchors for shear.
- C. Vertical seismic forces, when required, shall be presumed to act concurrently with horizontal seismic forces.
- D. Batteries on racks or for generators shall have wrap around restrains to ensure that the batteries will not slide laterally. Spacers shall be used between the restrains and cases to prevent damage to the cases.
- E. Electrical cabinet design shall comply with the applicable NEMA standards. Cutouts in the lower shear panel that have not been made by the manufacturer and reduce significantly the strength of the cabinet shall be specifically evaluated.

END OF SECTION

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SECTION 26 08 13
ACCEPTANCE TESTING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Basic requirements for acceptance testing.
- B. Related Specification Sections include but are not necessarily limited to:
 - 1. Division 00 - Procurement and Contracting Requirements.
 - 2. Division 01 - General Requirements.
 - 3. Section 01 61 03 - Equipment - Basic Requirements.

1.2 QUALITY ASSURANCE

- A. Referenced Standards:
 - 1. InterNational Electrical Testing Association (NETA):
 - a. ATS, Standard for Acceptance Testing Specifications for Electric Power Equipment and Systems.
 - 2. Nationally Recognized Testing Laboratory (NRTL).
 - 3. Telecommunications Industry Association/Electronic Industries Alliance/American National Standards Institute (TIA/EIA/ANSI):
 - a. 455-78-B, Optical Fibres - PART 1-40: Measurement Methods and Test Procedures - Attenuation.
- B. Qualifications:
 - 1. Testing firm qualifications: See Specification Section 01 61 03.
 - 2. Field personnel:
 - a. See Specification Section 01 61 03.
 - b. As an alternative, supervising technician may be certified by the equipment manufacturer.
 - 3. Analysis personnel:
 - a. See Specification Section 01 61 03
As an alternative, supervising technician may be certified by the equipment manufacturer.

1.3 SUBMITTALS

- A. Shop Drawings:
 - 1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
 - 2. See Specification Section 01 61 03 for electrical equipment and connection testing plan submittal requirements.
 - 3. Checklist for each piece of equipment and detailed steps for testing with pass/fail criteria.
- B. Informational Submittals:
 - 1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
 - 2. Prior to energizing equipment:
 - a. Coordinated phasing diagram.
 - b. Photocopies of all continuity tests.
 - 3. Within two weeks after successful completion of Demonstration Period (Commissioning Period):
 - a. Single report containing information including:
 - 1) Summary of Project.
 - 2) Information from pre-energization testing.

- 3) See testing and monitoring reporting requirements in Specification Section 01 61 03.

PART 2 - PRODUCTS

2.1 FACTORY QUALITY CONTROL

- A. Provide Electrical equipment with all factory tests required by the applicable industry standards or NRTL.
- B. Factory testing will not be accepted in lieu of field acceptance testing requirements specified in this Specification Section and Specification Section 01 61 03.

PART 3 - EXECUTION

3.1 FIELD QUALITY CONTROL

- A. General:
 1. See Specification Section 01 61 03.
 2. Complete electrical testing in three phases:
 - a. Pre-energization testing phase.
 - b. Equipment energized with no load.
 - c. Equipment energized under load.
 3. Perform testing in accordance with this Specification Section and NETA ATS.
 4. Provide field setting and programming of all adjustable protective devices and meters to settings as determined by the approved coordination study.
- B. Equipment Monitoring and Testing Plan: See Specification Section 01 61 03.
- C. Instruments Used in Equipment and Connections Quality Control Testing: See Specification Section 01 61 03.
- D. Testing and Monitoring Program Documentation: See Specification Section 01 61 03.
- E. Electrical Equipment and Connections Testing Program:
 1. See Specification Section 01 61 03.
 2. See individual Division 26 Specification Sections for equipment specific testing requirements.
 3. Test all electrical equipment.
 - a. Perform all required NETA testing.
 - b. Perform all required NETA testing plus the optional testing identified with each specific type of equipment in Article 3.2 of this Specification Section.

3.2 SPECIFIC EQUIPMENT TESTING REQUIREMENTS

- A. Transformers - Small Dry Type:
 1. Perform inspections and tests per NETA ATS 7.2.1.1.
 2. Perform the following additional tests:
 - a. Record phase-to-phase, phase-to-neutral, and neutral-to-ground voltages at no load after energizing, and at operating load after startup.
 3. Adjust tap connections as required to provide secondary voltage within 2-1/2 PCT of nominal under normal load after approval of Engineer.
 4. Record as-left tap connections.
- B. Cable - Low Voltage:
 1. Perform inspections and tests per NETA ATS 7.3.2.

- C. Cable – Optical Fiber:
 - 1. Perform inspections on tests per TIA/EIA/ANSI 455-78-B, including:
 - a. Optical time domain reflectometer test.
 - b. Power attenuation test.
 - c. Gain margin test.
 - 2. Perform inspection and tests on Fiber Optic Cables per NETA ATS 7.25
- D. Low Voltage Molded Case Circuit Breakers:
 - 1. Perform inspections and tests per NETA ATS 7.6.1.1.
 - 2. Components:
 - a. Test all components per applicable paragraphs of this Specification Section and NETA ATS.
 - b. Thermal magnetic breakers: Visual and mechanical inspection per NETA ATS only.
 - c. Solid state trip type: Visual and mechanical inspection and electrical tests per NETA ATS.
 - 3. Record as-left settings.
- E. Instrument Transformers:
 - 1. Perform inspections and tests per NETA ATS 7.10.
 - 2. Components: Test all components per applicable paragraphs of this Specification Section and NETA ATS.
 - 3. Perform the following optional tests per NETA ATS:
 - a. Dielectric withstand test on potential transformers.
- F. Metering:
 - 1. Perform inspections and tests per NETA ATS 7.11.
 - 2. Components: Test all components per applicable paragraphs of this Specification Section and NETA ATS.
- G. Grounding:
 - 1. Perform inspections and tests per NETA ATS 7.13.
 - 2. Components: Test all components per applicable paragraphs of this Specification Section and NETA ATS.
- H. Motors:
 - 1. Perform inspections and tests per NETA ATS 7.15.
 - 2. See Specification Section 01 61 03.
- I. Motor Controllers, Moto Starters, Low Voltage:
 - 1. Perform inspections and tests per NETA ATS 7.16.1.1.
 - 2. Components: Test all components per applicable paragraphs of this Specification Section and NETA ATS.
- J. Variable Frequency Drives:
 - 1. Perform inspections and tests per NETA ATS 7.17.
 - 2. Components: Test all components per applicable paragraphs of this Specification Section and NETA ATS.

END OF SECTION

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SECTION 26 09 13
ELECTRICAL METERING DEVICES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Digital metering equipment.
- B. Related Sections include but are not necessarily limited to:
 - 1. Division 00 - Procurement and Contracting Requirements.
 - 2. Division 01 - General Requirements.
 - 3. Section 26 05 00 - Electrical - Basic Requirements.
 - 4. Section 26 08 13 - Acceptance Testing.

1.2 QUALITY ASSURANCE

- A. Referenced Standards:
 - 1. National Electrical Manufacturers Association (NEMA):
 - a. 250, Enclosures for Electrical Equipment (1000 Volts Maximum).
 - 2. National Electrical Manufacturers Association/American National Standards Institute (NEMA/ANSI):
 - a. C12.20, For Electricity Meter - 0.2 and 0.5 Accuracy Classes.
 - 3. Underwriters Laboratories, Inc. (UL):
 - a. 508, Standard for Safety Industrial Control Equipment.

1.3 SUBMITTALS

- A. Shop Drawings:
 - 1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
 - 2. Product technical data including:
 - a. Provide submittal data for all products specified in PART 2 of this Specification:
 - b. See Section 26 05 00 for additional requirements.
 - 3. Fabrication and/or layout drawings.
 - a. Electrical wiring/connection diagrams.
- B. Contract Closeout Information:
 - 1. Operation and Maintenance Data:
 - a. See Specification Section 01 33 04 for requirements for the mechanics, administration, and the content of Operation and Maintenance Manual submittals.
 - b. Content of Operation and Maintenance Manual:
 - 1) Data sheet of the meters electrical parameters, configuration and characteristics including a complete model number and associated equipment connected to.
 - 2) Operating instructions of the meter(s) supplied.
 - 3) Operating instructions of the Power Management software.
 - 4) Maintenance instructions.
 - 5) As-constructed electrical wiring/connection diagrams.
 - 6) Acceptance testing data.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
1. Allen-Bradley.
 2. Eaton.
 3. Electro Industries.
 4. General Electric Company.
 5. Power Measurement.
 6. Square D Company.
 7. Siemens.

2.2 DIGITAL METERING DEVICES

- A. General:
1. Direct reading metered or calculated values.
 2. Microprocessor based.
 3. Integral LED or LCD display.
 4. Current and potential transformers as required.
 5. Integral fusing.
 6. Operating temperature: 0 DEGF to 150 DEGF.
 7. Standards:
 - a. NEMA/ANSI C12.20.
 - b. UL 508.
- B. Type 'C' High Range Meter:
1. Display the following minimum electrical parameters (accuracy):
 - a. RMS current per phase (+0.2 PCT full scale).
 - b. RMS voltage line-to-line and line-to-neutral (+0.2 PCT full scale).
 - c. Real power (W): 3 PH total (+0.4 PCT full scale).
 - d. Apparent power (VA): 3 PH total (+0.4 PCT full scale).
 - e. Reactive power (VAR): 3 PH total (+0.4 PCT full scale).
 - f. Power factor (+1.0 PCT).
 - g. Frequency (+0.04 PCT).
 - h. Percent current individual harmonic and total harmonic distortion (50th).
 - i. Percent voltage individual harmonic and total harmonic distortion (50th).
 - j. Watt-hours (0.5 PCT).
 - k. VAR-hours (1.0 PCT).
 - l. VA-hours (0.5 PCT).
 - m. Ampere demand (+0.2 PCT full scale).
 - n. Watt demand (+0.4 PCT full scale).
 - o. VAR demand (+0.4 PCT full scale).
 - p. VA demand (+0.4 PCT full scale).
 2. Data logging:
 - a. 128 KB.
 - b. Selectable for parameters listed above for display.
 - c. Software for configuration, retrieval, and trending.
 3. NEMA/ANSI C12.20, Class 0.2 revenue accuracy.
 4. Communication ports and protocols: EtherNet/IP
 - a. A protocol converter shall be installed by the MCC manufacturer to achieve EtherNet/IP communications if EtherNet/IP is not native to the power meter.
 5. Supply voltage: 120 VAC.

2.3 TRANSFORMERS

- A. Current Transformer (CT):
 - 1. Standard: IEEE C57.13.
 - 2. Current ratios: As indicated on the Drawings.
 - 3. Window type current transformers shall be accessible from front of cubicle to permit changing or adding, without disconnecting bus joints.
 - 4. Minimum ANSI metering accuracy class of 0.3 thru B-0.5.
 - 5. Mount and brace to withstand mechanical stresses resulting from short circuit currents.
- B. Potential Transformers (PT):
 - 1. Standard: IEEE C57.13.
 - 2. Voltage ratio: As required.
 - 3. Primary current-limiting fuses.
 - 4. Secondary fuses or circuit breaker.
 - 5. Accuracy class: 0.3 at burden W thru Z and 0.6 at burden ZZ.
 - 6. Thermal burden rating: Exceed maximum connected burden.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install as indicated and in accordance with manufacturer's recommendations and instructions.
 - 1. Provide all equipment as necessary to provide a complete and functioning system.
 - 2. Coordinate with the Owner on final computer screen layouts, trending requirements and printouts.
- B. Meter Type Application:
 - 1. Type C meters: Connected to monitor incoming feeder of MCC as indicated on the drawings.
- C. Communication Configuration:
 - 1. As indicated on the Drawings.

3.2 FIELD QUALITY CONTROL

- A. Acceptance Testing: See Section 26 08 13.

3.3 TRAINING

- A. A qualified factory-trained manufacturer's representative shall provide the Owner with 8 HRS of on-site training in the operation and maintenance of the metering system and its components.

END OF SECTION

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SECTION 26 09 16
CONTROL EQUIPMENT ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Operator control devices (selector switches, pushbuttons, indicator lights, etc.).
 - 2. Control devices (timers, relays, contactors, etc.).
 - 3. Industrial Control Panels.
 - 4. Operator Control Stations.
- B. Related Sections include but are not necessarily limited to:
 - 1. Division 00 - Procurement and Contracting Requirements.
 - 2. Division 01 - General Requirements.
 - 3. Section 26 05 00 - Electrical - Basic Requirements.

1.2 QUALITY ASSURANCE

- A. Referenced Standards:
 - 1. National Electrical Manufacturers Association (NEMA):
 - a. 250, Enclosures for Electrical Equipment (1000 Volts Maximum).
 - b. ICS 2, Industrial Control and System Controllers, Contactors and Overload Relays Rated 600 Volts.
 - c. ICS 5, Control Circuit and Pilot Devices.
 - 2. Underwriters Laboratories, Inc. (UL):
 - a. 508, Standard for Safety Industrial Control Equipment.
 - b. 508A, Standard for Industrial Control Panels.
 - c. 698A, Standard for Industrial Control Panels Relating to Hazardous (Classified) Locations.

1.3 SYSTEM DESCRIPTION

- A. This Specification specifies components used within other equipment as referenced in other Contract documents.
- B. This Specification is used to specify the components and construction of control stations and monitor control centers.

1.4 SUBMITTALS

- A. Shop Drawings:
 - 1. See Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
 - 2. Product technical data:
 - a. Provide submittal data for all products specified in PART 2 of this Specification:
 - 1) When components are used within equipment specified in another Section, submittal data for components specified herein shall be included with the submittal for the equipment the components are used in.
 - b. Industrial Control Panel bill of material.
 - c. Control Station bill of material.
 - d. See Section 26 05 00 for additional requirements.
 - 3. Fabrication and/or layout drawings.
 - a. Industrial Control Panel:
 - 1) Interior and exterior layout.
 - 2) Wiring/connection diagrams.
 - 3) Copy of the UL 508A label.

- 4) Short Circuit Current Rating (SCCR) nameplate marking per NFPA 70. Include any required calculations.
 - b. Operator Control Station:
 - 1) Interior (if applicable) and exterior layout.
 - 2) Wiring/connection diagrams.
 - c. Associate Industrial Control Panel and Operator Control Stations with associated equipment name and tagging.
- B. Informational Submittals:
- 1. See Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
 - 2. Functional Test Plan.
- C. Contract Closeout Information:
- 1. Operation and Maintenance Data:
 - a. See Section 01 33 04 for requirements for the mechanics, administration, and the content of Operation and Maintenance Manual submittals.
 - b. Content of Operation and Maintenance Manual:
 - 1) Product technical data of components used within Industrial Control Panels and Operator Control Stations.
 - 2) As-constructed wiring/connection diagrams for Industrial Control Panels and Operator Control Stations.
 - 3) Functional Test Report.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
- 1. Pilot devices, relays, contactors, and termination equipment:
 - a. Allen-Bradley by Rockwell Automation, Inc.
 - b. ATC Diversified Electronics by Bellofram Group of Companies.
 - c. ASCO by Emerson Electric Co.
 - d. c3controls.
 - e. Eaton.
 - f. General Electric.
 - g. IDEC Corporation.
 - h. Phoenix Contact.
 - i. Potter and Brumsfield (P&B) by TE Connectivity.
 - j. Schneider Electric.
 - k. Siemens Corporation.
 - l. Time Mark Corporation.
 - 2. Photocells and time clocks:
 - a. Grasslin by Intermatic.
 - b. Tork by NSi Industries.
 - c. Intermatic.
 - d. Paragon Auto Control.
 - 3. Alarm devices:
 - a. Edwards Signaling by United Technologies Corp.
 - b. Federal Signal Corporation.
 - 4. Enclosures:
 - a. Hoffman Engineering.
 - b. Wiegmann by Hubbell.
 - c. B-Line by Eaton.
 - d. Adalet.
 - e. Stahlin by Robroy Enclosures.

2.2 PILOT DEVICES

- A. General Requirements:
 - 1. Standards: NEMA ICS 5, UL 508.
 - 2. Heavy-duty NEMA 4/13 watertight/oiltight.
 - 3. Heavy-duty NEMA 4/4X corrosion resistant.
 - 4. Heavy-duty factory sealed, explosion-proof and dust ignition-proof (Class I and II).
 - 5. Mounting hole: 30.5 MM.
 - 6. Contact blocks: 10 amp, NEMA A600 rated, number as required to fulfill functions shown or specified.
 - 7. Legend plate marked as indicated on Drawings or specified.
- B. Selector Switches:
 - 1. Two, three- or four-position rotary switch as required to fulfill functions shown or specified.
 - 2. Maintained contact type.
 - 3. Knob or lever type operators.
- C. Pushbuttons:
 - 1. Non-illuminated type:
 - a. Protective boot.
 - b. Momentary contact.
 - c. Standard flush and mushroom operators.
 - d. Black colored buttons for START or ON and black color for STOP or OFF.
 - e. Emergency stop pushbuttons: Mushroom head operator and maintained contact.
 - 2. Illuminating type:
 - a. Protective boot.
 - b. Momentary contact.
 - c. Standard flush operator.
 - d. Serves as both pushbutton control and indicating light.
 - e. Green colored lenses: START or ON.
 - f. Red colored lenses: STOP or OFF.
 - g. Resistor-type full voltage light unit with lens and panel gasket.
- D. Indicating Lights:
 - 1. Allowing replacement of bulb without removal from control panel.
 - 2. Lamp: LED, 120 V or 24 V as required.
 - 3. Full voltage type.
 - 4. Push-to-test indicating lights.
 - 5. Plastic lens.
 - 6. Color code lights as follows:
 - a. Green: ON or running; valve open.
 - b. Amber: Standby; auto mode; ready.
 - c. Red: OFF or stopped; valve closed.

2.3 RELAYS

- A. General Requirements:
 - 1. Standards: NEMA ICS 5, UL 508.
- B. Control Relays:
 - 1. General purpose (ice cube) type:
 - a. Plug-in housing.
 - b. Clear polycarbonate dust cover with clip fastener.
 - c. Coil voltage: 120 VAC or as required.
 - d. Contacts:
 - 1) 10 amp continuous.
 - 2) Silver cadmium oxide.
 - 3) Minimum of 3 SPDT contacts.
 - e. Sockets: DIN rail mounted.

- f. Internal neon or LED indicator is lit when coil is energized.
 - g. Manual operator switch.
2. Industrial type:
 - a. Coil voltage: 120 VAC or as required.
 - b. Contacts:
 - 1) 10 amp, NEMA A600 rated.
 - 2) Double break, silver alloy.
 - 3) Convertible from normally open to normally closed or vice versa, without removing any wiring.
 - 4) Expandable from 2 poles to 12 poles.
 - c. Provide contacts for all required control plus two spares.
- C. Time Delay Relays:
1. General purpose type:
 - a. Timing modes: On and Off delay, interval, one shot and repeat cycle.
 - b. Plug-in housing.
 - c. Polycarbonate dust cover with clip fastener.
 - d. Coil voltage: 120 VAC or as required.
 - e. Contacts:
 - 1) 10 amp continuous.
 - 2) Silver cadmium oxide.
 - 3) Two normally open and two normally closed DPDT contacts.
 - f. Sockets: DIN rail mounted.
 - g. External timing adjustment knob.
 - h. Timing ranges: 0.05 seconds to 16.65 HRS.
 - i. Repeat accuracy: +1 PCT.
 2. Solid State industrial type:
 - a. Timing modes: On and Off delay and repeat cycle.
 - b. Industrial housing.
 - c. Coil voltage: 120 VAC or as required.
 - d. Contacts:
 - 1) 5 amp, NEMA B150 rated.
 - 2) Silver alloy.
 - 3) Convertible On Delay and Off Delay contacts.
 - 4) One normally open and one normally closed timed contacts.
 - 5) One normally open and one normally closed instantaneous contacts.
 - e. Furnish with "on" and "timing out" indicators.
 - f. External timing adjustment knob.
 - g. Timing ranges: 0.05 seconds to 10 HRS.
 - h. Repeat accuracy: +1 PCT.
 3. Mechanical industrial type:
 - a. Timing modes: On and Off delay.
 - b. Coil voltage: 120 VAC or as required.
 - c. Contacts:
 - 1) 10 amp, NEMA A600 rated.
 - 2) Double break, silver alloy.
 - 3) Convertible On Delay and Off Delay contacts.
 - 4) Convertible normally open and normally closed timed contacts.
 - 5) Convertible normally open instantaneous contacts.
 - d. External timing adjustment knob.
 - e. Timing ranges: 0.2 - 60 seconds or 5 - 180 seconds.
 - f. Repeat accuracy: Greater than +10 PCT.

2.4 ALARM DEVICES

A. Alarm Horns:

1. Vibrating horn type.
2. PLC compatible as required.
3. Heavy-duty die cast housing with corrosion resistant finish.
4. Adjustable volume: 78 to 103 dB at 10 FT.
5. Voltage: 120 VAC or as required.
6. Enclosures/mountings:
 - a. Flush wall or panel mounting in dry areas.
 - b. NEMA 4X panel mounting in wet areas.
 - c. Surface mounting in dry areas.
 - d. NEMA 4X surface mounting in wet areas.
 - e. NEMA 4X, hazardous location surface mounting in wet and hazardous areas.
 - 1) Fixed volume: 97 dB at 10 FT.

B. Alarm Lights:

1. Panel mounted:
 - a. Strobe type.
 - b. Shatter resistant polycarbonate lens and base.
 - c. Lens color as indicated on Drawings.
 - d. NEMA 4X enclosure.
 - e. PLC compatible.
 - f. Voltage: 120 VAC.
2. Wall mounted:
 - a. Heavy-duty strobe type.
 - b. Weatherproof shatter resistant polycarbonate lens and cast base.
 - c. Optically designed fresnel lens with color as indicated on Drawings.
 - d. Immune to shock and vibration, no moving parts.
 - e. Xenon flash tube providing a minimum of 65 single flashes per minute.
 - f. Mounting: Wall or corner wall brackets.
3. Hazardous and corrosive locations:
 - a. Heavy-duty strobe type.
 - b. Weatherproof and rated for the indicated hazardous location.
 - c. Body: Zinc plated cast iron or cast copper free aluminum and/or coated with 20 mils of PVC.
 - d. High impact glass dome with guard.
 - e. Shatter resistant polycarbonate lens with color as indicated on Drawings.
 - f. Immune to shock and vibration, no moving parts.
 - g. Xenon flash tube providing a minimum of 65 single flashes per minute.
 - h. Mounting: Wall bracket or pendant.

2.5 MISCELLANEOUS DEVICES

A. Run Time Meters:

1. Six-digit wheels including a 1/10 digit.
2. Non-reset type.
3. Time range in hours.
4. Automatic recycle at zero.
5. Accuracy: 1 PCT.
6. Sealed against dirt and moisture.
7. Tamperproof.

B. Control Power Transformer:

1. Primary voltage: 480 V.
2. Secondary voltage: 120 V.
3. Sized for 125 PCT of required load.
4. Fused on primary and secondary.

5. Standard: NEMAST 1.

2.6 TERMINATION EQUIPMENT

- A. General Requirements:
 1. Modular type with screw compression clamp.
 2. Screws: Stainless steel.
 3. Current bar: Nickel-plated copper alloy.
 4. Thermoplastic insulation rated for -40 to +90 DEGC.
 5. Wire insertion area: Funnel-shaped to guide all conductor strands into terminal.
 6. End sections and end stops at each end of terminal strip.
 7. Machine-printed terminal markers on both sides of block.
 8. Spacing: 6 MM.
 9. Wire size: 22-12 AWG.
 10. Rated voltage: 600 V.
 11. DIN rail mounting.
- B. Standard-Type Block:
 1. Rated current: 30 A.
 2. Color: Gray body.
- C. Bladed-Type Disconnect Block:
 1. Terminal block with knife blade disconnect which connects or isolated the two sides of the block.
 2. Rated current: 10 A.
 3. Color:
 - a. Panel control voltage leaves enclosure - normal: Gray body, orange switch.
 - b. Foreign voltage entering enclosure: Orange body, orange switch.
- D. Grounded-Type Block:
 1. Electrically grounded to mounting rail.
 2. Terminal ground wires and analog cable shields.
 3. Color: Green and yellow body.
- E. Fuse Holders:
 1. Blocks can be ganged for multi-pole operation.
 2. Spacing: 9.1 MM.
 3. Wire size: 30-12 AWG.
 4. Rated voltage: 300 V.
 5. Rated current: 12 A.
 6. Fuse size: 1/4 x 1-1/4.
 7. Blown fuse indication.
 8. DIN rail mounting.

2.7 ENCLOSURES

- A. Industrial Control Panels:
 1. See Specification 40 6700.
- B. Operator Control Stations:
 1. NEMA 4/13 rated:
 - a. Die cast aluminum body with manufacturer's standard finish.
 - b. Gasketed die cast aluminum cover with manufacturer's standard finish.
 - c. Number of device mounting holes as required.
 2. NEMA 4X rated:
 - a. Type 304 or 316 stainless steel body.
 - b. Gasketed Type 304 or 316 stainless steel cover.
 - c. Number of device mounting holes as required.

3. NEMA 7 and 9 rated:
 - a. Zinc plated cast iron or die-cast copper free aluminum, with threaded hubs, grounding screw and with manufacturer's standard finish.
 - b. "EDS" or "EFS" style.
 - c. Single or multiple gang or tandem.
 - d. Accessories: 40 MIL PVC exterior coating and 2 MIL urethane interior coating.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install as indicated and in accordance with manufacturer's recommendations and instructions.
- B. Control Panels:
 1. See Specification 40 6700.
- C. Operator Control Stations:
 1. Permitted uses of NEMA 4/13 enclosure:
 - a. Surface mounted in areas designated as dry and/or dusty architecturally or non-architecturally finished areas and wet.
 2. Permitted uses of NEMA 4X enclosure:
 - a. Surface mounted in areas designated as wet and/or corrosive or highly corrosive.
 3. Permitted uses of NEMA 7 enclosure:
 - a. Surface mounted in areas designated as Class I hazardous with PVC coating in corrosive and highly corrosive areas when PVC coated conduit is used.

3.2 FIELD QUALITY CONTROL

- A. See Section 26 05 00.
- B. Operator Control Station Functional Test:
 1. The test is to prove the correct interaction of all sensing, processing and action devices.
 2. Develop a test plan and parameters for the purpose of evaluating the performance of the system.
 - a. Plan shall have witness signature lines for the contractor and owner and submitted when system pass the test.
 3. Perform the following tests:
 - a. Verify functionality of all control states.
 - b. Verify the correct operation of all interlock safety devices for fail-safe functions
 - c. Verify the correct operation of all sensing devices, alarms and indicating devices.

3.3 TRAINING

- A. A qualified supplier representative shall provide the Owner with on-site training in the operation and maintenance of the Industrial Control Panel(s) and its components.

END OF SECTION

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SECTION 26 22 13
DRY-TYPE TRANSFORMERS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Dry-type transformers, 1000 kVA and less.
 - 2. Dry-type transformers, hazardous location.
- B. Related Sections include but are not necessarily limited to:
 - 1. Division 00 - Procurement and Contracting Requirements.
 - 2. Division 01 - General Requirements.
 - 3. Section 26 05 00 - Electrical - Basic Requirements.
 - 4. Section 26 05 26 - Grounding.
 - 5. Section 26 08 13 - Acceptance Testing.

1.2 QUALITY ASSURANCE

- A. Referenced Standards:
 - 1. Institute of Electrical and Electronics Engineers, Inc. (IEEE):
 - a. C57.96, Guide for Loading Dry-Type Distribution and Power Transformers.
 - 2. National Electrical Manufacturers Association (NEMA):
 - a. 250, Enclosures for Electrical Equipment (1000 Volts Maximum).
 - b. ST 20, Dry Type Transformers for General Applications.
 - 3. Underwriters Laboratories, Inc. (UL):
 - a. 506, Standard for Specialty Transformers.
 - b. 1561, Standard for Dry-Type General Purpose and Power Transformers.

1.3 SUBMITTALS

- A. Shop Drawings:
 - 1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
 - 2. Product technical data:
 - a. Provide submittal data for all products specified in PART 2 of this Specification Section.
 - b. See Specification Section 26 05 00 for additional requirements.
 - 3. Fabrication and/or layout drawings.
 - a. Nameplate drawing.
 - 4. Certifications:
 - a. Sound level certifications.
- B. Contract Closeout Information:
 - 1. Operation and Maintenance Data:
 - a. See Specification Section 01 33 04 for requirements for the mechanics, administration, and the content of Operation and Maintenance Manual submittals.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
 - 1. Eaton.
 - 2. General Electric.

3. Square D by Schneider Electric.
4. SolaHD by Emerson Electric Co.

B. Submit request for substitution in accordance with Specification Section 01 25 13.

2.2 GENERAL PURPOSE DRY-TYPE TRANSFORMERS

- A. Ventilated or non-ventilated, air cooled, two winding type.
- B. Cores:
 1. High grade, non-aging silicon steel with high magnetic permeability, and low hysteresis and eddy current losses.
 2. Magnetic flux densities are to be kept well below the saturation point.
- C. Coils: Continuous wound with electrical grade aluminum.
- D. Non-ventilated Units:
 1. Core and coil assembly encapsulated in a proportioned mixture of resin and aggregate to provide a moistureproof, shock resistant seal.
 2. Totally enclosed, NEMA 3R, sType 316 stainless steel enclosure finished with a weather-resistant enamel.
- E. Ventilated Units:
 1. Core and coils assembly impregnated with non-hygroscopic, thermosetting varnish and cured to reduce hot spots and seal out moisture and completely isolated from the enclosure by means of vibration dampening pads.
 2. Dripproof, NEMA 1, steel enclosure finished with a weather-resistant enamel and ventilation openings protected from falling dirt.
- F. Furnish Taps for Transformers as follows:
 1. 1 PH, 2 kVA and below: None.
 2. 1 PH, 3 to 25 kVA: Two, 5 PCT FCBN.
 3. 1 PH, 25 kVA and above: Two, 2.5 PCT FCAN and four, 2.5 PCT FCBN.
 4. 3 PH, 3 to 15 kVA: Two, 5 PCT FCBN.
 5. 3 PH, 15 kVA and above: Two, 2.5 PCT FCAN and four, 2.5 PCT FCBN.
- G. Sound Levels:
 1. Manufacturer shall guarantee not to exceed the following:
 - a. 10 to 50 kVA: 45 dB.
 - b. 151 to 300 kVA: 55 dB.
- H. Efficiency (minimum):
 1. Ventilated:
 - a. 1 PH, 15 - 333 kVA: DOE 2016 Efficiency.
 - b. 3 PH, 15 - 1000 kVA: DOE 2016 Efficiency.
- I. Insulating Material (600 V and below):
 1. 3 to 15 kVA units: 185 DEGC insulation system with a 115 DEGC rise.
 2. 15 kVA and above units: 220 DEGC insulation system with a 150 DEGC rise.
- J. Ratings: 60 Hz, voltage, KVA and phase, as indicated on the Drawings.
- K. Finish: Rust inhibited primer and manufacturers standard paint inside and out.
- L. Standards: IEEE C57.96, NEMA ST 20, UL 506, UL 1561.

2.3 DRY-TYPE TRANSFORMERS

- A. UL listed for hazardous locations.
- B. 316 stainless steel NEMA 4X enclosure.
- C. Cores:
 1. Resin-encapsulated core-coil assembly.

- D. Aluminum windings.
- E. 180DEGC insulations system; 115DEGC winding temperature rise.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Indoor Locations:
 - 1. Provide ventilated type for 15 kVA units and above.
 - 2. Mount 15 kVA units and above on chamfered 4 IN high concrete housekeeping pad or from wall and/or ceiling, at 7 FT above finished floor, using equipment support brackets per Section 26 05 00.
 - 3. Provide rubber vibrations isolation pads.
- C. Enclosures: Painted steel in all areas except stainless steel in highly corrosive areas.
- D. Ground in accordance with Section 26 05 26.

END OF SECTION

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SECTION 26 24 16

PANELBOARDS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Branch circuit panelboards.
 - 2. Distribution panelboards.
 - 3. Panelboards.
- B. Related Specification Sections include but are not necessarily limited to:
 - 1. Division 00 - Procurement and Contracting Requirements.
 - 2. Division 01 - General Requirements.
 - 3. Section 10 14 00 – Identification Devices.
 - 4. Section 26 05 00 - Electrical - Basic Requirements.
 - 5. Section 26 28 00 - Overcurrent and Short Circuit Protective Devices.
 - 6. Section 26 43 13 - Low Voltage Surge Protective Devices (SPD).

1.2 QUALITY ASSURANCE

- A. Referenced Standards:
 - 1. National Electrical Manufacturers Association (NEMA):
 - a. 250, Enclosures for Electrical Equipment (1000 Volts Maximum).
 - b. PB 1, Panelboards.
 - 2. National Fire Protection Association (NFPA):
 - a. 70, National Electrical Code (NEC).
 - 3. Underwriters Laboratories, Inc. (UL):
 - a. 50, Enclosures for Electrical Equipment, Non-Environmental Considerations.
 - b. 67, Standard for Panelboards.
 - c. 1203, Standard for Safely Explosion-Proof and Dust-Ignition-Proof Electrical Equipment for Use in Hazardous (Classified) Locations.

1.3 DEFINITIONS

- A. Branch Circuit Panelboard: Bus rating of 400A and less or where labeled as Branch Circuit Panelboard on the Drawings.
- B. Distribution Panelboard: Bus rating of 600A and greater or where labeled as Distribution Panelboard on the Drawings.

1.4 SUBMITTALS

- A. Shop Drawings:
 - 1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
 - 2. Product technical data.
 - a. Provide submittal data for all products specified in PART 2 of this Specification Section.
 - b. See Specification Section 26 05 00 for additional requirements.
 - 3. Fabrication and/or layout drawings:
 - a. Panelboard layout with alphanumeric designation, branch circuit breakers size and type, as indicated in the panelboard schedules.

- B. Contract Closeout Information:
 - 1. Operation and Maintenance Data:
 - a. See Specification Section 01 33 04 for requirements for the mechanics, administration, and the content of Operation and Maintenance Manual submittals.
 - 2. Panelboard schedules with as-built conditions.
- C. Informational Submittals:
 - 1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
 - 2. Service equipment marking and documentation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
 - 1. Eaton.
 - 2. ABB/GE.
 - 3. Square D by Schneider Electric.
- B. Submit request for substitution in accordance with Specification Section 01 25 13.

2.2 MANUFACTURED UNITS

- A. Standards: NEMA PB 1, NFPA 70, UL 50, UL 67, UL 1203.
- B. Ratings:
 - 1. Current, voltage, number of phases, number of wires as indicated on the Drawings.
 - 2. Short Circuit Current Rating (SCCR) and/or Ampere Interrupting Current (AIC) ratings equal to or greater than the interrupting rating indicated on the Drawings or in the schedule.
 - a. Series rating is not acceptable.
 - b. When fault current or minimum interrupting rating is not indicated, use rating of upstream equipment or infinite bus calculation of transformer secondary.
 - 3. Panelboards rated 240 Vac or less: 10,000 amp minimum short circuit rating or as indicated in the schedule.
 - 4. Panelboards rated 480 Vac: 65,000 amp minimum short circuit rating or as indicated in the schedule.
 - 5. Service Entrance Equipment rated when indicated on the Drawings or when shown to be fed from a utility source.
- C. Construction:
 - 1. Interiors factory assembled and designed such that switching and protective devices can be replaced without disturbing adjacent units and without removing the main bus connectors.
 - 2. Multi-section panelboards: Feed-through or sub-feed lugs.
 - 3. Main lugs: Solderless type approved for copper and aluminum wire.
- D. Bus Bars:
 - 1. Main bus bars:
 - a. Tin plated aluminum or tin plated copper sized to limit temperature rise to a maximum of 65 DEGC above an ambient of 40 DEGC.
 - b. Drilled and tapped and arranged for sequence phasing of the branch circuit devices.
 - 2. Ground bus and isolated ground bus, when indicated on the Drawings: Solderless mechanical type connectors.
 - 3. Neutral bus bars: Insulated 100 PCT rated or 200 PCT rated, when indicated on the Drawings and with solderless mechanical type connectors.

- E. Overcurrent and Short Circuit Protective Devices:
 - 1. Main overcurrent protective device:
 - a. Molded case circuit breaker.
 - 2. Branch overcurrent protective devices:
 - a. Bolt-on molded case circuit breaker.
 - 3. See Specification Section 2628 00 for overcurrent and short circuit protective device requirements.
 - 4. Factory installed.
- F. Integral surge protective device:
 - 1. Provide for panelboards where indicated on the Drawings
 - 2. See Specification Section 26 43 13.
- G. Enclosure:
 - 1. Boxes: Code gage galvanized steel, furnish without knockouts.
 - 2. Trim assembly: Code gage steel finished with rust inhibited primer and manufacturers standard paint inside and out.
 - 3. Branch circuit panelboard:
 - a. Trims supplied with hinged door-in-door construction.
 - 1) Outer door:
 - a) Allows access to the interior of the enclosure.
 - b) Hinged to the enclosure.
 - c) Opened by removal of screws or by operating a mechanical latch located behind the inner door.
 - 2) Inner door:
 - a) Allows access to breakers (non-live parts).
 - b) Hinged to outer door.
 - c) Opened by operation of a keyed corrosion resistant chrome-plated combination lock and catch. Locks for all branch circuit panelboards keyed alike.
 - b. Trims for surface mounted panelboards, same size as box.
 - c. Trims for flush mounted panelboards, overlap the box by 3/4 IN on all sides.
 - d. Nominal 20 IN wide and 5-3/4 IN deep with gutter space in accordance with NFPA 70.
 - e. Clear plastic cover for directory card mounted on the inside of each door.
 - f. Where NEMA 12 rating is indicated: Door gasketed.
 - g. Where NEMA 4X is indicated: Stainless Steel.
 - h. Where NEMA 7 is indicated: 316L Stainless Steel, gasketed.
 - 1) Integrated steel lifting eye.
 - 4. Distribution panelboard:
 - a. Trims cover all live parts with switching device handles accessible.
 - b. Minimum 8 IN deep and less than or equal to 12 IN deep with gutter space in accordance with NFPA 70.
 - c. Clear plastic cover for directory card mounted front of enclosure.
 - d. Where NEMA 3R or NEMA 12 rating is indicated: Doors gasketed and lockable with corrosion resistant chrome-plated combination lock and catch, all locks keyed alike, or provisions for padlocks.
 - e. Where NEMA 4X is indicated: Stainless Steel.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install as indicated on the Drawings, in accordance with the NFPA 70, and in accordance with manufacturer's instructions.
- B. Support panelboard enclosures from wall studs or modular channels support structure, per Specification Section 2605 00.

- C. Provide NEMA rated enclosure as indicated on the Drawings. Where enclosure type is not indicated, provide enclosure rating suitable for the atmosphere where equipment is installed.
- D. Field identification:
 - 1. Provide all required tagging and markings per the NFPA 70 and Specification Section 10 14 00.
- E. Provide each panelboard with a typed directory:
 - 1. Identify all circuit locations in each panelboard with the load type and location served.
 - 2. Use Owner-furnished mechanical equipment designation if different than designation indicated on the Drawings.
 - 3. Use final building room names and numbers as identified by the Owner if different than designation indicated on the Drawings.
 - 4. Identify spare overcurrent devices.

END OF SECTION

SECTION 26 24 19

MOTOR CONTROL EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Motor control centers.
 - 2. Separately mounted motor starters (including those supplied with equipment).
 - 3. Manual motor starters.

- B. Related Specification Sections include but are not necessarily limited to:
 - 1. Division 00 - Procurement and Contracting Requirements.
 - 2. Division 01 - General Requirements.
 - 3. Section 26 05 00 - Electrical - Basic Requirements.
 - 4. Section 26 08 13 - Acceptance Testing.
 - 5. Section 26 29 23 - Variable Frequency Drives - Low Voltage.
 - 6. Section 26 28 00 - Overcurrent and Short Circuit Protective Devices.
 - 7. Section 26 43 13 - Low Voltage Surge Protective Devices (SPD).
 - 8. Section 26 09 13 - Electrical Metering Devices.
 - 9. Section 26 09 16 - Control Equipment Accessories.

1.2 QUALITY ASSURANCE

- A. Referenced Standards:
 - 1. International Electrotechnical Commission (IEC).
 - 2. National Electrical Manufacturers Association (NEMA):
 - a. 250, Enclosures for Electrical Equipment (1000 Volt Maximum).
 - b. ICS 2, Controllers, Contactors and Overload Relays Rated 600 V.
 - c. ICS 18, Motor Control Centers.
 - 3. Underwriters Laboratories, Inc. (UL):
 - a. 508, Standard for Industrial Control Equipment.
 - b. 845, Motor Control Centers.

- B. Miscellaneous:
 - 1. Verify motor horsepower loads, other equipment loads, and controls from approved shop drawings and notify Engineer of any discrepancies.
 - 2. Verify the required instrumentation and control wiring for a complete system and notify Engineer of any discrepancies.

1.3 SUBMITTALS

- A. Shop Drawings:
 - 1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
 - 2. Product technical data:
 - a. Provide submittal data for all products specified in PART 2 of this Specification Section.
 - b. See Specification Section 26 05 00 for additional requirements.
 - 3. Fabrication and/or layout drawings:
 - a. Motor control center:
 - 1) Elevation drawing with overall dimensions.
 - 2) Starter and component schedule.
 - 3) Identification of units and their location in the MCC.
 - 4) Location of incoming line terminals.
 - 5) Mounting dimensions.

- 6) Available conduit entrance areas.
 - 7) Nameplate schedule.
 - 8) Assembly ratings (amps, volts, short circuit, etc.).
 - 9) Unit ladder logic wiring for each unit depicting electrical interlocking and wiring between units (NEMA ICS 18 Class II) and identification of terminals where field devices or remote control signals are to be terminated (NEMA ICS 18 Class II-S) including industry standard symbology of the field devices as indicated on the Drawings, product specification and/or loop descriptions. Drawings indicate basic control functionality, provide diagrams for the manufacturer's product(s) meeting the required functionality.
- b. Separately mounted combination starters:
- 1) Unit ladder logic wiring for each unit depicting electrical wiring and identification of terminals where field devices or remote control signals are to be terminated including industry standard symbology of the field devices as indicated on the Drawings, specification and/or loop descriptions. Drawings indicate basic control functionality, provide diagrams for the manufacturer's product(s) meeting the required functionality.
 - 2) Short Circuit Current Rating (SCCR) nameplate marking per NFPA 70, include any required calculations.
- B. Contract Closeout Information:
1. Operation and Maintenance Data:
 - a. See Specification Section 01 33 04 for requirements for the mechanics, administration, and the content of Operation and Maintenance Manual submittals.
 - b. Fabrication and/or layout drawings updated with as-built conditions.
- C. Informational Submittals:
1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
 2. Service equipment marking and documentation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
1. Allen-Bradley by Rockwell Automation, Inc.
 2. Eaton.
 3. General Electric.
 4. Square D by Schneider Electric.
 5. Siemens Corporation.
- B. Submit request for substitution in accordance with Specification Section 01 25 13.

2.2 MOTOR CONTROL CENTERS

- A. Ratings:
1. 600 V class, 3 PH, 60 Hz with operating voltage and number of wires as indicated on the Drawings.
 2. Assembly short circuit current and interrupting device rating as indicated on the Drawings.
 3. Service Entrance Equipment rated when indicated on the Drawings.
- B. Construction:
1. Standards: UL 845.
 2. Totally enclosed, dead front, free standing assemblies, bolted together to form a single assembly.

3. Fabricate of not less than 14 GA steel with 16 GA steel doors in standardized units.
4. Nominal size per section: 20 IN wide, 20 or 21 IN deep, and 90 IN high.
5. Enclosure:
 - a. NEMA 1 gasketed.
6. Horizontal wireways:
 - a. At the top, isolated from the main bus
 - b. At the bottom.
 - c. Easily accessible.
 - d. Full length of the MCC.
7. Vertical wireway:
 - a. Located in each MCC section that accepts plug-in units.
 - b. Connect to top and bottom wireways.
 - c. Isolated from the unit interiors.
 - d. Accessible through a separate hinged door.
 - e. Cable tie supports to hold wiring in place.
8. Unit doors:
 - a. Formed round corners and rolled edges.
 - b. Minimum of two heavy-duty hinges or continuous piano hinge.
 - c. Held closed by means of captive fasteners.
 - d. Fabricate to be a part of the structure and not part of the starter.
9. Unit cubicles:
 - a. Draw-out type for motor starters through NEMA Size 5, breakers through 400A frame and fusible switches through 400A.
 - b. Guide rails for supporting and aligning starters.
 - 1) Larger motor starters, breakers and fusible switches to be bused or cabled to the main horizontal bus.
 - c. Operating handle:
 - 1) With the unit stabs engaged and door closed the handle mechanism allows complete ON/OFF control of the unit disconnect and clear indication of the disconnect status.
 - 2) Circuit breaker and MCP operators includes a separate TRIPPED position.
 - 3) Mechanical interlock to prevent the opening of the door when the disconnect is in the ON position with a defeater mechanism.
 - 4) Mechanical interlock to prevent the placement of the disconnect in the ON position with the door open with a defeater mechanism.
 - 5) Non-defeatable interlock to prevent the installation or removal of a unit unless the disconnect is in the OFF position.
 - 6) Padlockable in the OFF position.
 - d. Control panel:
 - 1) Provide control devices (selector switch, indicating devices, etc.) as indicated on the Drawings per Specification Section 26 09 16.
 - e. Control power:
 - 1) Control power transformer:
 - a) 120 V secondary.
 - b) Fused on primary and secondary side.
 - c) Sized for 140 PCT of required load.
 - f. Minimum of one full size space unit (12 IN) for any combination magnetic motor starter or starter without overload relay.
 - g. One-half full size space unit (6 IN) for circuit breakers 100 A and less.
 - h. Effectively baffled to isolate any ionized gases which may occur within unit starter.
10. Assemblies effectively ventilated to allow relocation of starters and other components:
 - a. Within the assembly and with the same load.
 - b. Without having to compensate for changes in location.
11. Finish: Rust inhibited primer and manufacturer's standard paint inside and out.
12. Provide ample unrestricted space for conduit entry from the bottom.

13. Wiring: NEMA ICS 18 Class II, Type B-D.
- C. Buses:
1. Material: Tin-plated copper.
 2. Main horizontal bus:
 - a. As indicated on the Drawings.
 - b. Extend the full-length of the MCC with provisions for splicing additional sections to either end.
 3. Vertical buses:
 - a. 300 A minimum.
 - b. Securely bolted to the horizontal main bus with joint easily accessible for maintenance.
 - c. Completely isolated and insulated by means of a barrier.
 - d. Extended full length of vertical section to distribute incoming power to each circuit breaker and starter in structure.
 - 1) Starters NEMA Size 5 and larger and certain other components may be cable connected to the main bus with the approval of the Engineer.
 - e. Extend Vertical bus to spaces provided for future equipment.
 4. Ground bus:
 - a. Extend the full-length of the MCC with provisions for splicing additional sections to either end.
 - b. 300 A tin-plated copper.
 - c. Solidly grounded to each structure.
 - d. Locate near bottom of structure.
 - e. Provide for lug connection of equipment ground wires.
- D. Overcurrent and Short Circuit Protective Devices:
1. Main device:
 - a. Molded case circuit breaker.
 2. Feeder devices:
 - a. Molded case circuit breaker.
 3. Motor protection with full voltage starters:
 - a. Molded case circuit breaker.
 4. See Specification Section 2628 00 for overcurrent and short circuit protective device requirements.
 5. Factory installed.
- E. Motor Starters: See requirements within this Specification Section.
- F. Surge Protective Device: Integrally mounted, see Specification Section 2643 13.
- G. Power Monitor Metering:
1. Separate compartment.
 2. See Specification Section 2609 13 for meter requirements.
- H. Ethernet/IP Communication:
1. An industrial Ethernet switch and power supply shall be installed in the MCC. The Ethernet switch shall include a sufficient number of ports to connect to Ethernet/IP devices including power meter, overload relays, VFDs, and plant SCADA system.
- I. Miscellaneous:
1. See Drawings for items provided by other but factory installed (e.g., submersible motor temperature/leak controller, control system gateways or switches).

2.3 SEPARATELY MOUNTED COMBINATION STARTERS

- A. Standards:
1. NEMA 250, NEMA ICS 2.
 2. UL 508.

- B. Enclosure:
 - 1. NEMA 4 rated:
 - a. Body and cover: Sheet steel finished with rust inhibiting primer and manufacturer's standard paint inside and out.
 - b. No knockouts, external mounting flanges, hinged and gasketed door.
 - 2. NEMA 4X rated:
 - a. Body and cover: Type 304 or 316 stainless steel.
 - b. No knockouts, external mounting flanges, hinged and gasketed door.
 - 3. NEMA 7 rated:
 - a. Cast gray iron alloy or copper-free aluminum with manufacturer's standard finish.
 - b. Drilled and tapped openings or tapered threaded hub.
 - c. Gasketed cover bolted-down with stainless steel bolts.
 - d. External mounting flanges.
 - e. Front operating handle padlockable in the OFF position.
 - f. Accessories: 40 MIL PVC exterior coating.
 - 4. NEMA 12 rated:
 - a. Body and cover: Sheet steel finished with rust inhibiting primer and manufacturer's standard paint inside and out.
 - b. No knockouts, external mounting flanges, hinged and gasketed door.
- C. Operating Handle:
 - 1. With the door closed the handle mechanism allows complete ON/OFF control of the unit disconnect and clear indication of the disconnect status.
 - 2. Circuit breaker and MCP operators includes a separate TRIPPED position.
 - 3. Mechanical interlock to prevent to prevent the opening of the door when the disconnect is in the ON position with a defeater mechanism for use by authorized personnel.
 - 4. Mechanical interlock to prevent the placement of the disconnect in the ON position with the door open with a defeater mechanism for use by authorized personnel.
 - 5. Padlockable in the OFF position.
 - 6. Exceptions: NEMA 7 enclosures.
- D. Control Devices:
 - 1. Provide control devices as indicated on the Drawings per Specification Section 26 09 16.
 - 2. Devices will be accessible with the door closed.
- E. Control Power Transformer:
 - 1. 120V secondary.
 - 2. Fused on primary and secondary side.
 - 3. Sized for 140 PCT of required load.
- F. Fault Current Withstand Rating: Equal to the rating of the electrical gear from which it is fed.
- G. Motor Starters: See requirements within this Specification Section.
- H. Disconnect Switch, Overcurrent and Short Circuit Protective Devices:
 - 1. Motor circuit protector.
 - 2. See Specification Section 26 28 00 for overcurrent and short circuit protective device requirements.
 - 3. Factory installed.

2.4 MOTORSTARTERS

- A. Standards:
 - 1. NEMA ICS 2.
 - 2. UL 508.
- B. Full Voltage Non-Reversing (FVNR) Magnetic Starters:
 - 1. NEMA full size rated contactor.
 - a. NEMA half sizes and IEC contactors are not permitted.
 - 2. Double-break silver alloy contacts.

3. Overload relays:
 - a. Provide electronic intelligent overload with current and voltage sensing for three phase power and run time monitoring and all other manufacturers standard intelligent functions.
 - b. (4) Discrete Inputs and (2) Discrete Outputs
 - c. LEDs for status indication.
 - d. Protective functions including: programmable trip level, warning level, time delay, inhibit window, thermal overload, phase loss, stall, jam, underload, current imbalance, remote trip, and PTC thermistor input.
 - e. Current monitoring functions including: phase current, average current, full load current, current imbalance percent, percent thermal capacity utilized, and ground fault current (if required).
 - f. Voltage, energy, and frequency measuring capabilities.
 - g. Diagnostic information including: device status, warning status, time to reset, trip status, time to overload trip, and history of last five trips.
 - h. Preventative maintenance information including: allowable starts per hour, required time between starts, starts counter, starts available, time until next start, total operating hours, and elapsed operating time.
 - i. Test/Reset button.
 - j. Ethernet/IP communication with RJ45 port.
 4. Interlock and auxiliary contacts, wired to terminal blocks:
 - a. Holding circuit contact, normally open.
 - b. Overload alarm contact, normally open.
 - c. Normally open auxiliary contact, for remote run status.
 - d. Additional field replaceable auxiliary contacts as required per the Sequence of Operation.
 - e. Two additional normally open spare field replaceable auxiliary contacts.
- C. Full Voltage Two-Speed (FV2S) Magnetic Starters:
1. Two FVNR starters with two overload relays assembled together.
 2. Configured for two winding or one winding consequent pole motors.
 3. See FVNR paragraph for additional requirements.
- D. Variable Frequency Drives: See Specification Section 26 29 23.

2.5 MANUAL MOTOR STARTERS

- A. Standards:
1. NEMA 250, NEMA ICS 2.
 2. UL 508.
- B. Quick-make, quick-break toggle mechanism that is lockable in the OFF position.
- C. Types:
1. Horsepower rated, for ON/OFF control.
 2. Horsepower rated, for ON/OFF control and thermal overload protection.
 - a. Switch to clearly indicate ON, OFF, and TRIPPED position.
- D. Voltage and current ratings and number of poles as required for the connected motor.
- E. Enclosures:
1. NEMA 1 rated:
 - a. Galvanized steel or steel finished with rust inhibiting primer and manufacturer's standard paint inside and out.
 - b. With or without concentric knockouts.
 2. NEMA 4 rated:
 - a. Sheet steel finished with rust inhibiting primer and manufacturer's standard paint inside and out or cast gray iron alloy or copper-free aluminum with manufacturer's standard finish.

- b. No knockouts, external mounting flanges.
- 3. NEMA 4X rated:
 - a. Type 304 or 316 stainless steel.
 - b. No knockouts, external mounting flanges.
- 4. NEMA 7 rated:
 - a. Cast gray iron alloy or copper-free aluminum with manufacturer's standard finish.
 - b. Drilled and tapped openings or tapered threaded hub, external mounting flanges.
 - c. Accessories: 40 MIL PVC exterior coating.
- 5. NEMA 12 rated:
 - a. Body and cover: Sheet steel finished with rust inhibiting primer and manufacturer's standard paint inside and out.
 - b. No knockouts, external mounting flanges.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install as indicated on the Drawings and in accordance with manufacturer's recommendations and instructions.
- B. Mounting height for surface mounted equipment: See Specification Section 26 05 00.
- C. Mount MCC on 4 IN high concrete pad:
 - 1. Install two, 4 IN wide channel sills flush in pads to support and maintain alignment of the MCC.
 - 2. Align front of MCC with top edge of pad chamfer.
- D. Service Equipment Marking and Documentation:
 - 1. Provide service rated equipment with available fault current and arc-flash hazard warning labels as required by NFPA 70 and other applicable codes.
 - 2. Provide documentation of the calculations made for compliance with the marking requirements.
 - 3. Provide labels in accordance with Section 10 14 00.
- E. Provide separately mounted combination starters with Short Circuit Current Rating (SCCR) labeling as required by NFPA 70 and other applicable codes.
 - 1. Determine the SCCR rating by one of the following methods:
 - a. Method 1: SCCR rating meets or exceeds the available fault current of the source equipment when indicated on the Drawings.
 - b. Method 2: SCCR rating meets or exceeds the source equipment's Amp Interrupting Current (AIC) rating as indicated on the Drawings.
 - c. Method 3: SCCR rating meets or exceeds the calculated available short circuit current at the control panel.
 - 2. The source equipment is the switchboard, panelboard, motor control center or similar equipment where the equipment or control panel circuit originates.
 - 3. For Method 3, provide calculations justifying the SCCR rating. Utilize source equipment available fault current or AIC rating as indicated on the Drawings.
- F. Overload Heaters:
 - 1. Size for actual motor full load current of the connected motor.
 - 2. For motors with power factor correction capacitors, size to compensate for the capacitors effect on load current.
- G. Combination and Manual Starter Enclosures:
 - 1. Permitted uses of NEMA 1 enclosure:
 - a. Surface or flush mounted in architecturally finished areas.
 - b. Surface mounted above 10 FT in areas designated as dry in architecturally and non-architecturally finished areas.

2. Permitted uses of NEMA 4 enclosure:
 - a. Surface mounted in areas designated as wet.
3. Permitted uses of NEMA 4X enclosure:
 - a. Surface mounted in areas designated as wet and/or corrosive.
4. Permitted uses of NEMA 7 enclosure:
 - a. Surface mounted in areas designated as Class I hazardous.
 - b. Provide PVC coating in corrosive and highly corrosive areas when PVC coated conduit is used.
5. Permitted uses of NEMA 12 enclosure:
 - a. Surface mounted in areas designated as dry.

3.2 FIELD QUALITY CONTROL

- A. Acceptance Testing: See Specification Section 26 08 13.

3.3 TRAINING

- A. Manufacturer shall provide factory authorized application engineer to train Owner personnel in the operation and programming of the motor control equipment.

END OF SECTION

SECTION 26 27 26

WIRING DEVICES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Material and installation requirements for:
 - a. Wall switches.
 - b. Receptacles.
 - c. Device wallplates and coverplates.
- B. Related Specification Sections include but are not necessarily limited to:
 - 1. Division 00 - Procurement and Contracting Requirements.
 - 2. Division 01 - General Requirements.
 - 3. Section 26 05 00 - Electrical - Basic Requirements.
 - 4. Section 26 05 33 - Raceways and Boxes.
 - 5. Section 26 24 19 - Motor Control Equipment.

1.2 QUALITY ASSURANCE

- A. Referenced Standards:
 - 1. National Electrical Manufacturers Association (NEMA):
 - a. 250, Enclosures for Electrical Equipment (1000 Volts Maximum).
 - b. WD 1, General Color Requirements for Wiring Devices.
 - c. WD 6, Wiring Devices - Dimensional Requirements.
 - 2. Underwriters Laboratories, Inc. (UL):
 - a. 20, General-Use Snap Switches.
 - b. 498, Standard for Attachment Plugs and Receptacles.
 - c. 514A, Metallic Outlet Boxes.
 - d. 894, Standard for Switches for Use in Hazardous (Classified) Locations.
 - e. 943, Ground-Fault Circuit-Interrupters.
 - f. 1010, Standard for Receptacle-Plug Combinations for Use in Hazardous (Classified) Locations.
 - g. 1310, Standard for Class 2 Power Units.
 - h. 1449, Standard for Surge Protective Devices.

1.3 SUBMITTALS

- A. Shop Drawings:
 - 1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
 - 2. Product technical data:
 - a. Provide submittal data for all products specified in PART 2 of this Specification Section.
 - b. See Specification Section 26 05 00 for additional requirements.
- B. Contract Closeout Information:
 - 1. Operation and Maintenance Data:
 - a. See Specification Section 01 33 04 for requirements for the mechanics, administration, and the content of Operation and Maintenance Manual submittals.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
 - 1. Wall switches and receptacles:
 - a. Bryant Electric.
 - b. Cooper Wiring Devices by Eaton.
 - c. Hubbell Incorporated Wiring Device-Kellems.
 - d. Leviton Manufacturing Company.
 - e. Legrand/Pass & Seymour.
 - f. Eaton Crouse-Hinds.
 - g. Appleton Electric Co.
 - h. Hubbell Killark.
- B. Submit request for substitution in accordance with Specification Section 01 25 13.

2.2 WALL SWITCHES

- A. Basic requirements unless modified in specific requirements paragraph of switches per designated areas or types:
 - 1. Industrial Specification Grade.
 - 2. Quiet action, snap switch.
 - 3. Self-grounding with grounding terminal.
 - 4. Back and side wired.
 - 5. Solid silver cadmium oxide contacts.
 - 6. Rugged thermoplastic and/or nylon housing and one-piece switch arm.
 - 7. Ratings: 20 A, 120/277 VAC.
 - 8. Switch handle type: Toggle.
 - 9. Switch handle color: Ivory.
 - 10. Types as indicated on the Drawings:
 - a. Single-pole.
 - b. Double-pole.
 - c. 3-way.
 - d. 4-way.
 - e. Momentary contact.
 - 11. Standards: UL 20, UL 514A, NEMA WD 1, NEMA WD 6.
- B. Architecturally Finished Area Specific Requirements:
 - 1. Wallplate:
 - a. 302 or 304 brushed finish stainless steel.
 - b. Single or multiple gang as required.
- C. Dry Non-architecturally Finished Area Specific Requirements:
 - 1. Coverplate for use on surface mounted outlet boxes:
 - a. 302 or 304 brushed finish stainless steel.
 - b. Single or multiple gang as required.
 - 2. Wallplate for use on recessed outlet boxes:
 - a. 302 or 304 brushed finish stainless steel.
 - b. Single or multiple gang as required.
- D. Wet or Damp Non-Architecturally Finished or Exterior Area Specific Requirements:
 - 1. Coverplate:
 - a. Copper-free aluminum, gasketed, weatherproof, while in use, stainless steel hardware.
 - b. Operator type:
 - 1) Front mounted lever type handle to operate snap switch.
 - 2) Push/pull operator to operate snap switch.
 - 3) Lockable.

- c. Wet location rated.
 - d. Single or multiple gang as required.
- E. Corrosive and Wet or Damp Area Specific Requirements:
- 1. Corrosion resistant nickel plated metal parts.
 - 2. Coverplate for use on metallic outlet boxes:
 - a. Zinc-plated malleable iron alloy or copper-free aluminum, gasketed, stainless steel hardware, galvanized and factory painted finish.
 - b. Operator type:
 - 1) Front mounted lever to operate snap switch.
 - 2) Push/pull operator to operate snap switch.
 - 3) Lockable,
 - c. Wet location rated.
 - d. Single or multiple gang as required.
- F. Hazardous and Dry Area Specific Requirements:
- 1. Rated for Class I, Division 1 and 2, Groups C and D; and Class II, Division 1 and 2 areas, Groups E, F, and G.
 - 2. Assembly consists of outlet box, snap switch and coverplate.
 - a. NEMA 7 and 9 rated.
 - 3. Snap switch (EDS Type):
 - a. Enclosed in separate sealing chamber and approved for installation without additional external sealing fittings.
 - b. Sealing chamber has prewired factory sealed pigtail leads.
 - 4. Coverplate:
 - a. Zinc-plated malleable iron alloy or copper-free aluminum, stainless steel hardware, galvanized and factory painted finish.
 - b. Operator type:
 - 1) Front mounted lever to operate snap switch.
 - 2) Lockable.
 - 3) Single or multiple gang as required.
 - 5. Standards: UL 894.

2.3 RECEPTACLES

- A. Basic requirements unless modified in specific requirements paragraph of receptacles and per designated areas:
- 1. Extra Heavy Duty Industrial Specification Grade.
 - 2. Straight blade.
 - 3. Corrosion resistant nickel plated metal parts.
 - 4. One-piece grounding system with double wipe brass grounding contacts and self-grounding strap with grounding terminal.
 - 5. Back and side wired.
 - 6. Rating: 20 A, 125 VAC.
 - 7. High impact nylon body.
 - 8. Receptacle body color:
 - a. Normal power: Ivory.
 - b. GFCI: Brown
 - c. Generator or UPS power: Red.
 - 9. Duplex or simplex as indicated on the Drawings.
 - 10. Configuration: NEMA 5-20R.
 - 11. Standards: UL 498, UL 514A, NEMA WD 1, NEMA WD 6.
- B. Receptacle Type Specific Requirements:
- 1. Basic receptacles:
 - a. Weather-resistant when located in exterior locations or interior damp or wet areas as indicated on the Drawings.
 - 1) Identification: Letters “WR” on face of receptacle.

2. Ground Fault Circuit Interrupter (GFCI):
 - a. Specification Grade.
 - b. Class A protection.
 - c. Feed through type.
 - d. Test and reset buttons.
 - e. Self-testing.
 - f. Visual indicator light.
 - g. Weather-resistant when located in exterior locations or interior damp or wet areas as indicated on the Drawings.
 - 1) Identification: Letters “WR” on face of receptacle.
 - h. Tamper resistant.
 - i. Additional standards: UL 943.
- C. Architecturally Finished Areas Specific Requirements:
 1. Wallplate:
 - a. 302 or 304 brushed finish stainless steel.
 - b. Single or multiple gang as required.
- D. Dry Non-Architecturally Finished Areas Specific Requirements:
 1. Coverplate for use on surface mounted outlet boxes:
 - a. 302 or 304 brushed finish stainless steel.
 - b. Single or multiple gang as required.
- E. Wet Non-architecturally Finished Areas Specific Requirements:
 1. Coverplate:
 - a. Extra-duty rated, weatherproof (NEMA 3R) while in use, gasketed, stainless steel hardware, copper-free aluminum, 3.2 IN minimum cover depth for #12 AWG cords.
- F. Exterior Locations Specific Requirements:
 1. Coverplate:
 - a. Extra-duty rated, weatherproof (NEMA 3R) while in use, gasketed, stainless steel hardware, copper-free aluminum, 3.2 IN minimum cover depth for #12 AWG cord.
- G. Corrosive Area Specific Requirements:
 1. Coverplate for use on metallic outlet boxes:
 - a. Zinc-plated malleable iron alloy, stainless steel hardware, galvanized and factory painted finish.
 - b. Single or multiple gang as required.
- H. Hazardous and Corrosive or Highly Corrosive and Dry, Wet or Damp Area Specific Requirements:
 1. Rated for Class I, Division 1 and 2, Groups C and D; and Class II, Division 1 and 2 areas, Groups E, F, and G. Assembly consists of outlet box and a combination receptacle/switch and housing.
 - a. NEMA 7 and 9 rated.
 2. Receptacle/switch and housing:
 - a. Receptacle and switch enclosed in a factory sealed chamber and approved for installation without additional external sealing fittings.
 - b. Insertion of “interchanger” plug and plug rotation will close the switch to energize receptacle and lock plug into the receptacle.
 - c. “Interchanger” plug to be compatible with other manufacturers hazardous receptacle and work in ordinary convenience receptacles.
 - d. Ordinary equipment plugs will not active the hazardous receptacle.
 - e. Housing: (EDS Type)
 - 1) Zinc plated malleable iron alloy or copper-free aluminum, stainless steel hardware, galvanized and factory painted finish.
 - 2) Spring-loaded door seats against neoprene gasket. Stainless steel spring.

3. Ground Fault Circuit Interrupter (GFCI):
 - a. Mount in same type of outlet box as receptacle.
 - b. Enclosed in factory sealed chamber.
 - c. Cover cast aluminum, stainless steel hardware, natural, lacquer, or factory painted finish.
 - d. Buttons stainless steel and gasketed.
 - e. Standards: UL 943.
 4. "Interchanger" plug:
 - a. Provide 10 plugs for Owners use.
 5. Standards: UL 894 and 1010.
- I. Special Purpose Receptacles:
1. NEMA configuration as indicated on the Drawings.
 2. Coverplate: See requirements per area designations herein.
 3. Portable Generator Plug Receptacle:
 - a. NEMA configuration: Coordinate with Owner for plug connection of portable generator.
 - 1) Powertite 400 amp pin and sleeve receptacle and plug, rain tight, 600VAC.
 - 2) Coverplate: See requirements per area designations herein.

2.4 MISCELLANEOUS WIRING DEVICES

- A. Manual Motor Starters: Horsepower rated with or without thermal overloads, see Specification Section 26 24 19.

2.5 OCCUPANCY SENSORS

- A. Dual Technology (PIR) and Ultrasonic Ceiling Sensor:
1. Basis of Design: Legrand DT-300.
 2. 360 degrees coverage.
 3. 18-24 VDC/VAC.
 4. Ultrasonic frequency 40 KHz
 5. Time delays 5, 10, 15, 20, 30 minutes.
 6. Walk-through test modes.
 7. Built-in light level sensor: 10-300 FC
 8. Low voltage momentary switch input for ON/OFF operation.
 9. Contains isolated relay for NC and NO contacts rated 1 Amp.
- B. Low Voltage Passive Infrared Ceiling Sensor:
1. Detection of changes in the infrared energy: Sensor to respond only to those signals caused by human motion.
 2. Analog and digital processing to provide immunity to RFI and EMI.
 3. Temperature compensated, dual element sensor and a multi-element lens with a minimum field of view of 110 DEG.
 4. Daylight filter or compensation for short wavelength infrared wave from the sun.
 5. Cover up to 300 SQFT at normal mounting heights.
 6. System voltage: 24 VDC through power pack.
 7. Load ON-OFF control through power pack.
 8. Adjustable time delay set at 30 minutes.
 9. Adjustable sensitivity set at maximum.
 10. Adjustments and mounting hardware under a removable cover.
 11. Parallel wiring of multiple sensors to allow coverage of large areas.
- C. Passive Infrared Wall Switch:
1. Self-contained control system that replaces a standard toggle switch.
 - a. Latching air gap relay switching mechanism, compatible with electronic ballasts, compact fluorescent and inductive loads.
 2. Detection of changes in the infrared energy: Sensor to respond only to those signals caused by human motion.

3. Analog and digital processing to provide immunity to RFI and EMI.
 4. Temperature compensated, dual element sensor and a multi-element Fresnel lens.
 5. Cover up to 300 SQ FT for walking motion, with a field of view of 180 DEG.
 6. System voltage: 120 VAC or 277 VAC.
 7. No minimum load.
 - a. 0 to 500 watts LED lighting load, 1/6 HP at 120 VAC, 60 Hz.
 - b. 0 to 1200 watts LED lighting load or 1/3 HP at 277 VAC, 60 Hz.
 8. DIP switch to control the following functions:
 - a. Built-in light level feature adjustable from 8 to 180 FT candles.
 - b. AUTOMATIC-ON or MANUAL-ON operation.
 - c. Time delay adjustable from 30 seconds to 30 minutes.
 - d. High/low sensitivity adjustments.
 9. Adjustments and mounting hardware under a removable, tamper resistant cover.
 10. Normal operation: OFF and AUTO.
- D. Ultrasonic Ceiling Sensor:
1. Detection of Doppler shifts in transmitted ultrasound.
 2. Ultrasonic sensing is volumetric in coverage with a frequency of 32 kHz and automatically adjust the detection threshold dynamically to compensate for constantly changing levels of activity and air flow throughout controlled areas.
 3. Temperature and humidity resistant, 32 kHz tuned ultrasonic receivers.
 - a. Receivers have less than a 6 dB shift in the humidity range of 10 PCT to 90 PCT and less than a 10 dB shift in the temperature range of -20 to 60 DEGC.
 4. DIP switch to control the following functions:
 - a. Override-ON function for use in the event of failure.
 - b. Time delay adjustable from 15 seconds to 30 minutes.
 - c. High/low sensitivity adjustments.
 5. Cover 360 DEG and hallway and corridor sensors shall cover up to 90 linear feet.
 6. Additional single-pole, double-throw isolated relay with normally open, normally closed, and common outputs rated at 1 amp for 24 VDC.
 - a. The isolated relay is for use with HVAC control, data logging and other control options.
- E. Power Pack:
1. Self-contained transformer and relay module.
 2. Dry contacts capable of switching:
 - a. 20 amp ballast load, 13 amp incandescent, 1 HP at 120 VAC, 60 Hz.
 - b. 20 amp ballast at 277 VAC, 60 Hz.
 3. 24 VDC, 100 mA output.
 4. Capable of parallel wiring without regard to AC phases on primary.
 5. Used as a standalone, low voltage switch or wired to sensor for auto control.
 6. Low voltage Teflon coated leads, rated for 300 V, suitable for use in plenum applications.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Mount devices where indicated on the Drawings and as scheduled in Specification Section 26 05 00.
- C. See Specification Section 26 05 33 for device outlet box requirements.
- D. Where more than one receptacle is installed in a room, they shall be symmetrically arranged.
- E. Provide blank plates for empty outlets.

- F. Occupancy Sensors:
1. Locations and quantity of sensors shown on the Drawings are diagrammatic and indicate only the rooms and spaces to be provided with sensors.
 2. Verify sensor type, quantity, location, aiming and sensitivity with manufacturer's recommendations.
 3. All controlled spaces shall be tested to insure 90 to 100 PCT coverage of the controlled space.
 - a. If test fails, adjust sensitivity, re-aim, relocate, and/or add sensor(s) as required at no cost to Owner.
 4. Power supplies and slave units if required shall be located above accessible ceilings.

END OF SECTION

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SECTION 26 28 00

OVERCURRENT AND SHORT CIRCUIT PROTECTIVE DEVICES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Low voltage circuit breakers.
 - 2. Low voltage fuses.
- B. Related Specification Sections include but are not necessarily limited to:
 - 1. Division 00 - Procurement and Contracting Requirements.
 - 2. Division 01 - General Requirements.
 - 3. Section 26 05 00 - Electrical - Basic Requirements.
 - 4. Section 26 08 13 - Acceptance Testing.

1.2 QUALITY ASSURANCE

- A. Referenced Standards:
 - 1. Institute of Electrical and Electronics Engineers, Inc. (IEEE):
 - a. 242, Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems (Buff Book).
 - b. 399, Recommended Practice for Industrial and Commercial Power Systems Analysis (Brown Book).
 - c. C37.13, Standard for Low-Voltage AC Power Circuit Breakers Used in Enclosures.
 - d. C37.16, Low-Voltage Power Circuit Breakers and AC Power Circuit Protectors - Preferred Ratings, Related Requirements, and Application Recommendations.
 - e. C37.17, Trip Devices for AC and General Purpose DC Low Voltage Power Circuit Breakers.
 - 2. National Fire Protection Association (NFPA):
 - a. 70, National Electrical Code (NEC).
 - 3. Underwriters Laboratories, Inc. (UL):
 - a. 489, Standard for Safety Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit-Breaker Enclosures.
 - b. 943, Standard for Safety for Ground-Fault Circuit-Interrupters.
 - c. 1066, Standard for Low-Voltage AC and DC Power Circuit Breakers Used in Enclosures.

1.3 SUBMITTALS

- A. Shop Drawings:
 - 1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
 - 2. Product technical data including:
 - a. Provide submittal data for all products specified in PART 2 of this Specification Section.
 - b. See Specification Section 26 05 00 for additional requirements.
- B. Contract Closeout Information:
 - 1. Operation and Maintenance Data:
 - a. See Specification Section 01 33 04 for requirements for the mechanics, administration, and the content of Operation and Maintenance Manual submittals.
- C. Reports:
 - 1. As-left condition of all circuit breakers that have adjustable settings.
 - 2. Short circuit calculations study report.
 - 3. Overcurrent protective coordination study report.

4. Arc Flash Hazard Analysis and report.
- D. Certifications
1. PE stamped and signed reports to be submitted for review and approval.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
1. Circuit breakers:
 - a. Eaton.
 - b. General Electric Company.
 - c. Square D Company.
 - d. Siemens.
- B. Submit request for substitution in accordance with Specification Section 01 25 13.

2.2 CIRCUIT BREAKERS

- A. Molded Case Type:
1. General:
 - a. Standards: UL 489.
 - b. Unit construction.
 - c. Over-center, toggle handle operated.
 - d. Quick-make, quick-break, independent of toggle handle operation.
 - e. Manual and automatic operation.
 - f. All poles open and close simultaneously.
 - g. Three position handle: On, off and tripped.
 - h. Molded-in ON and OFF markings on breaker cover.
 - i. One-, two- or three-pole as indicated on the Drawings.
 - j. Current and interrupting ratings as indicated on the Drawings.
 2. Thermal magnetic type:
 - a. Inverse time overload and instantaneous short circuit protection by means of a thermal magnetic element.
 - b. Frame size 150 amp and below:
 - 1) Non-interchangeable, non-adjustable thermal magnetic trip units.
 - c. Frame sizes 225 to 400 amp (trip settings less than 400A):
 - 1) Interchangeable and adjustable instantaneous thermal magnetic trip units.
 - d. Ground Fault Circuit Interrupter (GFCI) Listed:
 - 1) Standard: UL 943.
 - 2) One- or two-pole as indicated on the Drawings.
 - 3) Class A ground fault circuit.
 - 4) Trip on 5 mA ground fault (4-6 mA range).
 3. Solid state trip type:
 - a. Inverse time overload, instantaneous short circuit and ground fault protection by means of a solid state trip element, associated current monitors and flux shunt trip mechanism.
 - b. Frame size 400 amp to 1200 amp (trip settings between 400 and 1200A):
 - 1) Standard rating.
 - 2) Interchangeable current sensor or rating plug.
 - 3) Adjustable long time pick-up setting.
 - a) Adjustable from 50 to 100 PCT of the current sensor or rating plug.
 - 4) Adjustable short time pick-up setting.
 - 5) Adjustable instantaneous pick-up.
 - 6) Fixed ground fault pick-up, when indicated on the Drawings.

4. Motor circuit protector:
 - a. Adjustable instantaneous short circuit protection by means of a magnetic or solid state trip element.
 - b. Sized for the connected motor.

2.3 FUSES

- A. UL Class RK-1 fuses:
 1. Standard: UL 248-1 and UL 248-12.
 2. Single-element fast-acting and current limiting rejection type.
 3. Ratings: 250 and 600 V, 1/10-600 amps and 200,000 RMS AIC symmetrical.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Current and interrupting ratings as indicated on the Drawings.
- B. Series rated systems not acceptable.
- C. Devices shall be ambient temperature compensated.
- D. Circuit Breakers:
 1. Molded case circuit breakers shall incorporate the following, unless indicated otherwise on the Drawings:
 - a. Frame sizes 400 amp and less with trip setting less than 400A shall be thermal magnetic type.
 - b. Frame sizes 400 amp and larger shall be solid state trip type.
 - c. Frame sizes 1000 amp and above shall include integral ground fault protection, when indicated on the Drawings.
 - d. Motor circuit protectors sized for the connected motor.
- E. Fuses:
 1. UL Class RK-1 (fast acting): Use where indicated.

3.2 FIELD QUALITY CONTROL

- A. Coordinated Power System Protection:
 1. Prepare a study to demonstrate that the equipment and system constructed within the scope of these Contract Documents, meet the specified requirements for equipment ratings, coordination and protection.
 2. Perform the studies in accordance with IEEE 242 and IEEE 399.
 3. Include the name of the software developer, software package and software version number in the computer generated studies.
 4. System short circuit study report:
 - a. Begin the study at the connection point of the new equipment to the existing equipment and extend down the system through all buses.
 - 1) Perform a balanced three-phase fault, bolted line-to-line fault and line-to-ground fault study.
 - b. Prepare a one-line diagram to show the electrical system buses, transformers and all sources of fault current including generators and motors.
 - c. Utilize manufacturer's data for the actual proposed equipment (e.g., transformer impedance).
 - d. Coordinate the available utility fault current with the power utility company.
 - e. Show input data in tabular form in the report and/or on the one-line diagram.
 - 1) Input data shall include but is not limited to:
 - a) Utility fault current or MVA and X/R ratio.
 - b) Bus voltages.
 - c) Conductor sizes and type of conduit.
 - d) Generator and motor sizes and contributions.

- e) Transformer sizes and impedances.
- f. Show available fault current at each bus in tabular form in the report and/or on the one-line diagram.
- g. Perform studies for both normal power and emergency/standby power scenarios.
- 5. System protective coordination study report:
 - a. Begin the study at the protective device upstream of the connection point of the new equipment and extend down the system through all buses as required to ensure a coordinated power system.
 - b. Demonstrate that the maximum possible degree of selectivity has been obtained between devices specified for the protection of equipment and conductors from damage from overloads and fault conditions.
 - 1) Where necessary, an appropriate compromise shall be made between system protection and service continuity.
 - 2) Consider system protection and service continuity to be of equal importance.
 - c. Prepare a one-line diagram to show the electrical system buses, transformers and protective devices.
 - d. Utilize manufacturer's data for the actual proposed protective devices.
 - e. Summarize the coordination study, conclusions and recommendations.
 - 1) As a minimum, include the following:
 - a) The manufacturer's information used to prepare the study.
 - b) Assumptions made during the study.
 - c) Recommended taps and settings of all adjustable devices in tabulated form.
 - d) Composite coordination time-current curves on log-log paper showing:
 - (1) That the settings for each protective device will provide protection and selectivity.
 - (2) Identify each curve.
 - (3) Cable and equipment damage points.
 - (4) Circuit interrupting device operating and interrupting times.
 - (5) One-line sketch of the part of the system being investigated.
 - (6) Include as many curves as possible on a graph while maintaining readability.
 - e) Position time-current curves for each device to provide for maximum selectivity to minimize system disturbances during fault clearing.
 - f) Advise the Engineer of potential coordination problems discovered during the study and include recommendations to resolve the problem.
 - (1) Provide time-current curves for the "as found" and "proposed" conditions for upgrade/retrofit projects.
 - g) Submit the report for approval 90 days prior to equipment energization.
 - 6. Arc Flash Hazard Analysis:
 - a. Utilize short circuit and protective device coordination studies results to conduct an arc flash hazard analysis.
 - 1) The analysis shall be performed both with all motors rated at 50 HP and above on-line for all system configurations and with all motors off-line. Arc flash analysis shall be done for all 208 volt equipment and above.
 - 2) Calculate the arc flash energy based upon the breaker/fuse time-current curves. Whichever upstream device operates the fastest will be used to determine the incident energy and flash protection boundary.
 - 3) When calculating the arc flash energy on a piece of equipment, such as an MCC or switchboard, there are two considerations:
 - a) What is the energy released if a fault were to occur on the main bus.
 - b) What is the energy released if a fault were to occur on the source side of the main breaker within the equipment.
 - 4) Determine the arc flash incident energy. Locations that have high incident energy levels will be identified. Reduce Arc Flash Hazard to Risk category 2 (8 cal/cm²) or lower, where possible.

- 5) Revise the coordination study to lower the breaker trip times and thus the incident energy.
 - 6) Determine the worst case incident energy level from all the operating modes for each piece of equipment.
 - 7) For those instances where the risk category is above 2, recommend Arc Flash Mitigation options that may be used to lower the risk category.
 - 8) Analysis shall use the latest information from approved shop drawings.
- b. Based on analysis, recommend the level of personal protective equipment (PPE) for each electrical panel/component.
 - c. Using power system analysis software prepare report and print Arc Flash Hazard Warning Labels for the electrical system include the flash hazard PPE category, incident energy level, assumed working distance, and flash protection boundary on all arc flash labels.
 - 1) In addition to arc flash information, it is recommended that the label contain shock protection information, including the voltage, shock hazard PPE class, and prohibited, restricted, and limited approach boundary distances.
 - 2) Labels shall be printed and installed after the arc flash report has been approved.
 - 3) Label installation location shall be coordinated with Owner and approved by Owner prior to installation of labels.
- B. Adjustable Circuit Breakers:
1. Set all circuit breaker adjustable taps as defined in the coordination study, except adjust motor circuit protectors per the motor nameplate and NFPA 70 requirements.
- C. Testing:
1. Acceptance testing: See Specification Section 26 08 13.

END OF SECTION

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SECTION 26 28 16

SAFETY SWITCHES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Safety switches.
- B. Related Specification Sections include but are not necessarily limited to:
 - 1. Division 00 - Procurement and Contracting Requirements.
 - 2. Division 01 - General Requirements.
 - 3. Section 26 05 00 - Electrical - Basic Requirements.
 - 4. Section 26 28 00 - Overcurrent and Short Circuit Protective Devices.

1.2 QUALITY ASSURANCE

- A. Referenced Standards:
 - 1. National Electrical Manufacturers Association (NEMA):
 - a. 250, Enclosures for Electrical Equipment (1000 Volts Maximum).
 - b. KS 1, Heavy Duty Enclosed and Dead-Front Switches (600 Volts Maximum).
 - 2. Underwriters Laboratories, Inc. (UL):
 - a. 98, Enclosed and Dead-Front Switches.

1.3 SUBMITTALS

- A. Shop Drawings:
 - 1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
 - 2. Product technical data:
 - a. Provide submittal data for all products specified in PART 2 of this Specification Section.
 - b. Provide a Summary Table or use Exhibit A that associates the safety switch features with connected equipment tag number. Exhibit A indicates minimum data required.
 - c. See Specification Section 26 05 00 for additional requirements.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with the Contract Documents, the following safety switch manufacturers are acceptable:
 - 1. Eaton.
 - 2. General Electric.
 - 3. Square D by Schneider Electric.
 - 4. Siemens Corporation.
 - 5. Appleton by Emerson Electric Co.
 - 6. Crouse-Hinds by Eaton.
 - 7. Killark by Hubbell.

2.2 SAFETY SWITCHES

- A. General:
 - 1. Non-fusible or fusible as indicated on the Drawings.
 - 2. Suitable for service entrance when required.
 - 3. NEMA Type HD heavy-duty construction.
 - 4. Switch blades will be fully visible in the OFF position with the enclosure door open.

5. Quick-make/quick-break operating mechanism.
 6. Deionizing arc chutes.
 7. Manufacture double-break rotary action shaft and switchblade as one common component.
 8. Clear line shields to prevent accidental contact with line terminals.
 9. Operating handle (except NEMA 7 rated enclosures):
 - a. Red and easily recognizable.
 - b. Padlockable in the OFF position.
 - c. Interlocked to prevent door from opening when the switch is in the ON position with a defeater mechanism.
- B. Ratings:
1. Horsepower rated of connected motor.
 2. Voltage and amperage: As indicated on the Drawings.
 3. Short circuit withstand:
 - a. Non-fused: 10,000A.
 - b. Fused: 200,000A.
- C. Accessories, when indicated in PART 3 of this Specification Section or on the Drawings:
1. Neutral kits.
 2. Ground lug kits.
 3. Auxiliary contact kits:
 - a. Opens before main switch.
 - b. Rated 10A at 125/250 VAC.
 - c. One N.O. and one N.C. contact.
- D. Enclosures:
1. NEMA 3R rated:
 - a. Body and cover: Sheet steel finished with rust inhibiting primer and manufacturers standard paint inside and out.
 - b. With or without knockouts, hinged and lockable door.
 2. NEMA 4 rated:
 - a. Body and cover: Sheet steel finished with rust inhibiting primer and manufacturers standard paint inside and out.
 - b. No knockouts, external mounting flanges, hinged, gasketed and lockable door.
 3. NEMA 4X rated (metallic):
 - a. Body and cover: Type 304 or 316 stainless steel.
 - b. No knockouts, external mounting flanges, hinged and gasketed door.
 4. NEMA 7 rated:
 - a. Cast gray iron alloy or copper-free aluminum with manufacturer's standard finish.
 - b. Drilled and tapped openings or tapered threaded hub.
 - c. Gasketed cover bolted-down with stainless steel bolts.
 - d. External mounting flanges.
 - e. Operating handle padlockable in the OFF position.
 5. NEMA 12 rated:
 - a. Body and cover: Sheet steel finished with rust inhibiting primer and manufacturers standard paint inside and out.
 - b. No knockouts, external mounting flanges, hinged and gasketed door.
- E. Overcurrent and short circuit protective devices:
1. Fuses.
 2. See Specification Section 2628 00 for overcurrent and short circuit protective device requirements.
- F. Standards: NEMA KS 1, UL 98.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install as indicated and in accordance with manufacturer's instructions and recommendations.
- B. Install switches adjacent to the equipment they are intended to serve unless otherwise indicated on the Drawings.
- C. Provide auxiliary contact kit on local safety switches for motors being controlled by a variable frequency drive.
 - 1. The VFD is to be disabled when the switch is in the open position.
- D. Permitted uses of NEMA 3R enclosure:
 - 1. Surface mounted in exterior location for HVAC equipment only.
- E. Permitted uses of NEMA 4 enclosure:
 - 1. Surface mounted in areas designated as wet.
- F. Permitted uses of NEMA 4X metallic enclosure:
 - 1. Surface mounted in areas designated as wet and/or corrosive.
- G. Permitted uses of NEMA 7 enclosure:
 - 1. Surface mounted in areas designated as Class I hazardous.
 - 2. Provide PVC coating in corrosive areas when PVC coated conduit is used.
- H. Permitted uses of NEMA 12 enclosure:
 - 1. Surface mounted in areas designated as dry in non-architecturally finished areas.

END OF SECTION

SECTION 26 29 23
VARIABLE FREQUENCY DRIVES - LOW VOLTAGE

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Variable frequency drives (VFDs) for operation of inverter duty motors.
- B. Related Specification Sections include but are not necessarily limited to:
 - 1. Division 00 - Procurement and Contracting Requirements.
 - 2. Division 01 - General Requirements.
 - 3. Section 10 14 00 - Identification Devices.
 - 4. Section 26 05 00 - Electrical - Basic Requirements.
 - 5. Section 01 61 03 - Equipment - Basic Requirements.

1.2 QUALITY ASSURANCE

- A. Referenced Standards:
 - 1. American National Standards Institute (ANSI).
 - 2. ETL Testing Laboratories (ETL).
 - 3. Institute of Electrical and Electronics Engineers, Inc. (IEEE):
 - a. 399, Recommended Practice for Industrial and Commercial Power Systems Analysis.
 - b. 519, Recommended Practices and Requirements for Harmonic Control in Electrical Power Systems.
 - c. C62.41, Recommended Practice for Surge Voltages in Low-Voltage AC Power Circuits.
 - 4. National Electrical Manufacturer's Association (NEMA):
 - a. 250, Enclosures for Electrical Equipment (1000 Volts Maximum).
 - b. MG 1, Motors and Generators.
 - 5. National Fire Protection Association (NFPA):
 - a. 70, National Electrical Code (NEC):
 - 1) Article 430, Motors Motor Circuits, and Controllers..
 - 6. Occupational Safety and Health Administration (OSHA).
 - 7. Underwriters Laboratory, Inc. (UL):
 - a. 508, Standard for Industrial Control Equipment.
 - b. 508A, Standard for Industrial Control Panels.
- B. Qualifications:
 - 1. Provide drives that are listed and labeled by UL, ETL, or other Nationally Recognized Testing Laboratory (NRTL) as defined by OSHA regulations, or that have been inspected and subsequent field-labeled by such NRTL.
 - 2. Where listed drives and other components are installed in a common enclosure, the assembly shall be listed and labeled per UL 508 and UL 508A or equivalent NRTL standard.
 - a. Entire assembly shall be affixed with a UL 508A label "Listed Enclosed Industrial Control Panel" or equivalent NRTL label prior to shipment to the jobsite.
 - 3. VFD Supplier shall maintain an authorized service organization within 300 miles of the Project Site.
- C. Coordination:
 - 1. The intent of this Specification Section is to allow the VFD manufacturer to provide the best solution for the harmonic and motor protection outlined herein.
 - a. This solution shall include, but not be limited to, all aspects of the distribution system including standby generation, motor feeder cable type and a available floor space.
 - 2. Motor and VFD coordination: See Specification Section 01 61 03.

3. VFD shall be supplied complete with all required control components.
 - a. Provide control as indicated:
 - 1) On the electrical drawings.
 - 2) As specified in this Specification Section.
 - 3) As specified in the process control system loop descriptions.
 - a) See Specification Section 4090 05.
 - b. VFD manufacturer shall review the application (including distance from VFD to motor) and provide, at no additional cost to the Owner, the hardware and software necessary to allow the VFD to control the driven equipment motor over its required operating range.
 - 1) These may include, but are not limited to, analog and digital interface modules, communication interface modules, switches, lights and other devices.
 - c. Coordinate control devices with devices furnished with driven equipment such as vibration switches, thermal sensors, leak detectors, etc.
4. Verify plan dimensions with equipment space requirements as indicated on the Drawings.
 - a. Equipment which exceeds the allotted maximum dimensions may not be acceptable.
 - b. Equipment which reduces clear work space below the minimums established by the NFPA 70 will not be acceptable.

1.3 DEFINITIONS

- A. Variable Torque (VT):
 1. Defines a load characteristic in which the torque delivered from the motor to the load is reduced as speed is reduced below full rated.
 2. This type of load permits the VFD and the motor to operate at reduced output current at reduced speed.
- B. Constant Torque (CT):
 1. Defines a load characteristic in which the torque delivered from the motor to the load remains constant as speed is varied.
 2. This type of load requires the VFD to be able to continuously deliver rated output current over the entire speed range.
- C. Constant Horsepower:
 1. Defines a load characteristic in which the torque delivered from the motor to the load is reduced as the speed is increased.
 2. This characteristic is required for operation of the VFD and motor above rated frequency to maintain output current within the rated value.
- D. Inverter Duty Motor: An AC induction motor complying with all requirements of NEMA MG 1 Part 31 for definite-purpose inverter-fed motors.
- E. Standard Motor: An AC induction motor that fails to comply with one or more requirements of NEMA MG 1 Part 31.
- F. Low Voltage: 600 VAC or less.

1.4 SUBMITTALS

- A. Shop Drawings:
 1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
 2. Provide a schedule for each VFD including the following information:
 - a. Equipment Tag Number.
 - b. VFD Complete Catalog Number.
 - c. VFD Amp Frame Size.
 - d. Variable or Constant Torque Rating Basis.
 - e. Rated Input Current.
 - f. Rated Continuous Output Current.
 - g. Rated Short Circuit Current.
 - h. VFD cable type specified (shielded or non-shielded).

- i. VFD Maximum Motor Lead Length for the type of cable used.
 - j. Motor Manufacturer.
 - k. Motor Frame Size.
 - l. Motor Full Load Amps.
 - m. Motor Service Factor.
 - n. As installed motor Lead Length.
 - o. VFD options provided to meet harmonic or motor protection specifications.
3. Submit VFD Shop Drawings concurrently with driven equipment and motor Shop Drawings.
 4. Product technical data:
 - a. Complete electrical ratings and performance specifications confirming compliance with specified ratings and performance.
 - b. Maximum rate of heat rejection from VFD and all related components and associated cooling requirements.
 - c. Manufacturer's installation instructions.
 - d. Manufacturer's programming and operating instructions.
 - e. See Specification Section 2605 00 for additional requirements.
 5. Fabrication and/or layout drawings:
 - a. Top, front and side exterior views, with details showing maximum overall dimensions of enclosure, mounting provisions and conduit/cable entry provisions.
 - b. Identify minimum clearances from other VFDs or electrical equipment required for proper cooling at top, bottom, side and back of enclosure.
 - c. Three-line diagrams showing AC schematic of VFD, input, output and bypass devices including device ratings.
 - d. Interior layout drawings showing location of all components within enclosure, field wiring terminal boards, and power and grounding connections.
 - e. Field wiring diagrams showing locations and sizes of all electrical connections, ground terminations, and requirements for shielded wire usage or any other special installation considerations.
 - f. Short Circuit Current Rating (SCCR) nameplate marking per NFPA 70, include any required calculations.
 6. Certifications:
 - a. Submit with Shop Drawings:
 - 1) Identification and location of closest authorized service organization.
 - 2) Harmonic analysis at each PCC per Harmonic Protection Requirements Article.
 - b. Submit prior to shipment:
 - 1) Certified factory test reports confirming compliance with specified requirements.
 - c. Submit after installation:
 - 1) Certified field service reports showing:
 - a) Each VFD is operational.
 - b) Each VFD and its driven equipment motor are compatible.
 - c) Each VFD responds correctly to the input control signals.
 - d) Critical frequencies of the drive system and that the VFD has been set to lockout these frequencies.
 - e) Measured harmonic levels per Harmonic Protection Requirements Article.
 - f) Measured motor terminal peak voltages per Motor Protection Requirements Article.
- B. Contract Closeout Information:
1. Operation and Maintenance Data:
 - a. See Specification Section 01 33 04 for requirements for the mechanics, administration, and the content of Operation and Maintenance Manual submittals.
 2. Approved copy of VFD schedule per Submittals Article.
 3. Manufacturer's instruction manuals.
 4. Troubleshooting procedures with a cross-reference between symptoms and corrective recommendations.

5. Connection data to permit removal and installation of recommended smallest field-replaceable parts.
6. Recommended spare parts list.
7. Commissioning sheets showing “as-left” values of all user-programmable or adjustable drive parameters.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
 1. Allen Bradley.
 2. ASEA Brown Bovari (ABB).
 3. Eaton.
 4. Danfoss.
 5. General Electric Company.
 6. Siemens/Robicon.
 7. Siemens.
 8. Square D Company.
 9. Toshiba.
 10. Yaskawa.
- B. Submit request for substitution in accordance with Specification Section 01 25 13.

2.2 GENERAL

- A. VFDs shall consist of a rectifier-DC bus-inverter combination producing a sine-coded pulse-width-modulated (PWM) output voltage waveform.
- B. VFDs, whether installed in motor control center (MCC) construction or separately-mounted, shall constitute a complete combination motor controller per NFPA 70, Article 430 and shall provide the following per the requirements of that article without the addition of any external components or devices.
 1. Motor control.
 2. Motor overload protection.
 3. Motor and motor branch circuit short circuit and ground fault protection.
 4. Motor and controller disconnecting means.
- C. It is the intent of this Specification that VFDs shall be an “engineered” or “configured” drive package in which the VFD chassis, all input, output and bypass power devices, VFD accessories, ancillary switches, contactors, relays, and related control devices are selected, furnished, factory-assembled and -tested by the VFD manufacturer in a single enclosure requiring only connection of the power supply circuit, motor branch circuit, and external control wiring in the field.

2.3 PERFORMANCE AND DESIGN REQUIREMENTS

- A. Application:
 1. VFD(s) shall be of sufficient capacity and shall provide a quality of output waveform for stepless motor control from 10 to 100 PCT of base speed of the driven equipment.
 2. VFDs shall be compatible with:
 - a. Inverter duty induction motors.
 3. VFDs shall be suitable for Constant Torque (CT) or Variable Torque (VT) applications.
 - a. VFD manufacturer shall coordinate with the manufacturer of the driven equipment to identify CT and VT applications.
 4. VFDs shall be designed to operate successfully under the following site conditions:
 - a. Ambient:
 - 1) Temperature: 0-40 DEGC.
 - 2) 95 PCT non-condensing relative humidity.

- b. Elevation: Less than 3,300.
 - c. Power supply characteristics:
 - 1) 480Vac, 3 PH, 60 Hz, 3 wire, (± 10 PCT).
 - 2) Effectively grounded.
- B. Ratings and Performance Specifications:
1. Voltage rating:
 - a. Nominal: 480] VAC, 3 PH, 60 Hz.
 - b. Range for continuous full load operation: ± 10 PCT of nominal.
 - c. Voltage imbalance tolerance for full load operation: 3 PCT minimum.
 2. Current ratings:
 - a. Continuous:
 - 1) Equal to or greater than the motor nameplate full load.
 - b. Short-term overload:
 - 1) VT: 110 PCT for 1 minute.
 - 2) CT: 150 PCT for 1 minute.
 - 3) Permissible for 1 minute every 10 minutes continuously.
 - c. Short circuit:
 - 1) As indicated on the Drawings.
 - 2) Where a short circuit rating is not indicated or specified for individual VFDs, each VFD shall have a rating not less than indicated on the Drawings for the MCC, switchboard or panelboard the VFD is supplied from.
 - 3) Where specified short circuit rating indicates additional input impedance is required to protect semiconductors, provide input AC line reactors, whether required to meet harmonic performance specifications or not.
 3. Efficiency:
 - a. 97 PCT, minimum, at full speed and full load.
 - b. 93 PCT, minimum at 1/2 speed and full load.
 4. Displacement power factor:
 - a. 95 PCT, minimum from 50 PCT to 100 PCT speed and load.
 5. Efficiency and power factor criteria apply from the input terminals to the output terminals of the VFD alone, excluding losses of input and output power circuit accessories.
 6. Frequency drift:
 - a. $+0.5$ PCT of set frequency.
 7. Speed regulation (motor dependent): 3 PCT.
 8. Speed range: 10:1.
 9. Control type:
 - a. Volts/Hertz ratio; constant over the entire operating range of the VFD except:
 - 1) When operating under voltage boost.
 - 2) At frequencies over 60 Hz.
- C. Operational Features:
1. Insensitive to input phase sequence.
 2. Continued operation with momentary voltage dips of 25 PCT of rated voltage, or single phase condition: 4 SEC, minimum.
 3. Controls power loss ride-through: 500 MSEC, minimum.
 4. Electronic reversing.
 5. DC injection braking.
 6. Anti-windmilling: Synchronization of VFD starting frequency with spinning or coasting load, forward or reverse.
 7. Critical frequency band lockout:
 - a. Minimum of three settings.
 - b. Adjustable bandwidth, 1 - 5 Hz.
 8. Capable of operating without the motor connected for start-up and troubleshooting.

- D. The VFD shall be provided with the following minimum user-programmable parameters:
1. Carrier frequency.
 2. Independent maximum and minimum speeds for forward and reverse operation.
 3. Start frequency and hold time.
 4. Independent linear acceleration and deceleration time.
 5. Preset "jog" speed.
 6. Three critical frequency bands.
 7. One preset speed selectable by logic input.
 8. Volts/Hertz ratio.
 9. Voltage boost, magnitude and frequency range.
 10. Process controller gain, offset and bias.
 11. Current limit.
 12. Overcurrent pickup.
 13. Overcurrent delay.
 14. Ground fault pickup.
 15. DC injection level and time.
- E. The VFD shall be designed such that the power circuit components are fully protected from line side disturbances and load side faults:
1. General:
 - a. Shutdown conditions associated with supply circuit conditions which can be corrected external to the VFD-motor system shall be provided with automatic reset, with shutdown cause logged in memory:
 - 1) Input under voltage.
 - 2) Input over voltage.
 - 3) Input under frequency.
 - 4) Input over frequency.
 - 5) Input Phase loss.
 - 6) DC Bus under voltage.
 - b. Shutdown conditions which indicate overload or fault within the VFD, the output circuit, or the motor shall require local manual reset at the VFD, requiring operator intervention.
 - 1) Over temperature.
 - 2) Blown fuse.
 - 3) Component failure.
 - 4) Overload.
 - 5) Short circuit.
 - 6) Ground fault.
 - 7) DC Bus over voltage.
 - 8) External safety input (e.g., motor thermal protection).
 - 9) Logic fault.
 - c. When automatic shutdown occurs, VFD shall restart immediately upon reset, whether automatic or manual.
 - d. VFD shall hold cause of trip data for a minimum of four shutdowns in memory.
 - 1) Data to be accessible through the keypad, local communication link and remotely.
 2. Input protection:
 - a. Input circuit breaker or current-limiting fuses with externally operable disconnect.
 - 1) Fault current interrupting rating equal to or greater than the specified withstand rating of the VFD.
 - 2) Handle padlockable in the OFF position.
 - b. Provide full protection for semiconductors integral to the VFD; units requiring current-limiting fuses or circuit breakers in the supply circuit are not acceptable.
 - c. Incoming line transient suppression.
 - 1) 6000V peak per IEEE C62.41.
 - 2) Phase-to-phase and phase-to-ground protection.
 - d. Sustained over voltage trip.

3. Internal protection:
 - a. Surge suppression and power device snubbers.
 - b. Power devices rated at 2.5 times line voltage.
 - c. Instantaneous over current trip.
 - d. DC bus over voltage trip.
 - e. Power device over temperature trip.
 - f. Control logic circuit malfunction trip.
4. Output protection:
 - a. Inverse-time overload trip:
 - 1) UL Class 10 characteristic.
 - b. Over voltage trip.
 - c. Over frequency trip.
 - d. Short circuit trip.
 - 1) Line to line and line to ground.
 - e. Ground fault trip.

2.4 OPERATOR AND REMOTE CONTROL INTERFACE

- A. Drive controls shall be microprocessor-based with on-board human machine interface and both local and remote digital communications capability.
 1. All monitoring and control functions, other than those shutdowns specified to be manual reset only, shall be available both locally and remotely.
- B. Control circuits shall be 120 VAC or 24 VAC or 24 VDC.
 1. 120 VAC supplied by CPT in the VFD.
 - a. CPT shall have minimum additional capacity of 60 VA greater than that required by control devices.
 - b. CPT shall have two fuses on the primary side and one fuse on the secondary side.
 - c. CPT shall have surge protection on the primary side independent of any other surge protection in the VFD.
 2. 24 VAC or 24 VDC supplied by Class 2 power supply in the VFD.
 - a. Power supply shall have minimum additional capacity of 33 PCT greater than that required by control devices.
 - b. Provide two current-limiting fuses on the AC supply to the power supply.
 - c. Power supply shall have surge protection on the primary side independent of any other surge protection in the VFD.
- C. Operator Interface:
 1. Door mounted sealed keypad, membrane type with LED or LCD display.
 - a. Messages shall be in English and engineering units.
 - b. Drive operating parameters shall be programmable.
 - c. Menu driven.
 - d. Password security.
 - e. Display fault and diagnostic data.
 - f. Operating parameters, fault and diagnostic data maintained in non-volatile memory with historic log of fault and diagnostic data.
 - g. Gold plated plug-in contacts.
 2. Provide indication and control interface, integral in the keypad, as required in the sequence of operation and Drawings.
 - a. Minimum indications:
 - 1) Run.
 - 2) Stop.
 - 3) Ready.
 - 4) Alarm.
 - 5) Fault.
 - 6) Local control.
 - 7) Remote control.

- 8) Control source local.
- 9) Control source remote.
- 10) Speed indication.
- b. Minimum control functions:
 - 1) Local/Remote switch.
 - 2) Stop button.
 - 3) Start button.
 - 4) Reset button.
 - 5) Speed control buttons.
- 3. Diagnostic indicators located externally on the face of the drive shall show the type of fault responsible for drive warning, shutdown or failure.
 - a. On occurrence of more than one condition, each shall be recorded or indicated by the diagnostics.
- D. Remote Control Interface:
 - 1. Analog and discrete inputs:
 - a. As indicated on the Drawings.
 - 2. Analog and discrete outputs:
 - a. As indicated on the Drawings.
 - 3. Contacts:
 - a. Contacts shall be rated 2 A inductive at 120 VAC.
 - b. All contacts shall be wired to field wiring terminal boards.
 - 4. Drive shutdown on external fault input:
 - a. Provide isolated input for dry contact from external motor or system safety devices to cause immediate shutdown of VFD.
 - b. Safety shutdown to be operable in all operating modes of drive, including local operation from keypad.
 - c. Local safety switch, to driven equipment, a auxiliary contact to lock-out VFD from running when safety switch is open.
 - 5. Network communications capability:
 - a. Provide VFD with communication card, protocol and required programming for digital communication of all VFD program and operational parameters to plant control system via:
 - 1) Ethernet/IP.

2.5 HARMONIC PROTECTION REQUIREMENTS

- A. All VFDs shall be capable of satisfactory operation from a source having voltage distortion and notch characteristics identified as acceptable for a “dedicated system” in IEEE 519 Table 10.2.
- B. With all VFDs operating under worst-case harmonic current conditions, and the facility supplied from the utility, the VFDs shall not produce harmonic effects in excess of the following limits at any point of common coupling (PCC).
 - 1. Voltage distortion and notch characteristics: IEEE 519 Table 10.2 for General System.
 - 2. Current distortion: IEEE 519 Table 10.3 based on calculated I_{sc}/I_L at each PCC
- C. PCC shall be considered:
 - 1. Each MCC, switchboard, switchgear, or panelboard supplying a VFD branch circuit.
- D. VFD manufacturer shall determine, for their proposed equipment, uncorrected harmonic distortion levels and mitigation techniques required to meet the specified limits and shall furnish the VFD types and all accessory items and equipment necessary to do so, whether specified herein or not.
- E. VFD manufacturer shall provide a harmonic analysis of the distribution system based on their proposed specific equipment characteristics and mitigation techniques confirming that the specified levels are not exceeded.
 - 1. Analysis shall be based on the methodology of IEEE 519 and IEEE 399.

2. Power system data for analysis shall be taken from the electrical drawings and approved equipment submittals.
 - a. VFDs provided in a package with equipment specified elsewhere, shall be included in the analysis.
- F. Following start-up, with facility at full load operation, provide measurement of harmonic voltage, current and notch characteristics at each PCC according to the requirements of IEEE 519 Section 9.
 1. Values in excess of specified limits require correction by contractor and re-measurement.
 2. Provide certification of compliant measurements as part of Field Service Engineer's final report.

2.6 MOTOR PROTECTION REQUIREMENTS

- A. The VFD shall produce a quality of output waveform adequate to allow the motor to produce rated torque at rated RPM continuously without exceeding the temperature rise given in NEMA MG 1 Table 31-2.
- B. Provide motor overload, short circuit and ground fault protection integral to drive electronics.
- C. The VFD shall not produce voltage spikes in excess of the following values at the motor terminals when operated with the feeder types shown on the Drawings and the actual installed feeder lengths.
 1. If unmitigated voltage peaks exceed the specified limits, provide output line reactors, filters, or other devices as required to meet the specified limits:
 - a. Inverter duty motors: 1280 V.
 - b. Rise time shall be greater than or equal to 0.1 microsecond.
 - c. Motor lead length and data shall be determined by the Contractor based on the actual routing of the conductors.
- D. Following start-up, provide measurement of peak voltage at the terminals of each motor, unless the lead lengths are 10 PCT shorter than the manufacturers published literature for maximum lead length for the type of cable installed.
 1. Values in excess of specified limits require correction by contractor and re-measurement.
 2. Provide certification of compliant measurements as part of Field Service Engineer's final report.

2.7 EQUIPMENT CONSTRUCTION

- A. Fabrication and Assembly:
 1. Each VFD system shall be factory-assembled for installation in an MCC or in an enclosure for remote mounting, and shall utilize interchangeable plug-in printed circuit boards and power conversion components wherever possible.
 - a. Factory assembly shall be performed by the VFD manufacturer or authorized agent.
 - b. Systems fabricated or assembled in whole or in part by parties other than the VFD manufacturer or authorized agent will not be acceptable.
 2. Reactors and/or filters, where required, shall be mounted within the drive enclosure, or with the Engineer's permission may be mounted in a separate enclosure.
 3. Cooling fans, as required, shall be provided to run when drive is running.
 4. Enclosures for separately mounted VFD's:
 - a. NEMA Type 1 for installation in Electrical Rooms.
 - b. NEMA Type 12 for installation in other unclassified areas.
- B. Wiring:
 1. The wiring in the VFD shall be neatly installed in wire ways or with wire ties where wire ways are not practical.
 - a. Where wire ties are used, the wire bundles are to be held at the back panel with a screw-mounted wire tie mounting base.

- b. Bases with a self-sticking back will not be allowed.
 - 2. All plug-in contacts shall be gold-plated.
 - 3. Provide terminal boards for all field wiring and inter-unit connections, including analog signals.
 - a. Provide terminals for shield continuity where required.
 - 4. Terminal blocks shall be complete with marking strip, covers and pressure connectors.
 - a. Non-brittle, interlocking, track-mounted type.
 - b. Screw terminals will not be allowed.
 - c. A terminal for each conductor of external circuits plus one ground for each shielded cable.
 - d. For free-standing panels, 8 IN of clearance shall be provided between terminals and the panel base for conduit and wiring space.
 - e. Not less than 25 PCT spare terminals shall be provided.
 - f. Terminals shall be labeled to agree with identification indicated on the suppliers submittal drawings.
 - g. Individually fuse each control loop or system and all fuses or circuit breakers shall be clearly labeled and located for easy maintenance.
 - 5. All grounding wires shall be attached to the enclosure sheet metal with a ring tongue terminal.
 - a. The surface of the sheet metal shall be prepared to assure good conductivity and corrosion protection.
 - 6. Wiring shall not be kinked or spliced and shall have markings on both ends or be color coded.
 - a. Markings or color code shall match the manufacturer's drawings.
 - 7. With the exception of electronic circuits, all interconnecting wiring and wiring to terminals for external connection shall be stranded copper, type MTW or SIS, insulated for not less than 600 V, with a moisture-resistant and flame-retardant covering rated for not less than 90 DegC.
- C. Nameplates:
- 1. All devices mounted on the face of the drive shall be provided with a suitable nameplate as specified in Specification Section 10 14 00.
 - 2. Push buttons, selector switches, and pilot lights shall have the device manufacturer's standard legend plate.
 - 3. Relays, terminals and special devices inside the control enclosure shall have permanent markings to match identification used on manufacturer's wiring diagrams.
- D. Painting: Enclosure, after being phosphate washed, shall be thoroughly cleaned and given at least one (1) coat of rust-inhibiting primer on all inner surfaces prior to fabrication.

2.8 COMPONENTS AND ACCESSORIES

- A. Reactors:
- 1. Impedance: As required.
 - 2. Continuous current: Not less than drive rating.
 - 3. Current overload: 150 PCT for 1 minute.
 - 4. Insulation temperature rating: 180 DEGC.
 - 5. Copper windings.
 - 6. Saturation current rating: 3.5 to 5 times rated current.
 - 7. Hi-potential rating: 2500 VAC line to ground and line to line, for 1 minute.
 - 8. Noise reduction features:
 - a. Epoxy over cast coil.
 - b. Extra dips and bakes of varnish over continuous wound coil.

2.9 SOURCE QUALITY CONTROL

- A. Factory Tests:
 - 1. Conduct all standard tests in accordance with NEMA and ANSI standards to ensure conformance to Specification requirements.

2.10 MAINTENANCE MATERIALS

- A. Provide manufacturer's recommended renewable spare parts (e.g., power and control fuses).
- B. Spare parts utilized during pre-start-up or start-up and demonstration testing shall be immediately restocked, at no cost to the Owner.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install products in accordance with manufacturer's instructions and as indicated on the Drawings.
- B. Provide separately mounted VFD enclosure with Short Circuit Current Rating (SCCR) labeling as required by NFPA 70 and other applicable codes.
 - 1. Determine the SCCR rating by one of the following methods:
 - a. Method 1: SCCR rating meets or exceeds the available fault current of the source equipment when indicated on the Drawings.
 - b. Method 2: SCCR rating meets or exceeds the source equipment's Amp Interrupting Current (AIC) rating as indicated on the Drawings.
 - c. Method 3: SCCR rating meets or exceeds the calculated available short circuit current at the control panel.
 - 2. The source equipment is the switchboard, panelboard, motor control center or similar equipment where the equipment or control panel circuit originates.
 - 3. For Method 3, provide calculations justifying the SCCR rating. Utilize source equipment available fault current or AIC rating as indicated on the Drawings.
- C. Verify the installed motor nameplate electrical requirements do not exceed the VFD capacity.
- D. Provide services of manufacturer's representative to perform start-up services.
- E. The selection of input and output harmonic and voltage spike protection shall also be made on the available physical space.
 - 1. The space available on the Drawings shall not be exceeded.

3.2 START UP

- A. Pre-start-up Services:
 - 1. Shall be completed a minimum of 30 days prior to the start-up and demonstration period described in Specification Section 01 75 00.
 - 2. Shall consist of:
 - a. Physical and electrical installation check.
 - b. Final adjustments and calibration of drive parameters.
 - c. VFD operation from simulated input signals.
 - 3. Shall be complete when VFD(s) are fully operational.
- B. Field Quality Control:
 - 1. Perform field measurement of harmonics at each PCC per Harmonic Protection Requirements Article.
 - a. For each individual VFD.
 - b. For the maximum number of VFDs that will be operational at the same time.
 - c. When all loads are at 75 PCT load minimum.
 - d. Duration: 1 HR minimum.

2. Perform field measurement of the maximum voltage peak at the terminals of each motor fed from a VFD per Motor Protection Requirements Article.
 - a. Use a high speed oscilloscope to produce a plot of Voltage (Y axis) versus Time (X axis).
 - 1) Time shall be measured in microseconds.
 - b. Tests shall be performed at full:
 - 1) Full voltage and speed.
 - 2) Loaded to 75 PCT minimum.
 - 3) Duration: 1 HR minimum.
 3. Record all data necessary for the preparation of required test reports.
- C. Start-up and Demonstration Services:
1. Supervise start-up of all units including recheck of settings made during the pre-start-up tests.
 - a. Perform all work in the presence of the Owner's designated representatives.
 2. Setup all VFDs with carrier frequency at minimum value consistent with proper operation; inform Engineer of carrier frequencies set in excess of 5 kHz and reason for setting.
 3. Simulate operation of the VFD and its associated control and instrumentation system in both the manual and automatic modes.
 - a. Ensure compatibility of VFD with a associated control and instrumentation signals.
 4. Simulate VFD failures and demonstrate troubleshooting aids.
- D. Instruct Owner's designated personnel:
1. Minimum of 8 HRS at the jobsite.
 2. Include both field and classroom instruction.
 3. Instructions shall include proper operation and maintenance procedures including, but not limited to:
 - a. Lubrication.
 - b. Troubleshooting.
 - c. Repair and replacement.
 - d. Parts inventory.
 - e. Maintenance records.

END OF SECTION

SECTION 26 36 00
TRANSFER SWITCHES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Manual transfer switches.
 - 2. Automatic transfer switches used in manual mode while no generator is connected.
- B. Related Sections include but are not necessarily limited to:
 - 1. Division 00 - Procurement and Contracting Requirements.
 - 2. Division 01 - General Requirements.
 - 3. Section 26 05 00 - Electrical - Basic Requirements.

1.2 QUALITY ASSURANCE

- A. Referenced Standards:
 - 1. National Electrical Manufacturers Association (NEMA):
 - a. 250, Enclosures for Electrical Equipment (1000 Volts Maximum).
 - b. KS 1, Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum).
 - 2. Underwriters Laboratories, Inc. (UL):
 - a. 98, Standard for Safety Enclosed and Dead-Front Switches.
 - b. 1008, Standard for Safety Switch Equipment.

1.3 SUBMITTALS

- A. Shop Drawings:
 - 1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
 - 2. Product technical data:
 - a. Provide submittal data for all products specified in PART 2 of this Specification:
 - b. See Section 26 05 00 for additional requirements.
 - 3. Fabrication and/or layout drawings.
 - 4. Certifications:
 - 5. Test reports:
- B. Contract Closeout Information:
 - 1. Operation and Maintenance Data:
 - a. See Specification Section 01 33 04 for requirements for the mechanics, administration, and the content of Operation and Maintenance Manual submittals.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. See Section 26 05 00.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with the Contract Documents, the listed manufacturers are acceptable:
 - 1. Automatic transfer switches:
 - a. Automatic Switch Company.
 - b. Eaton.
 - c. Cummins.
 - d. Kohler.

- e. Onan.
- f. Russelectric.
- g. Zenith Products.

B. Submit request for substitution in accordance with Specification Section 01 25 13.

2.2 AUTOMATIC TRANSFER SWITCH

A. Construction:

1. Electrically operated mechanically held, double throw, air-break type.
2. Silver-surface main contacts and protect by arcing contacts.
3. Switch shall have provisions for visual inspection of switch blades and contacts.
4. Mechanical design will positively open all ungrounded conductors from normal source before connection is made to alternate source and will positively open alternate source before connection is made to normal source.
5. Mechanical interlock to ensure the switch cannot be readily disabled, disconnected, improperly adjusted, removed or otherwise made inoperative.
6. Make all contacts and coils readily accessible for replacement from front of panel without major disassembly.
7. Ratings:
 - a. Continuous duty in both normal and emergency.
 - b. Three-phase, three-pole, four-wire.
 - c. Voltage and current ratings as indicated on the Drawings.
 - d. Short circuit withstand rating:
 - 1) Equal to or greater than the normal source electrical gear.
 - 2) Equal to or greater than the available short-circuit current determined by Short-Circuit Study; see Section 26 28 00.
8. Bus: Tin-plated copper or silver-plated copper.
9. Standards: UL 1008.

B. Operation:

1. Microprocessor based control module.
2. Open transition.
3. Red and green indicating lights with fuses, identification nameplates, and test switch on front to simulate normal power failure at switch.
4. Engine starting contacts and all other auxiliary contacts and accessory devices for functions to be performed.
5. Supervisory voltage relays on each phase of normal source and single phase supervisory voltage and frequency relay for emergency source.
 - a. Normal source voltage sensing.
 - 1) Adjustable pickup from 85-100 PCT of rated voltage, factory set 90 PCT.
 - 2) Adjustable dropout from 75-98 PCT of pickup setting, factory set 85 PCT.
 - b. Emergency source voltage and frequency sensing:
 - 1) Adjustable pickup from 85-100 PCT of rated voltage, factory set 90 PCT.
 - 2) Fixed voltage dropout at 85 PCT of pickup setting.
 - 3) Adjustable pickup from 90-100 PCT of rated frequency, factory set 95 PCT.
 - 4) Fixed frequency dropout at 88 PCT of pickup setting.
6. Time delays:
 - a. Engine start, adjustable from 0 to 10 seconds, factory set at 4 seconds, to avoid unnecessary starting caused by short time outages.
 - b. Transfer to generator, adjustable from 0 to 120 seconds, factory set at 10 seconds.
 - c. Retransfer to normal, adjustable from 2 to 30 minutes, factory set at 15 minutes to avoid erratic operation caused by short time reestablishment of normal source.
 - 1) Automatically bypassed when emergency source fails and normal source is available.
 - d. Generator cool down, adjustable from 0 to 60 minutes, factory set at 10 minutes.

7. Exerciser timer:
 - a. Enable and disable function.
 - b. Selectable to exercise with or without transferring load.
 - c. Adjustable exercise duration from 1 minute to 24 HRS, factory set at 15 minutes.
 - d. Adjustable day of the week exercise setting, factory set for Monday.
 8. Inphase monitor:
 - a. Compare the phase relationship and frequency difference between the normal and emergency sources and permit transfer the first time the sources are within 15 electrical degrees and only if transfer can be accomplished within 60 electrical degrees as determined by monitoring the frequency differences.
 - b. Inphase transfer accomplished if both sources are within 2 Hz of rated frequency and 70 PCT or more of rated voltage.
- C. Enclosure:
1. NEMA 1 rated.
 2. Body and cover: Sheet steel finished with a rust inhibiting primer and manufacturers standard paint inside and out.
 3. No knockouts, hinged and lockable door.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install as indicated and in accordance with manufacturer's recommendations and instructions.
- B. Connect as indicated in one-line diagram.
- C. Mounting of automatic transfer switches:
 1. Floor mounted on 4 IN high concrete pad.

3.2 FIELD QUALITY CONTROL

- A. Automatic Transfer Switch Testing:
 1. Simulate power outage by opening normal source overcurrent device.
 - a. Verify engine generator starts and switch transfers in the specified time.
 2. Close normal source overcurrent device to simulate the return of normal power.
 - a. Verify the switch retransfers and engine generator shuts down in the specified time.
 3. Perform a manual transfer and retransfer.
 4. Verify the indicator lights function properly.

END OF SECTION

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SECTION 26 43 13
LOW VOLTAGE SURGE PROTECTION DEVICES (SPD)

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
1. Type 1 SPD - High exposure locations (switchgear, switchboard, panelboard or motor control center), integrally mounted.
 2. Type 3 SPD - Medium exposure locations (switchboard, panelboard and motor control center), integrally mounted.
- B. Related Sections include but are not necessarily limited to:
1. Division 00 - Procurement and Contracting Requirements.
 2. Division 01 - General Requirements.

1.2 QUALITY ASSURANCE

- A. Referenced Standards:
1. Institute of Electrical and Electronics Engineers, Inc. (IEEE):
 - a. C62.41, Recommended Practice for Surge Voltages in Low-Voltage AC Power Circuits.
 - b. C62.41.1, Guide on the Surge Environment in Low-Voltage (1000V and Less) AC Power Circuits.
 - c. C62.41.2, Recommended Practice on Characterization of Surges in Low-Voltage (1000 V and Less) AC Power Circuits.
 - d. C62.45, Recommended Practice on Surge Testing For Equipment Connected to Low-Voltage (1000V and Less) AC Power Circuits.
 2. Military Standard:
 - a. MIL-STD-220B, Method of Insertion Loss Measurement.
 3. National Electrical Manufacturers Association (NEMA):
 - a. 250, Enclosures for Electrical Equipment (1000 Volts Maximum).
 4. National Fire Protection Association (NFPA):
 - a. 70, National Electrical Code (NEC).
 5. Underwriters Laboratories, Inc. (UL):
 - a. 1283, Standard for Electromagnetic Interference Filters.
 - b. 1449, Standard for Surge Protective Devices.
- B. Qualifications:
1. Provide devices from a manufacturer who has been regularly engaged in the development, design, testing, listing and manufacturing of SPDs of the types and ratings required for a period of 10 years or more and whose products have been in satisfactory use in similar service.
 - a. Upon request, suppliers or manufacturers shall provide a list of not less than three customer references showing satisfactory operation.

1.3 DEFINITIONS

- A. Clamping Voltage:
1. The applied surge shall be induced at the 90 DEG phase angle of the applied system frequency voltage.
 2. The voltage measured at the end of the 6 IN output leads of the SPD and from the zero voltage reference to the peak of the surge.
- B. Let-Through Voltage:
1. The applied surge shall be induced at the 90 DEG phase angle of the applied system frequency voltage.

2. The voltage measured at the end of the 6 IN output leads of the SPD and from the system peak voltage to the peak of the surge.
- C. Maximum Continuous Operating Voltage (MCOV): The maximum steady state voltage at which the SPD device can operate and meet its specification within its rated temperature.
- D. Maximum Surge Current:
1. The maximum 8 x 20 microsecond surge current pulse the SPD device is capable of surviving on a single-impulse basis without suffering either performance degradation or more than 10 PCT deviation of clamping voltage at a specified surge current.
 2. Listed by mode, since number and type of components in any SPD may vary by mode.
- E. MCC: Motor Control Center.
- F. Protection Modes: This parameter identifies the modes for which the SPD has directly connected protection elements, i.e., line-to-neutral (L-N), line-to-line (L-L), line-to-ground (L-G), neutral-to-ground (N-G).
- G. Surge Current per Phase:
1. The per phase rating is the total surge current capacity connected to a given phase conductor.
 - a. For example, a wye system surge current per phase would equal L-N plus L-G; a delta system surge current per phase would equal L-L plus L-G.
 - b. The N-G mode is not included in the per phase calculation.
- H. System Peak Voltage: The electrical equipment supply voltage sine wave peak (i.e., for a 480/277 V system the L-L peak voltage is 679 V and the L-N peak voltage is 392 V).

1.4 SUBMITTALS

- A. Shop Drawings:
1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
 2. Product technical data including:
 - a. Manufacturer's qualifications.
 - b. Standard catalog cut sheet.
 - c. Electrical and mechanical drawing showing unit dimensions, weights, mounting provisions, connection details and layout diagram of the unit.
 - d. Testing procedures and testing equipment data.
 - e. Create a Product Data Sheet for each different model number of SPD provided (i.e., Model XYZ with disconnect and Model XYZ without disconnect, each require a Product Data Sheet).
 - 1) Data in the Product Data Sheet heading:
 - a) SPD Type Number per PART 2 of the Specification.
 - b) Manufacturer's Name.
 - c) Product model number.
 - 2) Data in the Product Data Sheet body:
 - a) Column one: Specified value/feature of every paragraph of PART 2 of the Specification.
 - b) Column two: Manufacturer's certified value confirming the product meets the specified value/feature.
 - c) Name of the nationally recognized testing laboratory that preformed the tests.
 - d) Warranty information.
 - 3) Data in the Product Data Sheet closing:
 - a) Signature of the manufacturer's official (printed and signed).
 - b) Title of the official.
 - 4) Date of signature.

- B. Operation and Maintenance Manuals:
 - 1. See Specification Section 01 33 04 for requirements for:
 - a. The mechanics and administration of submittal process.
 - b. The content of the Operation and Maintenance Manuals.
 - 2. Warranty.

1.5 WARRANTY

- A. Minimum of a five year Warranty from date of shipment against failure when installed in compliance with applicable national/local electrical codes and the manufacturer's installation, operation and maintenance instructions.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
 - 1. Eaton.
 - 2. Square D.
 - 3. ABB/GE.

2.2 GENERAL

- A. Standards: IEEE C62.41.1, IEEE C62.41.2, IEEE C62.45, MIL-STD 220B, UL 1283, UL 1449.

2.3 TYPE 1 SPD

- A. Product:
 - 1. SPD tag number or electrical equipment tag number SPD is connected to MCCs.
 - 2. Integrally mounted in switchgear, switchboards or MCCs.
 - 3. Hybrid solid-state high performance suppression system.
 - a. Do not use a suppression system with gas tubes, spark gaps or other components which might short or crowbar the line resulting in interruption of normal power flow to connected loads.
 - 4. Do not connect multiple SPD modules in series to achieve the specified performance.
 - 5. Designed for parallel connection.
 - 6. Field connection: Use mechanical or compression lugs for each phase, neutral and ground that will accept bus bar or #10 through #1/0 conductors.
 - 7. Device monitor:
 - a. Long-life, solid state, externally visible indicators and Form C dry contact(s) that monitors the on-line status of each mode of the units suppression filter system and power loss in any of the phases.
 - b. A fuse status only monitor system is not acceptable.
- B. Operating Voltage: The nominal unit operating voltage and configuration as indicated on Drawings.
- C. Modes of Protection: All modes.
 - 1. Three phase (delta): L-L, L-G.
 - 2. Three phase (wye): L-N, L-L, L-G and N-G.
 - 3. Single phase (2-pole): L-L, L-N, L-G and N-G.
 - 4. Single phase: L-N, L-G and N-G.
- D. Maximum Continuous Operating Voltage: Less than 130 PCT of system peak voltage.
- E. Operating Frequency: 45 to 65 Hz.
- F. Short Circuit Rating: Equal to or greater than rating of equipment SPD is connected to.
- G. Maximum Surge Current: 240,000 A per phase, 120,000 A per mode minimum.

- H. Minimum Repetitive Surge Current Capacity: 4000 IEEE C High waveform impulses with no degradation greater than 10 PCT deviation of the clamping voltage.
- I. SPD Protection:
 - 1. Integral unit level and/or component level overcurrent fuses and sustained overvoltage thermal cutout device.
 - 2. An IEEE C High waveforms shall not cause the fuse to open and render the SPD inoperable.
- J. Maximum Clamping Voltages: Dynamic test at the 90 degree phase angle including 6 IN lead length and measured from the zero voltage reference:

System Voltage	Test Mode	IEEE C62.41		UL 1449
		C High V & I Wave	B Combination Wave	
L-L < 250 V L-N < 150 V	L-L	1470 V	1000 V	800 V
	L-N	850 V	600 V	500 V
	L-G	1150 V	800 V	600 V
	N-G	1150 V	800 V	600 V
L-L > 250 V L-N > 150 V	L-L	2700 V	2000 V	1800 V
	L-N	1500 V	1150 V	1000 V
	L-G	2000 V	1550 V	1200 V
	N-G	2000 V	1550 V	1200 V

- K. EMI-RFI Noise Rejection: Attenuation greater than 30 dB for frequencies between 100 kHz and 100 MHz.

2.4 TYPE 3 SPD

- A. Product:
 - 1. SPD tag number or electrical equipment tag number SPD is connected to panelboards.
 - 2. Integrally mounted in a switchboard, panelboards or motor control centers.
 - 3. Hybrid solid state high performance suppression system.
 - a. Do not use gas tubes, spark gaps or other components in suppression system which might short or crowbar the line resulting in interruption of normal power flow to connected loads.
 - 4. Do not connect multiple SPD modules in series to achieve the specified performance.
 - 5. Designed for parallel connection.
 - 6. Field connection: Use mechanical or compression lugs for each phase, neutral and ground that will accept bus bar or #10 through #1/0 conductors.
 - 7. Device monitor:
 - a. Long-life, solid state, externally visible indicators and Form C contact(s) that monitor the on-line status of each mode of the units suppression filter system or power loss in any of the phases.
 - b. A fuse status only monitor system is not acceptable.
- B. Operating Voltage: The nominal unit operating voltage and configuration as indicated on the Drawings.
- C. Modes of Protection: All modes.
 - 1. Three phase (delta): L-L, L-G.
 - 2. Three phase (wye): L-N, L-L, L-G and N-G.
 - 3. Single phase (2 pole): L-L, L-N, L-G and N-G.
 - 4. Single phase: L-N, L-G and N-G.

- D. Maximum Continuous Operating Voltage: Less than 130 PCT of system peak voltage.
- E. Operating Frequency: 45 to 65 Hz.
- F. Short Circuit Rating: Equal to or greater than rating of equipment SPD is connected to.
- G. Maximum Surge Current: 160,000 A per phase, 80,000 A per mode minimum.
- H. Minimum Repetitive Surge Current Capacity: 4000 IEEE C High or B combination waveform impulses with no degradation of more than 10 PCT deviation of the clamping voltage.
- I. SPD Protection:
 - 1. Integral unit level and/or component level overcurrent fuses and sustained overvoltage thermal cutout device.
 - 2. An IEEE B combination wave shall not cause the fuse to open and render the SPD inoperable.
- J. Maximum Clamping Voltages: Dynamic test at the 90 DEG phase angle including 6 IN lead length and measured from the zero voltage reference:

System Voltage	Test Mode	IEEE C62.41		UL 1449
		B Comb. Wave	B3 Ring Wave	
L-L < 250 V L-N < 150 V	L-L	1000 V	700 V	800 V
	L-N	600 V	400 V	500 V
	L-G	800 V	550 V	600 V
	N-G	800 V	550 V	600 V
L-L > 250 V L-N > 150 V	L-L	2000 V	1400 V	1800 V
	L-N	1150 V	800 V	1000 V
	L-G	1550 V	1000 V	1200 V
	N-G	1550 V	1000 V	1200 V

- K. EMI-RFI Noise Rejection: Attenuation greater than 30 dB for frequencies between 100 kHz and 100 MHz.

2.5 SOURCE QUALITY CONTROL

- A. SPD approvals and ratings shall be obtained by manufacturers from nationally recognized testing laboratories.
- B. The SPD are to be tested as a complete SPD system including:
 - 1. Integral unit level and/or component level fusing.
 - 2. Neutral and ground shall not be bonded during testing.
 - 3. 6 IN lead lengths.
 - 4. Integral disconnect switch when provided.
- C. The “as installed” SPD system including the manufacturers recommended circuit breaker, the SPD is connected to, will not open when tested with a IEEE C3 combination waveform.
- D. Tests to be performed in accordance with IEEE C62.45:
 - 1. Clamping voltage performance testing using IEEE C62.41 Category waveforms.
 - 2. Single pulse surge current capacity test.
 - 3. Repetitive surge current capacity testing.
 - 4. Spectrum analysis for EMI-RFI noise rejection.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Type 1 and 3 SPD:
 - 1. Connected in parallel to the equipment.
 - 2. Install in dedicated electrical equipment compartment, bucket or panelboard box at the factory before shipment.
 - 3. Provide leads that are as short and straight as possible.
 - 4. Maximum lead length: 12 IN.
 - 5. Minimum lead size: #2 stranded AWG or bus bar.
 - 6. Connect leads to the equipment to be protected by one of the following means:
 - a. Through a circuit breaker or molded case switch mounted in the equipment.
 - b. Use manufacturer recommended circuit breaker size.
 - c. Circuit breaker or switch to be operable from the equipment exterior or from behind a hinged door.

END OF SECTION

SECTION 26 50 00
INTERIOR AND EXTERIOR LIGHTING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Material and installation requirements for:
 - a. Interior building and exterior building mounted luminaires.
 - b. Exterior and site luminaires.
 - c. Lamps and LEDs.
 - d. Ballasts and drivers.
 - e. Lighting control.
- B. Related Specification Sections include but are not necessarily limited to:
 - 1. Division 00 - Procurement and Contracting Requirements.
 - 2. Division 01 - General Requirements.
 - 3. Section 26 05 00 - Electrical - Basic Requirements.
 - 4. Section 26 05 19 - Wire and Cable - 600 Volt and Below.
 - 5. Section 26 09 16 - Control Equipment Accessories.

1.2 QUALITY ASSURANCE

- A. Referenced Standards:
 - 1. American National Standards Institute (ANSI):
 - a. C78.377, Specification for the Chromaticity of Solid State Lighting Products.
 - 2. Federal Communications Commission (FCC):
 - a. Code of Federal Regulations (CFR), 47 CFR 18, Industrial, Scientific and Medical Equipment.
 - 3. Institute of Electrical and Electronics Engineers, Inc. (IEEE):
 - a. C62.41, Recommended Practice on Surge Voltages in Low-Voltage AC Power Circuits.
 - 4. Illuminating Engineering Society of North America (IESNA):
 - a. LM-79, Electrical and Photometric Measurements of Solid-State Lighting Products.
 - b. LM-80, Measuring Luminous Flux and Color Maintenance of LED Packages, Arrays and Modules.
 - 5. National Electrical Manufacturers Association (NEMA):
 - a. 250, Enclosures for Electrical Equipment (1000 Volts Maximum).
 - b. 410, Performance Testing for Lighting Controls and Switching Devices with Electronic Drivers and Discharge Ballasts.
 - c. LE 4, Recessed Luminaires, Ceiling Compatibility.
 - 6. National Electrical Manufacturers Association/American National Standards Institute (NEMA/ANSI):
 - a. SSL 1, Electronic Drivers for LED Devices, Arrays or Systems.
 - 7. National Fire Protection Association (NFPA):
 - a. 70, National Electrical Code (NEC).
 - b. 101, Life Safety Code.
 - 8. Underwriters Laboratories, Inc. (UL):
 - a. 248-4, Low-Voltage Fuses - Part 4: Class CC Fuses.
 - b. 844, Standard for Luminaires for Use in Hazardous (Classified) Locations.
 - c. 924, Standard for Emergency Lighting and Power Equipment.
 - d. 1012, Power Units Other Than Class 2.
 - e. 1310, Standard for Class 2 Power Units.
 - f. 1598, Luminaires.
 - g. 8750, Standard for Light Emitting Diode (LED) Equipment for Use in Lighting Products.

9. United States Department of Energy (USDOE):
 - a. EPAct, the National Energy Policy Act.

1.3 DEFINITIONS

- A. Useful Life for LED luminaire light sources:
 1. The operating hours before reaching 70 PCT of the initial rated lumen output (L70) with no catastrophic failures under normal operating conditions.
 2. This is also known as 70 PCT "Rated Lumen Maintenance Life" as defined in IESNA LM-80.

1.4 SUBMITTALS

- A. Shop Drawings:
 1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
 2. Product technical data:
 - a. Provide submittal data for all products specified in PART 2 of this Specification Section.
 - b. Identify luminaire by Luminaire Schedule designation.
 - c. Luminaire data sheet:
 - 1) Name of manufacturer.
 - 2) Complete order information (catalog number).
 - 3) Description of construction and optics.
 - 4) Total input wattage.
 - 5) Luminous efficacy (lumens/Watt).
 - 6) Photometric performance data including candlepower distribution and coefficient of utilization (CU) table.
 - 7) Dimensional size.
 - 8) Weight.
 - 9) UL nameplate data for luminaires used in Class 1, Division 1 and 2 areas.
 - 10) Effective Projected Areas (EPA) for pole mounted luminaires.
 - d. Solid state Luminaire additional data:
 - 1) Voltage.
 - 2) Initial and IES L70 lumens.
 - 3) Luminous efficacy (lumens/Watt).
 - 4) Correlated Color Temperature (CCT).
 - 5) Color Rendering Index (CRI).
 - 6) Total Harmonic Distortion (THD).
 - 7) Lamp life.
 - 8) Driver manufacturer and model number.
 - 9) Driver life.
 - 10) Driver type (0-10V, constant voltage, constant current).
 - 11) Dimming range and control device compatibility.
 - 12) Remote driver: Maximum wire length to luminaire.
 - 13) Emergency battery driver:
 - a) Compatibility with lighting module.
 - b) Lumen output of lighting module in emergency operation.
 - c) Battery life.
 - d) Description of testing.
 - e) Ambient operating temperature.
 - 14) Toxicity Characteristic Leaching Procedure (TCLP) compliance.
 - 15) Warranty information.
 - e. Photometric calculation for manufacturers not listed in the Luminaire Schedule:
 - f. See Specification Section 26 05 00 for additional requirements.

3. Test Reports:
 - a. IESNA LM-79 Test Report for Solid-State Luminaire.
 - b. IESNA LM-80 Test Report Solid-State Light Source.
 4. Certifications: Solid-state Luminaire Useful Life Certificate.
- B. Contract Closeout Information:
1. Operation and Maintenance Data:
 - a. See Specification Section 01 33 04 for requirements for the mechanics, administration, and the content of Operation and Maintenance Manual submittals.
 - b. Submittal data for each component covered by warranty.
 - c. Warranty.

1.5 WARRANTY

- A. Minimum of a five year Warranty from date of manufacture against failure for solid-state luminaire including LED arrays, LED drivers and integral control devices. The solid-state product is considered defective if more than 15 PCT of the individual light emitting diodes fail to illuminate.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
1. Luminaires: Per Luminaire Schedule or equal.
 2. Solid State Light Sources:
 - a. Cree.
 - b. Xicato.
 - c. Luminaire manufacturer's proprietary system.
 3. LED Driver: Luminaire manufacturer's standard.
 4. Emergency ballasts:
 - a. Iota Engineering.
 - b. Philips Bodine.
 5. Emergency transfer devices: Philips Bodine.

2.2 GENERAL REQUIREMENTS

- A. Luminaires complete with LED modules and drivers.
- B. Rated for area classification as indicated on the Drawings.
1. In Class I, Division 1 and 2 areas, the temperature rating of the LED combination shall not exceed the auto-ignition temperature of the atmosphere in which the Luminaire is used.
- C. Provide all recessed luminaires with gaskets of rubber, fiberglass, or equivalent material to prevent light leaks around flush trim.
1. Provide recessed luminaires with trim gaskets cemented in proper position.
- D. Provide standard plaster frame for all recessed luminaires installed in plaster walls or ceilings.
1. Design, finish and fabricate material to preclude possibility of rust stain in plaster.
- E. Coordinate luminaire mounting where recessed into building canopies prior to Submitting Shop Drawings. Confirm clearances and luminaire flange compatibility with construction.
- F. Electrical components of recessed luminaires shall be accessible and removable through luminaire without having to remove luminaire from ceiling.
- G. No live parts normally exposed to contact.
- H. When intended for use in wet areas: Mark luminaire "Suitable for wet locations."

- I. When intended for use in damp areas: Mark luminaire "Suitable for damp locations" or "Suitable for wet locations."
- J. Wiring:
 - 1. Factory-wired to be compatible with the project electrical and controls systems.
- K. Mounting Accessories:
 - 1. Provide appropriate mounting accessories for each luminaire, compatible with various structural conditions encountered.
 - 2. All luminaires with adjustable beam angles shall have a locking device to ensure that the beam distribution is not effected during relamping or cleaning.
 - 3. Luminaire Suspension Material:
 - a. Unfinished Spaces:
 - 1) 1/2 IN minimum diameter swivel stem, unless otherwise noted.
 - 2) Safety chain on high bay type.

2.3 SOLID-STATE LUMINAIRES

- A. Standards:
 - 1. IESNA LM-79, IESNA LM-80.
 - 2. NEMA SSL 1.
 - 3. UL 1012, 1310, and 8750.
 - 4. UL 844 for hazardous locations.
- B. Solid state modules and driver to be provided and warrantied by luminaire manufacturer.
- C. Solid-State Modules:
 - 1. Uniform color temperature of 4000K unless otherwise noted on the Luminaire schedule.
 - 2. Minimum color rendering index (CRI) of 80.
 - 3. LED module light output and efficacy: Measured in accordance with IESNA LM-79 standards.
 - 4. LED useful life and lumen maintenance: Measured in accordance with IESNA LM-80 standards.
 - 5. Driver and LED module: Minimum useful life of 50,000 HRS (L70).
 - 6. Individual LEDs connected such that a failure of one LED will not result in a light output loss of the entire luminaire.
- D. Driver:
 - 1. Compatible with solid-state modules and control devices specified.
 - 2. Operate from 60 Hz input source of 120V through 277V with sustained variations of ± 10 PCT (voltage and frequency).
 - 3. Input current Total Harmonic Distortion (THD): Less than 20 PCT when operated at nominal line voltage.
 - 4. Power Factor: Greater than 0.90.
 - 5. Avoid interference with infrared devices and eliminate visible flicker.
 - 6. Comply with ANSI C62.41 Category A for Transient protection.
 - 7. Comply with the requirements of the Federal Communications Commission (FCC) rules and regulations, Title 47 CFR part 18, Non-Consumer (Class A) for EMI/RFI (conducted and radiated).
 - 8. Dimmable drivers capable of continuous dimming over a range of 100 PCT to 1 PCT of rated lumen output. Dimming controlled by a 0 - 10 VDC signal, unless otherwise specified in Luminaire Schedule.
 - 9. Control device must be compatible with type of driver, and coordinated prior to submission of Shop Drawings. List of compatible dimming controllers must include the range of perceived brightness. No visible flicker throughout the dimming range.
 - 10. Operating temperature range must be suitable for site temperature conditions within exterior and gasketed luminaires.

- E. Emergency Battery Driver:
 - 1. UL 924.
 - 2. Confirm compatibility with LED modules utilized.
 - 3. Consist of a high temperature, maintenance-free nickel cadmium battery, charger and electronic circuitry.
 - 4. A solid state charging indicator light to monitor the charger and battery.
 - 5. Single-pole test switch.
 - 6. The following product family shall be selected based on coordination with LED lamp type:
 - a. Philips Bodine “BSL23C”: can operate up to 4.5W at 410mA.
 - b. Philips Bodine “BSL26C”: can operate up to 5.1W at 265mA.
 - c. Philips Bodine “BSL722 IN: can operate up to 23W at 770mA.
 - d. Philips Bodine “BSL23C”: can operate up to 23W at 770mA in operating conditions ranging from -20 DEGC (-4 DEGF) to 60 DEGC (140 DEGF).
 - e. Alternate manufacturer: Iota.
- F. Luminaire properly heat sunk to assure LED junction temperature ratings are not exceeded.
 - 1. Provide ambient operating temperature range for which product is warranted.

2.4 EXIT SIGNS AND EMERGENCY LIGHTING UNITS

- A. Standards:
 - 1. UL 924.
 - 2. NFPA 101.
 - 3. Local State or City requirements.
- B. Exit Signs:
 - 1. Housing and finish: As indicated in the Luminaire Schedule.
 - 2. LED illuminated with integral driver.
 - 3. AC powered or AC and battery powered: As indicated in the Luminaire Schedule.
 - 4. Battery powered units:
 - a. Battery type: As indicated in the Luminaire Schedule.
 - b. Self-testing/self-diagnostic.
 - 1) Electronic circuitry automatically test emergency lighting for a minimum of 30 seconds every 30 days and 90 minutes once a year.
 - c. Consist of battery, charger and electronic circuitry.
 - d. Solid state charging indicator light to monitor the charger and battery.
 - e. Single-pole test switch.
 - f. A user selectable audible alarm. The alarm shall be engaged unless noted otherwise on the Drawings.
- C. Emergency Lighting Units:
 - 1. Housing: As indicated in the Luminaire Schedule.
 - 2. Lamps: As indicated in the Luminaire Schedule.
 - 3. Battery type: As indicated in the Luminaire Schedule.
 - 4. Self-testing/self-diagnostic.
 - a. Electronic circuitry automatically test emergency lighting for a minimum of 30 seconds every 30 days and 90 minutes once a year.
 - 5. Consist of battery, charger and electronic circuitry.
 - 6. Solid state charging indicator light to monitor the charger and battery.
 - 7. Single-pole test switch.
 - 8. A user selectable audible alarm. The alarm shall be engaged unless noted otherwise on the Drawings.
- D. Emergency Circuit Transfer Device:
 - 1. Transfer device permits emergency lights to be switched under normal conditions and automatically transfers to unswitched emergency circuit upon power interruption.
 - 2. Multiple luminaire switching:
 - a. Up to 20A.

- b. Mounting as indicated on the Drawings.
- c. Acceptable product family:
 - 1) Philips Bodine GTD20A or equal.
- 3. Individual luminaire switching:
 - a. Mount on top of luminaire or in ballast channel.
 - b. Acceptable product family:
 - 1) Philips Bodine GTD or equal.

2.5 LAMPS

- A. Solid State:
 - 1. Type and initial lumens as indicated in the Luminaire Schedule.
 - 2. Size and shape coordinated with luminaire.
 - 3. Solid state:
 - a. Integral driver.
 - b. Types: A and PAR.

2.6 MAINTENANCE MATERIALS

- A. Furnish a minimum of 2 or 10 PCT of total of each type and wattage of lamps, whichever is greater.
- B. Furnish a minimum of 10 PCT of total of each type and amperage of fuses for fixtures indicated to be fused.
- C. Spare parts are to be stored in a box clearly labeled as to its contents.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Coordinate Luminaire Types with Ceiling Construction:
 - 1. Provide mounting hardware for the ceiling system in which the luminaire is to be installed.
- B. Fasten luminaires supported by suspended ceiling systems to ceiling framing system with hold down clips.
- C. Provide mounting brackets and/or structural mounting support for wall-mounted luminaires.
 - 1. Do not support luminaire from conduit system.
 - 2. When luminaire is supported from outlet boxes, install per NFPA 70.
 - 3. Supports for luminaire mounted on exterior walls shall not be attached to exterior face of the wall.
- D. Provide pendant luminaires with swivel hangers which will allow luminaire to swing in any direction but will not permit stem to rotate.
 - 1. Provide hangers with enclosure rating (NEMA 1, 4, or 7) equal to enclosure requirements of area in which they are installed.
 - 2. Swivel hangers for luminaires in mechanical equipment areas: Shock absorbing type.
 - 3. Secure low and high bay luminaires with safety chain or safety aircraft cable to the building structure.
 - a. Chain or cable to prevent luminaire from falling more than 3 IN before the luminaire is caught by the chain or cable.
- E. Mount luminaire at heights indicated in Specification Section 26 05 00 or per Luminaire Schedule or as indicated on the Drawings.
- F. Install exterior luminaires so that water can not enter or accumulate in the wiring compartment.

- G. Emergency Battery Ballasts:
 - 1. Where emergency battery ballasts are shown controlled via switching device, wire ballast so lamps will not operate when normal power is available and switching device turns lights off. Lamps will operate in emergency mode regardless of switch position.
 - 2. Luminaire manufacturer to supply the emergency battery ballasts with luminaire.
- H. Ground luminaire and ballasts.

3.2 LIGHTING CONTROL

- A. Exterior wall mounted and pole mounted fixtures controlled as detailed on the Drawings.

3.3 ADJUST AND CLEAN

- A. See Specification Section 01 74 00.
- B. Replace all inoperable lamps with new lamps prior to final acceptance.
- C. Aim all emergency lighting units, so that, the path of egress is illuminated.

END OF SECTION

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DIVISION 27

COMMUNICATIONS



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SECTION 27 10 00
STRUCTURED CABLING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
1. Requirements for the structural cabling system such as:
 - a. Service entrance protection.
 - b. Cabinets, racks, frames and enclosures.
 - c. Termination blocks and patch panels.
 - d. Cable management and cable pathways.
 - e. Rack mounted power protection and power strips.
 - f. Backbone cabling.
 - g. Horizontal cabling.
 - h. Patch cords.
- B. Related Sections include but are not necessarily limited to:
1. Division 00 - Procurement and Contracting Requirements.
 2. Division 01 - General Requirements.
 3. Section 07 84 00 - Firestopping.
 4. Section 26 05 00 - Electrical - Basic Requirements.
 5. Section 26 05 26 - Grounding and Bonding.
 6. Section 26 05 33 - Raceways and Boxes.
 7. Section 26 05 36 - Cable Tray.
 8. Section 33 82 00 - Communications Distribution (OSP).

1.2 QUALITY ASSURANCE

- A. Referenced Standards:
1. Building Industry Consulting Service International (BICSI).
 2. Electronics Components Industry Association (ECA):
 - a. 310, Cabinets, Racks, Panels and Associated Equipment.
 3. National Electrical Manufacturers Association (NEMA):
 - a. WC 66, Standard for Category 6 and 6A, 100 Ohm, Individually Unshielded Twisted Pairs, Indoor Cables (With Or Without An Overall Shield) For Use In LAN Communication Wiring Systems.
 4. National Fire Protection Association (NFPA):
 - a. 70, National Electrical Code (NEC).
 5. Telecommunications Industry Association/Electronic Industries Alliance/American National Standards Institute (TIA/EIA/ANSI):
 - a. 526-7, Measurement of Optical Power Loss of Installed Singlemode Fiber Cable Plant.
 - b. 526-14, Optical Power Loss Measurements of Installed Multimode Fiber Cable Plant.
 - c. 568-C.0, Generic Telecommunications Cabling for Customer Premises.
 - d. 568-C.1, Commercial Building Telecommunications Cabling Standard.
 - e. 568-C.2, Balanced Twisted-Pair Telecommunications Cabling and Components Standards.
 - f. 568-C.3, Optical Fiber Cabling Components Standard.
 - g. 568-C.4, Broadband Coaxial Cabling and Components Standard.
 - h. 569-C, Telecommunications Pathways and Spaces.
 - i. 598-D, Optical Fiber Cable Color Coding.
 - j. 606-B, Administration Standard for Telecommunications Infrastructure.
 - k. 607-B, Generic Telecommunications Bonding and Grounding (Earthing) for Customer Premises.

- B. Qualifications:
1. Telecommunications Contractor:
 - a. Shall be regularly and professionally engaged in the business of the applications, installation, and testing of telecommunications systems and equipment.
 - b. Include three references of similar scope jobs completed in the last two years.
 - c. Supervisors and installers shall be Building Industry Consulting Services International (BICSI) Registered Cabling Installers, Technician Level.
 - d. In lieu of BICSI certification, supervisors and installers assigned to the installation of this system or any of its components shall have:
 - 1) A minimum of five years experience in the installation of the specified copper and fiber optic cable and components.
 - 2) Factory or factory approved certification from each equipment manufacturer indicating that they are qualified to install and test the provided products.
 2. Manufacturer:
 - a. Company specializing in manufacturing products specified in this Section with minimum 10 years documented experience in the manufacturing, assembly, and factory testing of components which comply with TIA-568-C.1, TIA-568-C.2 and TIA-568-C.3.

1.3 SYSTEM DESCRIPTION

- A. The building telecommunications cabling and pathway system shall include:
1. All permanently installed backbone and horizontal cabling.
 2. Horizontal and backbone pathways.
 3. Service entrance facilities.
 4. Work area pathways.
 5. Telecommunications outlet assemblies.
 6. Racks.
 7. Cabinets.
 8. Enclosures.
 9. Conduit.
 10. Raceway.
 11. Patch panels.
 12. Fiber enclosures and hardware for splicing.
 13. Terminating and interconnecting cabling necessary to transport voice and data between equipment items in a building.
- B. All components required for the above shall be provided for a fully tested operational system per the latest TIA/EIA/ANSI Standards.
- C. Provide and install all components per this Specification for the Structured Cabling System.
- D. Active equipment including switched hubs, routers, data switch(es) for fiber/copper shall be provided by others under a separate contract.
- E. Patch cords connected to active equipment shall be installed by others.

1.4 SUBMITTALS

- A. Shop Drawings:
1. See Specification Section 01 33 00 for requirements for the mechanics and administration for the submittal process.
 2. Provide product technical data including:
 - a. Submittal data for all products specified in PART 2 of this Specification.
 - b. See Specification Section 26 05 00 for additional requirements.
 3. Fabrication and/or layout drawings, sealed and approved by a registered communications distribution designer (RCDD):
 - a. Layout of complete building per floor:
 - 1) Building area boundaries, backbone systems and horizontal pathways.

- b. Building area drawings:
 - 1) Drop locations and cable identifications in accordance with TIA-606.
- c. Telecommunications space drawings:
 - 1) Telecommunication rooms plan views, pathway layout, mechanical/electrical layout, and cabinet, rack, backboard and wall elevations.
- d. Typical detail drawings:
 - 1) Faceplate labeling, faceplate types, and firestopping.
- 4. Certificates:
 - a. Telecommunications Contractor and Installers qualifications.
 - b. Key Personnel qualifications.
 - c. Manufacturer qualifications.
- 5. Test reports:
 - a. Testing plan and procedures.
 - b. Telecommunications cabling test results.

PART 2 - PRODUCTS

2.1 MATERIALS AND EQUIPMENT

- A. Materials and equipment shall be the standard products of a manufacturer regularly engaged in the manufacture of the products and shall be the manufacturer's latest standard design that has been in satisfactory use for at least one year prior to installation.
 - 1. Materials and equipment shall conform to the respective publications and other requirements specified below and to the applicable requirements of NFPA 70.
 - 2. Components shall be UL or third-party certified.

2.2 EQUIPMENT RACKS

- A. Floor mounted 2-post equipment racks shall be welded steel or aluminum relay racks with uprights to mount industry standard 19 IN components and equipment.
 - 1. Uprights shall be 3 IN deep channel, 1-1/4 IN wide, drilled and tapped 12 - 24 IN standard EIA pattern.
 - 2. Racks shall be provided with a standard top cross member, and predrilled base plate to allow floor fastening.
 - 3. Open frame equipment racks shall be 7 FT tall, 45U capacity.
 - 4. Equipment racks shall be black powder coated.
- B. Cable Management:
 - 1. Cable management shall be specifically manufactured for the purpose of routing cables, wires and patch cords horizontally across 19 IN equipment racks.
 - 2. Cable management shall be specifically manufactured for the purpose of routing cables, wires and patch cords vertically adjacent to equipment racks.
 - 3. Cable management shall consist of ring or bracket-like devices with removable covers.
 - 4. Cable management shall mount to racks by screws and/or nuts and lock washers.

2.3 TELEPHONE TERMINAL CABINETS

- A. Factory painted or galvanized steel NEMA 3R enclosure with hinged door.
 - 1. Used to house building entrance protector and terminal blocks.

2.4 TELECOMMUNICATIONS OUTLET BOXES

- A. Electrical boxes for telecommunication outlets shall be 4-1 1/16 IN square by 2-1/8 IN deep with minimum 3/8 IN deep single or two gang plaster rings as required.
 - 1. Provide a minimum 1 IN conduit.

2.5 TELECOMMUNICATIONS CABLE TRAYS

- A. Provide cable trays with width and side heights as shown on drawings.
 - 1. Cable tray types are defined in and shall be installed as specified in Section 2605 36 - Cable Tray.

2.6 TELECOMMUNICATIONS CABLE RUNWAY

- A. Provide cable runways with widths as shown on Drawings.
 - 1. Materials:
 - a. Steel:
 - 1) Side stringers: 3/8 IN wide by 1-1/2 IN high tubular steel with 0.065 IN wall thickness.
 - 2) Cross members: 1 IN wide by 1/2 IN high tubular steel with 0.065 IN wall thickness, spaced 9 IN apart on center. There will be a maximum of 8 IN open space between each cross member.
 - 3) Black powder coat finish.

2.7 EQUIPMENT MOUNTING BACKBOARD

- A. Plywood backboards shall be provided on three adjacent walls of telecommunications spaces.
 - 1. Void-free, interior grade A-C fire-rated plywood, A-side mounted facing out, 3/4 IN thick, 4 FT x 8 FT sheets.

2.8 PATCH PANELS

- A. Patch panels mounted in equipment racks with sufficient ports to accommodate all installed cable plus 25 PCT spare:
 - 1. Copper Patch Panel:
 - a. 48-port modular jack (2U maximum), with rear mounted type 110 insulation displacement connectors.
 - b. Panel shall have incoming cable strain relief and cable management guides.
 - c. Jack pin/pair configuration shall be T568B.
 - d. Jacks shall be unkeyed.
 - 2. Fiber Optic Patch Panel:
 - a. Panel shall accommodate 12 duplex connectors (1U maximum).
 - b. Panel shall have cable management tray, incoming cable strain relief and cable management guides.
 - c. Connectors shall be duplex LC.
 - d. Connectors shall be unkeyed.
 - e. Provide dust covers for unused connectors.
 - 3. Fiber Optic Distribution Panel:
 - a. Panel shall accommodate 72 duplex connectors (4U maximum).
 - b. Panel shall have cable management tray(s), incoming cable strain relief and cable management guides.
 - c. Connectors shall be duplex LC.
 - d. Connectors shall be unkeyed.
 - e. Provide dust covers for unused connectors.

2.9 TERMINATION BLOCKS

- A. Terminal blocks:
 - 1. Wall mounted or rack mounted wire termination units consisting of insulation displacement connectors mounted in plastic blocks, frames or housings.
 - a. Blocks shall be type 110 which meet the requirements for Category 6 or as shown.
 - 2. Blocks shall be mounted on standoffs and shall include cable management hardware.
 - 3. Provide space for the number of horizontal and backbone cables terminated on the blocks plus 25 PCT spare.

2.10 BACKBONE CABLING SYSTEM

- A. Outside Plant Cable:
 - 1. Same as horizontal cabling System except gel filled with UV resistant jacketed suitable for installation underground.
- B. Backbone Fiber Cable:
 - 1. Singlemode, 9um/125um OS2 rated cable, formed into 12-strand color coded groups.
 - 2. Multimode, 50um/125um OM4 rated cable, formed into 12-strand color coded groups.
 - 3. Cable shall be label-verified.
 - 4. Cable jacket shall be factory marked at regular intervals indicating verifying organization and performance level.
 - 5. Cable shall be rated CMP per NFPA 70.

2.11 HORIZONTAL CABLING SYSTEM

- A. Horizontal Copper Cable:
 - 1. Category 6.
 - 2. Cable shall be label-verified.
 - 3. Cable jacket shall be factory marked at regular intervals indicating verifying organization and performance level.
 - 4. Conductors shall be solid untinned copper 24 AWG.
 - 5. Cable shall be rated CMP per NFPA 70.
 - 6. Cable shall be shielded, 600V, plenum rated.
- B. Horizontal Fiber Cable:
 - 1. Singlemode, 9um/125um OS2 rated cable.
 - 2. Multimode, 50um/125um OM4 rated cable.
 - 3. Cable shall be label-verified.
 - 4. Cable jacket shall be factory marked at regular intervals indicating verifying organization and performance level.
 - 5. Cable shall be rated CMP per NFPA 70.
- C. Telecommunications Outlets:
 - 1. General wall and desk outlet plates shall come equipped with two modular jacks and two blank spaces.
 - 2. Wall telephone outlet plates shall come equipped with one modular jack type.
 - 3. Modular jacks shall be the same category as the cable they terminate.
 - 4. Modular copper jack pin/pair configuration shall be T568B.
 - 5. Modular jacks shall be unkeyed.
 - 6. Wall plates:
 - a. High impact thermoplastic or nylon.
 - b. Color: White.
 - 7. Outlet assemblies used in the premises distribution system shall consist of modular jacks in outlet assemblies mounted in single or double gang covers as specified in this Section and as indicated on the Drawings.

2.12 PATCH CORDS

- A. Supply patch cords equal to 1.1 times the number of cables terminated in the communication room(s).
 - 1. Provide for installed copper and fiber-optic systems.
 - 2. 10 FT cords.
- B. Patch Cords, Copper:
 - 1. Assemblies consisting of flexible, twisted pair stranded wire with eight-position plugs at each end.
 - 2. Cable shall be label-verified.
 - 3. Cable jacket shall be factory marked at regular intervals indicating verifying organization and performance level.

4. Patch cords shall be wired straight through; pin numbers shall be identical at each end and shall be paired to match T568B patch panel jack wiring.
 5. Patch cords shall be unkeyed.
 6. Patch cords shall be factory assembled.
 7. Patch cords shall match the color of the installed system.
- C. Patch Cords, Singlemode Fiber:
1. Assemblies consisting of flexible, 9um/125um OS2 rated cable with duplex LC connectors at each end.
 2. Cable shall be label-verified.
 3. Cable jacket shall be factory marked at regular intervals indicating verifying organization and performance level.
 4. Patch cords shall have crossover orientation.
 5. Patch cords shall be unkeyed.
 6. Patch cords shall be factory assembled.
 7. Patch cords shall be yellow.

2.13 DEVICE CABLES

- A. Supply Device cables equal to 1.1 times the number of jacks installed.
1. Provide for installed copper and fiber-optic systems.
 2. 10 FT cords.
- B. Device Cables, Copper:
1. Assemblies consisting of flexible, twisted pair stranded wire with eight -position plugs at each end.
 2. Cable shall be label-verified.
 3. Cable jacket shall be factory marked at regular intervals indicating verifying organization and performance level.
 4. Device cables shall be wired straight through; pin numbers shall be identical at each end and shall be paired to match T568B patch panel jack wiring.
 5. Device cables shall be unkeyed.
 6. Device cables shall be factory assembled.
 7. Device cables shall match the color of the installed system.

2.14 LABELING AND COLOR CODING

- A. Labels shall be developed by the contractor and approved by the Owner.
1. Labels shall be machine printed on opaque or clear tape, stenciled onto adhesive labels.
 2. Handwritten labeling is unacceptable.
- B. Cable and Jacks:
1. Voice: White.
 2. Data: Blue.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. System components and appurtenances shall be installed in accordance with NFPA 70, manufacturer's instructions and as shown.
- B. Necessary interconnections, services, and adjustments required for a complete and operable signal distribution system shall be coordinated with the local communications provider(s).
- C. Components shall be labeled in accordance with TIA/EIA/ANSI 606.
- D. Penetrations in fire-rated construction shall be firestopped.

- E. Wiring shall be installed in accordance with TIA/EIA/ANSI Standards.
 - 1. Wiring, and terminal blocks and outlets shall be marked in accordance with TIA/EIA/ANSI 606.
- F. Cables shall not be installed in the same cable tray, utility pole compartment, or floor trench compartment with AC power cables.
- G. Equipment Racks:
 - 1. Open frame equipment racks shall be bolted to the floor.
 - 2. Cable guides shall be bolted or screwed to racks.
 - 3. Racks shall be installed level.
 - 4. Wall mounted racks shall be secured to the mounting surface to prevent fully loaded racks from separating from the mounting surface.
- H. Rack Mounted Equipment: Equipment to be rack mounted shall be securely fastened to racks by means of the manufacturer's recommended fasteners.
- I. Terminal Blocks:
 - 1. Terminal blocks shall be mounted in orderly rows and columns.
 - 2. Adequate vertical and horizontal wire routing areas shall be provided between groups of blocks.
 - 3. Industry standard wire routing guides shall be utilized.
- J. Pathway System:
 - 1. Provide in accordance with TIA 569 and NFPA 70.
 - 2. Provide conduits in accordance with 26 05 33 - Raceways and Boxes.
 - 3. Provide grounding of raceways and cable tray in accordance with TIA 607 and NFPA 70.
- K. Unshielded Twisted Pair Patch Panels:
 - 1. Patch panels shall be mounted in equipment racks with sufficient modular jacks to accommodate the installed cable plant plus 25 PCT spares.
 - 2. Cable guides shall be provided above, below and between each panel.
- L. Fiber Optic Patch Panels:
 - 1. Patch panels shall be mounted in equipment racks with sufficient connectors to accommodate the installed cable plant plus 25 PCT spares.
 - 2. Cable guides shall be provided above, below and between each panel.
- M. Backbone and Horizontal Distribution Cable:
 - 1. Cable pulling tension shall not be exceeded.
 - a. 110N (25 LBF) for copper cabling.
 - 2. Cable shall not be stressed such that twisting, stretching or kinking occurs.
 - 3. Cable shall not be spliced.
 - 4. All backbone cable shall be installed in conduit or cable tray.
 - 5. All horizontal cable shall be installed in an appropriate telecommunications pathway.
 - 6. Cable shall not be run through structural members or in contact with conduits, pipes, ducts, or other potentially damaging items.
 - 7. Placement of cable parallel to power conductors shall be avoided, if possible; a minimum separation of 12 IN shall be maintained when such placement cannot be avoided.
 - 8. Cables shall be terminated; no cable shall contain unterminated elements.
 - 9. Minimum bending radius shall not be exceeded during installation or once installed.
 - 10. Only fabric hook and loop fasteners shall be used to wrap cables, 1/2 IN width minimum. Plastic or nylon cable ties shall not be used.
- N. Telecommunications Outlets:
 - 1. Faceplates: As a minimum each jack shall be labeled as to its function and a unique number to identify cable link.

2. Cables:
 - a. Unshielded twisted pair cables shall have a minimum of 12 IN of slack cable loosely coiled into the telecommunications outlet boxes.
 - b. Minimum manufacturers bend radius for each type of cable shall not be exceeded.

3.2 TERMINATION

- A. Cables and conductors shall sweep into termination areas; cables and conductors shall not bend at right angles.
 1. Manufacturer's minimum bending radius shall not be exceeded.
 2. When there are multiple system type drops to individual workstations, relative position for each system shall be maintained on each system termination block or patch panel.
 3. Unshielded Twisted Pair Cable:
 - a. Each pair shall be terminated on appropriate outlets, terminal blocks or patch panels.
 - b. No cable shall be unterminated or contain unterminated elements.
 - c. Pairs shall remain twisted together to within the proper distance from the termination as specified in the TIA/EIA/ANSI 568B Series.
 - d. Conductors shall not be damaged when removing insulation.
 - e. Wire insulation shall not be damaged when removing outer jacket.
 4. Fiber Optic Cable:
 - a. Each pair shall be terminated with appropriate connectors.
 - b. No cable shall be unterminated or contain unterminated elements.

3.3 GROUNDING

- A. Signal distribution system ground shall be installed in the telecommunications entrance facility and in each telecommunications closet in accordance with TIA/EIA/ANSI J-STD-607.
 1. Equipment racks shall be connected to the electrical safety ground.

3.4 LABELING

- A. All cables will be labeled using color labels on both ends per TIA/EIA/ANSI 606.
- B. All workstation and patch panel connections will be labeled using color coded labels per TIA/EIA/ANSI 606.

3.5 TESTING

- A. Testing shall conform to the TIA/EIA/ANSI Standards for all test parameters.
 1. All test data sheets shall be downloaded from the tester, printed out and provided to the Owner.
 2. A CD-ROM shall be provided to the Owner with all test results.
 3. Tester shall be capable of testing parameters for the warranted system.
- B. Materials and documentation to be furnished under this Specification are subject to inspections and tests.
 1. All components shall be terminated prior to testing.
 2. Equipment and systems will not be accepted until the required inspections and tests have been made, demonstrating that the signal distribution system conforms to the specified requirements, and that the required equipment, systems, and documentation have been provided.
- C. Unshielded Twisted Pair Tests:
 1. All metallic cable pairs shall be tested for proper identification and continuity.
 2. All opens, shorts, crosses, grounds, and reversals shall be corrected.
 3. Correct color coding and termination of each pair shall be verified in the communications closet and at the outlet.
 4. Horizontal wiring shall be tested from and including the termination device in the communications closet to and including the modular jack in each room.
 5. These tests shall be completed and all errors corrected before any other tests are started.

D. Category 6 Circuits:

1. Perform Category 6 link tests in accordance with TIA-568-C.1 and TIA-568-C.2. Tests shall include wire map, length, insertion loss, NEXT, PSNEXT, ELFEXT, PSELFEXT, return loss, propagation delay, and delay skew.
2. Cables which contain failed circuits shall be replaced and retested to verify the standard is met.

E. Fiber Optic Cable:

1. Unless stated otherwise, tests shall be performed from both ends of each circuit.
2. All terminations shall be visually inspected for scratches, pits or chips and shall be reterminated if any of these conditions exist.
3. Each link shall be tested for insertion loss using a light source similar to that used for the intended communications equipment.
4. High-resolution optical time domain reflectometer (OTDR) tests shall be performed for each fiber.
5. Scale of the OTDR trace shall be such that the entire circuit appears over a minimum of 80 PCT of the X-axis.

END OF SECTION

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DIVISION 28

ELECTRONIC SAFETY AND SECURITY



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SECTION 28 46 00
FIRE DETECTION AND ALARM

PART 1 - GENERAL

1.1 SUMMARY

- A. The contractor shall provide a new, code compliant fire alarm system that meets the requirements of all applicable local and national codes. This system shall act as an automatic alarm system serving the ground floor of the Mechanical Building. The fire alarm system is a delegated design with performance specifications.
- B. A manual fire alarm system is being provided to serve the ground floor of the Mechanical Building, which has Thickening processes, in accordance with 2020 NPFA 820 Table 6.2.2(a) row 12.
- C. Section Includes:
 - 1. Material and installation requirements for:
 - a. Fire Alarm Control Units.
 - b. Initiating Devices.
 - c. Notification Appliances.
 - d. Miscellaneous Devices.
- D. Related Specification divisions include but are not necessarily limited to:
 - 1. Division 00 - Procurement and Contracting Requirements.
 - 2. Division 01 - General Requirements.
 - 3. Section 23 09 00 - Instrumentation and Control for HVAC Systems.
 - 4. Section 26 05 33 - Raceways and Boxes.

1.2 QUALITY ASSURANCE

- A. Referenced Standards (appropriate editions as adopted by Authority(ies) Having Jurisdiction (AHJ) and including all local amendments):
 - 1. Americans with Disabilities Act (ADA):
 - a. Accessibility Guidelines for Buildings and Facilities (ADAAG).
 - b. ADA Standards for Accessible Design.
 - 2. FM Global (FM):
 - a. All applicable standards.
 - b. All components FM approved.
 - 3. National Electrical Manufacturers Association (NEMA).
 - 4. National Fire Protection Association (NFPA):
 - a. 70, National Electrical Code (NEC):
 - 1) Article 760, Fire Alarm Systems.
 - b. 72, National Fire Alarm and Signaling Code.
 - c. 90A, Standard for the Installation of Air-Conditioning and Ventilating Systems.
 - d. 101, Life Safety Code.
 - 5. National Institute for Certification in Engineering Technologies (NICET).
 - 6. Underwriters Laboratories, Inc. (UL):
 - a. 38, Standard for Manual Signaling Boxes for Fire Alarm Systems.
 - b. 268, Smoke Detectors for Fire Alarm Systems.
 - c. 268A, Standard for Smoke Detectors for Duct Applications.
 - d. 464, Standard for Audible Signaling Appliances.
 - e. 497B, Standard for Protectors for Data Communication and Fire Alarm Circuits.
 - f. 521, Standard for Heat Detectors for Fire Protective Signaling Systems.
 - g. 864, Standard for Control Units and Accessories for Fire Alarm Systems.
 - h. 1971, Standard for Signaling Devices for the Hearing Impaired.

7. Building code:
 - a. International Code Council (ICC):
 - 1) International Building Code and associated standards, 2015 Edition including all local amendments, referred to herein as Building Code.
- B. Design Criteria:
1. Provide a complete fire alarm system as described in the Contract Documents and according to criteria of the AHJ) and all applicable national and local codes such as NFPA, ADAAG, building code, etc.
 - a. Where system requirements described in the Contract Documents exceed those of the AHJ and/or NFPA, meet the requirements of both.
 - b. Perform a thorough examination of Contract Documents and shall coordinate with other disciplines and trades, e.g. verification of hazardous area locations requiring equipment rated for that type of environment.
 - c. Contractor shall be responsible for providing a fully functional and code compliant fire alarm system at no additional cost to the Owner.
 2. Submit documents after design has been approved by Authority Having Jurisdiction (AHJ).
 3. The fire alarm system shall be designed by a NICET Fire Alarm Systems Level III or IV engineering technician.
 - a. The designer is responsible for understanding the construction of the building to take in consideration ceiling heights, ceiling construction (flat or not flat), and other features of the building that will affect the layout of devices as required to provide a fire alarm system that is fully compliant with NFPA 72.
 4. If required by state regulations, a Professional Fire Protection Engineer shall seal drawings submitted to the AHJ.
- C. Service Organization Qualifications:
1. Offer an annual maintenance contract including complete service and equipment costs for maintenance of complete system.
 2. 10 years' experience minimum serving fire alarm systems.
 3. Provide for 24 HR emergency service. Response time to site shall be 24 HRS or less and service office shall be within 250 miles of site.
 4. System shall be installed under the direct supervision of a technician who is factory trained by manufacturer and is certified as a minimum of NICET Level II in Fire Alarm Systems.
- D. Field quality control:
1. Manufacturer's field services: Provide service by a factory-authorized and certified service representative to supervise field assembly and connection of components and pre-testing, testing, and adjustment of system.
 2. Pre-testing: Determine, through pre-testing, conformance of system to requirements of drawings and specifications. Correct deficiencies observed in pre-testing. Replace malfunctioning or damaged items with new and retest until satisfactory performance and conditions are achieved.
 3. Inspection:
 - a. Inspect equipment installation, interconnection with system devices, mounting locations, and mounting methods.
 - b. Verify that units and controls are properly installed, connected, and labeled and that interconnecting wires and terminals are identified.
- E. Authority Having Jurisdiction (AHJ) review:
1. Prior to submission to Engineer, submit shop drawing and product data to Authority Having Jurisdiction (AHJ).
 2. Upon receipt of comments from AHJ, make resubmissions, if required, to make clarifications or revisions to obtain approval.
 3. The contractor shall submit shop drawings and product data sheets to the AHJ for their review and approval before beginning installation the system.
 4. Provide a copy of the AHJ approval with the shop drawing submission to Engineer.

5. The AHJ shall witness final testing and inspection in order to obtain final approval for system.

1.3 DEFINITIONS

- A. For the purposes of providing materials and installing electrical work the following definitions shall be used.
 1. Outdoor Area: Exterior locations where the equipment is normally exposed to the weather and including below grade structures, such as vaults, manholes, handholes and in-ground pump stations.
 2. Architecturally Finished Area: Offices, laboratories, conference rooms, restrooms, corridors and other similar occupied spaces.
 3. Non-architecturally Finished Area: Pump, chemical, mechanical, electrical rooms and other similar process type rooms.
 - a. Highly Corrosive and Corrosive Areas: Rooms or areas identified on the Drawings where there is a varying degree of spillage or splashing of corrosive materials such as water, wastewater or chemical solutions; or chronic exposure to corrosive, caustic or acidic agents, chemicals, chemical fumes or chemical mixtures.
 4. Hazardous areas: Class I, II or III areas as defined in NFPA 70.
 5. Shop Fabricated: Manufactured or assembled equipment for which a UL test procedure has not been established.
 6. Service Organization: Commercial entity comprised of professionals capable of providing the technical knowledge and a supply of replacement equipment required for the comprehensive maintenance of a fire alarm system.

1.4 SYSTEM DESCRIPTION

- A. Automatic and manual, addressable, general alarm and non-coded evacuation alarm, supervised, closed-circuit, 24 VDC microprocessor based fire detection and alarm system.
- B. Provide components and features as required by the applicable codes, AHJ and/or Fire Department, including but not limited to following.
 1. Main FACU in the Electrical Room on the upper level, as indicated on the Electrical Drawings.
 2. Remote Fire Alarm Annunciator (FAA) located at main building entry.
 3. Printer terminals.
 4. Manual stations (throughout the ground floor Thickening area of the Mechanical Building, located at each exit).
 - a. All system components in the Thickening area of the Mechanical Building shall be rated for a wet and corrosive environment (i.e. weatherproof devices, corrosion resistant conduit and fittings, etc.).
 5. Smoke detectors (Above FACU).
 6. Open-area Smoke Imaging Detection (OSID) projected beam smoke detectors (ground floor Thickening area of Maintenance Building).
 7. Ductwork smoke sensors (for any air handling units exceeding 2,000 CFP, installed in accordance with both NFPA 90A and the International Mechanical Code).
 8. Remote alarm indicator for concealed smoke sensors.
 9. Smoke sensors with auxiliary relays (as needed to perform required sequences of operation).
 10. Fan control relays (as needed for HVAC shutdown upon duct detector activation in accordance with both NFPA 90A and the International Mechanical Code).
 11. Visual and audible notification appliances (full coverage throughout the Thickening areas of the Mechanical Building).
 - a. All system components in the Thickening area of the Mechanical Building shall be rated for a wet and corrosive environment (i.e. weatherproof devices, corrosion resistant conduit and fittings, etc.).
 12. Fire alarm system wire, with all wiring in conduit.
 13. Tone generator.

14. Digital Alarm Communicator Transmitter (DACT):
 - a. The DACT shall be a cellular dialer as allowed by NFPA 72.
 - b. DACT shall automatically communicate all Alarm and Trouble signals to a listed Central Station:
 - 1) For Alarm signals, the Central Station shall contact the local Fire Department to initiate Emergency Services Notification.
 - 2) For Trouble signals, the Central Station shall contact the appropriate parties, identified by the Owner on the call list, to inform them that the system requires attention and/or maintenance.
- C. Basic Performance:
1. Signal Line Circuits (SLC) shall be wired Class B NFPA Style 4.
 2. Notification Appliance Circuits (NAC) shall be wired Class B.
 3. Each SLC and NAC shall be limited to only 80 PCT of its total capacity at the time of initial installation.
 4. Fire alarm system and all associated equipment and devices shall be suited to the environment in which it is installed, e.g. in a hazardous areas all equipment shall be appropriately rated as explosion-proof, intrinsically safe, etc.

1.5 SUBMITTALS

- A. Shop Drawings:
1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
 2. Shop drawings submittal shall include minimum required documentation as prescribed in NFPA 72. This includes, but is not limited to, the following:
 - a. Written narrative providing design intent and system description.
 - b. Floor plan layout showing location of all devices and control equipment:
 - 1) Indicate salient features of each device (e.g., weatherproof, strobe candle rating).
 - 2) Designate where protective equipment is provided (e.g. pull station covers, device guards, etc.).
 - 3) Explosion-proof or intrinsically safe ratings for devices.
 - c. Wiring diagrams (including riser diagram).
 - d. Include system details including location of FACU and all devices and circuiting.
 - e. System power and battery backup calculations and voltage drop calculations to assure that system will operate in accordance with prescribed backup time periods and under all voltage conditions per UL and NFPA standards.
 - f. Provide equipment technical data sheet Submittal for all products specified in product section (PART 2), below.
 - g. System operation description including method of operation and supervision of each type of circuit and sequence of operations for all manually and automatically initiated system inputs and outputs.
 - h. Provide list of all input and output points in system with label indicating location or use of IDC, SLC, NAC, relay, sensor, and auxiliary control circuits.
 - i. Equipment design considerations for future expansion as indicated.
 - j. Operating instructions for FACU.
 - k. Completed NFPA 72 record of inspection and testing (see Contract Closeout Information: below for additional requirements).
 - l. Copy of site specific software.
 - m. Name of local service organization.
 - n. Documentation of AHJ approval for system submittal.
- B. Contract Closeout Information:
1. Operation and Maintenance Data:
 - a. See Specification Section 01 33 04 for requirements for the mechanics, administration, and the content of Operation and Maintenance Manual submittals.

2. Field test reports.
3. Owner instruction report.
4. Pro-rata warranty for batteries.
5. Spare parts: Furnish extra materials, packaged with protective covering for storage, and identified with labels clearly describing contents as follows:
 - a. Manual Stations: Furnish quantity equal to 15 PCT of number of manual stations installed but no less than one.
 - b. Notification Appliances: Furnish quantity equal to 5 PCT of each type and number of units installed, but not less than one of each type.
 - c. Automatic initiation devices including but not limited to smoke sensors and heat sensors: Furnish quantity equal to 5 PCT of each type and number of units installed but not less than one of each type.
 - d. Detector or Sensor Bases: Furnish quantity equal to 2 PCT of each type and number of units installed but not less than one of each type.

1.6 AREA DESIGNATIONS

- A. Designation of an area will determine the NEMA rating of the electrical equipment enclosures, types of conduits and installation methods to be used in that area.
 1. Outdoor areas:
 - a. Wet.
 - b. Also, corrosive and/or hazardous when specifically designated on the Drawings or in the Specification Sections.
 2. Indoor areas:
 - a. Dry.
 - b. Also, wet, corrosive and/or hazardous when specifically designated on the Drawings or in the Specification Sections.
 - c. All system components in the Thickening area of the Mechanical Building shall be rated for a wet and corrosive environment (i.e. weatherproof devices, corrosion resistant conduit and fittings, etc.).

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable.
 1. Fire alarm system:
 - a. Edwards Systems Technology (EST).
 - b. Gamewell FCI.
 - c. Notifier.
 - d. Monaco.
 - e. Siemens Industry.
 - f. Silent Knight.
 - g. Simplex Grinnell.
 - h. Cooper Wheelock.
 2. Manufacturer must have a service organization local to the project site.
- B. Submit request for substitution in accordance with Specification Section 01 25 13.
- C. All Equipment:
 1. UL listed as a product of a single manufacturer under a appropriate category.
 2. Equipment shall not be modified or installed to alter or void UL label or listing.
 3. FM approved.
 4. Approved by Fire Marshal.

2.2 MAIN FIRE ALARM CONTROL UNIT (FACU)

- A. FACU shall perform operations as described in Fire Alarm System Operation:
- B. The Fire Alarm system shall have 100 point minimum initiating device capacity with the capability to add additional 100 point minimum initiating device control modules.
- C. Construction shall be modular with solid-state, microprocessor-based electronics.
 - 1. An 80-character LCD display shall indicate alarms, supervisory service conditions and any troubles.
- D. Keyboards or keypads shall not be required to operate system during fire alarm conditions.
- E. Provide necessary switches, relays, indicator lamps, wiring terminals, etc., to provide complete operation supervising, control, and testing facilities for entire system.
- F. FACU shall allow for loading or editing special instructions and operating sequences as required.
 - 1. System shall be capable of on-site programming to accommodate and facilitate expansion, building parameter changes or changes as required by local codes.
 - 2. All software operations shall be stored in a non-volatile programmable memory within FACU.
- G. System shall have provisions for disabling and enabling all circuits individually for maintenance and testing purposes.
- H. System shall be capable of logging and storing 300 events in a history log.
 - 1. These events shall be stored in a battery protected random access memory.
 - 2. Each recorded event shall include time and date of that event's occurrence.
 - 3. System shall have capability of recalling alarms, supervisory conditions, trouble conditions, acknowledgments, silencing and reset activities in chronological order for purpose of recreating an event history.
- I. FACU shall be listed under UL 864.
- J. FACU shall be in an enclosed metal cabinet with glass door specifically designed for public areas.
 - 1. Mounting: Surface.
 - 2. Finish: Red baked enamel.
- K. Each addressable device shall be represented individually in FACU.
 - 1. Indicate TROUBLE by a discreet LCD readout for each supervised circuit.
 - 2. Indicate ALARM by a discreet LCD readout for each alarm initiating addressable device.
 - 3. Include individual supervisory and alarm relays in each circuit arranged so that ground or open condition in any circuit or group of circuits, will not affect proper operation of any other device.
- L. FACU shall include the capability to report alarm and trouble conditions via a telephone line to a third party alarm reporting services.
- M. FACU shall include a system testing capability to help ensure that zoning and supervision have been maintained throughout system.
 - 1. Actuation of the enable walk test program at FACU shall activate "Walk-Test" mode of system which shall cause the following to occur:
 - a. Third party reporting connection circuit shall be disconnected or put in test mode with central station.
 - b. Control relay functions shall be bypassed.
 - c. FACU shall indicate a trouble condition.
 - d. FACU shall, at a minimum, be capable of causing audible signals to activate for 2 SEC upon alarm activation of any initiation device.
 - e. FACU shall automatically reset itself after code is complete.

- f. Any momentary opening of alarm initiating or alarm indicating circuit wiring shall cause audible signals to sound continuously for 4 SEC to indicate trouble condition.
 - g. System shall have four distinctive walk test groups such that only a portion of system need be disabled during testing and an alarm in any other area will be processed normally.
- N. General Alarm Circuits: Positive non-interfering type so that a second device can be annunciated simultaneously, or closely following first zone.
- O. Power Supply:
- 1. Power limited operation per NFPA 70, Article 760.
 - 2. 120 VAC dedicated circuit from panel board to integral 24 VDC regulated power supply in FACU and battery charger.
 - a. The power supply shall provide all panel and peripheral device power needs.
 - 3. If the FACU cannot provide power for the required number of notification appliances a power extender shall be used.
 - a. An additional 120 VAC dedicated circuit from a panel board shall be used to power the power extenders power supply and battery charger.
 - 4. Provide transient voltage surge suppression (TVSS) for Main FACU for power supply and communication channel(s).
- P. Battery:
- 1. Low maintenance sealed type, for fire alarm use with automatic battery charger.
 - 2. Fire alarm systems without voice evacuation capability shall be provided with batteries capable of operating maximum normal load of system for 24 HRS and then capable of operating system for 5 minutes in alarm condition.
 - 3. Fire alarm systems with voice evacuation capability shall be provided with batteries capable of operating maximum normal load of system for 24 HRS and then capable of operating system for 15 minutes in alarm condition.
 - 4. Size batteries for the total maximum number of devices that can be connected to the FACU not the install number of devices.
 - 5. The notification appliance power extender shall have the same battery requirements as the FACU.

2.3 FIRE ALARM ANNUNCIATOR PANEL (FAA)

- A. Annunciator provides remote annunciation using a two-line 40 character, back-lit, alphanumeric, LCD readout.
 - 1. The readout shall display, in descriptive English language; system status, alarm type, supervisory conditions, troubles, and location.
- B. LED's and a tone-alert audible indication is provided for alarm, supervisory or trouble conditions.
 - 1. Each condition has an acknowledge push-button switch that silences the tone-alert but leaves the LED on until all conditions are returned to normal.
- C. FAA shall be an enclosed metal cabinet designed for public areas:
 - 1. Mounting: Flush.
 - 2. Finish: Red baked enamel.

2.4 INITIATING DEVICES

- A. Addressable Manual Pull Stations:
 - 1. Pull-type with handle which shall lock in a protruding manner to facilitate quick visual identification of activated station.
 - a. Reset using key or special tool after operation.
 - b. Non-coded.
 - c. Single action.

2. High impacted Lexan with operating directions in white letters.
 - a. Semi-flush mounted in architecturally finished areas.
 - b. Surface mounted in non-architecturally finished areas.
 - c. Surface mounted with clear Lexan weatherproof protective shield in areas designated as wet or in areas indicated in the schedules herein.
 3. Stations shall be keyed alike with FACU.
 4. Standards: UL 38.
- B. Addressable Detector Base:
1. Plug-in arrangement:
 - a. Detector and associated encapsulated electronic components are mounted in a module that connects to a fixed base with a twist-locking plug connection.
 - b. The plug connection requires no springs for secure mounting and contact maintenance.
 - c. Terminals in the fixed base accept building wiring.
 - d. Detector construction shall have a mounting base with a twist-lock detecting head that is lockable.
 - e. The locking feature must be field removable when not required.
 - f. Removal of the detector head shall interrupt the supervisory circuit of the fire alarm detection loop and cause a trouble signal at the Control Unit.
 2. LED that will flash each time it is scanned by the Control Unit.
 - a. When the Control Unit determines that a detector is in an alarm or a trouble condition, the Control Unit shall command the LED on that detector's base to turn on steady indicating that an abnormal condition exists.
 - b. Detectors which do not provide a visible indication of an abnormal condition at the detector location shall not be acceptable.
 3. Each detector shall be scanned by the Control Unit for its type identification to prevent inadvertent substitution of another detector type.
 - a. The Control Unit shall operate with the installed device but shall initiate a "Wrong Device" or "Incorrect Device ID" trouble condition until the proper type is installed or the programmed detector type is changed.
 4. Addressability: Detectors include a communication transceiver in the detector or mounting base having a unique identification and capability for status reporting to the FACU.
 5. Provide auxiliary relays in detector base to provide local control of equipment as described under system operation.
 - a. Provide separate 24 VDC supply to detector base with auxiliary relays to guarantee that sufficient power will be available to operate relays.
- C. Addressable Smoke Detectors:
1. Photoelectric type that utilizes a sensor chamber with a light source and a photosensitive element that detects products of combustion.
 2. Self-restoring: Detectors do not require resetting or readjustment after actuation to restore them to normal operation.
 3. Quantity and spacing based upon manufacturer's UL listed spacing and the following:
 - a. Provide detectors in accordance with NFPA 72 and the requirements of the AHJ.
 - b. Devices shall be suitable for environment in which they are installed.
 - c. Spacing shall be reduced for increased air changes as required by NFPA 72.
 4. Detectors in non-accessible or controlled access locations shall be provided with a remotely located test switch to provide for ease of testing.
 5. The detector's electronics shall be immune from false alarms caused by EMI and RFI.
 6. Standards: UL 268.
- D. Open-area Smoke Imaging Detection (OSID) projected beam smoke detectors:
1. Dual wavelength type LED-based projected beam smoke detection using optical imaging technology for early warning smoke detection.
 2. Optical imaging with CMOS imaging chip.
 3. On-board event log for fault and alarm diagnostics.
 4. High tolerance to false alarm due to building movement.

5. High tolerance to transient dust, steam and intrusion of solid objects.
 6. Easy alignment with large adjustment and viewing angles, no need for precise alignment, and tolerant of alignment drift.
 7. Automatic commissioning in under ten minutes.
 8. Simple DIP switch configuration.
 9. Three selectable alarm thresholds.
 10. Status LEDs for Fire, Trouble and Power.
 11. Conventional alarm interface for straightforward fire system integration (OSID projected beam smoke detectors Alarm and Trouble relay outputs shall be monitored by FACU).
 12. Powered with externally provided 24 VDC power from FACU or nearby fire alarm power booster panel.
 13. Provide factory environmental housing with NEMA 4X and IP66 ratings that is appropriate for use in harsh environments.
- E. Air Duct Smoke Detector:
1. Duct smoke detectors shall utilize addressable photoelectric type detector as specified herein.
 2. Duct housing mounted directly to outside of duct with a sampling tube extended across duct to sample air movement.
 3. Duct housing couplings slotted to insure proper alignment of sampling and exhaust tubes.
 - a. Tube lengths as required per duct width.
 4. Detector housing shall have an alarm LED visible through front cover.
 5. Remote red LED alarm indicators shall be provided on the wall or ceiling adjacent to detectors above the ceiling or that are not visible from the ground.
 - a. Duct detectors in non-accessible locations shall be provided with a remotely located test switch to provide for ease of testing.
 6. Standards: UL 268A.
- F. Addressable Monitor Modules:
1. Provides addressability and supervision to a conventional initiating device (e.g., tamper switches, pressure switches, flow switches, etc).
 - a. The conventional initiating device shall be wired Class B, Style B.
 2. Integral or remote LED shall be provided that will flash each time it is scanned by the FACU.
 - a. When the FACU determines that a monitor module is in an alarm or a trouble condition, the FACU shall command the LED on that module to turn on steady, change color, or otherwise indicate that an abnormal condition exists.

2.5 AUTOMATIC CONTROL DEVICES

- A. Addressable Relay/Control Modules:
1. Allows FACU to control a remotely located Form "C" contact (e.g., HVAC fans, dampers, fire shutters, elevator capture).
- B. Fan Control Relays:
1. Compatible with unit being controlled.
 2. Industrial grade relays shall be furnished.
 3. Provide enclosures suitable for environment.
 4. Provide engraved phenolic nameplate on enclosure identifying fan or air handling unit being controlled.
 5. Coil voltage as required.

2.6 NOTIFICATION APPLIANCES

- A. Alarm Horns:
1. Electric-vibrating polarized type, operating on 24 VDC, with provision for housing the operating mechanism behind a grille.
 2. Horns produce a sound pressure level of 85 dB, measured at 10 FT.

3. Housing: Red with white "FIRE" lettering.
 - a. Semi-flush or flush mounted in architecturally finished areas.
 - b. Surface-mounted in non-architecturally finished areas.
 4. Horns shall be weatherproof in areas designated as wet.
 - a. All system components in the Thickening area of the Mechanical Building shall be rated for a wet and corrosive environment (i.e. weatherproof devices, corrosion resistant conduit and fittings, etc.).
- B. Alarm Strobes:
1. White tamper resistant lexan lens with 24 VDC xenon strobe.
 2. Provide Candela rating as required per ADA and synchronize of multiple strobes when required.
 3. Housing: Red with white "FIRE" lettering.
 - a. Semi-flush or flush mounted in architecturally finished areas.
 - b. Surface-mounted in non-architecturally finished areas.
 4. Strobes shall be weatherproof in areas designated as wet or in areas indicated in the schedules herein.
 - a. All system components in the Thickening area of the Mechanical Building shall be rated for a wet and corrosive environment (i.e. weatherproof devices, corrosion resistant conduit and fittings, etc.).
- C. Combination Audio/Visual Devices:
1. Shall be mounted in an integral unit and shall have the same features as the individual units specified in the previous subsections.
- D. Standards: UL 464, UL 1971.

2.7 MISCELLANEOUS DEVICES

- A. Isolated Loop Circuit Protector (Transient Suppression):
1. Hybrid solid state high performance suppression system.
 - a. Do not use gas tubes, spark gaps or other suppression system components which might short or crowbar the line resulting in interruption of normal power flow to connected loads.
 2. Line-to-line response time of less than 1 nanosecond capable of accepting a 2000 A (8 x 20 usec pulse) at 28 V.
 3. Line-to-ground response time of less than 1 nanosecond capable of accepting a 2000 A (8 x 20 usec pulse) to earth.
 4. Shield-to-ground shall be capable of accepting a 5,000 A (10 x 50 usec pulse) to earth.
 5. Standard: UL 497B.

2.8 WIRING

- A. Conduit:
1. 1/2 IN minimum.
 2. See Specification Section 26 05 33.
- B. Conductors:
1. Insulation type per NFPA 70, Article 760.
 2. 120 VAC and power supply connections: 12 GA, minimum.
 3. Low-voltage general alarm circuits: 14 GA, minimum.
 4. Low-voltage initiating circuits: 18 GA, minimum.
 5. Annunciator and data communication circuits: As required by manufacturer, UL listed.
 6. Use larger wire sizes when recommended by equipment manufacturer and per voltage drop calculations.
- C. Outlet Boxes: See Specification Section 26 05 33.

2.9 SYSTEM OPERATION

- A. Activation of any alarm-causing Initiating device shall cause the following:
 - 1. General evacuation notification via activation of audible and visual notification appliances.
 - 2. Automatic control devices to operate as defined by the operating sequences.
 - 3. Alarm information shall be displayed at the FACU.
 - 4. DACT shall automatically communicate to a listed Central Station, which in turn shall contact the local Fire Department to initiate Emergency Services Notification.
- B. All fire alarm signals are automatically locked on the display of the FACU until originating device is returned to normal and FACU is manually reset.
 - 1. Audible alarm signals shall be silence-able from FACU allowing for re-initiation following a subsequent alarm.
 - a. Silencing of alarm signals shall not impair ability of system to continue to perform as specified.
- C. Air Handling Equipment Fan Control:
 - 1. De-energize indicated air-handling equipment and interlocked exhaust fans upon alarm and close all associated smoke dampers.
 - 2. See Specification Section 23 09 00 for mechanical equipment sequence of operation and coordinate all fan controls.
 - 3. Fans shall not restart until FACU is manually reset.
- D. Activation of any system trouble shall initiate the following:
 - 1. Common audible trouble signal shall sound and common trouble light shall illuminate at the FACU, any FAA's, and any remote FACU's.
 - 2. Specific device in trouble shall be indicated.
 - 3. DACT shall automatically communicate to a listed Central Station, which in turn shall contact the appropriate parties, identified by the Owner on the call list, to inform them that the system requires attention and/or maintenance.
- E. Audible trouble signal shall be silenceable by FACU.
 - 1. Visual trouble indication remains until trouble condition is corrected.
 - a. A subsequent trouble condition received after manually silencing shall cause audible trouble signal to resound.
 - b. Restoration of system to normal causes audible trouble signal until silencing switch is returned to normal position.
 - 2. Trouble signal(s) will be initiated under following conditions:
 - a. Open on an initiation or alarm indicating circuit.
 - b. Open in wiring to any FAA or any remote FACU's.
 - c. Ground fault condition.
 - d. Auxiliary manual control switch out of normal position.
 - e. Loss of 120 VAC operating power to the Main FACU or any Remote FACU's.
 - f. Low or no battery voltage condition.
- F. Install isolated loop circuit protectors on all fire alarm data communication circuits, SLC and NAC wiring, including shields, which extends beyond the a building.
 - 1. The isolated loop circuit protector shall be located as close as practicable to the point at which the circuits leave or enter a building.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install all fire alarm equipment and wiring in accordance with local and national codes and NFPA 72.
- B. Install all wiring in raceways and all devices in boxes:
 - 1. Install raceways and boxes in accordance with Specification Section 2605.33.
 - 2. In unfinished areas, exposed fire alarm conduit shall be red in color.
 - 3. All boxes are to be red in color (either painted or a manufacturer's red box).
- C. Install all components as indicated and in accordance with manufacturer's wiring diagrams, instructions and recommendations.
- D. Make all fire alarm wiring continuous from terminal to terminal or from terminal to device pigtail lead.
 - 1. Circuit splices not permitted.
 - 2. Wiring joints, only when required at device pigtail leads shall utilize insulated conical spring connector.
- E. Color coding or other identification is required for all fire alarm wiring.
 - 1. Coordinate requirements with Owner.
- F. Installation of equipment and devices that pertain to other work in contract shall be closely coordinated with appropriate subcontractors.
 - 1. Coordinate 8 IN minimum square access door with rubber gasket in duct approximately 2 FT upstream from smoke detector for testing and servicing.
- G. Detection devices shall be protected during construction as required by NFPA 72.
- H. Device Mounting Schedule:
 - 1. Dimensions are to center of item unless otherwise indicated.
 - 2. Mounting heights as indicated below unless otherwise indicated on the Contract Drawings:
 - a. Manual pull stations (Install per ADA and ADAAG Standards):
 - 1) Forward Reach.
 - a) Unobstructed: Maximum 48 IN.
 - b) Obstructed High Reach (depth less than 20 IN): Maximum 48 IN.
 - c) Obstructed High Reach (depth greater than 20 IN): Maximum 44 IN.
 - 2) Side Reach.
 - a) Unobstructed: Maximum 48 IN.
 - 3) Obstructed High Reach (reach depth less than 10 IN): Maximum 48 IN.
 - 4) Obstructed High Reach (reach depth greater than 10 IN): Maximum 46 IN.
 - b. Notification appliances: Lens is not less than 80 IN and not greater than 96 IN.
 - c. Control panels and remote annunciators: 72 IN to top (display at eye level).

3.2 TESTING

- A. Obtain services of factory trained representative of system manufacturer to supervise installation and its progress, supervise final connections to equipment and provide testing to assure that system is in proper operating condition, and is in compliance with all applicable regulations.
- B. Entire system shall test free from opens, grounds, and short circuits.
- C. Test system to satisfaction of Engineer and state and local fire authorities in accordance with NFPA 72, state and local codes and manufacturer's requirements.
- D. Acceptance Operational Tests:
 - 1. Perform operational system tests to verify conformance with specifications:
 - a. Each alarm initiating device installed shall be operationally tested.
 - b. Each device shall be tested for alarm and trouble conditions.

- c. Fire Alarm Submit written certification that Fire Alarm System installation is complete including all punch-list items.
 - d. Test battery operated emergency power supply. Test emergency power supply to minimum durations specified.
 - e. Test supervising station signal transmitter. Coordinate testing with supervising station monitoring firm/entity.
 - f. Test each notification appliance installed for proper operation. Submit written report indicating sound pressure levels at specified distances.
 - g. Test FACU.
2. Provide minimum 5 business days' notice of acceptance test performance schedule to Owner, and local Authority Having Jurisdiction (AHJ).
- E. Retesting: Correct deficiencies indicated by tests and completely retest work affected by such deficiencies. Verify by system test that total system meets Specifications and complies with applicable standards.
- F. Report of Tests and Inspections: Provide written record of inspections, tests, and detailed test results in form of test log. Use NFPA 72 Forms for documentation.
- G. Final Test, Record of Completion, and Certificate of Occupancy:
- H. Test system as required by Authority Having Jurisdiction in order to obtain certificate of occupancy. Provide completed NFPA 72 Record of Completion form to Owner and AHJ.

3.3 CLEANING AND ADJUSTING

- A. Cleaning: Remove paint splatters and other spots, dirt, and debris from all devices and equipment panels. Clean panel internally using methods and materials recommended by manufacturer.
- B. Occupancy Adjustments: When requested within one year of date of substantial completion, provide on-site assistance in adjusting sound pressure levels and adjusting controls and sensitivities to suit actual occupied conditions. Provide up to three visits to site for this purpose.

3.4 TRAINING

- A. Provide services of factory-authorized service representative to demonstrate system and train Owner's personnel in operation of system as specified below.
 - 1. Train Owner's maintenance personnel in procedures and schedules involved in operating, troubleshooting, servicing, and preventive maintaining of system.
 - 2. Provide minimum of 8 HRS training.
 - 3. Schedule training with Owner at least two weeks in advance.
 - 4. Fill out Owner instruction reports.

END OF SECTION

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DIVISION 31

EARTHWORK



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SECTION 31 10 00

SITE CLEARING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Site clearing, tree protection, stripping topsoil and demolition.
- B. Related Specification Sections include but are not necessarily limited to:
 - 1. Division 00 - Procurement and Contracting Requirements.
 - 2. Division 01 - General Requirements.
 - 3. Section 31 23 00 - Earthwork.
 - 4. Section 31 25 00 - Soil Erosion and Sediment Control.
 - 5. Section 32 91 13 - Topsoiling and Finished Grading.

PART 2 - PRODUCTS - (NOT USED)

PART 3 - EXECUTION

3.1 PREPARATION

- A. Protect existing trees and other vegetation to remain against damage.
 - 1. Do not smother trees by stockpiling construction materials or excavated materials within drip line.
 - 2. Avoid foot or vehicular traffic or parking of vehicles within drip line.
 - 3. Provide temporary protection as required.
- B. Repair or replace trees and vegetation damaged (not shown to be removed on drawings) by construction operations.
 - 1. Repair to be performed by a qualified tree surgeon/licensed arborist.
 - 2. Remove trees which cannot be repaired and restored to full-growth status.
 - 3. Replace with new trees of minimum 4 IN caliper or as required by local tree ordinance.
- C. Protection of monuments and benchmarks
 - 1. Section, section subdivision, plat, property corner and any other official monuments or bench marks shall be carefully preserved or referenced and replaced. In the event any such monument or marker and casing is disturbed as a result of contractors operations, the contractor shall replace or reset the monument or marker in a manner as approved by the Engineer, at no additional cost to the Owner. Replaced and reset monuments and casings shall be of an acceptable type and quality and shall be reset by a registered land surveyor.
- D. If required, Owner will obtain authority for removal and alteration work on an adjoining property, as applicable.

3.2 SITE CLEARING

- A. Topsoil Removal:
 - 1. Strip topsoil to depths encountered or as specified within the soils report, 4 IN minimum.
 - a. Remove heavy growths of grass before stripping.
 - b. Stop topsoil stripping sufficient distance from such trees (not shown to be removed) to prevent damage to main root system.
 - c. Separate from underlying subsoil or objectionable material.
 - 2. Stockpile topsoil where directed by Engineer.
 - a. Construct storage piles to freely drain surface water.
 - b. Seed or cover storage piles to prevent erosion.

3. Do not strip topsoil in wooded areas where no change in grade occurs.
 4. Borrow topsoil: Reasonably free of subsoil, objects over 2 IN DIA, weeds and roots.
- B. Clearing and Grubbing:
1. Clear from within limits of construction all trees not marked to remain.
 - a. Include shrubs, brush, downed timber, rotten wood, heavy growth of grass and weeds, vines, rubbish, structures and debris.
 2. Grub (remove) from within limits of construction all stumps, roots, root mats, logs and debris encountered.
 - a. Completely grub under areas to be paved and within limits of proposed structures.
 - b. Grubbing in areas to be landscaped:
 - 1) In cut areas, totally grub.
 - c. Grubbing depths for mature on-site trees shall extend to depth required to remove roots greater than 1/2 IN in diameter.
- C. Disposal of Waste Materials:
1. Do not burn combustible materials on site.
 2. Remove all waste materials from site.
 3. Do not bury organic matter on site.

3.3 ACCEPTANCE

- A. Upon completion of the site clearing, obtain Engineer's acceptance of the extent of clearing, depth of stripping and rough grade.

END OF SECTION

SECTION 31 23 00 EARTHWORK

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Earthwork - excavation, backfilling, grading, compaction, disposal of waste and surplus materials, placing crushed stone, construction of berms, sheeting, bracing, dewatering and other Earthwork related work.
- B. Related Specification Sections include but are not necessarily limited to:
 - 1. Division 00 - Procurement and Contracting Requirements.
 - 2. Division 01 - General Requirements.
 - 3. Section 07 26 00 - Under Slab Vapor Retarder.
 - 4. Section 31 23 33 - Trenching, Backfilling and Compacting for Utilities.
 - 5. Section 31 25 00 - Soil Erosion and Sediment Control.
 - 6. Section 31 50 00 - Contractor-Designed Excavation Support

1.2 QUALITY ASSURANCE

- A. Referenced Standards:
 - 1. ASTM International (ASTM):
 - a. C33/C33M, Standard Specification for Concrete Aggregates.
 - b. D698, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 FT-LBF/FT³).
 - c. D1557, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 FT-LBF/FT³ (2,700 kN-M/M³)).
 - d. D2487, Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System).
 - e. D3786, Standard Test Method for Bursting Strength of Textile Fabrics--Diaphragm Bursting Strength Tester Method.
 - f. D4253, Standard Test Methods for Maximum Index Density and Unit Weight of Soils Using a Vibratory Table.
 - g. D4254, Standard Test Methods for Minimum Index Density and Unit Weight of Soils and Calculation of Relative Density.
 - h. D4632, Standard Test Method for Grab Breaking Load and Elongation of Geotextiles.
 - 2. WSDOT Standard Specifications for Road, Bridge, and Municipal Construction (2018).
 - 3. Occupational Safety and Health Administration (OSHA):
 - a. 29 CFR Part 1926.650, Safety and Health Regulations for Construction - Excavations, referred to herein as OSHA Standards.
- B. Qualifications:
 - 1. Designer of excavation support systems.
 - a. See Specification Section 31 50 00.
- C. Temporary Slopes and Excavation Support Systems:
 - 1. Conform to excavation support regulations of the Washington State Department of Labor and Industries (WISHA), as described in the Safety Standards for Construction Work, Chapter 296-155 Washington Administrative Code (WAC), Part N, Excavation, Trenching and Shoring.

1.3 DEFINITIONS

- A. Excavation:
 - 1. Consists of removal of material encountered to subgrade elevations required or indicated.
 - 2. Includes excavation of soils; pavements and other obstructions visible on surface; underground structures, utilities, and other items indicated to be demolished and removed; boulders; and rock.
- B. Foundations: Footings, base slabs, foundation walls, mat foundations, grade beams, piers and any other support placed directly on soil or rock.
- C. Non-Structural Fill/Backfill: Soil materials placed and compacted to achieve finish grade elevations that do NOT support foundations, slabs, paving, or other flatwork.
- D. Structure: Buildings, foundations, slabs, tanks, curbs, or other man-made stationary features occurring above or below ground surface.
- E. Subgrade: The earth or soil layer immediately below foundation bearing elevation, subbase material, fill material, backfill material, or topsoil materials.
- F. Unauthorized Excavation:
 - 1. Consists of removal of materials beyond indicated subgrade elevations or dimensions without specific direction of Engineer.
 - a. Unauthorized excavation, as well as associated remedial work as directed by Engineer shall be at Contractor's expense.
 - 2. Unsuitable Soil Materials: Soil materials encountered at or below subgrade elevation of insufficient strength and stiffness to support construction as determined by the Engineer.

1.4 SUBMITTALS

- A. Shop Drawings:
 - 1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
 - 2. Product technical data including:
 - a. Acknowledgement that products submitted meet requirements of standards referenced.
 - b. Manufacturer's installation instructions.
 - 3. Certifications.
 - 4. Soil Samples:
 - a. Submit source information and samples
 - b. Submit samples of on-site materials proposed for use.
 - c. Other test reports as necessary or applicable.
 - 5. Shoring System:
 - a. See Specification Section 31 50 00.
- B. Samples:
 - 1. Coordinate samples and testing for approval of off-site materials with the Engineer.
 - 2. Submit samples and source of fill and backfill materials proposed for use.
 - 3. Submit samples and source of borrow materials proposed for use.
 - 4. Test reports.
 - a. Report and certification of aggregate fill and drainage fill.
 - b. Test reports on borrow material.
 - c. Verification of suitability of each footing subgrade material, in accordance with specified requirements.
 - d. Field reports; in-place soil density and moisture tests.
 - e. One optimum moisture-maximum density curve for each type of soil encountered.
 - f. Report of actual unconfined compressive strength and/or results of bearing tests of each strata tested.

1.5 PROJECT CONDITIONS

- A. Salva geable Items: Carefully remove items to be salvaged, and store on Owner's premises unless otherwise directed.
- B. Dispose of waste materials, legally, off site.
 - 1. Burning, as a means of waste disposal, is not permitted.
- C. Site Information:
 - 1. Data in subsurface investigation reports was used for the basis of the design.
 - a. Conditions are not intended as representations or warranties of accuracy or continuity between soil borings.
 - b. The Owner or Engineer will not be responsible for interpretations or conclusions drawn from this data by Contractor.
 - 2. Additional test borings and other exploratory operations may be performed by Contractor, at the Contractor's option; however, no change in the Contract Sum will be authorized for such additional exploration.
 - 3. Site data provided is not contractual and shall be considered "for information only."

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Fill and Backfill:
 - 1. Selected material approved by Engineer from site excavation or from off-site borrow.
- B. Granular Fill under Building Floor Slabs-On-Grade:
 - 1. Clean, crushed, nonporous rock, crushed or uncrushed gravel complying with ASTM C33 gradation size No. 67, 3/4 IN to No. 4.
- C. Granular Fill Under Mechanical Building and Digester Foundations: Imported fill meeting the gradational requirements specified in Section 9-03.9(2), Permeable Ballast, of the WSDOT and American Public Works Association (APWA) Standard Specifications (WSDOT and APWA, 2018).
- D. Structural Backfill: Backfill adjacent to Mechanical Building, Digester and Retaining Structures: Imported structural backfill shall meet the gradational requirements specified in Section 9-03.14(1) of the WSDOT Standard Specifications for Gravel Borrow. Native soil may be used if compaction requirements can be satisfied.
- E. Crushed Surfacing Top Course: Imported granular fill shall meet the gradational requirements specified in Section 9-03.9(3) of the WSDOT Standard Specifications for Gravel Borrow.
- F. Crushed Surfacing Base Course: Imported granular fill shall meet the gradational requirements specified in Section 9-03.9(3) of the WSDOT Standard Specifications for Gravel Borrow.
- G. Geotextile Filter Fabric:
 - 1. Nonwoven type.
 - 2. Equivalent opening size: 50 - 100 (U.S. Standard Sieve).
 - 3. Permeability coefficient (cm/second): 0.07 minimum, 0.30 maximum.
 - 4. Permissivity (1/SEC): 0.02 min.
 - 5. Grab strength: 90 LBS minimum in either direction in accordance with ASTM D4632 requirements.
 - 6. Mullen burst strength: 125 PSI minimum in accordance with ASTM D3786 requirements.

PART 3 - EXECUTION

3.1 PROTECTION

- A. Erosion Control:
 - 1. See Specification Section 31 25 00.
 - 2. Clean paved roadways daily of any spillage of dirt, rocks or debris from vehicles and equipment entering or leaving site.
 - 3. Conduct work to minimize erosion of site. Remove eroded material washed off site.
 - a. If necessary or requested by Engineer, construct stilling areas to settle and detain eroded material.

- B. Protect existing surface and subsurface features on-site and adjacent to site as follows:
 - 1. Provide barricades, coverings, or other types of protection necessary to prevent damage to existing items indicated to remain in place.
 - 2. Protect and maintain bench marks, monuments or other established reference points and property corners.
 - a. If disturbed or destroyed, replace at own expense to full satisfaction of Owner and controlling agency.
 - 3. Verify location of utilities.
 - a. Omission or inclusion of utility items does not constitute nonexistence or definite location.
 - b. Secure and examine local utility records for location data.
 - c. Take necessary precautions to protect existing utilities from damage due to any construction activity.
 - 1) If utilities are indicated to remain in place, provide adequate means of support and protection during earthwork operations.
 - 2) Do not interrupt existing utilities serving facilities occupied by Owner or others, during occupied hours, except when permitted in writing by Owner and then only after acceptable temporary utility services have been provided.
 - 3) Obtain Owner's approval prior to disconnecting any utility service.
 - d. Repair damages to utility items at own expense.
 - e. In case of damage, notify Engineer at once so required protective measures may be taken.
 - 4. Maintain free of damage, existing sidewalks, structures, and pavement, not indicated to be removed.
 - a. Protect new and existing structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earthwork operations.
 - b. Any item known or unknown or not properly located that is inadvertently damaged shall be repaired to original condition.
 - c. All repairs to be made and paid for by Contractor.
 - 5. Provide full access to public and private premises, fire hydrants, street crossings, sidewalks and other points as designated by Owner to prevent serious interruption of travel.
 - 6. Maintain stockpiles and excavations in such a manner to prevent inconvenience or damage to structures on-site or on adjoining property.
 - 7. Avoid surcharge or excavation procedures which can result in heaving, caving, or slides.

- C. Protection of trees to remain:
 - 1. Perform excavation by hand within dripline of large trees designated to remain. Protect root systems from damage or dry out to the greatest extent possible.
 - a. Maintain moist condition for root system and cover exposed roots with moistened burlap.

3.2 SITE EXCAVATION AND GRADING

- A. The site excavation and grading work includes the offsite disposition of all material:
 - 1. That exceed quantities required for earthwork on the project.
 - 2. That the Engineer classifies as unclassified excavation.
 - 3. That the Engineer classifies as unacceptable.
 - 4. That the Engineer classifies as potentially contaminated.
- B. Excavation and Grading:
 - 1. Perform as required inside the construction limits as shown on the Contract Drawings.
 - 2. Contract Drawings indicate both existing grade and finished grade required for construction of Project.
 - a. Stake all units, structures, piping, roads, parking areas and walks and establish their elevations.
 - b. Perform other layout work required.
 - c. Replace property corner markers to original location if disturbed or destroyed.
 - 3. Preparation of ground surface for embankments or fills:
 - a. Before fill is started, scarify to a minimum depth of 6 IN in all proposed embankment and fill areas.
 - b. Where ground surface is steeper than one vertical to four horizontal, plow surface in a manner to bench and break up surface so that fill material will bind with existing surface.
 - 4. Protection of finish grade:
 - a. During construction, shape and drain embankment and excavations.
 - b. Maintain ditches and drains to provide drainage at all times.
 - c. Protect graded areas against action of elements prior to acceptance of work.
 - d. Reestablish grade where settlement or erosion occurs.
 - 5. Last 1 foot of excavation shall be accomplished with an excavation bucket with a flat plate over teeth.
 - 6. Prior to final placement of structural backfill, foundations or slabs, the foundation soils shall be compacted.
 - 7. There shall be 1-foot of over excavation and replaced with a gravel working mat placed immediately after over excavation if groundwater is encountered.
- C. Borrow:
 - 1. Provide necessary amount of approved fill compacted to density equal to that indicated in this Specification.
 - 2. Include cost of all borrow material in original proposal.
 - 3. Fill material to be approved by the Engineer prior to placement.
- D. Construct embankments and fills as required by the Contract Drawings:
 - 1. Construct embankments and fills at locations and to lines of grade indicated.
 - a. Completed fill shall correspond to shape of typical cross section or contour indicated regardless of method used to show shape, size, and extent of line and grade of completed work.
 - 2. Provide approved fill material which is free from roots, organic matter, trash, frozen material, and stones having maximum dimension greater than 6 IN.
 - a. Ensure that stones larger than 4 IN are not placed in upper 6 IN of fill or embankment.
 - b. Do not place material in layers greater than 8 IN loose thickness.
 - c. Place layers horizontally and compact each layer prior to placing additional fill.
 - 3. Compact soils as required to obtain specified density. Selection of appropriate equipment is the Contractor's responsibility.
 - a. In general, compact cohesive soils by sheep's foot, and granular soils by pneumatic rollers, vibrators, or by other equipment as required to obtain specified density.
 - b. Control moisture for each layer necessary to meet requirements of compaction.
- E. Grading Tolerances: ± 0.1 FT from required elevations..

3.3 ROCK EXCAVATION

- A. All rock excavation shall be under one classification.
 - 1. This classification shall include solid ledge rock in its natural location that requires systematic quarrying, drilling and/or blasting for its removal and also boulders that exceed 1/2 CUYD in volume.
- B. Rock excavation includes any material which cannot be dislodge by a D-8 Caterpillar tractor, or equivalent, equipped with a hydraulically operated power ripper, or by a Caterpillar 330 hydraulic excavator, or equivalent, without the use of drilling or blasting. When rock is encountered, strip free of earth.
 - 1. Employ an independent surveyor to determine rock quantities before removal operation begins.
 - 2. In computing the volumetric content of rock excavation for payment, the pay lines shall be taken as follows:
 - a. For structures: 3 FT outside the exterior limits of foundations and from rock surface to 6 IN below bottom of foundations.
 - b. For piping and utilities: A width 18 IN wider than the outside diameter of the pipe or conduit and from rock surface to 6 IN below bottom exterior surface of the pipe or conduit.
 - c. For paving: 2 FT outside the exterior limits of paving and from rock surface to 6 IN below bottom of pavement subbase.

3.4 USE OF EXPLOSIVES

- A. Blasting with any type of explosive is prohibited.

3.5 COMPACTION DENSITY REQUIREMENTS

- A. Obtain approval from the Engineer with regard to suitability of soils and acceptable subgrade prior to subsequent operations.
- B. Provide dewatering system necessary to successfully complete compaction and construction requirements.
- C. Remove frozen, loose, wet, or soft material and replace with approved material as directed by the Engineer.
- D. Stabilize subgrade with well graded granular materials as directed by the Engineer.
- E. Assure by results of testing that the backfill is compacted to 95% of its Modified Proctor maximum dry density (ASTM Designation D1557, Method C or D). The moisture content of the imported fill shall have a moisture content of plus or minus 2%.

- 1. Sitework:

LOCATION	COMPACTION DENSITY	MOISTURE CONTENT
Under Paved Areas:		
Sidewalk, ACP, Curbing, Subgrade	95 PCT per ASTM D1557	-2 to +2 PCT of optimum
Unpaved Areas:		
Landscaping	90 PCT of ASTM D698	-2 to +2 PCT of optimum

2. Structures:

LOCATION	COMPACTION DENSITY	MOISTURE CONTENT
Inside of structures under foundations, under equipment support pads, under slabs-on-grade and scarified existing subgrade under mechanical building and digester foundations.	95 PCT per ASTM D1557	-2 to +2 PCT of optimum
Outside structures next to walls, piers, columns and any other structure exterior member	95 PCT per ASTM D1557	-2 to +2 PCT of optimum

3. Specific areas:

LOCATION	COMPACTION DENSITY	MOISTURE CONTENT
Outside structures under equipment support foundations	95 PCT per ASTM D1557	-2 to +2 PCT of optimum
Granular Fill and Sub-Grade Under Mechanical Building and Digester Foundations and Retaining Structure	95 PCT per ASTM D1557	-2 to +2 PCT of optimum
Granular fill under manholes	90 PCT per ASTM D1557	-2 to +2 PCT of optimum

3.6 EXCAVATION, FILLING, AND BACKFILLING FOR STRUCTURES

A. General:

1. In general, work includes, but is not necessarily limited to, excavation for structures and retaining walls, removal of underground obstructions and undesirable material, backfilling, filling, and fill, backfill, and subgrade compaction.
2. Obtain fill and backfill material necessary to produce grades required.
 - a. Materials and source to be approved by the Engineer.
 - b. Excavated material approved by the Engineer may also be used for fill and backfill.
3. In the paragraphs of this Specification Section, the word "soil" also includes any type of rock subgrade that may be present at or below existing subgrade levels.

B. Excavation Requirements for Structures:

1. General:
 - a. Do not commence excavation for foundations for structures until the Engineer approves:
 - 1) The removal of topsoil and other unsuitable and undesirable material from existing subgrade.
 - 2) Density and moisture content of site area compacted fill material meets requirements of specifications.
 - 3) Site surcharge or mass fill material can be removed from entire construction site or portion thereof.
 - 4) Surcharge or mass fill material has been removed from construction area or portions thereof.
 - 5) Contractor shall use smooth edged bucket without teeth for excavations.
 - b. Engineer grants approval to begin excavations.
2. Dimensions:
 - a. Excavate to elevations and dimensions indicated or specified.
 - b. Allow additional space as required for construction operations and inspection of foundations.

- c. Slope sides of excavations to comply with local codes, ordinances, and requirements of agencies having jurisdiction.
 - d. Maintain sides and slopes of excavations in safe condition until completion of backfilling.
3. Removal of obstructions and undesirable materials in excavation includes, but is not necessarily limited to, removal of old foundations, existing construction, unsuitable subgrade soils, expansive type soils, and any other materials which may be concealed beneath present grade, as required to execute work indicated on Contract Drawings.
 - a. If undesirable material and obstructions are encountered during excavation, remove material and replace as directed by the Engineer.
 - b. Remove unsuitable subgrade soils located below foundations. The bottom of the overexcavation shall be located outside the exterior limits of foundations around the perimeter of structure as directed by the Engineer.
 - c. When excavation has reached required subgrade elevations, notify the Engineer, who will make an inspection of conditions.
 - 1) If the Engineer determines that bearing materials at required subgrade elevations are unsuitable, provide Subgrade Stabilization as specified herein.
 4. Construction traffic:
 - a. Use backhoe and/or other low contact pressure equipment to remove the existing fill and excavate into the native soils.
 - b. Minimize construction traffic on native soils and saturated soils to a void soil disturbance.
 - c. Repair disturbed subgrade soils prior to placing fill or construction work as directed by the Engineer
 - d. Allow only minimal foot traffic on bearing soils prepared for fill or foundations.
 5. Proof-roll all subgrades to receive fill or concrete placement after subgrade has been scarified and compacted.
 - a. Proof-roll in the presence of Engineer with a fully-loaded tandem axle dump truck or other equipment with a minimum gross weight of 25 tons.
 6. Install working surface over approved subgrade.
 - a. Minimum thickness: 12-inches.
 7. Level off bottoms of excavations to receive foundations, floor slabs, equipment support pads, or compacted fill.
 - a. Remove loose materials and bring excavations into approved condition to receive concrete or fill material.
 - b. Where compacted fill material must be placed to bring subgrade elevation up to underside of construction, scarify existing subgrade upon which fill material is to be placed to a depth of 6 IN and then compact to density stated in this Specification Section before fill material can be placed thereon.
 - c. Do not carry excavations lower than shown for foundations except as directed by the Engineer.
 - d. If any part of excavations is carried below required depth without authorization, notify Engineer and correct unauthorized excavation as directed. Corrections may include:
 - 1) Under soil supported footings, foundation bases, or retaining walls, fill unauthorized excavation by extending indicated bottom elevation of footing or base to excavation bottom, without altering required top elevation.
 - a) Concrete fill may be used to bring elevations to proper position.
 - 2) In locations other than those above, including slabs on grade and pile supported foundations, backfill and compact unauthorized excavations as specified for authorized excavations of same classification, unless otherwise directed by Geotechnical Engineer.
 - 3) No extra compensation will be made to Contractor for correcting unauthorized excavations.
 8. Make excavations large enough for working space, forms, dampproofing, waterproofing, and inspection.

9. Notify Engineer as soon as excavation is completed in order that subgrades may be inspected.
 - a. Do not commence further construction until subgrade under compacted fill material, under foundations, under floor slabs-on-grade, under equipment support pads, and under retaining wall footings has been inspected and approved by the Engineer as being free of undesirable material, being of compaction density required by this specification, and being capable of supporting the allowable foundation design bearing pressures and superimposed foundation, fill, and building loads to be placed thereon.
 - b. The Engineer shall be given the opportunity to inspect subgrade below fill material both prior to and after subgrade compaction.
 - c. Place fill material, foundations, retaining wall footings, floor slabs-on-grade, and equipment support pads as soon as weather conditions permit after excavation is completed, inspected, and approved and after forms and reinforcing are inspected and approved.
 - d. Before concrete or fill material is placed, protect approved subgrade from becoming loose, wet, frozen, or soft due to weather, construction operations, or other reasons.
10. Dewatering:
 - a. Where groundwater is or is expected to be encountered during excavation, install a dewatering system to prevent softening and disturbance of subgrade below foundations and fill material, to allow foundations and fill material to be placed in the dry, and to maintain a stable excavation side slope.
 - b. Groundwater shall be maintained at least 3 FT below the bottom of any excavation.
 - c. Review Geotechnical investigation before beginning excavation and determine where groundwater is likely to be encountered during excavation.
 - d. Employ dewatering specialist for selecting and operating dewatering system.
 - e. Keep dewatering system in operation until dead load of structure exceeds possible buoyant uplift force on structure.
 - f. Dispose of groundwater to an area which will not interfere with construction operations or damage existing construction.
 - 1) Install groundwater monitoring wells as necessary.
 - g. Shut off dewatering system at such a rate to prevent a quick upsurge of water that might weaken the subgrade.
11. Subgrade stabilization:
 - a. If subgrade under foundations, fill material, floor slabs-on-grade, or equipment support pads is in a frozen, loose, wet, or soft condition before construction is placed thereon, remove frozen, loose, wet, or soft material and replace with approved compacted material as directed by the Engineer.
 - b. Provide compaction density of replacement material as stated in this Specification Section.
 - c. Loose, wet, or soft materials, when approved by the Engineer, may be stabilized by a compacted working mat of well graded crushed stone.
 - d. Compact stone mat thoroughly into subgrade to avoid future migration of fines into the stone voids.
 - e. Remove and replace frozen materials as directed by the Engineer.
 - f. Method of stabilization shall be performed as directed by the Engineer.
 - g. Do not place further construction on the repaired subgrades, until the subgrades have been approved by the Engineer.
12. Do not place floor slabs-on-grade including equipment support pads until subgrade below has been approved, piping has been tested and approved, reinforcement placement has been approved, and Contractor receives approval to commence slab construction.
 - a. Do not place building floor slabs-on-grade including equipment support pads when temperature of air surrounding the slab and pads is or is expected to be below 40 DEGF before structure is completed and heated to a temperature of at least 50 DEGF.

13. Protection of structures:
 - a. Prevent new and existing structures from becoming damaged due to construction operations or other reasons.
 - b. Prevent subgrade under new and existing foundations from becoming wet and undermined during construction due to presence of surface or subsurface water or due to construction operations.
 14. Shoring:
 - a. See Specification Section 31 50 00.
 15. Drainage:
 - a. Control grading around structures so that ground is pitched to prevent water from running into excavated areas or damaging structures.
 - b. Maintain excavations where foundations, floor slabs, equipment support pads or fill material are to be placed free of water.
 - c. Provide pumping required to keep excavated spaces clear of water during construction.
 - d. Should any water be encountered in the excavation, notify Engineer.
 - e. Provide free discharge of water by trenches, pumps, wells, well points, or other means as necessary and drain to point of disposal that will not damage existing or new construction or interfere with construction operations.
 16. Frost protection:
 - a. Do not place foundations, slabs-on-grade, equipment support pads, or fill material on frozen ground.
 - b. When freezing temperatures may be expected, do not excavate to full depth indicated, unless foundations, floor slabs, equipment support pads, or fill material can be placed immediately after excavation has been completed and approved.
 - c. Protect excavation from frost if placing of concrete or fill is delayed.
 - d. Where a concrete slab is a base slab-on-grade located under and within a structure that will not be heated, protect subgrade under the slab from becoming frozen until final acceptance of the Project by the Owner.
 - e. Protect subgrade under foundations of a structure from becoming frozen until structure is completed and heated to a temperature of at least 50 DEGF.
- C. Fill and Backfill Inside of Structure and Below Foundations, Base Slabs, Floor Slabs, Equipment Support Pads and Piping:
1. General:
 - a. Subgrade to receive fill or backfill shall be free of undesirable material as determined by Engineer and scarified to a depth of 6 IN and compacted to density specified herein.
 - b. Surface may be stepped by at not more than 12 IN per step or may be sloped at not more than 2 PCT.
 - c. Do not place any fill or backfill material until subgrade under fill or backfill has been inspected and approved by Engineer as being free of undesirable material and compacted to specified density.
 2. Obtain approval of fill and backfill material and source from Engineer prior to placing the material.
 3. Granular fill under floor slabs-on-grade: Place all floor slabs-on-grade on a minimum of 6 IN of granular fill unless otherwise indicated.
 4. Vapor barrier: Install a continuous vapor barrier under floor slabs-on-grade as required by Specification Section 07 26 00 and shown on Contract Drawings.
 5. Fill and backfill placement:
 - a. Prior to placing fill and backfill material, optimum moisture and maximum density properties for proposed material shall be obtained from the Engineer.
 - b. Compaction within 3 feet of walls,
 - c. A maximum backfill lift of 9 inches shall be used for heavy compaction equipment or 6-inch lift for hand operated equipment.
 - d. Place loose backfill material in 9 IN lifts for heavy compaction equipment and 6 IN lifts for hand operated compaction equipment.

- e. Compact material by means of equipment of sufficient size and proper type to obtain specified density.
 - f. Use hand operated equipment (smaller vibrating-plate compactor) for filling and backfilling within 3 FT of walls and less than 3 FT above pipes.
 - 1) Compaction equipment exceeding 3000 LBS dead weight shall not be used within 5 FT of the wall as a minimum.
 - 2) Contractor is responsible for method of compaction so as not to damage wall.
 - g. Use hand operated equipment for filling and backfilling next to walls.
 - h. Do not place fill and backfill when the temperature is less than 40 DEGF and when subgrade to receive fill and backfill material is frozen, wet, loose, or soft.
 - i. Use vibratory equipment to compact granular material; do not use water.
6. Where fill material is required below foundations, place fill material, conforming to the required density and moisture content as required to fill the specified overexcavation to bottom of foundation.
 7. If groundwater is encountered granular fill under the Mechanical Building and Digester as aggregate under the foundations will be required.
 8. If debris is encountered at subgrade elevations under the Mechanical Building and Digester or soil disturbance where the foundation will sit then granular fill shall be provided in that particular area after debris is removed.
 9. If the soil is undisturbed and there is no groundwater then the native soil (subgrade) can be compacted with no aggregate provided under the foundation.
 10. Native soil may be able to be used for Structural Backfill if 95% compaction can be achieved (moisture content near optimum plus/minus 2%). If not, import shall be used..
 11. Maximum lifts will be 8-inch.

D. Filling and Backfilling Outside of Structures:

1. This paragraph of this Specification applies to fill and backfill placed outside of structures above bottom level of both foundations and piping but not under paving.
2. Provide material as approved by the Engineer for filling and backfilling outside of structures.
3. Fill and backfill placement:
 - a. Prior to placing fill and backfill material, obtain optimum moisture and maximum density properties for proposed material from the Engineer.
 - b. Place fill and backfill material to maximum allowable lift thickness indicated in this Specification Section.
 - c. Compact material with equipment of proper type and size to obtain density specified.
 - d. Place loose backfill material in 8 IN lifts for heavy compaction equipment and 6 IN lifts for hand operated compaction equipment.
 - 1) Compaction equipment exceeding 3000 LBS dead weight shall not be used within 3 FT of the wall as a minimum
 - 2) Contractor is responsible for method of compaction so as not to damage wall.
 - e. Use only hand operated equipment for filling and backfilling next to walls and retaining walls.
 - f. Do not place fill or backfill material when temperature is less than 40 DEGF and when subgrade to receive material is frozen, wet, loose, or soft.
 - g. Use vibratory equipment for compacting granular material; do not use water.
4. Backfilling against walls:
 - a. Do not backfill around any part of structures until each part has reached specified 28-day compressive strength and backfill material has been approved.
 - b. Do not start backfilling until concrete forms have been removed, trash removed from excavations, pointing of masonry work, concrete finishing, dampproofing and waterproofing have been completed.
 - c. Do not place fills against walls until floor slabs at top, bottom, and at intermediate levels of walls are in place and have reached 28-day required compressive strength to prevent wall movement.
 - 1) See Contract Drawings for specific exceptions.

- d. Bring backfill and fill up uniformly around the structures and individual walls, piers, or columns.
- E. Backfilling Outside of Structures under Piping or Paving:
 - 1. When backfilling outside of structures requires placing backfill material under piping or paving, the material shall be placed from bottom of excavation to underside of piping or paving at the density required for fill under piping or paving as indicated in this Specification Section.
 - 2. This compacted material shall extend transversely to the centerline of piping or paving a horizontal distance each side of the exterior edges of piping or paving equal to the depth of backfill measured from bottom of excavation to underside of piping or paving.
 - 3. Provide compacted bedding or compacted subgrade material under piping or paving as required by other Specification Sections for the Project.

3.7 FIELD QUALITY CONTROL

- A. All excavation, trenching, and related sheeting, bracing, etc. shall comply with the requirements of OSHA Standards, and WISHA requirements. Where conflict between OSHA and WISHA regulations exists, the more stringent requirements shall apply.
- B. Special Inspection and Testing:
 - 1. See Section 01 45 33.
- C. Contractor provides sufficient notification and access so inspection and testing can be accomplished.
- D. Contractor pays for retesting of failed tests and for additional testing required when defects are discovered.

3.8 SPECIAL REQUIREMENTS

- A. Erosion Control:
 - 1. Conduct work to minimize erosion of site.
 - 2. Construct stilling areas to settle and detain eroded material.
 - 3. Remove eroded material washed off site.
 - 4. Clean streets daily of any spillage of dirt, rocks or debris from equipment entering or leaving site.

END OF SECTION

SECTION 31 23 19 DEWATERING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Dewatering system.
 - 2. Surface water control system.
 - 3. Monitoring wells.
 - 4. System operation and maintenance.
 - 5. Water disposal.
- B. Related Specification Sections include but are not necessarily limited to:
 - 1. Division 00 - Procurement and Contracting Requirements.
 - 2. Division 01 - General Requirements.
 - 3. Section 31 23 00 - Earthwork
 - 4. Section 31 25 00 - Soil Erosion and Sediment Control.

1.2 QUALITY ASSURANCE

- A. Obtain permit from Washington State Department of Ecology (Ecology) National Pollutant Discharge Elimination System (NPDES) for storm-water discharge.
- B. Permits:
 - 1. Obtain and pay respective fees for Ecology NPDES permit required for the withdrawal, treatment and disposal/discharge of water from the dewatering operation, prior to start of work.
- C. Qualifications:
 - 1. Dewatering system designer
 - a. Experienced in the design, installation, and operation and maintenance of dewatering systems that are of similar design to those being proposed for this project.

1.3 DEFINITIONS

- A. Dewatering:
 - 1. Lowering of groundwater table and intercepting horizontal water seepage to prevent groundwater from entering excavations and trenches.
 - 2. Disposing of removed water.
- B. Surface Water Control:
 - 1. Removal of surface water within open excavations.
- C. Foundations:
 - 1. Footings, base slabs, foundation walls, mat foundations, grade beams, piers and any other support placed directly on soil or rock.

1.4 SUBMITTALS

- A. Shop Drawings:
 - 1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
 - 2. Dewatering plan design data and Drawings including the following:
 - a. Proposed type of dewatering system with complete description of equipment and instrumentation to be used.
 - b. Arrangement, locations, and depths of system components.
 - c. Pipe sizes and capacities.

- d. Filter types and sizes.
 - e. Water disposal method and location.
 - f. Surface water control devices.
 - g. System operation, monitoring, and maintenance procedures.
 - h. Method of monitoring water quality.
 - i. Documentation for all well installations and decommissioning, including permits.
 - j. Documentation in support of filter grain size determination.
 - k. Location of dewatering wells.
 - l. Plan for decommissioning dewatering wells and site restoration.
 - m. Decommissioning records after completion of decommissioning.
 - n. Signed and sealed by professional engineer.
3. Product technical data including:
- a. Dewatering pump data including the following:
 - 1) Size, capacity, and means of operation of engine and motor.
 - b. Pumping equipment for control of surface water within excavation.

1.5 DESIGN REQUIREMENTS

- A. Dewatering system shall include mitigation measures to limit drawdown and settlement as determined by the Dewatering System Designer and shall consider the excavation support system.
- B. Limit dewatering efforts to localized areas for specific structures. Take such mitigating measures necessary to limit drawdown-induced differential settlement to structures and facilities adjacent to the Work. At a minimum, provide the following:
 - 1. Drawings indicating the number, location, size, and depth of all dewatering wells, well points, and dewatering discharge pit location.
 - 2. Location and dimension of discharge piping, discharge points, valves, flow meters, and other dewatering equipment.
 - 3. Capacities of pumps and standby equipment.
 - 4. Design calculations proving adequacy of system and selected equipment.
 - 5. Detailed description of the dewatering schedule, sequence, operation, maintenance, and abandonment procedures.
 - 6. Projected water level drawdown and elevation in all dewatering wells, well points, monitoring wells/piezometers, private stormwater ponds, and recharge/injection wells.
 - 7. Plan view drawing showing the estimated zone of influence and resulting groundwater elevations for each aquifer during dewatering.
 - 8. Estimated dewatering system discharge flow rates.
 - 9. Monitoring program that provides for the evidence that improved areas are not affected by the dewatering system.
- C. Review by the Engineer of the drawings and data submitted shall not in any way be considered to relieve the Contractor from full responsibility for all errors therein.
- D. The development, drilling, and decommissioning of all wells shall comply with Chapter 173-160 WAC.
- E. Washington State water quality requirements.
- F. Dewatering can affect improvements in the Work and surrounding area. Take adequate precautions in the design and implementation of the dewatering plan to protect existing improvements and avoid damage thereto. Design the dewatering system using accepted and professional methods of design and engineering consistent with the best practice.
- G. The dewatering system shall include wells, well points, sumps, pumps, discharge lines, discharge pit location and other equipment, appurtenances and related earthwork necessary to perform the function.

1.6 PROJECT CONDITIONS

A. Site Information:

1. Data in subsurface investigation reports was used for the basis of the design.
 - a. Conditions are not intended as representations or warranties of accuracy or continuity between soil borings.
 - b. The Owner or Engineer will not be responsible for interpretations or conclusions drawn from this data by Contractor.
2. Additional test borings and other exploratory operations may be performed by Contractor, at the Contractor's option; however, no change in the Contract Sum will be authorized for such additional exploration.
3. Site data provided is not contractual and shall be considered "for information only".

PART 2 - PRODUCTS

2.1 DEWATERING EQUIPMENT

- A. Select dewatering equipment to meet specified performance requirements.

PART 3 - EXECUTION

3.1 PROTECTION

A. Erosion Control:

1. See Specification Section 31 25 00.
2. Clean paved roadways daily of any spillage of dirt, rocks or debris from vehicles and equipment entering or leaving site.
3. Conduct work to minimize erosion of site. Remove eroded material washed off site.
 - a. If necessary or requested by Engineer, construct stilling areas to settle and detain eroded material.

B. Protect existing surface and subsurface features on-site and adjacent to site as follows:

1. Provide barricades, coverings, or other types of protection necessary to prevent damage to existing items indicated to remain in place.
2. Protect and maintain bench marks, monuments or other established reference points and property corners.
 - a. If disturbed or destroyed, replace at Contractors expense to full satisfaction of Owner and controlling agency.
3. Verify location of utilities.
 - a. Omission or inclusion of utility items does not constitute nonexistence or definite location.
 - b. Obtain and examine local utility records for location data.
 - c. Take necessary precautions to protect existing utilities from damage due to a ny construction activity.
 - 1) If utilities are indicated to remain in place, provide adequate means of support and protection during earthwork operations.
 - 2) Do not interrupt existing utilities serving facilities occupied by Owner or others, during occupied hours, except when permitted in writing by Owner and then only after acceptable temporary utility services have been provided.
 - 3) Obtain Owner's approval prior to disconnecting any utility service.
 - d. Repair damages to utility items at Contractors expense.
 - e. In case of damage, notify Engineer at once so required protective measures may be taken.

4. Maintain free of damage, existing sidewalks, structures, and pavement, not indicated to be removed.
 - a. Protect new and existing structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earthwork operations.
 - b. Any item known or unknown or not properly located that is inadvertently damaged shall be repaired to original condition.
 - c. All repairs to be made and paid for by Contractor.
5. Provide full access to public and private premises, fire hydrants, street crossings, sidewalks and other points as designated by Owner to prevent serious interruption of travel.

3.2 DEWATERING

- A. Review Geotechnical investigation before beginning excavation and determine where groundwater is likely to be encountered during excavation.
- B. Where groundwater is or is expected to be encountered during excavation, install a dewatering system to prevent softening and disturbance of subgrade below foundations and fill material, to allow foundations and fill material to be placed in the dry, and to maintain a stable excavation side slope.
 1. Employ dewatering specialist for selecting and operating dewatering system.
 2. Groundwater shall be maintained at least 3 FT below the bottom of any excavation.
 3. Install groundwater monitoring wells as necessary.
 4. Keep dewatering system in operation until dead load of structure exceeds possible buoyant uplift force on structure.
- C. Dispose of groundwater to an area which will not interfere with construction operations or damage existing construction.
 1. Shut off dewatering system at such a rate to prevent a quick upsurge of water that might weaken the subgrade.
 2. Discharge water into location indicated in dewatering plan.

3.3 SURFACE WATER CONTROL SYSTEMS

- A. Provide ditches, berms, and other devices to divert and drain surface water from excavation area as specified in Specification Section 31 25 00.
- B. Divert surface water and seepage water within excavation areas into sumps and pump water into] in accordance with requirements of the Ecology NPDES Permit.
- C. Control and remove unanticipated water seepage into excavation.

END OF SECTION

SECTION 31 23 33

TRENCHING, BACKFILLING, AND COMPACTING FOR UTILITIES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Excavation, trenching, backfilling and compacting for all underground utilities.
- B. Related Specification Sections include but are not necessarily limited to:
 - 1. Division 00 - Procurement and Contracting Requirements.
 - 2. Division 01 - General Requirements.
 - 3. Section 03 31 31 - Concrete Mixing, Placing, Jointing, and Curing.
 - 4. Division 26 - Electrical.
 - 5. Section 31 23 00 - Earthwork.
 - 6. Section 31 50 00 - Excavation Support and Protection
 - 7. Section 33 05 16 - Precast Concrete Manhole Structures.

1.2 QUALITY ASSURANCE

- A. Referenced Standards:
 - 1. ASTM International (ASTM):
 - a. C33/C33M, Standard Specification for Concrete Aggregates.
 - b. D698, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 FT-LBF/FT³ (600 kN-M/M³)).
 - c. D1557, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 FT-LBF/FT³ (2,700 kN-M/M³)).
 - d. D2321, Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications.
 - e. D4253, Standard Test Methods for Maximum Index Density and Unit Weight of Soils Using a Vibratory Table.
 - f. D4254, Standard Test Methods for Minimum Index Density and Unit Weight of Soils and Calculation of Relative Density.
 - 2. WSDOT Standard Specifications for Road, Bridge, and Municipal Construction (2018).
- B. Qualifications:
- C. Temporary Slopes and Excavation Support Systems:
 - 1. Conform to excavation support regulations of the Washington State Department of Labor and Industries (WISHA), as described in the Safety Standards for Construction Work, Chapter 296-155 Washington Administrative Code (WAC), Part N, Excavation, Trenching, and Shoring.

1.3 DEFINITIONS

- A. Excavation: All excavation will be defined as unclassified.

1.4 SUBMITTALS

- A. Shop Drawings:
 - 1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
 - 2. Product technical data including:
 - a. Acknowledgement that products submitted meet requirements of standards referenced.
 - b. Manufacturer's installation instructions.
 - 3. Submit respective pipe or conduit manufacturer's data regarding bedding methods of installation and general recommendations.

4. Submit sieve analysis reports on all granular materials.
- B. Informational Submittals:
1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
 2. Trench shield (trench box) certification if employed:
 - a. Specific to Project conditions.
 - b. Re-certified if members become distressed.
 - c. Certification by registered professional structural engineer, registered in the state where the Project is located.
 - d. Engineer is not responsible to, and will not, review and approve.
 3. Excavation support systems
 - a. Qualifications of excavation support system designer.
 - b. Trench Safety Plan and trench shoring drawings including current certification of trench shields employed.
 - c. Drawings and calculations for all proposed support systems sealed by a professional engineer.
 - d. Contingency plan for alternative procedures to be implemented if the excavation support system is found to perform unfavorably.
 - e. Dewatering requirements.
 4. Qualifications of excavation support system designer:

1.5 SITE CONDITIONS

- A. Avoid overloading or surcharge a sufficient distance back from edge of excavation to prevent slides or caving.
 1. Maintain and trim excavated materials in such manner to be as little inconvenience as possible to public and adjoining property owners.
- B. Provide full access to public and private premises and fire hydrants, at street crossings, sidewalks and other points as designated by Owner to prevent serious interruption of travel.
- C. Protect and maintain bench marks, monuments or other established points and reference points and if disturbed or destroyed, replace items to full satisfaction of Owner and controlling a agency.
- D. Verify location of existing underground utilities
- E. Protect work from erosion per Section 31 25 00 and Drawings.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Trench Backfill:
 1. Excludes Subgrade Material and Bedding Materials.
 2. Soil shall be approved by Engineer.
 3. Soil shall be classified as GP, GP-GM, GW, GW-GM, SP, SP-SM, or SW, or SW-SM according to the USCS.
 4. Soil shall not contain greater than 15 percent soil passing the No. 200 sieve (fines content).
 5. Soil shall not contain particles larger than 4 IN in median diameter.
 6. Soil shall be uniformly graded, free of topsoil, organic matter, and frozen soil.
- B. Subgrade Materials: Exposed undisturbed native subgrade soil at bottom of trenches shall be free of particles larger than 1.5 IN for flexible pipe and 4 IN for rigid pipe.

- C. Pipe Zone Backfill:
 - 1. The Contractor shall use imported bedding meeting the requirements of the following materials:
 - a. Section 9-03.12(3) of the WSDOT 2018 Standard Specifications.
 - b. No alternative material will be used.
 - 2. Loose soil shall be removed from the base of utility trenches or recompacted to a firm condition prior to placing bedding materials.
 - 3. Flowable fill (Controlled Density Fill - CDF):
 - a. Materials shall conform to WSDOT Section 2-09.3(1)E.

PART 3 - EXECUTION

3.1 GENERAL

- A. Remove and dispose of unsuitable materials as directed by the Engineer to site provided by Owner.

3.2 EXCAVATION

- A. Unclassified Excavation: Remove rock excavation, clay, silt, gravel, hard pan, loose shale, and loose stone as directed by Geotechnical Engineer.
- B. Excavation for Appurtenances:
 - 1. 12 IN (minimum) clear distance between outer surface and embankment.
 - 2. See Specification Section 31 23 00 for applicable requirements.
 - 3. See Specification Section 33 05 16 for applicable requirements.
- C. Groundwater Dewatering:
 - 1. Where groundwater is, or is expected to be, encountered during excavation, install a dewatering system to prevent softening and disturbance of subgrade to allow subgrade stabilization, pipe, bedding and backfill material to be placed in the dry, and to maintain a stable trench wall or side slope.
 - 2. Groundwater shall be drawn down and maintained at least 3 FT below the bottom of any trench or manhole excavation prior to excavation.
 - 3. Review soils investigation before beginning excavation and determine where groundwater is likely to be encountered during excavation.
 - a. Employ dewatering specialist for selecting and operating dewatering system.
 - 4. Keep dewatering system in operation until dead load of pipe, structure and backfill exceeds possible buoyant uplift force on pipe or structure.
 - 5. Dispose of groundwater to an area which will not interfere with construction operations or damage existing construction.
 - 6. Install groundwater monitoring wells as necessary.
 - 7. Shut off dewatering system at such a rate to prevent a quick upsurge of water that might weaken the subgrade.
 - 8. Cost of groundwater dewatering shall be the Contractors responsibility.
- D. Trench Excavation:
 - 1. Excavate trenches by open cut method to depth shown on Drawings and necessary to accommodate work.
 - a. Support existing utility lines and yard piping where proposed work crosses at a lower elevation.
 - 1) Stabilize excavation to prevent undermining of existing utility and yard piping.
 - 2. Open trench outside buildings, units, and structures:
 - a. No more than the distance between two manholes, structures, units, or 100 LF, whichever is less.
 - b. Field adjust limitations as weather conditions dictate.
 - 3. Trenching within buildings, units, or structures:
 - a. No more than 100 LF at any one time.

4. Any trench or portion of trench, which is opened and remains idle for seven calendar days, or longer, as determined by the Owner, may be directed to be immediately refilled, without completion of work, at no additional cost to Owner.
 - a. Said trench may not be reopened until Owner is satisfied that work associated with trench will be prosecuted with dispatch.
5. Observe following trenching criteria:
 - a. Trench size:
 - 1) Excavate width to accommodate free working space.
 - 2) Trench width: See standard details.
 - 3) Cut trench walls vertically from bottom of trench to 6 IN above top of pipe, conduit, or utility service.
 - 4) Keep trenches free of surface water runoff.
 - a) Include cost in Bid.
 - b) No separate payment for surface water runoff pumping will be made.
- E. Trenching for Electrical Installations:
 1. Observe the preceding Trench Excavation paragraph in PART 3 of this Specification Section.
 2. Modify for electrical installations as follows:
 - a. Open no more than 100 LF of trench in exterior locations for trenches more than 12 IN but not more than 30 IN wide.
 - b. Any length of trench may be opened in exterior locations for trenches which are 12 IN wide or less.
 - c. Do not over excavate trench.
 - d. Cut trenches for electrical runs with minimum 30 IN cover, unless otherwise specified or shown on Drawings.
 - e. See Division 26 for additional requirements.
- F. Flowable Fill:
 1. Flowable fill shall be:
 - a. Discharged from a mixer by any means acceptable to the Engineer into the area to be filled.
 - b. Placed in 4 FT maximum lifts to the elevations indicated.
 - 1) Allow 12 HR set-up time before placing next lift or as approved by the Engineer.
 - 2) Place flowable fill lifts in such a manner as to prevent flotation of the pipe.
 2. Flowable fill shall not be placed on frozen ground.
 3. Subgrade on which flowable fill is placed shall be free of disturbed or softened material and water.
 4. Conform to appropriate requirements of Specification Section 31 23 00.
 5. Flowable fill batching, mixing, and placing may be started if weather conditions are favorable, and the air temperature is 34 DEGF and rising.
 6. At the time of placement, flowable fill must have a temperature of at least 40 DEGF.
 7. Mixing and placing shall stop when the air temperature is 38 DEGF or less and falling.
 8. Each filling stage shall be as continuous an operation as is practicable.
 9. Prevent traffic contact with flowable fill for at least 24 HRS after placement or until flowable fill is hard enough to prevent rutting by construction equipment.
 10. Flowable fill shall not be placed until water has been controlled or groundwater level has been lowered in conformance with the requirements of the preceding Groundwater Dewatering paragraph in PART 3 of this Specification Section.

3.3 PREPARATION OF FOUNDATION FOR PIPE LAYING

- A. Over-Excavation:
 1. Backfill and compact to 90 PCT of maximum dry density per ASTM D698.
 2. Backfill with granular bedding material as option.

- B. Rock Excavation:
 1. Excavate minimum of 6 IN below bottom exterior surface of the pipe or conduit.
 2. Backfill to grade with suitable earth or granular material.
 3. Form bell holes in trench bottom.
- C. Subgrade Stabilization:
 1. Stabilize the subgrade when directed by the Owner.
 2. Observe the following requirements when unstable trench bottom materials are encountered.
 - a. Notify Owner when unstable materials are encountered.
 - 1) Define by drawing station locations and limits.
 - b. Remove unstable trench bottom caused by Contractor failure to dewater, rainfall, or Contractor operations.
 - 1) Replace with subgrade stabilization with no additional compensation.

3.4 BACKFILLING METHODS

- A. Do not backfill until tests to be performed on system show system is in full compliance with specified requirements.
- B. Carefully Compacted Backfill:
 1. Furnish where indicated on Drawings, specified for trench embedment conditions and for compacted backfill conditions up to 12 IN above top of pipe or conduit.
 2. Comply with the following:
 - a. Place backfill in lifts not exceeding 8 IN (loose thickness).
 - b. Hand place, shovel slice, and pneumatically tamp all carefully compacted backfill.
 - c. Observe specific manufacturer's recommendations regarding backfilling and compaction.
 - d. Compact each lift to specified requirements.
- C. Common Trench Backfill:
 1. Perform in accordance with the following:
 - a. Place backfill in lift thicknesses capable of being compacted to densities specified.
 - b. Observe specific manufacturer's recommendations regarding backfilling and compaction.
 - c. Avoid displacing joints and appurtenances or causing any horizontal or vertical misalignment, separation, or distortion.
- D. Water flushing for consolidation is not permitted.
- E. Backfilling for Electrical Installations:
 1. Comply with Paragraph 31 23 33-3.4B and Paragraph 31 23 33-3.4C.
 2. Modify for electrical installation as follows:
 - a. Observe notes and details on electrical drawings for fill in immediate vicinity of direct burial cables.

3.5 COMPACTION

- A. General:
 1. Place and assure bedding, backfill, and fill materials achieve an equal or higher degree of compaction than undisturbed materials adjacent to the work.
 2. In no case shall degree of compaction below minimum compactions specified be accepted.
- B. Compaction Requirements:
 1. Unless noted otherwise on Drawings or more stringently by other Specification Sections, comply with following minimum trench compaction criteria .

a. Pipe zone material:

LOCATION	COMPACTION DENSITY (PERCENT OF MAXIMUM DRY DENSITY)
All locations	92 PCT PER ASTM D1557

b. Toe drain bedding and backfill:

LOCATION	COMPACTION DENSITY (PERCENT OF MAXIMUM DRY DENSITY)
All locations	95 PCT PER ASTM D1557

c. Common trench backfill:

LOCATION	COMPACTION DENSITY (PERCENT OF MAXIMUM DRY DENSITY)
Under pavements	95 PCT PER ASTM D1557
Under turfed, sodded, plant seeded, nontraffic areas	92 PCT PER ASTM D1557

3.6 FIELD QUALITY CONTROL

- A. Moisture density relations, to be established by the Engineer required for all materials to be compacted.
- B. Extent of compaction testing will be as necessary to assure compliance with Specifications.
- C. Give minimum of 48 HR advance notice to Engineer when ready for compaction or subgrade testing and inspection.
- D. Should any compaction density test or subgrade inspection fail to meet Specification requirements, perform corrective work as necessary.
- E. Pay for all costs associated with corrective work and retesting resulting from failing compaction density tests.
- F. Ensure excavations are safe for testing personnel.

END OF SECTION

SECTION 31 25 00
SOIL EROSION AND SEDIMENT CONTROL

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Soil erosion and sediment control.
- B. Related Specification Sections include but are not necessarily limited to:
 - 1. Division 00 - Procurement and Contracting Requirements.
 - 2. Division 01 - General Requirements.

1.2 QUALITY ASSURANCE

- A. Referenced Standards:
 - 1. Erosion control standards: Standards and Specifications for Soil Erosion and Sediment Control in Developing Areas by the United States Department of Agriculture (USDA), Soil Conservation Service, College Park, Maryland.
 - 2. WSDOT Standard Specifications for Road, Bridge, and Municipal Construction.

1.3 SUBMITTALS

- A. Shop Drawing
 - 1. See Section 01 33 00 for requirements for mechanics and administration of submittal process.
 - 2. Temporary Erosion and Sediment Control (TESC) Plan per WSDOT Section 8-01.3(1)A.
 - 3. Spill Prevention, Control, and Countermeasures Plan per WSDOT Section 1-7.15(1)
 - 4. Stormwater Pollution Prevention Plan (SWPPP) in accordance with Washington State Department of Ecology's Construction Stormwater General Permit Special Condition 9.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Stabilized Construction Entrance: See Standard Details.
- B. Straw bales, twine tied.
- C. Pipe Riser and Barrel: 16 GA corrugated metal pipe (CMP) of size indicated.
- D. Stone for Stone Filter: 2 IN graded gravel or crushed stone.
- E. Grass Seed: Annual ryegrass.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Contractor shall have an Erosion and Sediment Control (ESC) Lead in accordance with WSDOT Section 8-01.3(1)B to inspect and maintain erosion and sediment control in accordance with the SWPPP.
- B. Prior to General Stripping Topsoil and Excavating:
 - 1. Install perimeter dikes and swales.
 - 2. Excavate and shape sediment basins and traps.
 - 3. Construct pipe spillways and install stone filter where required.

4. Machine compact all berms, dikes and embankments for basins and traps.
 5. Install straw bales where indicated.
 - a. Provide two stakes per bale.
 - b. First stake angled toward previously installed bale to keep ends tight against each other.
- C. Temporarily seed basin slopes and topsoil stockpiles:
1. Rate: 1/2 LB/1000 SQFT.
 2. Reseed as required until good stand of grass is achieved.

3.2 DURING CONSTRUCTION PERIOD

- A. Maintain Basins, Dikes, Traps, Stone Filters, Straw Bales, etc.:
 1. Inspect regularly especially after rain storms.
 2. Repair or replace damaged or missing items.
- B. After rough grading, sow temporary grass cover over all exposed earth areas not draining into sediment basin or trap.
- C. Construct inlets as soon as possible.
 1. Excavate and tightly secure straw bales completely around inlets.
- D. Provide necessary swales and dikes to direct all water towards and into sediment basins and traps.
- E. Do not disturb existing vegetation (grass and trees).
- F. Excavate sediment out of basins and traps when capacity has been reduced by 50 PCT.
 1. Remove sediment from behind bales to prevent overtopping.
- G. Topsoil and Fine Grade Slopes and Swales, etc.: Seed and mulch as soon as areas become ready.

3.3 NEAR COMPLETION OF CONSTRUCTION

- A. Eliminate basins, dikes, traps, etc.
- B. Grade to finished or existing grades.
- C. Fine grade all remaining earth areas, then seed and mulch.

END OF SECTION

SECTION 31 50 00
EXCAVATION SUPPORT AND PROTECTION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes:
 - 1. Requirements for excavation support systems of trenches and open excavations greater than 4 FT in depth.
 - 2. Requirements for monitoring of settlement and movement of existing structures.
- B. Related Sections include but are not necessarily limited to:
 - 1. Division 0 - Conditions of the Contract.
 - 2. Division 1 - General Requirements.
 - 3. Section 31 23 00 - Earthwork.
 - 4. Section 31 23 33 - Trenching, Backfilling, and Compacting for Utilities.
 - 5. Geotechnical Information.

1.2 QUALITY ASSURANCE

- A. Referenced standards:
 - 1. ASTM International (ASTM)
 - a. A36, Standard Specification for Carbon Structural Steel
 - b. A328, Standard Specification for Steel Sheet Piling
 - c. A416, Standard Specification for Steel Strand, Uncoated Seven-Wire for Prestressed Concrete
 - d. A572, Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel
 - 2. American Wood Preservers Association (AWPA)
 - 3. Washington State Safety Code (WSSC)
 - 4. Post Tensioning Institute - Recommendations for Prestressed Rock and Soil Anchors (1980).
- B. Qualifications:
 - 1. Designer of Contractor -Designed Excavation Support Systems:
 - a. Registered Professional Engineer licensed in the State of Washington.
 - b. Minimum of 10 years experience in design of excavation support systems.
 - 2. Settlement monitoring surveyor:
 - a. Professional land surveyor registered in the State of Washington.
- C. Temporary Slopes and Excavation Support Systems:
 - 1. Conform to excavation support regulations of the Washington State Department of Labor and Industries (WISHA), as described in the Safety Standards for Construction Work, Chapter 296-155 Washington Administrative Code (WAC), Part N, Excavation, Trenching, and Shoring.
 - 2. Excavation support systems shall be Contractor -Designed, and drawings and calculations shall be signed and stamped, by a Professional Engineer, licensed to practice in the State of Washington and experienced in the design of excavation support systems.
 - 3. Designer of excavation support system shall perform on-site inspections of excavation support system as the systems are constructed. Designer of excavation support system shall provide written approval of excavation support system following completion of each support system.
 - 4. Performance and proof tests of tieback anchors shall be completed under the review of the Design Engineer retained by the designer of Contractor -Designed Excavation Support Systems. Testing of tieback anchors should be in accordance with "Post Tensioning Institute, 'Recommendations for Prestressed Rock and Soil Anchors,' 2014".

1.3 SUBMITTALS

- A. Shop Drawings:
 - 1. See Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
 - 2. Provide information required by the Safety Standards for Construction Work (Chapter 216-155 WAC, Part N) prior to commencing excavation work requiring an excavation support system.
 - 3. Submit drawings and design calculations for all proposed excavation support systems for review and comment by the Engineer.
 - 4. Review by the Engineer of the Contractor's general compliance with the Washington State Safety Code shall not be construed as a detailed analysis for adequacy of the support system, nor shall any provisions of the above requirements be construed as relieving the Contractor of its overall responsibility and liability for the work.
- B. Submit drawings, calculations, and construction materials data sheets for excavation support systems in compliance with Section 01 33 00. The following shall be submitted:
 - 1. The proposed excavation support system for each construction component where excavation support systems will be used.
 - 2. Arrangement, size and details for each excavation support system.
 - 3. Supporting design calculations including but not limited to:
 - a. Calculations that demonstrate the excavation support system provides a factor of safety against collapse, overturning, anchor pullout sliding, buoyancy and bottom heave and provides protection to prevent settlement of adjacent structures and properties.
 - b. Estimates of likely deflections or deformations of the excavation support system walls and bottom during use.
 - c. Calculations demonstrating bottom stability of each excavation.
 - 4. Methods statement, working drawings, and work sequence for excavation support system installation through completion of each system. Address each work element including the equipment, layout, methods and sequence for excavation support, excavation, and bottom slab installation.
 - 5. Depending on the method of contractor designed-excavation support system proposed, submit the following:
 - a. Soldier pile installation methods, connection details, bracing requirements, tieback installation procedures, and tieback testing procedures.
 - b. The proposed method of installing sheet piling including sequence of installation, template, equipment description, and material data sheets.
 - c. Details of any proposed tieback systems and calculations. Indicate type, drilling and grouting method, location, anchor head design, no-load zone geometry, bond length, total length, and computed elongation of all tieback anchors. Provide a written procedure for measuring elongation. Full excavation depth load to be carried by various excavation support system members.
 - d. Tremie slab placement methods, layout, and sequence.
 - e. Preloads as required.
 - 6. Depths below the main excavation bottom elevation to which the excavation support system will be installed.
 - 7. Elevations of ground surface, struts, and shores, as applicable.
 - 8. Permissible depth to which excavation may be carried before excavation support system must be installed and engaged.
 - 9. Bracing loads for various stages of excavation, bracing removal, and concrete placement. If bracing loads from the Contractor's designed excavation support system are to be transferred to any existing structure, provide calculations showing that the structure will not be overstressed or exceeds deflection limits for structural members.
 - 10. Proposed sequence of strut and shore removal and tieback de-tensioning as applicable and as related to concrete placement and backfilling operations.
 - 11. Dewatering requirements.

12. Contingency plan for alternative procedures to be implemented if the excavation support system is found to perform unfavorably.
- C. Structure Settlement Monitoring Plan:
 1. Detailed monitoring plan that clearly outlines the monitoring schedule and when information will be transmitted to Engineer.
 2. Schedule and procedures for installation of monitoring points.
 3. Monitoring point location details.
 4. Submit settlement monitoring readings within 24 hours after reading.
- D. Qualifications of the Contractor-Designed excavation support system designer.
- E. Qualifications of the settlement monitoring surveyor.

1.4 PROJECT CONDITIONS

- A. The City of Wenatchee has not secured agreements to extend excavation support systems components or anchors beneath adjacent properties or rights-of-way.
- B. See "Geotechnical Information attached as appendix to these specifications for additional information. The report is not considered part of the Contract Documents and the Contractor may not rely on this information.
- C. See Section 01 14 16 for constraints related to work sequence and site access and use.
- D. Worthen Street and Riverside Drive are located immediately adjacent to the project site in close proximity. Excavation support systems shall be designed to protect the both Worthen Street and Riverside Drive right-of-ways from settlement and damage during the construction operations. Provide settlement monitoring for both roadways on the eastside and north side of the project site. The City of Wenatchee will obtain rights of entry for the Contractor to install and read settlement monitoring points.
- E. Utility agencies shall be notified and caution exercised while exposing utility facilities by hand or other methods approved by utility owner.
- F. If existing utility facilities interfere with the proposed method of support, the method shall be modified in a manner that will protect the facility and accommodate the proposed work. Submittals shall be revised and resubmitted along with design calculations required to account for the modified support method and to show the actual location of the existing utilities.
- G. Provisions shall be made for contingencies as follows:
 1. Monitor performance of support system components for both vertical and horizontal movement.
 2. Provide contingency plan for alternative procedures to be implemented if unfavorable performance is evidenced.
 3. Keep on hand materials and equipment necessary to implement contingency plan.
- H. Elements of the support system shall not be spliced unless reviewed by the Engineer.

1.5 DESIGN CRITERIA

- A. All systems shall be Contractor-Designed by a registered Professional Engineer licensed in the State of Washington.
- B. Design the excavation support system and all components to support the earth pressures, unrelieved hydrostatic pressures, utility loads, equipment, traffic, and construction loads including impact, and other surcharge loads in such manner as will allow the safe and expeditious construction of the permanent structures to minimize ground movement or settlement, and to prevent damage to or movement of adjacent buildings, structures, roadways and utilities.

- C. Design of the excavation support system should include the contractor's understanding of site-specific soil conditions and methods to mitigate exposed and subgrade conditions such as groundwater levels, caving soil, cobbles and boulders, etc.
- D. Means and methods of excavation support vary and the designer of the excavation support systems should verify and develop design criteria for the specific excavation support system proposed.
- E. Design support members to resist the maximum loads expected to occur during the excavation and support removal stages.
- F. If the excavation support system includes soldier piles and lagging, use positive means for securing timber lagging to the soldier piles to prevent shifting or falling off of the lagging, and positive means for containing material behind lagging.
- G. No portion of the excavation support system's vertical face will be permitted to penetrate the design lines that allow for the permanent concrete structure to be constructed within the excavation.
- H. Vertical support capacity shall be provided for wall systems and internal bracing elements, for loads due to vertical force components of tieback anchors, the weight of the structural system themselves, and live load on any portion of the system.
- I. Horizontal strutting below the barrel of a pipe and the use of pipe as support are not acceptable.
- J. Temporary Slopes:
 - 1. Inclined no steeper than 2H:1V (horizontal to vertical)
 - 2. Construction equipment, stockpiles, or building supplies shall not be allowed at the top of the cut within a distance of at least 1/2 the depth of the excavation from the top of the cut.
- K. Settlement limits within the Worthen Street and Riverside Drive right-of-way adjacent to the project site shall be compliant with City of Wenatchee Requirements.

1.6 PERMITS

- A. Comply with all permits.

PART 2 - PRODUCTS

2.1 SETTLEMENT MONITORING POINTS

- A. Settlement monitoring points installed in walls or vertical surfaces of existing structures shall consist shall be coordinated with the City of Wenatchee and meet City of Wenatchee Requirements.

PART 3 - EXECUTION

3.1 GENERAL

- A. The design, planning, installation, testing, and removal, if required, of all excavation support systems shall be accomplished in such a manner as to maintain the required excavation or trench section and to maintain the undisturbed state of the soils below and adjacent to the excavation.
- B. The excavation support system shall extend below the main excavation bottom elevation to a depth adequate to prevent hydrostatic uplift, seepage and piping, and lateral movement and to adequately support applied vertical loads. In areas where additional excavation is required below the main excavation subgrade provisions shall be made to prevent movement of main excavation supports.
- C. Damage to existing utilities and other structures during installation of excavation support system shall be avoided. If damage occurs it shall be repaired at no cost to the City of Wenatchee and to the satisfaction of utility owners.

- D. Water control measures shall be provided in accordance with the requirements specified in Section 31 23 00 and 31 23 19.
- E. Obstructions:
1. Obstructions and other impediments to drilling and excavation will be encountered within the Work Limits. If, during the course of the work, obstructions are encountered, the Engineer shall be immediately notified. Corrective measures shall be submitted by the Contractor to and accepted by the Engineer before further work.
 2. When obstructions are encountered during drilling for soldier pile installation, provide alternate drilling equipment suitable to break up, drill through, and/or remove the obstruction.
 3. If obstructions are encountered during sheet pile installation, remove the sheet pile affected and drill out the obstruction. Fill the hole with CDF and re-drive the sheet pile.
- F. Soil erosion and sediment control
1. See Section 31 25 00
 2. Protect exposed soil along slopes from surface erosion using waterproof tarps.
 3. Divert surface water away from excavation.
- G. Monitoring settlement of existing structures adjacent to the project site:
1. Install settlement monitoring points per City of Wenatchee requirements.
 2. Coordinate schedule of installation with Engineer to verify access to property.
 3. Make initial baseline readings (by Settlement Monitoring Surveyor) of monitoring points prior to initiation of excavation support system installation. Take at least three sets of initial baseline measurements.
 4. Take readings daily during the installation of the adjacent excavation support system. After completion of the excavation support system, take readings weekly until the Digester and Mechanical Building has been completed to finish ground level.
 5. If settlement reaches 50 percent of the limit specified, take the following actions:
 - a. Take immediate steps to stop cause of settlement.
 - b. Notify Engineer.
 - c. Develop a corrective action plan within 24 hours and submit for review.
 - d. Implement approved corrective action.
 - e. Verify success of corrective action.

3.2 REMOVAL OF EXCAVATION SUPPORT SYSTEMS

- A. Where removal is required wholly or in part, such removal shall be performed in a manner that will not disturb or damage adjacent new or existing construction or utilities. Fill all voids immediately with CDF, lean concrete, or other approved means.
- B. Tiebacks shall be de-tensioned before backfilling of the excavation. No tiebacks shall remain in tension following completion of construction.
- C. All damage to property resulting from removal shall be promptly repaired at no cost to the City of Wenatchee. The Engineer shall be the sole judge as to the extent and determination of the materials and methods for repair. Submit details of proposed repairs for review by the Engineer.

END OF SECTION

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DIVISION 32

EXTERIOR IMPROVEMENTS



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SECTION 32 12 16
ASPHALTIC CONCRETE VEHICULAR PAVING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Asphaltic concrete vehicular paving.
- B. Related Specification Sections include but are not necessarily limited to:
 - 1. Division 00 - Procurement and Contracting Requirements.
 - 2. Division 01 - General Requirements.

1.2 QUALITY ASSURANCE

- A. Referenced Standards:
 - 1. Construction standards: Washington State Department of Transportation Standard Specifications for Road, Bridge, and Municipal Construction "Standard Specifications".

1.3 SUBMITTALS

- A. Shop Drawings:
 - 1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
 - 2. Product technical data including:
 - a. Acknowledgement that products submitted meet requirements of standards referenced.
 - b. Manufacturer's installation instructions.
 - c. Asphalt design mix.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Asphaltic Concrete: HMA CL ½ IN, PG 64-28.
- B. Tack Coat:
 - 1. Emulsified asphalt.
 - 2. AASHTO M-140 (ASTM D-977) or M-208 (D-2397).
 - 3. CSS-1 diluted with one part water to one part emulsified asphalt.

2.2 MIXES

- A. Comply with mix design category per Section 5-04 of the WSDOT Standard Specifications (2020).

PART 3 - EXECUTION

3.1 APPLICATION

- A. Construct to line, grade and section as shown on Drawings and in accordance with the WSDOT Standard Specifications. Subgrade shall be prepared in accordance with Section 2-06 of WSDOT Standard Specifications.
- B. Install base course in accordance with Division 4 of the WSDOT Standard Specifications and compact in place to 95 percent of maximum dry density.
- C. Spread a prime coat uniformly on compacted aggregate base course at rate of 0.05 to 0.10 GAL per square yard in accordance with Section 5-1 of WSDOT Standard Specifications.

- D. Asphalt shall conform to applicable provisions of Section 5-04 Hot Mix Asphalt, Section 9-02 Bituminous Materials, and Section 9-03 Aggregates of the WSDOT 2018 Standard Specifications, except as modified by these Contract Documents. Asphalt shall be compacted in one or more lifts over the crushed surfacing to a minimum of 91% of the reference maximum density as determined by WSDOT FOP for AASHTO T 209. An approved herbicide (weed kill) shall be applied to the crushed surfacing prior to paving per WSDOT section 5-04.3(5)D. Tack coat shall be applied to all existing Asphalt and concrete surfaces prior to the HMA placement.
- E. Install binder course and surface course, in accordance with Division 4 of the WSDOT Standard Specifications.
- F. Tolerance of Finished Grade: +0.10 FT from required elevations.

END OF SECTION

SECTION 32 16 13
CONCRETE CURB AND GUTTER

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Concrete curb and gutter.
- B. Related Specification Sections include but are not necessarily limited to:
 - 1. Division 00 - Procurement and Contracting Requirements.
 - 2. Division 01 - General Requirements.
 - 3. Section 03 31 30 - Concrete, Materials and Proportioning.
 - 4. Section 03 31 31 - Concrete Mixing, Placing, Jointing, and Curing.
 - 5. Section 03 05 05 - Testing.

1.2 QUALITY ASSURANCE

- A. Referenced Standards:
 - 1. American Association of State Highway and Transportation Officials (AASHTO):
 - a. M153, Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction.
 - b. M171, Standard Specification for Sheet Materials for Curing Concrete.
 - c. M182, Burlap Cloth Made from Jute or Kenef.
 - d. M213, Preformed Expansion Joint Fillers for Concrete Paving and Structure Construction (Nonextruding and Resilient Bituminous Types).
 - e. M233, Boiled Linseed Oil Mixture for Treatment of Portland Cement Concrete.
 - 2. American Concrete Institute (ACI):
 - a. 305R, Hot Weather Concreting.
 - b. 306R, Cold Weather Concreting.
 - 3. ASTM International (ASTM):
 - a. A615, Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.
 - b. C33, Standard Specification for Concrete Aggregates.
 - c. C150, Standard Specification for Portland Cement.
 - d. C309, Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
 - e. D698, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 FT-LB/FT³).
 - f. D4253, Standard Test Methods for Maximum Index Density and Unit Weight of Soils Using a Vibratory Table.
 - g. D4254, Standard Test Methods for Minimum Index Density and Unit Weight of Soils and Calculation of Relative Density.
 - 4. Federal Specification (FS):
 - a. SS-S-1614, Sealants, Joint, Jet-Fuel-Resistant, Hot-Applied for Portland Cement and Tar Concrete Pavements.

1.3 SUBMITTALS

- A. Shop Drawings:
 - 1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
 - 2. Product technical data including:
 - a. Acknowledgement that products submitted meet requirements of standards referenced.
 - 3. Mix design(s) in accordance with Specification Section 03 31 30 and Specification Section 03 05 05.

4. Drawings detailing all reinforcing.
 5. Test reports:
 - a. Concrete cylinder test results from field quality control.
- B. Samples:
1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
 2. Samples of fabricated jointing materials and devices.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
1. Chemical admixtures:
 - a. Sika Chemical Corporation.
 - b. BASF Admixtures, Inc.
 - c. Protex Industries.
 - d. W. R. Grace and Company.
- B. Submit request for substitution in accordance with Specification Section 01 25 13.

2.2 MATERIALS

- A. Portland Cement:
1. ASTM C150, Type I or II.
- B. Aggregates:
1. ASTM C33, gradation size #67, 3/4 IN to #4.
- C. Water:
1. Potable quality.
- D. Admixtures:
1. Comply with Specification Section 03 31 30.
- E. Reinforcing Bars:
1. ASTM A615, Grade 60.
- F. Preformed Joint Filler:
1. Nonextruding cork, self-expanding cork, sponge rubber or cork rubber.
 2. AASHTO M153 or AASHTO M213.
- G. Hot-Poured Joint Sealing Material:
1. FS SS-S-1614.
- H. Membrane Curing Compound:
1. ASTM C309.
- I. Cover Materials for Curing:
1. Burlap:
 - a. AASHTO M182.
 - b. Minimum Class 2, 8 OZ material (1 YD x 42 IN).
 2. Polyethylene film, AASHTO M171.
- J. Paper Subgrade Cover:
1. Polyethylene film, AASHTO M171.
- K. Concrete Treatment:
1. Boiled linseed oil mixture.
 2. AASHTO M233.

- L. Forms:
 - 1. Steel or wood.
 - 2. Size and strength to resist movement during concrete placement and to retain horizontal and vertical alignment.
 - 3. Free of distortion and defects.
 - 4. Full depth.
 - 5. Metal side forms:
 - a. Minimum 7/32 IN thick.
 - b. Depth equal to edge thickness of concrete.
 - c. Flat or rounded top minimum 1-3/4 IN wide.
 - d. Base 8 IN wide or equal to height, whichever is less.
 - e. Maximum deflection 1/8 IN under center load of 1700 LBS.
 - f. Use flexible spring steel forms or laminated boards to form radius bends.

2.3 MIXES

- A. Mix design to provide 4,000 PSI 28-day compressive strength, 1-1/2 IN +1 IN slump, 6 PCT air.
- B. Comply with Specification Section 03 31 30 and Specification Section 03 31 31.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Subgrade Preparation:
 - 1. Prepare using methods, procedures, and equipment necessary to attain required compaction densities, elevation and section.
 - 2. Scarify and recompact top 6 IN of fills and embankments which will be under concrete curb and gutters.
 - 3. Remove soft or spongy areas.
 - a. Replace with aggregate material.
 - 4. Compact to the following densities:
 - a. Cohesive soils: 95 PCT per ASTM D698.
 - b. Noncohesive soils: 75 PCT relative per ASTM D4253 and ASTM D4254.
 - 5. Assure moisture content is within limits prescribed to achieve required compaction density.
 - 6. Following compaction, trim and roll to exact cross section.
 - 7. Check with approved grading template.
 - 8. Perform density tests on subgrade to determine that subgrade complies with the specification.
- B. Aggregate Course:
 - 1. Place material in not more than 6 IN thick layers.
 - 2. Spread, shape, and compact all material deposited on the subgrade during the same day.
- C. Loose and Foreign Material:
 - 1. Remove loose and foreign material immediately before application of paving.
- D. Appurtenance Preparation:
 - 1. Block out or box out curb inlets and curb returns.
 - 2. Provide for joint construction as detailed and dimensioned on Drawings.
 - 3. Adjust manholes, inlets, valve boxes and any other utility appurtenances to design grade.
 - a. Secure to elevation with concrete.
 - b. Place concrete up to 5 IN below design grade.
 - 4. Clean and oil forms.

3.2 INSTALLATION

- A. Concrete Production:
 - 1. Comply with Specification Section 03 31 31.

- B. Forms:
1. Form support:
 - a. Compact soil foundation and cut to grade to support forms and superimposed machine loads.
 - b. Use bearing stakes driven flush with bottom of form to supplement support as necessary.
 - c. Do not use earth pedestals.
 2. Staking forms:
 - a. Joint forms neatly and tightly.
 - b. Stake and pin securely with at least three pins for each 10 FT section.
 3. Clean and oil forms prior to placement of concrete.
 4. Set forms sufficiently in advance of work (minimum of 2 HRS) to permit proper inspection.
 5. Previously finished pavement or sidewalk contiguous with new work may serve as side form when specifically approved.
- C. Reinforcing:
1. Lap nonwelded bars 12 IN minimum.
 2. Support:
 - a. Place bars securely on chairs at called-for height.
- D. Joints:
1. Hold locations and alignment to within +1/4 IN.
 2. Finish concrete surface adjacent to previous section to within +1/8 IN, with tooled radius of 1/4 IN.
 3. Expansion joints:
 - a. Locate at 48 FT intervals and at all intersection curb returns.
 - b. Stake in place load transfer device consisting of dowels.
 - c. Supporting and spacing means and premolded joint filler as per Drawing details.
 - d. Provide preformed joint filler at all junctions with existing curb and gutter or other structures.
 4. Contraction joints:
 - a. Locate at 6 FT intervals.
 - b. Use steel template at least 1/4 IN thick, conforming to cross section of curb and gutter.
 - c. Remove template where concrete has set sufficiently to prevent spalling or adhesion of concrete.
 - d. If machine placed, use tooled joint formed in freshly placed concrete.
 - e. Groove dimensions shall be 3/8 IN at surface and 1/4 IN at root.
 5. Install construction joints at end of day's work or wherever concreting must be interrupted for 30 minutes or more.
 6. Thoroughly clean and fill joints with joint sealing material as specified.
 7. Upper surface of filled joint to be flush to 1/8 IN below finished surface.
- E. Place Concrete:
1. Comply with Specification Section 03 31 31.
 2. Construct driveway openings, ramps, and other features as per Drawing details.
- F. Cold and Hot Weather Concreting:
1. Cold weather:
 - a. Cease concrete placing when descending air temperature in shade falls below 40 DEGF.
 - b. Do not resume until ambient temperature has risen to 40 DEGF.
 - c. If placing is authorized below 40 DEGF by Engineer, maintain temperature of mix between 60 and 80 DEGF.
 - d. Heat aggregates or water or both.
 - e. Water temperature may not exceed 175 DEGF.
 - f. Aggregate temperature may not exceed 150 DEGF.
 - g. Remove and replace frost-damaged concrete.

- h. Salt or other antifreeze is not permitted.
 - i. Comply with ACI 306R.
 - 2. Hot weather:
 - a. Cease concrete placing when plastic mix temperature cannot be maintained under 90 DEGF.
 - b. Aggregates or water or both may be cooled.
 - c. Cool water with crushed ice.
 - d. Cool aggregates by evaporation of water spray.
 - e. Never batch cement hotter than 160 DEGF.
 - f. Comply with ACI 305R.
- G. Finishing:
 - 1. Bring combination curb and gutter to grade by running straightedge over steel templates with sawing motion.
 - 2. Float surface with a wood float to draw cement to surface.
 - 3. Broom finish after floating.
 - 4. Tool edges with suitable edger.
 - 5. Upon removal of forms, fill honeycombed or unevenly filled sections immediately with cement mortar.
 - 6. Assure that expansion joints are cleared of concrete, both at bottom of gutter and back of curb.
- H. Curing:
 - 1. Apply membrane curing compound complying with ASTM C309, and in accordance with manufacturer's directions but at a minimum rate of 200 SQFT/GAL.
 - 2. Apply curing compound within 4 HRS after finishing or as soon as surface moisture has dissipated.
 - 3. Cure for 7 days.
 - 4. When average daily temperature is below 50 DEGF, provide insulative protection of 12 IN minimum thickness loose dry straw, or equivalent, for 10 days.
- I. Protection of Concrete:
 - 1. Protect new curb and gutter and its appurtenances from traffic for minimum of 14 days.
 - 2. Repair or replace parts of curb and gutter damaged by traffic, or other causes, occurring prior to final acceptance.
- J. Opening to Traffic:
 - 1. After 14 days, area may, at Owner's discretion, be opened to traffic if job cured test cylinders have attained a compressive strength of 3,000 LBS per square inch when tested in accordance with ASTM standard methods.
 - 2. Prior to opening to traffic, clean and refill joints as required with specified filler material.
- K. Clean Up:
 - 1. Assure clean up work is completed within two weeks after work has been opened to traffic.
 - 2. No new work will begin until clean up work has been completed, or is maintained within two weeks after work has been opened to traffic.

3.3 FIELD QUALITY CONTROL

- A. Provide test cylinders in accordance with Specification Section 03 05 05.

END OF SECTION

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SECTION 32 16 23
CONCRETE SIDEWALK AND STEPS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Concrete sidewalk and steps.
- B. Related Specification Sections include but are not necessarily limited to:
 - 1. Division 00 - Procurement and Contracting Requirements.
 - 2. Division 01 - General Requirements.
 - 3. Section 03 31 30 - Concrete, Materials and Proportioning.
 - 4. Section 03 31 31 - Concrete Mixing, Placing, Jointing, and Curing.
 - 5. Section 03 05 05 - Testing.

1.2 QUALITY ASSURANCE

- A. Referenced Standards:
 - 1. American Association of State Highway and Transportation Officials (AASHTO):
 - a. M153, Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction.
 - b. M171, Sheet Materials for Curing Concrete.
 - c. M182, Burlap Cloth Made from Jute or Kenaf.
 - d. M213, Preformed Expansion Joint Fillers for Concrete Paving and Structure Construction (Nonextruding and Resilient Bituminous Types).
 - e. M224, Use of Protective Sealers for Portland Cement Concrete.
 - f. M233, Boiled Linseed Oil Mixture for Treatment of Portland Cement Concrete.
 - 2. American Concrete Institute (ACI):
 - a. 305R, Hot Weather Concreting.
 - b. 306R, Cold Weather Concreting.
 - 3. ASTM International (ASTM):
 - a. A185, Standard Specification for Steel Welded Wire Reinforcement, Plain, for Concrete.
 - b. A615, Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.
 - c. A1064, Standard Specification for Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete.
 - d. C33, Standard Specification for Concrete Aggregates.
 - e. C150, Standard Specification for Portland Cement.
 - f. C309, Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
 - g. D698, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 FT-LBF/FT³).
 - h. D4253, Standard Test Methods for Maximum Index Density and Unit Weight of Soils Using a Vibratory Table.
 - i. D4254, Standard Test Methods for Minimum Index Density and Unit Weight of Soils and Calculation of Relative Density.
 - 4. Federal Specification (FS):
 - a. SS-S-1614, Sealants, Joint, Jet-Fuel-Resistant, Hot-Applied for Portland Cement and Tar Concrete Pavements.
 - b. TT-S 00227E(3), Sealing Compound: Elastomeric Type, Multi-Component (for Calking, Sealing, and Glazing in Buildings and Other Structures).
 - 5. Concrete installer shall have successfully completed at least three other projects of similar size and type.

1.3 SUBMITTALS

- A. Shop Drawings:
 - 1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
 - 2. Product technical data including:
 - a. Acknowledgement that products submitted meet requirements of standards referenced.
 - b. Manufacturer's installation instructions.
 - 3. Mix design(s) in accordance with Specification Section 03 31 30 and Specification Section 03 05 05.
 - 4. Qualifications of concrete installer.
 - 5. Drawings detailing all reinforcing.
 - 6. Concrete cylinder test results from field quality control.
- B. Samples:
 - 1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
 - 2. Samples of fabricated jointing materials and devices.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
 - 1. Chemical admixtures:
 - a. Sika Chemical Corporation.
 - b. BASF Admixtures, Inc.
 - c. Protex Industries.
 - d. W. R. Grace and Company.
- B. Submit request for substitution in accordance with Specification Section 01 25 13.

2.2 MATERIALS

- A. Portland Cement:
 - 1. ASTM C150, Type I or II.
- B. Aggregates:
 - 1. ASTM C33, gradation size #67, 3/4 IN to #4.
- C. Water:
 - 1. Potable quality.
- D. Admixtures:
 - 1. Comply with Specification Section 03 31 30.
- E. Reinforcing Bars:
 - 1. ASTM A615, Grade 60.
- F. Welded Wire Reinforcement:
 - 1. ASTM A185 or ASTM A1064.
 - 2. Flat.
 - 3. Clean, free from dirt, scale, rust.
- G. Preformed Joint Filler:
 - 1. Nonextruding cork, self-expanding cork, sponge rubber or cork rubber.
 - 2. Meet AASHTOM153 or AASHTOM213.
- H. Hot-Poured Joint Sealing Material:
 - 1. FS SS-S-1614.

- I. Sidewalk Joint Sealant:
 - 1. Two compound, polyurethane sealant.
 - 2. Class A, Type 1.
 - 3. Self-leveling.
 - 4. Nontracking.
 - 5. FS TT-S 00227E(3).
- J. Membrane Curing Compound:
 - 1. ASTM C309.
- K. Cover Materials for Curing:
 - 1. Burlap:
 - a. AASHTOM182.
 - b. Minimum Class 2, 8 OZ material (1 YD x 42 IN).
 - 2. Polyethylene film:
 - a. AASHTOM171.
- L. Paper Subgrade Cover:
 - 1. Polyethylene film, AASHTOM171.
- M. Concrete Treatment:
 - 1. Boiled linseed oil mixture.
 - 2. Meets AASHTOM233.
- N. Forms:
 - 1. Steel or wood.
 - 2. Size and strength to resist movement during concrete placement and to retain horizontal and vertical alignment.
 - 3. Free of distortion and defects.
 - 4. Full depth.
 - 5. Metal Side Forms:
 - a. Minimum 7/32 IN thick.
 - b. Depth equal to edge thickness of concrete.
 - c. Flat or rounded top minimum 1-3/4 IN wide.
 - d. Base 8 IN wide or equal to height, whichever is less.
 - e. Maximum deflection 1/8 IN under center load of 1700 LBS.
 - f. Use flexible spring steel forms or laminated boards to form radius bends.

2.3 MIXES

- A. Mix design to provide 4,000 PSI 28-day compressive strength, 1-1/2 IN +1 IN slump, 6 PCT air.
- B. Comply with Specification Section 03 31 30 and Specification Section 03 31 31.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Subgrade Preparation:
 - 1. Prepare using methods, procedures, and equipment necessary to attain required compaction densities, elevation and section.
 - 2. Scarify and recompact top 6 IN of fills and embankments which will be sidewalk and step areas.
 - 3. Remove soft or spongy areas.
 - a. Replace with aggregate material.
 - 4. Compact to the following densities:
 - a. Cohesive soils: 95 PCT per ASTM D698.
 - b. Noncohesive soils: 75 PCT relative per ASTM D4253 and ASTM D4254.
 - 5. Assure moisture content is within limits prescribed to achieve required compaction density.

6. Following compaction, trim and roll to exact cross section.
 - a. Check with a approved grading template.
 7. Perform density tests on subgrade to determine that subgrade complies with the specification.
- B. Aggregate Course:
1. Place material in not more than 6 IN thick layers.
 2. Spread, shape, and compact all material deposited on the subgrade during the same day.
 3. Compact to 75 PCT relative per ASTM D4253 and ASTM D4254.
- C. Loose and Foreign Material:
1. Remove loose and foreign material immediately before a application of paving.
- D. Appurtenance Preparation:
1. Block out or box out curb inlets and curb returns.
 2. Provide for joint construction as detailed and dimensioned on Drawings.
 3. Adjust manholes, inlets, valve boxes and any other utility appurtenances to design grade.
 - a. Secure to elevation with concrete.
 - b. Place concrete up to 5 IN below design grade.
 4. Clean and oil forms.

3.2 ERECTION, INSTALLATION AND APPLICATION

- A. Concrete Production:
1. Comply with Specification Section 03 31 31.
- B. Forms:
1. Form support:
 - a. Compact soil foundation and cut to grade to support forms.
 - b. Use bearing stakes driven flush with bottom of form to supplement support as necessary.
 - c. Do not use earth pedestals.
 2. Staking forms:
 - a. Joint forms neatly and tightly.
 - b. Stake and pin securely with at least three pins for each 10 FT section.
 3. Clean and oil forms prior to placement of concrete.
 4. Set forms sufficiently in advance of work (minimum 2 HRS) to permit proper inspection.
 5. Previously finished pavement or curb and gutter contiguous with new work may serve as side form when specifically approved.
- C. Reinforcing:
1. Lap mats one full space.
 2. Tie end transverse member of upper mat securely to prevent curling.
 3. Lap nonwelded bars 12 IN minimum.
 4. Support:
 - a. Place bars securely on chairs at called-for height.
 - b. Place other fabric on the first of a two-course pour and cover promptly with final pour, or place fabric by a fabric-placer if procedure is reviewed and approved by Engineer.
- D. Joints:
1. Hold locations and alignment to within + 1/4 IN.
 2. Finish concrete surface adjacent to previous section to within + 1/8 IN, with tooled radius of 1/4 IN.
 3. Metal keyway joints:
 - a. Form by installing metal joint strip, left in place.
 - b. Stake and support like side form.
 - c. Provide dowels or tie bars.

4. Weakened plane joints:
 - a. Locate at 6 FT intervals.
 - b. Tool groove in freshly placed concrete with tooling device.
 - c. Groove dimensions shall be 3/8 IN at surface and 1/4 IN at root.
 5. Install construction joints at end of day's work or wherever concreting must be interrupted for 30 minutes or more.
 6. Expansion joints:
 - a. Locate at 48 FT intervals and at all intersection curb returns.
 - b. Stake in place load transfer device consisting of dowels.
 - c. Supporting and spacing means and premolded joint filler as per Drawing details.
 - d. Provide preformed joint filler at all junctions with existing sidewalks, steps, or other structures.
 7. Thoroughly clean and fill joints with joint sealing material as specified.
 8. Upper surface of filled joint to be flush to 1/8 IN below finish surface.
- E. Place Concrete:
1. Comply with Specification Section 03 31 31.
 2. Construct driveway openings and other features as per Drawing details.
- F. Cold and Hot Weather Concreting:
1. Cold weather:
 - a. Cease concrete placing when descending air temperature in shade falls below 40 DEGF.
 - b. Do not resume until ambient temperature has risen to 40 DEGF.
 - c. If placing is authorized below 40 DEGF by Engineer, maintain temperature of mix between 60 and 80 DEGF.
 - d. Heat aggregates or water or both.
 - e. Water temperature may not exceed 175 DEGF.
 - f. Aggregate temperature may not exceed 150 DEGF.
 - g. Remove and replace frost damaged concrete.
 - h. Salt or other antifreeze is not permitted.
 - i. Comply with ACI 306R.
 2. Hot weather:
 - a. Cease concrete placing when plastic mix temperature cannot be maintained under 90 DEGF.
 - b. Aggregates or water or both may be cooled.
 - c. Cool water with crushed ice.
 - d. Cool aggregates by evaporation or water spray.
 - e. Never batch cement hotter than 160 DEGF.
 - f. Comply with ACI 305R.
- G. Finishing:
1. As soon as placed, strike off and screed to crown and cross section, slightly above grade, so that consolidation and finishing will bring to final Drawing elevations.
 2. Maintain uniform ridge full width with first pass of first screed.
 3. Test with 6 FT straightedges equipped with long handles and operated from sidewalk.
 4. Draw excess water and laitance off from surface.
 5. Float finish so as to leave no disfiguring marks but to produce a uniform granular or sandy texture.
 6. Broom finish after floating.
 7. Tool edges with suitable edger.
 8. Provide exposed aggregate surfaces in areas indicated on the Drawings.
 9. Provide method such as abrasive blasting, bush hammering, or surface retarder acceptable to the Engineer.

- H. Curing:
1. Apply membrane curing compound complying with ASTM C309, and in accordance with manufacturer's directions but at a rate of minimum 200 SQFT per gallon.
 2. Apply curing compound within 4 HRS after finishing or as soon as surface moisture has dissipated.
 3. Cure for minimum of seven days.
 4. When average daily temperature is below 50 DEGF, provide insulative protection of 12 IN minimum thickness loose dry straw, or equivalent, for 10 days.
 5. Linseed oil sealant:
 - a. For concrete sidewalk and step, seal surface with linseed oil.
 - b. Apply linseed oil to clean surface as per AASHTO M224 after concrete has cured for 1 month.
 - c. Apply first application at rate of 67 SQYD per gallon.
 - d. Apply second application to a dry surface at rate of 40 SQYD per gallon.
- I. Protection of Concrete:
1. Protect new sidewalk, steps, and their appurtenances from traffic for a minimum of 14 days.
 2. Repair or replace parts of sidewalk and steps damaged by traffic, or other causes, prior to final acceptance.
- J. Opening to Traffic:
1. After 14 days, area may, at Owner's discretion, be opened to traffic if job cured cylinders have attained a compressive strength of 3000 LBS per square inch when tested in accordance with ASTM standard methods.
 2. Prior to opening to traffic, clean and refill joints as required with specified filler material.
- K. Clean Up:
1. Assure clean-up work is completed within two weeks after sidewalk has been opened to traffic.
 2. No new work will begin until clean-up work has been completed, or is maintained within 2 weeks after sidewalk has been opened to traffic.
- L. Handrails:
1. Provide handrails where required and as per Drawing details.

3.3 FIELD QUALITY CONTROL

- A. Provide test cylinders in accordance with Specification Section 03 05 05.

END OF SECTION

SECTION 32 31 16
ORNAMENTAL PERIMETER FENCE

PART 1 - PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Ornamental steel fencing.
- B. Related Sections include but are not necessarily limited to:
 - 1. Division 0 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
 - 2. Division 1 - General Requirements.
 - 3. Section 31 23 00 - Earthwork.
 - 4. Division 3 - Concrete.

1.2 QUALITY ASSURANCE

- A. Referenced Standards:
 - 1. ASTM International (ASTM):
 - a. A36 – Structural Steel
 - b. A123, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
 - c. A307, Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
 - d. A500 – Cold-formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.
 - e. A853, Standard Specification for Steel Wire, Carbon, for General Use.
 - f. B117 – Standard Practice for Operating Salt Spray (Fog) Apparatus.
 - g. C94, Standard Specification for Ready-Mixed Concrete.
 - h. D822- Tests on Paint and Related Coatings Using Filtered Open-flame Carbon-Arc Exposure Apparatus.
 - i. D1794 – Resistance of Organic Coatings to the Effects of Rapid Deformation (Impact).
 - j. D3363 – Test Method for Film Hardness by Pencil Test.
 - k. F552, Standard Terminology Relating to Chain-Link Fencing.
 - l. F567, Standard Practice for Installation of Chain Link Fence.
 - m. F626, Standard Specification for Fence Fittings.
 - n. F1043, Standard Specification for Strength and Protective Coatings on Metal Industrial Chain Line Fence Framework.
 - o. F1083, Standard Specification for Pipe, Steel, Hot-Dipped zinc-coated (galvanized) welded for fence structures.
 - p. F1916, Standard Specifications for Selecting Chain Link Barrier Systems with Coated Chain Link Fence Fabric and Round Posts for Detention Applications.
 - 2. American Welding Society (AWS).
 - 3. Chain Link Manufacturer's Institute for "Galvanized Steel Chain Link Fence Fabric and Accessories."
 - 4. National Fire Protection Association (NFPA):
 - a. 70, National Electrical Code (NEC).
 - 5. Underwriters Laboratories, Inc. (UL).
- B. Qualifications:
 - 1. Installer: A minimum of three years experience installing similar equipment, provide proof of attending a factory technical training within previous three years, or obtain other significant manufacturer endorsement of technical aptitude, if required, during the submittal process. Installer bonded and licensed in Washington State.

2. Utilize only AWS certified welders.

1.3 DEFINITIONS

- A. See ASTM F552.
- B. NPS: Nominal pipe size, in inches.
- C. Installer or Applicator:
 1. Installer or applicator is the person actually installing or applying the product in the field at the Project site.
 2. Installer and applicator are synonymous.

1.4 SUBMITTALS

- A. Shop Drawings:
 1. See Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
 2. Product technical data including:
 - a. Acknowledgement that products submitted meet requirements of standards referenced.
 - b. Manufacturer's installation instructions.
 - c. Manufacturer's catalog cut sheets.
 3. Scaled plan layout showing spacing of components, accessories, fittings, and post anchorage.
 4. Mill certificates.
 5. Source quality control test results.
- B. Specific to Ornamental Fence:
 1. Product data for components and accessories.
 2. Shop drawings showing layout, dimensions, spacing of components, anchorage and installation details.
 3. Sample: 8 by 10 inches [203 by 254 mm] minimum size sample of fence panel illustrating design, fabrication workmanship, and selected color coating.
- C. Copy of ornamental fence warranty specified in Paragraph 1.5 for review by Architect

1.5 PRODUCT DELIVERY AND STORAGE

- A. Comply with Specification Section 01 65 50.
- B. Store products upright in the original shipping containers, covered, ventilated and protected from all weather conditions.

1.6 WARRANTY

- A. Provide in accordance with Section 01 77 19 – Closeout Requirements:
 1. For ornamental steel fencing factory provide 20 years warranty for factory finish against cracking, peeling, and blistering under normal use.
- B. Provide a five-year limited warranty against all defects in materials or workmanship.
- C. Defective materials shall be replaced with comparable materials furnished by the manufacturer, at no cost to the owner.
- D. Freight, labor and other incidental costs are not covered under the factory warranty, but may be covered by a separate service agreement between installing company and the owner.
- E. To ensure validation of warranty, return completed warranty registration form to manufacturer.

PART 2 - PRODUCTS

2.1 ORNAMENTAL PERIMETER FENCE:

- A. Subject to compliance with the Contract Documents the following manufacturers are approved:
 - 1. Ametco Manufacturing Company.
 - 2. Tymetal Corporation
- B. Manufacturers of equivalent products submitted and approved in accordance with Section 01 25 13 – Product Substitution
- C. Materials:
 - 1. Steel bar stock: ASTM A36.
 - 2. Steel tubing: ASTM A500, Grade B.
 - 3. Grout: Non-shrink type, pre-mixed compound consisting of non-metallic aggregate, cement, and water reducing and plasticizing additives.
- D. Type: Ornamental steel fencing system consisting of modular open grille fencing panels fabricated by welding flat steel bars and rods, supported by steel posts.
- E. Reference Fence Panels: Fabricated from galvanized steel rods, flat bars, welded to form and open grille pattern; [Blockade®] as manufactured by Ametco® Manufacturing Corporation.
 - 1. Blockade® panel:
 - a. Vertical main bars: [1-3/16 by 5/32 inch] [30 by 4 mm] flat bars spaced at [2-7/16 inches] [62 mm].
 - b. Horizontal cross rods: [1/4 inch] [6 mm] diameter rods spaced at [5-3/16 inches] [132 mm.]
 - c. Top and bottom perimeter bars: [1-3/16 by 5/32 inch] [30 by 4 mm] flat bars.
 - d. Panel height: [[60][72] inches. [1524] [1829]mm.]
 - e. Panel width: [[64-21/32] [78-7/16] inches.] [[1642] [1992 mm.]

2.2 ORNAMENTAL PERIMETER FENCE FACTORY FINISH

- A. Steel fence panels and posts shall be hot-dip galvanized to 1.25 ounces per square foot minimum zinc coating in accordance with ASTM A123. Standard size components shall receive polyester powder coating.
- B. Polyester powder coating: Electrostatically applied colored polyester powder coating heat cured to chemically bond finish to metal substrate.
 - 1. Minimum hardness measured in accordance with ASTM D3363: 2H.
 - 2. Direct impact resistance tested in accordance with ASTM D2794: Withstand 160 inch-pounds.
 - 3. Salt spray resistance tested in accordance with ASTM B117: No undercutting, rusting, or blistering after 500 hours in 5 percent salt spray at 95 degrees F and 95 percent relative humidity and after 1000 hours less than [3/16 inch] [5 mm] undercutting.
 - 4. Weatherability tested in accordance with ASTM D822: No film failure and 88 percent gloss retention after 1 year exposure in South Florida with test panels tilted at 45 degrees.
- C. Polyurethane coating: 1.0 mil dry film thickness of coating of steel test panel cured 30 minutes at 180 degree F and aged 14 days shall resist the following test conditions without failure:
 - 1. 5 percent salt spray for 500 hours.
 - 2. 100 percent relative humidity for 1000 hours.
 - 3. Water immersion for 100 hours.
 - 4. 20 double rubs with cloth saturated with either lacquer thinner, acetone, MEK, gasoline, xylene.
 - 5. Exposure to lubricating oils, hydraulic fluids, and cutting oils.
 - 6. 16 cycles of 24 hours at 100 percent humidity, 24 hours at 10 degrees F, and 24 hours at 77 degrees F.
 - 7. Hardness: H to 2H.
 - 8. Flexibility: [1/8 inch] [3 mm] conical mandrel.

- D. Color: Selected by Architect from manufacturer's standard range.
 - 1. Complete with frames, latches, stops, keepers, hinges, fabric, braces.
 - 2. Provide intermediate members for rigid construction free of sag and twist.
 - 3. ASTM F1184
 - 4. Size: As shown.
 - 5. Installed on end and intermediate posts with guide wheel trolley assemblies.
 - 6. Guide Wheel trolleys:
 - a. Lubricated ball bearing wheels.
 - b. Wheels 2 IN diameter by 9/16 IN thick with two side rolling wheels to insure alignment of trolley in track.
 - 7. Guide wheel assemblies for each post.

2.3 SOURCE QUALITY CONTROL

- A. Test related fence construction materials to meet the following standards:
 - 1. Posts and rails:
 - a. ASTM F1043, Heavy Industrial.

PART 3 - EXECUTION

3.1 ORNAMENTAL PERIMETER FENCE INSTALLATION

- A. Install fencing in accordance with manufacturer's installation instructions and approved shop drawings.
- B. Install posts plumb and level by embedding post directly in concrete footing. Temporarily brace fence posts with 2 by 4 wood supports until grout is set. Do not install bent, bowed, or otherwise damaged panels. Remove damaged components from site and replace.
- C. Touch-up damaged finish with paint supplied by manufacturer and matching original coating.

3.2 CLEANING

- A. Cleanup, upon completion of the installation, all waste material resulting from the fence construction.

END OF SECTION

SECTION 32 84 00
IRRIGATION SYSTEM

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
1. Installation of underground automated irrigation system.
 2. System includes but not limited to piping, valves, fittings, spray heads, controllers and wiring, and final adjustments to ensure complete coverage.
 3. Trenching, stockpiling excavation materials and refilling and compacting trenches.
 4. Repair and modifications of existing right of way and on-sit underground automatic irrigation systems
 5. Water connection.
 6. Removal and/or restoration of existing improvements.
 7. Replacement of unsatisfactory materials.
 8. Clean up, inspection, and tests.
 9. Approval by Engineer.
- B. Related Specification Sections include but are not necessarily limited to:
1. Division 00 - Procurement and Contracting Requirements.
 2. Division 01 - General Requirements.
 3. Section 31 23 33 - Trenching, Backfilling, and Compacting for Utilities.
 4. Section 32 91 13 - Topsoiling and Finish Grading.
 5. Section 32 92 00 - Seeding, Sodding and Landscaping.

1.2 QUALITY ASSURANCE

- A. Referenced Standards:
1. Comply with NFPA 70 or code of the local agency having jurisdiction.
 - a. If conflict occurs between these codes, the more stringent shall be adopted.
 2. American National Standards Institute (ANSI).
 3. ASTM International (ASTM):
 - a. D1248, Standard Specification for Polyethylene Plastics Extrusion Materials for Wire and Cable.
 - b. D1557, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 FT-LBF/FT³).
 - c. D1784, Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds.
 - d. D2239, Standard Specification for Polyethylene (PE) Plastic Pipe (SIDR-PR) Based on Controlled Inside Diameter.
 - e. D2241, Standard Specification for Poly (Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series).
 - f. D2464, Standard Specification for Threaded Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80.
 - g. D2466, Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40.
 - h. D2609, Standard Specification for Plastic Insert Fittings for Polyethylene (PE) Plastic Pipe.
 - i. D3350, Standard Specification for Polyethylene Plastics Pipe and Fittings Materials.
 4. American Water Works Association (AWWA):
 - a. C500, Metal-Seated Gate Valves for Water Supply Service.
 5. National Fire Protection Association (NFPA):
 - a. 70, National Electrical Code (NEC).
 6. Occupational Safety and Health Administration (OSHA).

- B. Qualifications:
 - 1. Currently licensed and bonded in the state in which the work is to be performed, for a minimum of five years.
 - a. Work shall be performed by skilled persons with a minimum of two years experience.
 - 2. Submit names of three projects completed in the last two years.
 - a. Include the following:
 - 1) Name of project.
 - 2) Location.
 - 3) Owner.
 - 4) Brief description of work and project manager's name.
 - 3. Submit installer's current company financial statement
- C. Irrigation Equipment Modification:
 - 1. Review proposed irrigation plan, revise as necessary to conform to irrigation equipment furnished.
 - 2. Provide 100 PCT coverage to all areas within limits to be irrigated in this contract and as shown on the plans.
 - 3. Submit revised plans and computations for approval.
 - 4. Designed irrigation water will not be allowed to spray on any building surfaces.
 - 5. Plan scale to be no smaller than 1 IN equals 50 FT.
- D. Miscellaneous:
 - 1. Pre-construction conference:
 - a. Schedule and conduct a conference to review in detail quality control and construction requirements for equipment, materials, and systems used to perform the Work.
 - 1) Conference shall be scheduled not less than 10 days prior to commencement of Work.
 - 2) All parties required to be in attendance shall be notified no later than seven days prior to date of conference.
 - 3) Notify qualified representatives of each party concerned with that portion of Work to attend conference, including but not limited to Engineer, Consultant, Contractor's Superintendent, and Installer.
 - b. Minutes of conference shall be recorded and distributed by Contractor to all parties in attendance within five days of conference.
 - 2. Special requirements:
 - a. All pressure piping from water supply source, including backflow preventer to zoned irrigation control valves will be executed by licensed and bonded plumber(s).
 - 1) Secure permit at least 48 HRS prior to start of installation.
 - b. Tolerances:
 - 1) Specified depths of mains and laterals and pitch of pipes are minimums.
 - 2) Settlement of trenches is cause for removal of finish grade treatment, refilling, recompaction, and repair of finish grade treatment.
 - c. Coordination with other contracts: Protect, maintain, and coordinate work with work under other Specification Sections.
 - d. Damage to other improvements: Replace or repair damage to grading, soil preparation, seeding, sodding, or planting done under other Specification Sections during work associated with installation of irrigation system at no additional cost to Owner.
 - e. Wire splicing in lengths less than 1000 FT will not be allowed in direct bury conditions.
 - 1) When conduit is used a maximum of 300 FT will be allowed; however, pull boxes will be installed at all splices.

1.3 DEFINITIONS

- A. Installer or Applicator:
 - 1. Installer or applicator is the person actually installing or applying the product in the field at the Project site.
 - 2. Installer and applicator are synonymous.

1.4 SUBMITTALS

- A. Shop Drawings:
 - 1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
 - a. Electric wiring design.
 - b. Model make and numbers.
 - c. Equipment name.
 - d. Manufacturer's specifications for all materials.
- B. Record Drawings (As Constructed):
 - 1. Irrigation Furnish Owner with a scaled "as constructed" Drawing of the completed system.
 - a. This original 3 MIL mylar will be updated to scale of all changes or modifications which occur during installation.
 - b. This mylar Drawing will have dimensions, from two permanent points of reference (building corners, sidewalk, road intersections or permanent structures), location of the following items:
 - 1) Connection to existing water lines.
 - 2) Routing of sprinkler pressure lines (dimension maximum 100 FT along routing).
 - 3) Sprinkler control valves.
 - 4) Quick coupling valves.
 - 5) Drain valves (manual and/or automatic).
 - 6) Drip line blow-out stubs.
 - 7) All gate valves.
 - 8) Other related equipment as directed.
 - 2. Processing of final pay request will not occur until as-constructed plans have been submitted, dated, and approved by the Engineer.
- C. Contract Closeout Information:
 - 1. Operation and Maintenance Data:
 - a. See Specification Section 01 33 04 for requirements for the mechanics, administration, and the content of Operation and Maintenance Manual submittals.
- D. Operation Instructions:
 - 1. Submit three written operating instructions, including winterization procedures and start-up with cut sheets of products, and coordinate controller/watering operation instruction with Owner maintenance personnel.
 - 2. Controller charts:
 - a. Do not prepare charts until record (as constructed) Drawings have been reviewed by Engineer.
 - b. Provide one controller chart for each automatic controller installed.
 - 1) Chart may be reproduction of record Drawing if scale permits fitting inside of controller door.
 - a) If photo reduction prints are required, keep reduction to maximum size possible to retain full legibility.
 - 2) Chart shall be copy of actual "as constructed" system showing area covered by that controller.
 - c. Identify area of coverage of each remote control valve, using a distinctly different pastel color over entire area of coverage.
 - d. Following review of charts by Consultant, they shall be hermetically sealed between two layers of 20 MM thick plastic sheet.
 - e. Charts shall be completed and reviewed prior to final review of irrigation system.
- E. Submit thrust block design for pressure piping by registered professional Engineer in State of Washington.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, unload, store, and handle materials, packaging, bundling, products in dry, weatherproof, waterproof condition in manner to prevent damage, breakage, deterioration, intrusion, ignition, and vandalism.
 - 1. Deliver in original unopened packaging containers prominently displaying manufacturer name, volume, quantity, contents, instructions, and conformance to local, state, and federal law.
 - 2. Remove and replace cracked, broken, or contaminated items or elements prematurely exposed to moisture, inclement weather, snow, ice, temperature extremes, fire, or jobsite damage.
 - 3. Handling of PVC pipe:
 - a. Exercise care in handling, loading and storing of PVC pipe.
 - b. All PVC pipe shall be transported in a vehicle which allows length of pipe to lie flat so as not to subject it to undue bending or concentrated external loads.
 - c. All sections of pipe that have been dented or damaged shall be discarded, and, if installed, shall be replaced with new piping.

1.6 SITE CONDITIONS

- A. Contact "Utility Notification Center" before digging 48 HRS prior to start of excavation.
 - 1. Telephone: 811.

1.7 WARRANTY

- A. Owner will maintain turf and planting areas during warranty period, so as not to hamper proper operation of irrigation system.
- B. If Engineer will review final acceptability of installed areas at the end of the 1 calendar year from the date of acceptance.
- C. settlement occurs along main line, lateral lines, at valve boxes, or other irrigation related appurtenances within 1 calendar year from the date of acceptance, and adjustments in pipes, valves, or sprinkler heads are required to bring system, sod, or paving to the level of the permanent grade, the Contractor shall make all adjustments without additional cost to the Owner, including complete restoration of any plantings, paving, or other improvements damaged as a result of settlement.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
 - 1. Valves and controller:
 - a. Base:
 - 1) Rain bird.
 - b. Alternative:
 - 1) Weathermatic.
 - 2) Buckner.
 - 3) Toro.
 - 2. Sprinklers:
 - a. Pop-up Spray base:
 - 1) Rain bird.
 - b. Alternative
- B. Hunter Submit request for substitution in accordance with Specification Section 01 25 13.

2.2 MATERIALS

- A. General Piping:
 - 1. Pressure supply line (from point of connection through backflow prevent unit) - Type 'K' hard copper.
 - 2. Pressure supply lines (downstream of backflow prevention units to zone control valves) - Schedule 40 PVC pipe.
 - 3. Nonpressure lines: Class 200 PVC BE.
 - 4. Drip tubing: 1-1/2 IN and smaller ASTM D2239.
 - 5. Drip fittings: ASTM D2609.
 - 6. Emitter tubing: As recommended by Emitter manufacturer.
- B. Copper Pipe and Fittings:
 - 1. Copper pipe: Type K, hard tempered.
 - 2. Fittings:
 - a. Wrought copper.
 - b. Solder joint type.
 - 3. Joints:
 - a. Soldered.
 - 1) 45 PCT silver, 15 PCT copper, 15 PCT zinc, and 24 PCT cadmium.
 - 2) Solids at 1125 DEGF and liquids at 1145 DEGF.
- C. Brass Pipe and Fittings:
 - 1. Brass pipe:
 - a. 85 PCT red brass.
 - b. ANSI Schedule 40 screwed pipe.
 - 2. Fittings:
 - a. Medium brass.
 - b. Screwed 125 LB class.
- D. Plastic Pipe and Fittings:
 - 1. Solvent weld pipe:
 - a. Virgin polyvinyl chloride (PVC) compound; ASTM D2241 and ASTM D1784; cell classification 12454-B, Type 1, Grade 1.
 - b. Fittings:
 - 1) Standard weight, Schedule 40, injection molded PVC; complying with ASTM D1784 and ASTM D2466, cell classification 12454-B, Type 1, Grade 1.
 - 2) Threaded fittings: Schedule 80, injection molded PVC complying with ASTM D2464, cell classification 12454-B, Type 1, Grade 1. (where required)
 - 3) Tees and ells: Side gated.
 - c. Threaded nipples:
 - 1) ASTM D2464.
 - 2) Schedule 80.
 - 3) Molded threads.
 - d. Joint cement and primer: Type as recommended by manufacturer.
- E. Low Pressure/Volume Systems:
 - 1. Drip tubing: Flexible vinyl chloride compound, ASTM D1248, Type 1, Class C, Category 4, P14 and ASTM D3350 for PE 12211C.
 - 2. Fittings: Type and make recommended by tubing manufacturer.
 - 3. Drip valve assembly:
 - a. Type and size shown on Drawings.
 - b. Wye strainer:
 - 1) Plastic construction.
 - 2) Stabilized with 120 mesh nylon screen.
 - 3) 1/2 IN blow-out assembly.
 - c. Control valve:
 - 1) Two-way solenoid pilot operated type.

- 2) Synthetic, noncorrosive construction.
- 3) Diaphragm activated and slow closing.
- 4) Freely pivoted seat seal; retained (mounted) without attachment to diaphragm.
- d. Pressure reducing valve:
 - 1) Type as indicated on Drawings
 - 2) Manual adjusting nut.
- 4. Inline drip emitter tubing:
 - a. Type and size shown on Drawings.
 - 1) Pressure compensating.
 - 2) Contains root inhibitor.
- 5. Root watering emitter assemblies:
 - a. Type and size shown on Drawings.
- F. Isolation Valves:
 - 1. 3/4 through 1-1/2 IN pipe:
 - a. PVC construction.
 - 2. 3 IN and larger pipe:
 - a. Brass construction.
- G. Quick Coupling Valves:
 - a. Brass two-piece body.
 - b. 150 PSI, working pressure.
 - c. Operable with quick coupler.
 - 1) Equip with locking rubber cover.
 - 2) Key size and type as shown on Drawing.
- H. Valve Boxes:
 - 1. Green lids in landscape areas
 - 2. Gate valves, drip line blow-out stubs, wire junction box, and wire stub box: 10 IN circular box x 10 IN deep.
 - 3. Control valves 3/4 through 2 IN with single control valve:
 - a. Minimum 12 x 15 IN rectangular box.
 - b. Depth of cover denoted on the plans.
 - 4. Control valves 3/4 through 2 IN with multiple control valves:
 - a. Minimum 16 x 22 IN rectangular box.
 - b. Depth of cover denoted on the plans.
 - 5. Drip valve assemblies:
 - a. 12 x 15 IN rectangular box.
 - b. Depth of cover denoted on the Plans.
 - 6. Control wiring splices: 10 IN circular box x 10 IN deep gray, as detailed.
- I. Automatic Controller: Size and type shown on Drawings; mounted as shown.
- J. Electric Control Valves:
 - 1. Size and type shown on Drawings.
 - a. Manual flow adjustment (except drip valves).
 - b. Manual bleed nut.
- K. Sprinkler Heads:
 - 1. As indicated on Drawings.
 - 2. Fabricated riser units in accordance with details on Drawings.
 - a. Riser nipples of same size as riser opening in sprinkler body.

2.3 MAINTENANCE MATERIALS

- A. Furnish the following maintenance items to Owner prior to final acceptance:
 - 1. Two sets of special tools required for removing, disassembling, and adjusting each type of sprinkler head and valve supplied on this Project.
 - 2. Two, 6 FT valve keys for operation of gate valves or stop and waste valves (if applicable).

3. Two keys for each automatic controller.
 4. Four quick coupler keys and two matching hose swivels for each type of quick coupling valve installed.
 5. Two aluminum drain valve keys of sufficient length for operation of drain valves.
- B. Winterization:
1. Include cost in bid for winterizing complete system at conclusion of sprinkling season (in which system received final acceptance) within three days notification by the Owner.
 2. System shall be voided of water using compressed air or similar method reviewed by Architect/Consultant.
 3. Reopen, operate, and adjust system malfunctions accordingly during April of following season within three days of notification by Owner.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and conditions under which Work of this Specification Section is to be performed.
1. Do not proceed with Work until unsatisfactory conditions have been corrected.
- B. Grading operations, with the exception of final grading, shall be completed and approved by Owner before staking or installation of any irrigation system begins.

3.2 PREPARATION

- A. Staking:
1. Contact Consultant 48 HRS in advance and request review of staking.
 2. Consultant will advise installer as to the amount of staking to be prepared.
 3. Mark with powdered lime.
 4. Flag heads for first few zones.
 5. Consultant will review staking and direct changes, if required.
 6. Review does not relieve installer from coverage problems due to improper placement of heads after staking.
 7. If Project has significant topography, freeform planting beds, or other amenities which could require a alteration of irrigation equipment layout as deemed necessary by Consultant, do not install irrigation equipment in these areas until Consultant has reviewed equipment staking.
- B. Installation of sleeving under paving and concrete walks:
1. Extend a minimum 12 IN past edge of improvement prior to concreting and paving operations.
- C. Trenching:
1. Follow layout shown on Drawing where possible.
 2. Dig trenches straight, support pipe continuously on bottom of trench.
 3. Remove rock and organic debris from trench bottom.
 4. Depth of pipe and wire as shown on Drawings.

3.3 INSTALLATION

- A. Locate other equipment as near as possible to locations designated.
1. Deviations shall be reviewed by Consultant prior to installation.
- B. PVC Piping:
1. Snake pipe in trench as much as possible to allow for expansion and contraction.
 2. Do not install pipe when air temperature is below 40 DEGF.
 3. Place manual drain valves at low points and dead ends of pressure supply piping to ensure complete drainage of system.
 4. Close pipe ends with tight plug or cap when pipe laying is not in progress.

5. Solvent weld PVC pipe:
 - a. Lay pipe and make all plastic-to-plastic joints in accordance with manufacturer's recommendations.
 - b. Allow 24 HRS before pressurization.
- C. Flexible Plastic (Polyethylene) Pipe: Lay pipe and assemble fittings following manufacturer's recommendations.
- D. Drip Tubing:
 1. Install in bed areas at 8 IN depth, below top of soil before installation of mulch.
 2. Install at 12 IN depth if mulch is not to be installed.
 3. In turf areas, install as nonpressure piping.
 4. Install blow-out stubs at all dead ends.
- E. Control Wiring:
 1. Low voltage wiring:
 - a. Bury between controller and electric valves in pressure supply line trenches.
 - b. Locate as close as possible to main pipe lines.
 - 1) Locate below and to one side of pipe, or in separate trenches.
 - c. If separate trench is used, provide schedule 40 PVC conduit and 18 IN minimum cover.
 - d. Bundle all 24 V wires at 10 FT intervals.
 - e. Provide an expansion loop at every pressure pipe angle fitting, every electric control valve location (in valve box), and every 500 FT.
 - 1) Form expansion loop by wrapping wire at least eight times around a 3/4 IN pipe and withdrawing pipe.
 - f. Make all splices and ECV connections using approved wire connectors and sealants.
 - g. Install all control wire splices not occurring at control valve in a separate splice valve box.
 - h. Install control wire for each control valve.
 - i. Provide conduit for all pavement undercrossings or where other conditions make it necessary.
 - j. Run two spare #14-1 wires from controller pedestal or electric control valve on each leg of mainline.
 - 1) Label spare wires at controller and wire stub box.
 2. High voltage wiring for automatic controller:
 - a. Provide 120 V power connection to automatic controller.
 - b. All high voltage electrical work shall be performed by licensed electrician.
- F. Automatic Controller:
 1. Relocation of existing right of way controller:
 - a. Reinstall existing right of way irrigation controller in accordance with manufacturer's instructions where shown on Drawings.
 - b. Connect remote control valves in numerical sequence matching existing conditions.
 - c. Final location shall be reviewed by Engineer.
 - d. Furnish separate ground wire for each controller if multiple controllers are utilized.
 - e. All above ground conduit shall be rigid galvanized with appropriate fittings.
 2. Modifications to existing site controller:
 - a. Modify existing controller as required to provide fully operable site system.
- G. Electric Control Valves:
 1. Install 3 IN below finished grade as shown on Drawings and as detailed.
 2. When grouped, allow a minimum of 12 IN between valve boxes.
 3. Install each valve in separate valve box.
 4. Install individual valve box flush with ground.
 5. Place a minimum of 2 CUFT of 3/4 IN crushed gravel in bottom of each box below valve.
- H. Quick Coupling Valves:
 1. Install quick couplers on double swing-joint risers of Schedule 40 PVC pipe.

- a. Plumb and flush to grade.
- b. Angled nipple relative to pressure supply line shall be no more than 45 DEGF and no less than 10 DEGF.
- 2. Install quick coupling valves as detailed on Drawings.
- I. Drip Valve Assemblies: Install drip valve assembly as detailed on Drawings.
- J. Drip Emitters: Stake surface emitters with acceptable tubing stakes as detailed on Drawings.
- K. Drain Valves:
 - 1. Install at all low points in pressure supply line as detailed.
 - 2. Provide drainage sump for each drain valve based on the following:

CUBIC FEET OF GRAVEL PER DRAIN VALVE DISTANCE OF PIPING TO BE DRAINED				
PIPE SIZE	0-250 LF	250-500 LF	500-750 LF	750-1000 LF
1 IN	0.75	1.5	2.25	3.0
1-1/4 IN	0.75	1.5	2.25	3.0
1-1/2 IN	1.50	3.0	4.50	6.0
2 IN	2.50	5.0	7.50	10.00
2-1/2 IN	4.00	8.0	12.00	16.00
3 IN	6.00	12.00	18.00	24.00
4 IN	11.00	22.00	33.00	44.00
6 IN	25.00	50.00	50.00	50.00
8 IN	40.00	50.00	50.00	50.00
10 IN	50.00	50.00	50.00	50.00
12 IN	50.00	50.00	50.00	50.00

- L. Valve Boxes:
 - 1. Install one valve box for each type of valve.
 - a. Installed as detailed on Drawings.
 - b. Valve box extensions are acceptable for master valves only.
 - c. Install gravel sump after compaction of all trenches.
 - d. Place final portion of gravel inside valve box after valve box is backfilled and compacted.
 - 2. Brand controller letter and station number on lid of each valve box.
 - a. Letter and number size shall be 1 IN minimum and 1-1/2 IN minimum.
 - b. Depth of brand shall be 1/8 IN maximum into valve box lid.
- M. Isolation Valves: Install where shown on Drawings as detailed.
- N. Sprinkler Heads:
 - 1. Install where designated on Drawings or where staked.
 - a. Set to finish as detailed.
 - b. Spacing of heads shall not exceed the maximum indicated on Drawing unless re-staked as directed by Consultant.
 - c. In no case shall the spacing exceed maximum recommended by manufacturer.
 - d. Adjust part circle heads for proper coverage.
 - e. Adjust heads to correct height after sod is installed.
 - 2. Install heads on double swing-joint risers of schedule 40 PVC pipe.

- a. Angled nipple relative to nonpressure line shall be no more than 45 DEGF or less than 10 DEGF.
 - 3. Plant placement shall not interfere with intended sprinkler head coverage, piping, or other equipment.
 - 4. Engineer may request nozzle changes or adjustments without additional cost to the Owner.
- O. Backfilling: See Specification Section 31 23 33.
 - 1. Materials:
 - a. Excavated material is generally considered satisfactory for backfill purposes.
 - b. Backfill material shall be free of rubbish, vegetable matter, frozen materials, and stones larger than 1 IN in maximum dimension.
 - c. Do not mix subsoil with topsoil.
 - d. Material not suitable for backfill shall be hauled away.
 - e. The Contractor shall be responsible for providing suitable backfill if excavated material is unacceptable or not sufficient to meet backfill, compaction, and final grade requirements.
 - 2. Do not leave trenches open for a period of more than 48 HRS.
 - a. Open excavations shall be protected in accordance with OSHA regulations.
 - 3. Compact backfill to 90 PCT maximum density, determined in accordance with ASTM D1557 utilizing the following methods:
 - a. Mechanical tamping.
- P. Piping Under Paving:
 - 1. Provide for a minimum cover of 18 IN between the top of the pipe and the bottom of the aggregate base.
 - a. Provide sand (backfill, 6 IN below pipe and 3 IN above pipe).
 - 2. Compact backfill per Specification Section 31 23 33.
 - 3. Set in place, cap, and pressure test all piping under paving prior to backfilling and paving operations.
 - a. Notify Engineer prior to testing.
 - 4. Piping under existing walks or concrete pavement:
 - a. Complete by jacking, boring, or hydraulic driving.
 - b. Where cutting or breaking of walks and/or concrete is necessary, remove in panels and replace at no cost to Owner.
 - 1) Obtain permission to cut or break walks and/or concrete from Owner.
- Q. Water Supply and Point of Connection: Water supply shall be extended as shown from water supply lines.

3.4 FIELD QUALITY CONTROL

- A. Flushing:
 - 1. After piping, risers, and valves are in place and connected, but prior to installation of sprinkler heads, quick coupler assemblies, and hose valves, thoroughly flush piping system under full head of water pressure from dead end fittings.
 - 2. Maintain flushing for 5 minutes through furthest valves.
 - 3. Cap risers after flushing.
- B. Testing:
 - 1. Conduct tests in presence of Consultant.
 - a. Arrange for presence of Consultant 48 HRS in advance of testing.
 - b. Supply force pump and all other test equipment.
 - 2. After backfilling, and installation of all control valves, fill pressure supply line with water.
 - a. Pressurize to 40 PSI over the designated static pressure or 120 PSI, whichever is greater.
 - b. Test for a period of 2 HRS.
 - 3. Leakage, pressure loss: Test is acceptable if no leakage or loss of pressure is evident during test period.

4. Leaks: Detect and repair leaks.
 5. Retest system until test pressure can be maintained for duration of tests.
 6. Before final acceptance, pressure supply line shall remain under pressure for a period of 48 HRS.
- C. Walk Through for Substantial Completion:
1. Arrange for Consultant's presence 48 HRS in advance of walk-through.
 2. Entire system shall be completely installed and operational prior to scheduling of walk-through.
 3. Operate each zone in its entirety for Consultant at time of walk-through.
 - a. Open all valve boxes if directed.
 4. During walk-through, expose all drip emitters under operations for observation.
 - a. Demonstrate they are performing and installed as designed.
 - 1) Prior to placing of all mulch material.
- D. Walk-Through for Final Completion:
1. Arrange for Consultant's presence 48 HRS in advance of walk-through.
 2. Show evidence to Consultant that Owner has received all accessories, charts, record drawings, and equipment as required before Final Completion walk-through is scheduled.
 3. Operate each zone, in its entirety for Consultant at time of walk-through to ensure correction of all incomplete items.

3.5 ADJUSTMENT

- A. Upon completion of installation, "fine-tune" entire system by regulating valves, adjusting patterns and break-up arms, and setting pressure reducing valves at proper and similar pressure to provide optimum and efficient coverage.
1. Flush and adjust all sprinkler heads for optimum performance and to prevent overspray onto walks, roadways, and buildings as much as possible.
 2. Heads of same type shall be operating at same pressure +7 PCT.
- B. If it is determined that irrigation adjustments will provide proper and more adequate coverage, make such adjustments prior to Final Acceptance, as directed, at no additional cost to Owner.
1. Adjustments may also include changes in nozzle sizes, degrees of arc, and control valve throttling.
- C. All sprinkler heads shall be set perpendicular to finish grade unless otherwise designated.

3.6 CLEANING

- A. Maintain continuous cleaning operation throughout duration of work.
1. Dispose of, off-site at no additional cost to Owner, all trash or debris generated by installation of irrigation system.

END OF SECTION

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SECTION 32 91 13
TOPSOILING AND FINISHED GRADING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Topsoiling and finished grading.
- B. Related Specification Sections include but are not necessarily limited to:
 - 1. Division 00 - Procurement and Contracting Requirements.
 - 2. Division 01 - General Requirements.
 - 3. Section 31 10 00 - Site Clearing.
 - 4. Section 31 23 00 - Earthwork.
 - 5. Section 31 25 00 - Soil Erosion and Sediment Control.
 - 6. Section 32 92 00 - Seeding, Sodding and Landscaping.
- C. Location of Work: All areas within limits of grading and all areas outside limits of grading which are disturbed in the course of the work.

1.2 SUBMITTALS

- A. Shop Drawings:
 - 1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
 - 2. Project Data: Test reports for furnished topsoil.

1.3 SITE CONDITIONS

- A. Verify amount of topsoil stockpiled and determine amount of additional topsoil, if necessary to complete work.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Topsoil:
 - 1. Stockpiled soils:
 - a. Original surface soil typical of the area.
 - b. Existing topsoil stockpiled under Specification Section 31 10 00.
 - c. Friable, loamy soil capable of supporting native plant growth.
 - 2. Imported Topsoil:
 - a. Imported Topsoil shall consist of a uniform blend composed by volume of 60 percent to 70 percent Sandy Loam and 30 percent to 40 percent Compost.
 - b. Sandy Loam
 - 1) Sandy Loam shall be as defined by the US Department of Agriculture Natural Resource Conservation Services Soil Texture Triangle. Testing shall be performed by a Washington State Department of Ecology accredited testing laboratory approved through the North American Proficiency Testing Performance Assessment Program (NAPT-PAP) on a sample size of no less than 2 pounds. Testing shall not occur more than 90 days prior to installation and shall be submitted to the Engineer for approval a minimum of 14 calendar days prior to use or installation. The Sandy Loam analysis shall meet the following requirements:

Tested Item	Method*	Units	Specification Range
pH 1:1	S-2.20	S.U.	5.5 – 7.5
E.C. 1:1	S-2.20	mmhos/cm	≤ 2
Nitrate Nitrogen	S-3.10	mg/Kg	***
Ammonium Nitrogen	S-3.50	mg/Kg	***
Organic Matter	S-9.10	%	3 – 10
Phosphorus (P)	S-4.20 (Bray)	mg/Kg	***

Calcium (Ca)	S-5.10 (NH4OAC)	meq/100g	***
Magnesium (Mg)	S-5.10 (NH4OAC) S-6.11 (DTPA/Sorbitol)	meq/100g Mg/Kg	***
Sodium (Na)			***
Potassium (K)			***
Zinc (Zn)			***
Manganese (Mn)	S-6.11 (DTPA/Sorbitol) EPA 908/S-10.10	Mg/Kg meq/100g	***
Copper (Cu)			***
Iron (Fe)			***
Sulfur (SO4-S)			***
Boron (B)			***
Molybdenum (Mo)			***
Cation Exchange (CEC)			5 Min.
Total Nitrogen			AOAC 990.3
Total Carbon	AOAC 972.3	%	***
C:N Ratio			20:1 or less
Exchangeable Sodium Percentage (ESP)	ESP	%	10 Max.
Particle Size Analysis (Sand, Clay, Silt)	S-14.10 (Hydrometer)	%	Sandy Loam
Heavy Metals Testing	EPA 6010D	mg/Kg	From WAC 173-350- 220 Table 220-B unless otherwise noted
Arsenic			≤ 20
Cadmium			≤ 10
Chromium			≤ 42**
Copper			≤ 100**
Lead			≤ 150
Molybdenum			≤ 9
Nickel			≤ 100**
Selenium			≤ 18
Zinc			≤ 270**
Mercury	EPA 7473		≤ 8
*Methods are from "Soil, Plant, and Water Reference Methods for the Western Region" 2005, 3 rd Ed., Dr. R. Gavlak, Dr. D. Horneck, Dr. R.O. Miller.			**From WAC 173-340- 900 Table 749-2 for Unrestricted Land Uses ***Testing for soil- testing laboratory recommendations for soil treatments and amendments

- 1) The soil-testing laboratory shall state recommendations for soil treatments and soil amendments to be incorporated based on the results of the tests. Recommendations shall be in pounds per acre, or volume per cu. yd. for nitrogen, phosphorus, potash nutrients, and soil amendments to be added to produce satisfactory planting soil suitable for healthy, viable plants.
- c. Compost
 - 1) Compost shall conform to the requirements of this Section.
- d. Mixing Requirements
 - 1) Imported Topsoil shall be thoroughly mixed by the supplier prior to delivery to the site. The Contractor shall submit certification from the supplier that the Imported Topsoil has been mixed according to the above percentages at the point of delivery.
- e. Acceptance of Imported Topsoil for use on a project shall be on the basis of visual verification by the Engineer that the delivered material is representative of the laboratory analysis documentation and certification.

B. Compost/Soil Amendment:

- 1. Compost products shall be the result of the biological degradation and transformation of organic materials under controlled conditions designed to promote aerobic decomposition. Compost shall be stable with regard to oxygen consumption and carbon dioxide generation. Compost shall be mature with regard to its suitability for serving as a soil amendment or an erosion control BMP as defined below. The compost shall have a moisture content that has no visible free water or dust produced when handling the material.
- 2. Compost production and quality shall comply with WAC 173-350.
- 3. Compost products shall meet the following physical criteria:
 - a. Compost material shall be tested in accordance with U.S. Composting Council Testing Methods for the Examination of Compost and Composting (TMECC) 02.02- B, “Sample Sieving for Aggregate Size Classification”.
 - b. Fine compost shall meet the following gradation:

Sieve Size	Percent Passing	
	Minimum	Maximum
1"	100	
5/8"	90	100
1/4"	75	100

Note: Maximum particle length of 4 inches.

- c. The pH shall be between 6.0 and 8.5 when tested in accordance with U.S. Composting Council TMECC 04.11-A, “1:5 Slurry pH”
- d. Physical contaminants, defined in WAC 173-350 (plastic, concrete, ceramics, metal, etc.) shall be less than 0.5 percent by weight as determined by U.S. Composting Council TMECC 03.08-A “Classification of Inerts by Sieve Size”.
- e. Minimum organic matter shall be 40 percent by dry weight basis as determined by U.S. Composting Council TMECC 05.07A “Loss-On-Ignition Organic Matter Method (LOI)”.
- f. Soluble salt contents shall be less than 4.0 mmhos/cm when tested in accordance with U.S. Composting Council TMECC 04.10 “Electrical Conductivity”.
- g. Maturity shall be greater than 80 percent in accordance with U.S. Composting Council TMECC 05.05-A, “Germination and Root Elongation”.
- h. Stability shall be 7-mg CO₂-C/g OM/day or below in accordance with U.S. Composting Council TMECC 05.08-B “Carbon Dioxide Evolution Rate”.
- i. The compost product shall originate from organic feedstocks as defined in WAC 173-350 as “Wood waste”, “Yard debris”, “Post-consumer food waste”, “Preconsumer animal-based wastes”, and/or “Preconsumer vegetative waste”. The Contractor shall provide a list of feedstock sources by percentage in the final compost product.

- j. The Engineer may also evaluate compost for maturity using U.S. Composting Council TMECC 05.08-E "Solvita® Maturity Index". Fine compost shall score a number 6 or above on the Solvita® Compost Maturity Test. Medium and Coarse compost shall score a 5 or above on the Solvita® Compost Maturity Test

2.2 TOLERANCES

- A. Finish Grading Tolerance: ± 0.1 FT from required elevations.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Correct, adjust and/or repair rough graded areas.
 1. Cut off mounds and ridges.
 2. Fill gullies and depressions.
 3. Perform other necessary repairs.
 4. Bring all sub-grades to specified contours, even and properly compacted.
- B. Lawn areas:
 1. Set subgrade to 4 IN below finish grade.
 2. Loosen subgrade surface to depth of 6 IN, minimum.
- C. Tree, shrub and groundcover areas:
 1. Set subgrade to 16 IN below finish grade.
 2. Loosen subgrade surface to a depth of 6 IN, minimum.
- D. Rock mulch areas:
 1. Set subgrade to 3.5 IN below finish grade.
- E. Remove all stones and debris over 2 IN in any dimension.

3.2 ROUGH GRADE REVIEW

- A. Reviewed by Engineer in Specification Section 31 10 00.

3.3 PLACING TOPSOIL

- A. General:
 1. Do not place when subgrade is wet or frozen enough to cause clodding.
 2. Spread and lightly compact in 6 IN maximum lifts.
 3. If topsoil stockpiled is less than amount required for work, furnish additional topsoil at no cost to Owner.
 4. Typically use 1 IN, although this may lead to rocks and debris in topsoil. 3/8 IN or 3/4 IN will minimize rocks and debris, however, this may not be cost-effective for larger projects; most topsoil will be covered by sod or mulch so requiring screened 3/8 IN or smaller will not make much of a difference. Adjust finish grading tolerance value in Part 2 if using 3/8 IN or 3/4 IN to reflect smaller particle size.
 5. Provide finished surface free of stones, sticks, or other material 1 IN or more in any dimension.
 6. Provide finished surface smooth and true to required grades.
 7. Restore stockpile area to condition of rest of finished work.
- B. Lawn areas:
 1. Place topsoil to a compacted depth of 4 IN
 2. Roll with a 50# water filled roller
- C. Tree, shrub and groundcover areas:
 1. Place topsoil to a compacted depth of 12 IN
 2. Compact with a landscape roller to 85% of the maximum dry density

3.4 ACCEPTANCE

- A. Upon completion of topsoiling, obtain Engineer's acceptance of grade and surface.
- B. Make test holes where directed to verify proper placement and thickness of topsoil.

END OF SECTION

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SECTION 32 92 00
SEEDING, SODDING AND LANDSCAPING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Seeding, sodding and landscape planting:
 - a. Lawn-type seeding.
 - b. Sodding.
 - c. Plants and planting.
 - d. Maintenance of new and transplanted materials.
 - e. Pruning and repairing existing trees.
 - f. Replacement of dead or impaired materials at the end of the first growing season.
- B. Related Specification Sections include but are not necessarily limited to:
 - 1. Division 00 - Procurement and Contracting Requirements.
 - 2. Division 01 - General Requirements.
 - 3. Section 32 91 13 - Topsoiling and Finished Grading.

1.2 QUALITY ASSURANCE

- A. Referenced Standards:
 - 1. American Nursery and Landscape Association/American National Standards Institute (ANLA/ANSI):
 - a. Z60.1, American Standard for Nursery Stock.
 - 2. AOAC International (AOAC).
 - 3. ASTM International (ASTM):
 - a. D2028, Standard Specification for Cutback Asphalt (Rapid-Curing Type).
 - b. D5276, Standard Test Method for Drop Test of Loaded Containers by Free Fall.
 - 4. United States Department of Agriculture (USDA):
 - a. Federal Seed Act.
- B. Quality Control:
 - 1. Fertilizer:
 - a. If Engineer determines fertilizer requires sampling and testing to verify quality, testing will be done at Contractor's expense, in accordance with current methods of the AOAC.
 - b. Upon completion of Project, a final check of total quantities of fertilizer used will be made against total area seeded.
 - c. If minimum rates of application have not been met, Contractor will be required to distribute additional quantities to make up minimum application specified.
 - 2. Pruning work to be performed by a licensed arborist.

1.3 SUBMITTALS

- A. Shop Drawings:
 - 1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
 - 2. Product technical data including:
 - a. Acknowledgement that products submitted meet requirements of standards referenced.
 - b. Manufacturer's installation instructions.
 - c. Signed copies of vendor's statement for seed mixture required, stating botanical and common name, place of origin, strain, percentage of purity, percentage of germination, and amount of Pure Live Seed (PLS) per bag.

- d. Type of herbicide to be used during first growing season to contain annual weeds and application rate.
 - e. Source and location of sod, plants, and plant material.
 - 3. Certification that each container of seed delivered will be labeled in accordance with Federal and State Seed Laws and equals or exceeds Specification requirements.
- B. Samples:
- 1. Mulches:
 - a. Bark Dust
 - b. Landscape Gravel Type 1
 - c. Landscape Gravel Type 2
 - d. Landscape Gravel Type 3
- C. Contract Closeout Information:
- 1. Operation and Maintenance Data:
 - a. See Specification Section 01 33 04 for requirements for the mechanics, administration, and the content of Operation and Maintenance Manual submittals.
- D. Informational Submittals:
- 1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
 - 2. Copies of invoices for fertilizer used on Project showing grade furnished, along with certification of quality and warranty.
- E. Furnish seed in sealed standard containers labeled with producer's name and seed analysis.
- 1. Remove from the site seed which has become wet, moldy, or otherwise damaged in transit.
- F. Furnish fertilizer uniform in composition, free flowing and suitable for application with approved equipment, delivered to site in bags or other containers, each fully labeled and bearing the name, and warranty of the producer.

1.4 SEQUENCING AND SCHEDULING

- A. Installation Schedule:
- 1. Provide schedule showing when trees, shrubs, groundcovers and other plant materials are anticipated to be planted.
 - 2. Show schedule of when lawn type and other grass areas are anticipated to be planted.
 - 3. Indicate planting schedules in relation to schedule for irrigation system installation, finish grading and topsoiling.
 - 4. Indicate anticipated dates Engineer will be required to review installation for initial acceptance and final acceptance.
- B. Pre-installation Meeting:
- 1. Meet with Engineer and other parties as necessary to discuss schedule and methods, unless otherwise indicated by Engineer.

PART 2 - PRODUCTS

2.1 MANUFACTURERS AND SUPPLIERS

- A. Subject to compliance with the Contract Documents, the manufacturers and suppliers listed in the applicable Articles below are acceptable.
- B. Submit request for substitution in accordance with Specification Section 01 25 13.

2.2 MATERIALS

- A. Seed Quality:
- 1. Fresh, clean, new-crop seed labeled in accordance with USDA Rules and Regulations under the Federal Seed Act in effect on date of bidding.

2. Provide seed of species, proportions, and minimum percentages of purity, germination and maximum percentage of weed seed as specified.
3. Approval of all seed for use shall be based on the accumulative total of PLS specified for each phase of work.

B. Seeded Lawn Type A:

BOTANICAL AND COMMON NAME	PERCENT BY WEIGHT (PLS)	MINIMUM PERCENT GERMINATION	MINIMUM PERCENT PURITY
Kentucky Bluegrass (Poa pratensis)	60	85	95
Hard Fescue (Festuca trachyphylla 'Eureka II')	30	85	98
Ryegrass, Perennial (Lolium perenne)	10	90	95

C. Mulch:

1. For seeded areas:
 - a. Clean, seed-free, threshed straw of oats, wheat, barley, rye, beans, peanuts, or other locally available mulch material which does not contain an excessive quantity of matured seeds of noxious weeds or other species that will grow or be detrimental to seeding, or provide a menace to surrounding land.
 - b. Do not use material which is fresh or excessively brittle, or which is decomposed and will smother or retard growth of grass.
2. Trees, shrubs and groundcover areas: Fine or medium fine shredded pine or fir bark of commercial grade free from woody substrates, or other material as approved by the Engineer.
3. Landscape gravel: As indicated in the Drawings.

D. Fertilizer:

1. Commercial fertilizer meeting applicable requirements of State and Federal law.
2. Cyanic compound or hydrated lime not permitted in mixed fertilizers.
3. For lawn-type seeding and sod: 5-10-5 analysis.

E. Limestone: Agricultural grade ground limestone containing not less than 88 PCT of combined calcium and magnesium carbonates, 100 PCT passing a 10-mesh sieve, 90 PCT passing a 20-mesh sieve, and 60 PCT passing a 100-mesh sieve.

F. Herbicide:

1. In gravel or rock mulch areas: Novosac 4-G by ACME Agriculture Products.

G. Asphalt Binder: Emulsified asphalt per State specifications.

H. Water:

1. Water free from substances harmful to grass or sod growth.
2. Provide water from source approved prior to use.

I. Plants:

1. See plant list on Drawings.
2. Sound, healthy, vigorous, with normal top and root systems, free from disease, insect pests or their eggs, grown in same or colder climatic zone as project.
 - a. Nursery grown stock, freshly dug.
 - 1) No heeled-in, cold storage or collected stock.
 - b. Species and size as indicated on Drawings.
3. Deciduous shade trees: Single leader, straight trunk, well-branched, free of branches up to 6 FT high, and with symmetrical growth.
4. Balled and burlapped plants (B&B): Firm, natural balls of soil.

5. Container grown plants (CG): Roots well established in soil, grown in container for at least one growing season.
6. Meet the minimum requirements of the American Standard For Nursery Stock, ANSI Z 60.1.

2.3 ACCESSORIES

- A. Tree Stakes: 2 IN DIA treated pine stake
- B. Staking Wire: 12 GA galvanized.
- C. Reinforced Rubber Hose: 5/8 or 3/4 IN DIA.
- D. Filter Fabric / Weed Barrier: DeWitt weed barrier by DeWitt Company, Inc., Sikeston, Missouri.
- E. Metal Edging: Ryerson steel edging, 1/8 x 4 IN, 16 IN tapered steel stakes, painted black
- F. Antidesiccant: Emulsion that will provide a film over plant surfaces permeable enough to permit transpiration.

PART 3 - EXECUTION

3.1 SOIL PREPARATION

- A. General:
 1. Limit preparation to areas which will be planted soon after.
 2. Provide facilities to protect and safeguard all persons on or about premises.
 3. Protect existing trees designated to remain.
 4. Verify location and existence of all underground utilities.
 - a. Take necessary precaution to protect existing utilities from damage due to construction activity.
 - b. Repair all damages to utility items at sole expense.
 5. Provide facilities such as protective fences and/or watchmen to protect work from vandalism.
 - a. Contractor to be responsible for vandalism until acceptance of work in whole or in part.
- B. Preparation for Lawn-Type Seeding or Sodding:
 1. Loosen compacted surface to minimum depth of 2 IN.
 2. Remove stones over 1 IN in any dimension and sticks, roots, rubbish, and other extraneous matter.
 3. Prior to applying fertilizer, loosen areas to be seeded with a double disc or other suitable device if the soil has become hard or compacted.
 4. Correct any surface irregularities in order to prevent pocket or low areas which will allow water to stand.
 5. Distribute fertilizer uniformly over areas to be seeded:
 - a. For lawn-type seeding: 30 LBS per 1000 SQFT.
 - b. For pasture seeding: 200 LBS per acre.
 6. Incorporate fertilizer into soil to a depth of at least 2 IN by disking, harrowing, or other approved methods.
 7. Remove stones or other substances from surface which will interfere with turf development or subsequent mowing operations.
 8. Grade lawn areas to a smooth, even surface with a loose, uniformly fine texture.
 - a. Roll and rake, remove ridges and fill depressions, as required to meet finish grades.
 - b. Limit fine grading to areas which can be planted soon after preparation.
 9. Restore lawn areas to specified condition if eroded or otherwise disturbed after fine grading and before planting.

3.2 INSTALLATION

- A. Lawn-Type and Pasture Seeding:
1. Do not use seed which is wet, moldy, or otherwise damaged.
 2. Perform seeding work from April 20 to May 15 for spring planting, and August 1 to September 15 for fall planting, unless otherwise approved by Engineer.
 3. Employ satisfactory methods of sowing using mechanical power-driven drills or seeders, or mechanical hand seeders, or other approved equipment.
 4. Distribute seed evenly over entire area at rate of application not less than 4 LBS (PLS) of seed per 1000 SQFT, 50 PCT sown in one direction, remainder at right angles to first sowing.
 5. Stop work when work extends beyond most favorable planting season for species designated, or when satisfactory results cannot be obtained because of drought, high winds excessive moisture, or other factors.
 - a. Resume work only when favorable conditions develop.
 6. Lightly rake seed into soil followed by light rolling or cultipacking.
 7. Immediately protect seeded areas against erosion by mulching.
 - a. Spread mulch in continuous blanket using 1-1/2 tons per acre to a depth of 4 or 5 straws.
 8. Protect seeded slopes against erosion with erosion netting or other methods approved by Engineer.
 - a. Protect seeded areas against traffic or other use by erecting barricades and placing warning signs.
 9. Immediately following spreading mulch, anchor mulch using a rolling coulter or a wheatland land packer having wheels with V-shaped edges to force mulch into soil surface, or apply evenly distributed emulsified asphalt at rate of 10-13 GAL/1000 SQFT.
 - a. SS-1 emulsion in accordance with ASTM D5276 or RC-1 cutback asphalt in accordance with ASTM D2028 are acceptable.
 - b. If mulch and asphalt are applied in one treatment, use SS-1 emulsion with penetration test range between 150-200.
 - c. Use appropriate shields to protect adjacent site improvements.
- B. Sodding:
1. Notify Engineer of source and location of sod at least 30 days prior to sodding operation, to permit inspection.
 - a. Submit species and percentages of purity and state botanical and common names.
 2. Sod areas as designated and disturbed lawn areas which were sodded or established prior to construction.
 3. Perform sodding only during climatic or weather conditions conducive to successful results.
 - a. Lay within 24 HRS of stripping.
 - b. Do not use dormant or frozen sod.
 - c. Sodding may be accomplished at all seasonal periods providing adequate provisions for sod protection are taken to ensure fitness and survival.
 - d. Do not place sod when temperature is below 32 DEGF.
 - e. Do not place frozen or dried out sod.
 - f. Do not sod on frozen or dried out soil.
 4. Lay sod to form a solid mass with tightly fitted joints.
 - a. Butt ends and edges; do not overlap.
 - b. Stagger joints.
 - c. Tamp or roll lightly to ensure full contact with subgrade.
 - d. Work sifted soil into minor cracks, avoid smothering adjacent grass.
 - e. Peg sod on slopes to prevent slippage.
 - 1) Use sharpened 1 x 1 x 6 IN wooden pegs.

3.3 PLANTING TREES, SHRUBS, AND GROUND COVERS

- A. Notification:
 - 1. Notify Engineer of source of plants and plant materials at least 30 days prior to planting to permit Engineer's inspection of source qualifications.
- B. Preparation:
 - 1. Handle plants so that roots or balls are adequately protected from breakage of balls, from sun or drying winds.
 - a. Ensure tops or roots of plants are not permitted to dry out.
 - 2. During transportation, protect materials from wind and sun to prevent tops and roots from drying out.
 - 3. Protect tops of plants from damage.
 - a. Plants with damaged tops will be rejected.
 - 4. For purpose of inspection and planting identification, attach durable, legible labels to bundle or container of plant material delivered at the planting site.
 - a. State correct plant name and size of each plant in weather-resistant ink on labels.
 - 5. Do not prune trees and shrubs at nursery.
- C. Planting Season:
 - 1. Plant deciduous trees, shrubs, and groundcovers any time the ground is suitable between October 15 and June 1.
- D. Planting Procedure:
 - 1. Indicate locations of plants for approval by Engineer before excavating plant locations.
 - 2. In event underground construction, utilities, obstructions, or rock are encountered in excavation of plantings, secure alternate locations from Engineer.
 - a. Make said changes without additional compensation.
 - b. Where tree locations fall under existing overhead wires, or crowd existing trees, adjust locations as directed by Engineer.
 - 3. Excavate pits and beds as necessary and in accordance with ANLA/ANSI Z60.1.
 - a. Loosen bottom of pits prior to planting.
 - b. Excavation is unclassified, excavate all materials without additional cost.
 - 4. Tree and shrub pits to be circular in shape with vertical sides at least 1 FT greater in diameter than ball diameter.
 - a. Pit to be of sufficient depth to provide 6 IN of planting soil under ball when set to natural grade.
 - 5. Shrub and ground cover beds:
 - a. Plant shrubs used in mass plantings in individual holes of required size.
 - b. Strip all sod from among mass planting.
 - c. For ground cover beds, remove sod from within limits of bed.
 - d. Add soil amendments as specified and mix or rototill with existing topsoil to a depth of 6 IN.
 - 6. Set plants straight or plumb, in locations when indicated and at such level that after settlement they bear same relationship to finished grade as they did in their former setting.
 - a. Carefully tamp planting soil under and around base of balls to prevent voids.
 - b. Remove burlap, rope and wires from top of balls.
 - c. Do not remove burlap from sides and bottom of balls.
 - 7. Backfill plants with planting soil.
 - a. Tamp to 1/2 depth of pit and thoroughly water and puddle before bringing backfill to proper grade.
 - b. After planting has been completed, flood pit a gain so that backfill is thoroughly saturated and settled.
 - 8. After planting is complete, form a level saucer 3 IN high around each tree extending to limit of plant pit for watering purposes.

9. Mulch plant pit after saucer has been shaped.
 - a. Mulch to limits of pit and uniformly over ground cover beds to a depth of 3 IN.
 - b. In mass plantings of shrubs, mulch entire area uniformly among shrubs to a depth of 3 IN.
 - c. If mulching is delayed and soil has dried out, water plants thoroughly before spreading mulch.
 10. Staking: Stake trees immediately after planting as detailed on Drawings or in accordance with Nursery Standards.
 11. Wrap deciduous trees 2 IN or more in caliper by neatly overlapping wrapping material between ground line and second branch.
 - a. Place ties at top and bottom of wrapping material and not more than 12 IN apart between top and bottom ties.
 12. Remove dead or damaged branches.
 - a. Thin deciduous material to about two-thirds of initial branching.
 - b. Remove only dead or damaged branches from evergreens.
 13. Water plants during planting operations.
 - a. Water each plant a minimum of once each week until final acceptance.
 - b. Apply sufficient water to moisten backfill about each plant so that moisture will extend into the surrounding soil.
- E. Landscape Materials:
1. Edging: Install edging in accordance with manufacturer's recommendations in locations shown on Drawings.
 2. Rock areas:
 - a. Compact subgrade to limits of installation of rock layer.
 - b. Spread herbicide at rate of 100-120 LBS per acre in accordance with manufacturer's recommendations.
 - 1) If plant materials are being installed, delay herbicide application 3 to 4 weeks and then apply over rock surfaces.
 - c. Cover area with weed barrier fabric and overlap edge 6 IN minimum.
 - d. Install rock to depths indicated in the Drawings.
- F. Pruning and Repairing Existing Trees:
1. Remove dead or dying limbs, repair and treat wounds, remove limbs that interfere with construction or with vehicular traffic and repair, rotted or decayed areas specifically noted on Drawings.

3.4 MAINTENANCE AND REPLACEMENT

- A. General:
1. Begin maintenance of planted areas immediately after each portion is planted and continue until final acceptance or for a specific time period as stated below, whichever is the longer.
 2. Provide and maintain temporary piping, hoses, and watering equipment as required to convey water from water sources and to keep planted areas uniformly moist as required for proper growth.
 3. Protection of new materials:
 - a. Provide barricades, coverings or other types of protection necessary to prevent damage to existing improvements indicated to remain.
 - b. Repair and pay for all damaged items.
 4. Replace unacceptable materials with materials and methods identical to the original specifications unless otherwise approved by the Engineer.
- B. Seeded or Sodded Lawns:
1. Maintain seeded lawns: 90 days, minimum, after installation and review of entire project area to be planted.
 2. Maintenance period begins at completion of planting or installation of entire area to be seeded or sodded.
 3. Engineer will review seeded or sodded lawn area after installation for initial acceptance.

4. Maintain lawns by watering, fertilizing, weeding, mowing, trimming, and other operations such as rolling, regrading, and replanting as required to establish a smooth, uniform lawn, free of weeds and eroded or bare areas.
 5. Mow lawns as soon as there is enough top growth to cut with mower set at recommended height for principal species planted.
 - a. Repeat mowing as required to maintain height.
 - b. Do not delay mowing until grass blades bend over and become matted.
 - c. Do not mow when grass is wet.
 - d. Time initial and subsequent mowings as required to maintain a height of 1-1/2 to 2 IN.
 - e. Do not mow lower than 1-1/2 IN.
 6. Remulch with new mulch in areas where mulch has been disturbed by wind or maintenance operations sufficiently to nullify its purpose.
 - a. Anchor as required to prevent displacement.
 7. Unacceptable plantings are those areas that do not meet the quality of the specified material, produce the specified results, or were not installed to the specified methods.
 8. Replant bare areas using same materials specified.
 9. Engineer will review final acceptability of installed areas at end of maintenance period.
 10. Maintain repaired areas until remainder of maintenance period or approved by Engineer, whichever is the longer period.
- C. Trees, Shrubs and Groundcovers:
1. Maintenance includes but is not limited to watering when necessary, removing dead or dying branches, removing sprouts and suckers; tightening, repairing or replacing tree stakes and wrapping; maintaining mulch to originally specified depth; and weeding plant beds and pits.
 2. Remove and replace all new plants supplied, which are impaired, dead, or dying during one year from initial acceptance.
 - a. Plant material shall be replaced by the Contractor within 1 month of written notification from the Engineer. Plants shall be replaced with the same species, cultivar and size unless otherwise approved in writing by the Engineer.
 3. Engineer will review completed planting for acceptability of installation.
 - a. Approval of planting denotes initial acceptance and the beginning of the maintenance period.

END OF SECTION



DIVISION 33

UTILITIES



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SECTION 33 05 16
PRECAST CONCRETE MANHOLE STRUCTURES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Precast concrete round manhole structures and appurtenant items.
 - a. Sanitary sewer manholes and appurtenances.
 - b. Drain manholes and appurtenances.
 - c. Storm sewer manholes and appurtenances.
- B. Related Specification Sections include but are not necessarily limited to:
 - 1. Division 00 - Procurement and Contracting Requirements.
 - 2. Division 01 - General Requirements.
 - 3. Section 03 21 00 - Reinforcement.
 - 4. Section 03 31 30 - Concrete Materials and Proportioning.
 - 5. Section 31 23 33 - Trenching, Backfilling, and Compacting for Utilities.
 - 6. Section 09 96 00 - High Performance Industrial Coatings.

1.2 QUALITY ASSURANCE

- A. Referenced Standards:
 - 1. ASTM International (ASTM):
 - a. A48/A48M, Standard Specification for Gray Iron Castings.
 - b. C150/C150M, Standard Specification for Portland Cement.
 - c. C478, Standard Specification for Precast Reinforced Concrete Manhole Sections.
 - d. C923, Standard Specification for Resilient Connectors between Reinforced Concrete Manhole Structures, Pipes, and Laterals.
 - e. D1227, Standard Specification for Emulsified Asphalt Used as a Protective Coating for Roofing.
 - f. D4586, Standard Specification for Asphalt Roof Cement, Asbestos-Free.

1.3 SUBMITTALS

- A. Shop Drawings:
 - 1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
 - 2. Product technical data including:
 - a. Acknowledgement that products submitted meet requirements of standards referenced.
 - b. Manufacturer's installation instructions.
 - 3. Fabrication and/or layout drawings:
 - a. Include detailed diagrams of manholes showing typical components and dimensions, reinforcements and other details.
 - b. Itemize, on separate schedule, sectional breakdown of each manhole structure with all components and refer to drawing identification number or notation.
 - c. Indicate knockout elevations for all piping entering each manhole.
 - 4. Buoyancy uplift and structural calculations.
 - 5. Drawings shall be signed and sealed by a Professional Engineer registered in state corresponding to the project location.
- B. Unless approved prior to submittal, submit all products from this Specification Section in one complete submittal package. Include all products and accessories together.

1.4 SITE CONDITIONS

- A. For this project, the established high groundwater elevation is 623 FT MSL (Mean Sea Level).

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
1. Manhole rings, covers and frames:
 - a. Neenah Foundry and Neenah Enterprises, Inc.
 - b. Deeter Foundry.
 2. Steps:
 - a. Lane P-14938 Steps or Approved equivalent.
 3. Entry Couplings:
 - a. Kor-N-Seal or a PVC manhole adapter as manufactured by GPK Products, Inc. or a Dura-Seal III gasket as manufactured by Dura-Tech, Inc., or a acceptable alternate. Field installation will not be permitted.
 4. Black mastic joint compound:
 - a. Kalktite 340.
 - b. Tufflex.
 - c. Plastico.
 5. Premolded joint compound:
 - a. RAM-NEK.
 - b. Kent Seal.
 6. Emulsified fibrated asphalt compound:
 - a. Sonneborn Hydrocide 700B Semi Mastic.
- B. Submit request for substitution in accordance with Specification Section 01 25 13.

2.2 SANITARY SEWER, STORM AND DRAIN MANHOLE STRUCTURE COMPONENTS

- A. Manhole Components:
1. Reinforcement: ASTM C478.
 2. Minimum wall thickness: 5 IN.
 3. Minimum base thickness: 12 IN.
 4. Provide the following components for each manhole structure:
 - a. Base (precast) with integral bottom section or (cast-in-place).
 - b. Precast bottom section(s).
 - c. Precast barrel section(s).
 - d. Precast eccentric transition section.
 - e. Precast adjuster ring(s).
 - f. Precast concrete transition section.
 - g. Precast flat top.
 5. Unless dimensioned or specifically noted on Drawings, provide manhole section with minimum 48 IN inside dimensions.
- B. Nonpressure Type Frames and Cover:
1. Shall comply with the City of Wenatchee standards.
 2. Cast iron frame and covers: ASTM A48/A48M, Class 35 (minimum).
 3. Furnish frame and cover of heavy-duty construction a minimum total weight of 450 LBS.
 4. Machine all horizontal surfaces.
 5. Ensure minimum clear opening of 24 IN DIA.
- C. Pressure Type Frame and Cover:
1. Provide covers meeting the requirements of the Nonpressure Type Frames and Cover paragraph above and as modified below.
 2. Furnish frame and bolted cover of heavy-duty construction.
 - a. Equip unit with six stainless steel countersunk 3/8 IN DIA by 1-1/2 IN long bolts with stainless steel washers.
 3. Provide solid lid and minimum 1/8 IN thick x 1/2 IN wide continuous strip neoprene gasket.

4. Furnish unit with a minimum of six anchorage holes and six, 6 IN long x 3/4 IN DIA stainless steel anchor bolts.
- D. Special Coatings and Joint Treatment:
1. Joints of precast sections:
 - a. Black mastic compound: ASTM D4586.
 2. Aluminum components embedded in concrete:
 - a. See Section 09 96 00 for protective coating for a luminum embedded in concrete.
 3. Vertical wall surfaces:
 - a. Emulsified fibrated asphalt compound meeting ASTM D1227 Type II for all exterior and interior vertical wall surfaces.
- E. Sanitary Sewer Manhole:
1. Provide all sanitary manholes constructed with Portland ASTM C150/C150M, Type I or II cement with a tricalcium aluminate content not to exceed 8 PCT.
 2. Manholes shall be constructed in accordance with AASHTOM-199 (ASTM C 478).
 3. Precast bases shall be furnished with cutouts or knockouts.
 4. Knockout or cutout hole size is equal to pipe outer diameter plus manhole wall thickness.
 5. All base reinforcing shall have a minimum yield strength of 60,000 psi and be placed in upper half of bases with 1-inch minimum clearance.
 6. No steps shall be placed in the adjustment section.
 7. All reinforced cast in place concrete shall be class 4,000, Non-Reinforced concrete in channel shall be Class 3,000. All pre-cast concrete shall be Class 4000.
 8. Mix aggregate shall be a minimum of 50 PCT crushed limestone.
 9. Provide 3000 PSI non-shrink grout.

PART 3 - EXECUTION

3.1 MANHOLE CONSTRUCTION

- A. General:
1. Construct cast-in-place concrete base slabs.
 2. Make inverts with a semi-circular bottom conforming to the inside contour of the adjacent sewer sections.
 3. On all straight runs, lay pipe through manhole and cut out top half of pipe.
 - a. See standard details.
 - b. If pipes deflect at manhole, shape as specified in Paragraphs 2 and 4 IN this General Paragraph.
 4. Shape inverts accurately and steel trowel finish.
 - a. For changes in direction of the sewer and entering branches into the manhole, make a circular curve in the manhole invert using a large radius as manhole inside diameter will permit.
 - b. Pour base slab integral with bottom barrel section.
- B. Build each manhole to dimensions shown on plans and at such elevation that pipe sections built into wall of manhole will be true extensions of line of pipe.
- C. For all horizontal mating surfaces between concrete and concrete or concrete and metal, above established high groundwater elevation shown trowel apply to clean surface black mastic joint compound to a minimum wet thickness of 1/4 IN immediately prior to mating the surfaces.
- D. For horizontal joints that fall below established high groundwater elevation shown, install a resilient O-ring type gasket or pre-molded joint compound.
- E. Seal all pipe penetrations in manhole.
1. Form pipe openings smooth and well shaped.
 2. After installation, seal cracks with, nonshrink grout.
 3. After grout cures, wire brush smooth and apply two coats emulsified fibrated asphalt compound to minimum wet thickness of 1/8 IN to ensure complete seal.

- F. Set and adjust frame and cover final 6 IN (minimum) to 18 IN (maximum) to match finished pavement or finished grade elevation using precast adjuster rings.

END OF SECTION

SECTION 33 40 00
STORM DRAINAGE SYSTEM

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Storm drainage systems.
 - 2. Storm drainage pipe.
 - 3. Inlets, headwalls, flumes and flared end sections.
- B. Related Specification Sections include but are not necessarily limited to:
 - 1. Division 00 - Procurement and Contracting Requirements.
 - 2. Division 01 - General Requirements.
 - 3. Section 31 23 33 - Trenching, Backfilling, and Compacting for Utilities.
 - 4. Section 40 05 31 - Pipe - Plastic

1.2 QUALITY ASSURANCE

- A. Referenced Standards:
 - 1. American Association of State Highway and Transportation Officials (AASHTO):
 - a. M36, Standard Specification for Corrugated Steel Pipe, Metallic-Coated, for Sewers and Drains (Equivalent ASTM A760/A760M).
 - b. M190, Standard Specification for Bituminous-Coated Corrugated Metal Culvert Pipe and Pipe Arches.
 - 2. ASTM International (ASTM):
 - a. A760/A760M, Standard Specification for Corrugated Steel Pipe, Metallic-Coated for Sewers and Drains.
 - b. C14, Standard Specification for Nonreinforced Concrete Sewer, Storm Drain, and Culvert Pipe.
 - c. C76, Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe.
 - d. C361, Standard Specification for Reinforced Concrete Low-Head Pressure Pipe.
 - e. F2510/F2510M, Standard Specification for Resilient Connectors Between Reinforced Concrete Manhole Structures and Corrugated Dual- and Triple-Wall Polyethylene and Polypropylene Pipes.
 - f. F2648/F2648M, Standard Specification for 2 to 60 IN (50 to 1500 MM) Annular Corrugated Profile Wall Polyethylene (PE) Pipe and Fittings for Land Drainage Applications.
 - 3. Construction standards: Washington State Department of Transportation Standard Specifications for Road, Bridge, and Municipal Construction "Standard Specifications".
 - a. Standard Details.

1.3 SUBMITTALS

- A. Shop Drawings:
 - 1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
 - 2. Product technical data including:
 - a. Acknowledgement that products submitted meet requirements of standards referenced.
 - 3. Certifications.
 - 4. Test reports.
 - 5. Submit all tests and certification in a single coordinated submittal.
 - a. Partial submittals will not be accepted.
- B. Submit schedules and details for structures and joints.

1.4 WARRANTY

- A. Warrant that the infiltration will not exceed the amount specified in the Exfiltration Test paragraph in the FIELD QUALITY CONTROL Article in PART 3 of this Specification Section during the one year correction period.

PART 2 - PRODUCTS

2.1 PVC DRAINAGE PIPING

- A. Materials
 - 1. Furnish materials in full compliance to the following material specification.
 - 2. PVC pipe shall be rigid, unplasticized polyvinyl chloride (PVC) made of PVC plastic having a cell classification of 12454-B or 12454-C as described in specification ASTM D1784.
 - 3. The requirements of this Specification are intended to provide for pipe and fittings suitable for non-pressure drainage of wastewater and surface water.
 - 4. Joining systems shall consist of an elastomeric gasket joint meeting requirements of ASTM D3212.
 - 5. Supply to the Engineer all information and sample of joining method for his evaluation.
 - a. Only jointing methods acceptable to the Engineer will be permitted.
 - 6. Provide pipe and fittings meeting or exceeding the following requirements:
 - a. 4-27 INDIA: ASTM D3034 and ASTM F679, SDR 35.
 - b. 8-30 INDIA: ASTM F794.
 - c. 4-18 INDIA: ASTM F949.
 - 7. Ensure impact strengths and pipe stiffnesses in full compliance to these Specifications.
- B. Installation: Install pipe and fittings in accordance with ASTM D2321 and as recommended by the manufacturer.
 - 1. Provide for a maximum deflection of not more than 5 PCT.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Comply with Specification Section 31 23 33.

3.2 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Comply with Specification Section 31 23 33.

3.3 FIELD QUALITY CONTROL

- A. Verify and coordinate installation.
- B. Exfiltration Test:
 - 1. Perform an exfiltration test on each reach of pvc drain pipe between manholes and catch basins.
 - a. Test the first reach after backfilling and prior to installing any of the remaining pipe, or any additional reach.
 - b. Single or multiple reaches may be tested thereafter, at Contractor's option.
 - c. Subject each manhole and catch basin to at least one test.
 - d. Provide all necessary piping between the reach to be tested and the water supply, and other necessary materials and equipment.
 - e. Air testing may be allowed.
 - 1) Submit complete information to Engineer for review describing the proposed test method, scheduling, and duration, including the method of testing manholes and catch basins before beginning testing.

2. Procedure:
 - a. Block off all manhole and catch basin openings, except those connecting with the reach being tested.
 - b. Fill the line.
 - 1) Average depth: 10 FT above invert, except as required by manhole and catch basin depth.
 - 2) Depth at lower end: 25 FT maximum above crown.
 - 3) Depth at upper end: 5 FT minimum above crown.
 - c. Add and measure water as required to maintain a constant level.
 - 1) Exfiltration: 100 GAL maximum per inch of nominal diameter per mile per day.
 - 2) Manholes are considered section of 48 IN pipe.
 - d. Maintain test for at least 2 HRS, or as long as necessary in Engineer's opinion, to locate all leaks.
 3. Repair and retest any reach that exceeds the allowable exfiltration.
- C. Infiltration Test:
1. If at any time prior to expiration of the correction or warranty period infiltration exceeds 200 GAL/IN of nominal diameter/mile/day, locate the leaks and make repairs.
- D. Lamp Test:
1. Each section between manholes will be lamped by Engineer.
 2. Furnish suitable assistants to help Engineer.
 3. A minimum of 95 percent of a true circle will be required in the lamp test to indicate a properly constructed pipeline.
 4. Repair any sections not passing the lamp test.
- E. In case of conflict, do not relocate piping without prior approval from the Engineer.

END OF SECTION

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DIVISION 40

PROCESS INTERCONNECTIONS



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SECTION 40 05 00
PIPE AND PIPE FITTINGS - BASIC REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Process piping systems.
 - 2. Utility piping systems.
 - 3. Plumbing piping systems.

- B. Related Specification Sections include but are not necessarily limited to:
 - 1. Division 00 - Procurement and Contracting Requirements.
 - 2. Division 01 - General Requirements.
 - 3. Section 09 96 00 - High Performance Industrial Coatings.
 - 4. Section 10 14 00 - Identification Devices.
 - 5. Section 31 23 33 - Trenching, Backfilling, and Compacting for Utilities.
 - 6. Section 40 05 07 - Pipe Support Systems.
 - 7. Section 40 05 51 - Valves - Basic Requirements.
 - 8. Section 40 41 13 - Heat Tracing Cable.
 - 9. Section 40 42 00 - Pipe, Duct and Equipment Insulation.
 - 10. Section 40 91 10 - Primary Elements and Transmitters.

1.2 QUALITY ASSURANCE

- A. Referenced Standards:
 - 1. American Association of State Highway and Transportation Officials (AASHTO):
 - a. M36, Corrugated Steel Pipe, Metallic-Coated, for Sewers and Drains (Equivalent ASTM A760).
 - b. M190, Standard Specification for Bituminous Coated Corrugated Metal Culvert Pipe and Pipe Arches.
 - c. M252, Standard Specification for Corrugated Polyethylene Drainage Tubing.
 - d. M294, Interim Specification for Corrugated Polyethylene Pipe 12 to 24 Inch Diameter.
 - 2. American Iron and Steel Institute (AISI).
 - 3. American Society of Mechanical Engineers (ASME):
 - a. B16.3, Malleable Iron Threaded Fittings.
 - b. B16.5, Pipe Flanges and Flanged Fittings.
 - c. B16.9, Factory-Made Wrought Steel Butt-Welding Fittings.
 - d. B16.22, Wrought Copper and Bronze Solder - Joint Pressure Fittings.
 - e. B16.26, Cast Copper Alloy Fittings for Flared Copper Tubes.
 - f. B36.19, Stainless Steel Pipe.
 - g. B40.100, Pressure Gauges and Gauge Attachments.
 - 4. ASTM International (ASTM):
 - a. A53, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
 - b. A74, Standard Specification for Cast Iron Soil Pipe and Fittings.
 - c. A106, Standard Specification for Seamless Carbon Steel Pipe for High-Temperature Service.
 - d. A126, Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings.
 - e. A182, Standard Specification for Forged or Rolled Alloy-Steel Pipe Flanges, Forged Fittings, and Valves and Parts for High-Temperature Service.
 - f. A197, Standard Specification for Cupola Malleable Iron.
 - g. A234, Standard Specification for Pipe Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service.

- h. A269, Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service.
 - i. A312, Standard Specification for Seamless, Welded, and Heavily Cold Worked Austenitic Stainless Steel Pipes.
 - j. A518, Standard Specification for Corrosion-Resistant High-Silicon Iron Castings.
 - k. A536, Standard Specification for Ductile Iron Castings.
 - l. A587, Standard Specification for Electric-Resistance-Welded Low-Carbon Steel Pipe for the Chemical Industry.
 - m. A760, Standard Specification for Corrugated Steel Pipe, Metallic-Coated for Sewers and Drains.
 - n. A774, Standard Specification for As-Welded Wrought Austenitic Stainless Steel Fittings for General Corrosive Service at Low and Moderate Temperatures.
 - o. A778, Standard Specification for Welded, Unannealed Austenitic Stainless Steel Tubular Products.
 - p. B88, Standard Specification for Seamless Copper Water Tube.
 - q. C14, Standard Specification for Concrete Sewer, Storm Drain, and Culvert Pipe.
 - r. C76, Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe.
 - s. C425, Standard Specification for Compression Joints for Vitrified Clay Pipe and Fittings.
 - t. C443, Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets.
 - u. C564, Standard Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings.
 - v. C700, Standard Specification for Vitrified Clay Pipe, Extra Strength, Standard Strength and Perforated.
 - w. D1785, Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120.
 - x. D2466, Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40.
 - y. D2467, Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80.
 - z. D4101, Standard Specification for Polypropylene Plastic Injection and Extrusion Materials.
 - aa. F439, Standard Specification for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80.
 - bb. F441, Standard Specification for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe, Schedules 40 and 80.
5. American Water Works Association (AWWA):
- a. B300, Standard for Hypochlorites.
 - b. C200, Standard for Steel Water Pipe - 6 IN and Larger.
 - c. C207, Standard for Steel Pipe Flanges for Waterworks Service - Sizes 4 IN through 144 IN.
 - d. C208, Standard for Dimensions for Fabricated Steel Water Pipe Fittings.
 - e. C606, Standard for Grooved and Shouldered Joints.
 - f. C651, Standard for Disinfecting Water Mains.
 - g. C800, Standard for Underground Service Line Valves and Fittings.
6. American Water Works Association/American National Standards Institute (AWWA/ANSI):
- a. C110/A21.10, Standard for Ductile-Iron and Gray-Iron Fittings.
 - b. C111/A21.11, Standard for Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
 - c. C115/A21.15, Standard for Flanged Ductile-Iron Pipe with Ductile-Iron or Gray-Iron Threaded Flanges.
 - d. C151/A21.51, Standard for Ductile-Iron Pipe, Centrifugally Cast, for Water.
 - e. C153/A21.53, Standard for Ductile-Iron Compact Fittings for Water Service.

7. Chlorine Institute, Inc. (CI):
 - a. Pamphlet 6, Piping Systems for Dry Chlorine.
8. Cast Iron Soil Pipe Institute (CISPI):
 - a. 301, Standard Specification for Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications.
9. International Plumbing Code (IPC).
10. National Fire Protection Association (NFPA):
 - a. 54, National Fuel Gas Code.
 - b. 69, Standard on Explosion Prevention Systems.
11. Underwriters Laboratories, Inc. (UL).

B. Coordinate flange dimensions and drillings between piping, valves, and equipment.

1.3 DEFINITIONS

- A. Hazardous Gas Systems: Digester gas, chlorine gas, sulfur dioxide gas, carbon dioxide gas, lab gases.
- B. HPIC: High performance industrial coating.
- C. PVDF: Polyvinylidene fluoride.

1.4 SYSTEM DESCRIPTION

- A. Piping Systems Organization and Definition:
 1. Piping services are grouped into designated systems according to the chemical and physical properties of the fluid conveyed, system pressure, piping size and system materials of construction.
 2. See PIPING SPECIFICATION SCHEDULES in PART 3.

1.5 SUBMITTALS

- A. Shop Drawings:
 1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
 2. Product technical data including:
 - a. Acknowledgement that products submitted meet requirements of standards referenced.
 - b. Copies of manufacturer's written directions regarding material handling, delivery, storage, and installation.
 - c. Separate schedule sheet for each piping system scheduled in this Specification Section showing compliance of all system components.
 - 1) Attach technical product data on gaskets, pipe, fittings, and other components.
 3. Fabrication and/or Layout Drawings:
 - a. Exterior yard piping drawings (minimum scale 1 IN equals 10 FT) with information including:
 - 1) Dimensions of piping lengths.
 - 2) Invert or centerline elevations of piping crossings.
 - 3) Acknowledgement of bury depth requirements.
 - 4) Details of fittings, tapping locations, thrust blocks, restrained joint segments, harnessed joint segments, hydrants, and related appurtenances.
 - 5) Acknowledge designated valve or gate tag numbers, manhole numbers, instrument tag numbers, pipe and line numbers.
 - 6) Line slopes and vents.
 - b. Interior piping drawings (minimum scale 1/8 IN equals 1 FT) with information including:
 - 1) Dimensions of piping from column lines or wall surfaces.
 - 2) Invert or Centerline dimensions of piping.
 - 3) Centerline elevation and size of intersecting ductwork, conduit/conduit racks, or other potential interferences requiring coordination.
 - 4) Location and type of pipe supports and anchors.

- 5) Locations of valves and valve actuator type.
 - 6) Details of fittings, tapping locations, equipment connections, flexible expansion joints, connections to equipment, and related appurtenances.
 - 7) Acknowledgement of valve, equipment, and instrument tag numbers.
 - 8) Provisions for expansion and contraction.
 - 9) Line slopes and air release vents.
 - 10) Rough-in data for plumbing fixtures.
- c. Schedule of interconnections to existing piping and method of connection.
- B. Contract Closeout Information:
 - 1. Operation and Maintenance Data:
 - a. See Specification Section 01 33 04 for requirements for the mechanics, administration, and the content of Operation and Maintenance Manual submittals.
 - C. Informational Submittals:
 - 1. Qualifications of lab performing disinfection analysis on water systems.
 - 2. Test reports:
 - a. Copies of pressure test results on all piping systems.
 - b. Reports defining results of dielectric testing and corrective action taken.
 - c. Disinfection test report.
 - d. Notification of time and date of piping pressure tests.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Protect pipe coating during handling using methods recommended by manufacturer.
 - 1. Use of bare cables, chains, hooks, metal bars, or narrow skids in contact with coated pipe is not permitted.
- B. Prevent damage to pipe during transit.
 - 1. Repair abrasions, scars, and blemishes.
 - 2. If repair of satisfactory quality cannot be achieved, replace damaged material immediately.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
 - 1. Insulating unions:
 - a. "Dielectric" by EpcO.
 - 2. Dirt strainers (Y type):
 - a. Mueller (#351).
 - b. Sarco.
 - c. Armstrong.
 - 3. Chemical strainers (Y type):
 - a. Chemtrol.
 - b. Asahi.
 - 4. Dry disconnect couplings:
 - a. Kamlock.
 - 5. Dielectric flange kit:
 - a. PSI.
 - b. Maloney.
 - c. Central Plastics.
 - 6. Pipe saddles (for gage installation):
 - a. Dresser Style 91 (steel and ductile iron systems).
 - b. Dresser Style 194 (nonmetallic systems).

7. Expansion joint at FRP and poly tanks:
 - a. PROCO.
 - b. Garlock, Style 215.
 8. Elastomeric bellows type expansion joints:
 - a. Garlock, Guardian 200/204.
 - b. PROCO, equivalent model.
 - c. Red Valve, equivalent model.
 - d. Or equal.
 9. Dismantling Joint
 - a. Romac DJ400.
 - b. Smith Blair 972.
- B. Submit request for substitution in accordance with Specification Section 01 25 13.

2.2 PIPING SPECIFICATION SCHEDULES

- A. Piping system materials, fittings and appurtenances are subject to requirements of specific piping specification schedules located at the end of PART 3 of this Specification Section.

2.3 COMPONENTS AND ACCESSORIES

- A. Insulating Components:
1. Dielectric flange kits:
 - a. Flat faced.
 - b. 1/8 IN thick dielectric gasket, phenolic, non-asbestos.
 - c. Suitable for 175 PSI, 210 DEGF.
 - d. 1/32 IN wall thickness bolt sleeves.
 - e. 1/8 IN thick phenolic insulating washers.
 2. Dielectric unions:
 - a. Screwed end connections.
 - b. Rated at 175 PSI, 210 DEGF.
 - c. Provide dielectric gaskets suitable for continuous operation at union rated temperature and pressure.
- B. Dirt Strainers:
1. Y-type.
 2. Composition bronze.
 3. Rated for test pressure and temperature of system in which they are installed.
 4. 20 mesh Monel screen.
 5. Threaded bronze plug in the blowoff outlet.
 6. Threaded NPT end connections.
- C. Strainers for Chemical Applications:
1. Y-type.
 2. Strainers of same material, test pressure, and temperature rating as system in which strainer is placed.
- D. Reducers:
1. Furnish appropriate size reducers and reducing fittings to mate pipe to equipment connections.
 2. Connection size requirements may change from those shown on Drawings depending on equipment furnished.
- E. Protective Coating and Lining:
1. Include pipe, fittings, and appurtenances where coatings, linings, coating, tests and other items are specified.
 2. Field coating pipe in accordance with Specification Section 09 96 00.
- F. Underground Warning Tape:
1. See Specification Section 10 14 00.

- G. Pressure Gages:
 - 1. See Specification Section 01 61 03 and Specification Section 4091 10.
- H. Dry Disconnect Couplings:
 - 1. Adapters:
 - a. Male adapters: Size shown on Drawings.
 - b. Adapters:
 - 1) Female NPT end connection for sludge and flush applications.
 - 2) Male NPT end connection for chemical applications.
 - c. Construct adapters for sludge applications from cast iron or steel.
 - d. Construct adapters for chemical and PVC system applications 3 IN and below from polypropylene.
 - 1) Above 3 IN size, provide stainless steel units.
 - 2. Couplers:
 - a. Built-in valve and spring loaded poppet which close automatically when disconnected.
 - b. Designed to remain with only one arm locked in closed position.
 - c. Construct couplers for sludge applications fabricated from material utilized for adapters.
 - d. Construct couplers for chemical and PVC system applications 3 IN and less from polypropylene with stainless steel arms and pins.
 - 1) Above 3 IN, provide stainless steel units.
 - e. Gasket: Compatible with conveyed liquid.
 - 3. Dust caps: For all adapters.
- I. Sacrificial Anode Cathodic Protection:
 - 1. 3 LB magnesium sacrificial anodes, prepackaged in a cloth bag containing 75 PCT hydrated gypsum, 20 PCT bentonite and 5 PCT anhydrous sodium sulphate.
 - 2. TW 600 V or an HMWPE insulated copper lead attached to the anode.
- J. Valves:
 - 1. See schematics and details for definition of manual valves used in each system under 4 IN in size.
 - a. See Drawings and Specification Section 4005 51 schedule for valve types 4 IN and above and for automatic valves used in each system.
 - 2. See Specification Section 4005 51.
- K. Expansion Joints at FRP and Poly Tanks:
 - 1. Materials:
 - a. Bellows: PTFE-62.
 - b. Flanges: PVC.
 - c. Limit bolts and nuts: 316 stainless steel.
 - d. Reinforcing rings: Stainless steel.
 - 2. Pressure rating at 70 DEGF: 70 PSIG.
 - 3. Minimum axial movement: 3/8 IN.
- L. Elastomeric Bellows Type Expansion Joints:
 - 1. Provide reducing type where indicated on the Drawings.
 - 2. Air piping: Refer to stainless steel Specification 4005 23.
 - 3. Flanges: ANSI 125/150.
 - 4. Materials:
 - a. Bellows:
 - 1) Sludge service: Natural rubber.
 - 2) Hot Water (over 100 DEGF): EPDM.
 - 3) All other: Compatible with fluid.
 - b. Restraint:
 - 1) Provide restraint limit bolts (control rods) and nuts to restrain joint at test pressure of piping.
 - 2) Control rod material: 316 stainless steel.

- c. Working pressure: Equal to or greater than test pressure of connecting piping.
- d. Minimum axial movement: 3/8IN.
- 5. Arches:
 - a. Sludge service: Provide single filled arches.
 - b. All other service: Provide double open arches.

PART 3 - EXECUTION

3.1 EXTERIOR BURIED PIPING INSTALLATION

- A. Unless otherwise shown on the Drawings, provide a minimum of 6 FT earth cover over exterior buried piping systems and appurtenances conveying water, fluids, or solutions subject to freezing.
- B. Enter and exit through structure walls, floors, and ceilings by using penetrations and seals specified in Specification Section 01 73 20 and as shown on Drawings.
- C. When entering or leaving structures with buried mechanical joint piping, install joint within 2 FT of point where pipe enters or leaves structure.
 - 1. Install second joint not more than 6 FT nor less than 4 FT from first joint.
- D. Install expansion devices as necessary to allow expansion and contraction movement.
- E. Laying Pipe in Trench:
 - 1. Excavate and backfill trench in accordance with Specification Section 31 23 33.
 - 2. Clean each pipe length thoroughly and inspect for compliance to specifications.
 - 3. Grade trench bottom and excavate for pipe bell and lay pipe on trench bottom.
 - 4. Install gasket or joint material according to manufacturer's directions after joints have been thoroughly cleaned and examined.
 - 5. Except for first two joints, before making final connections of joints, install two full sections of pipe with earth tamped alongside of pipe or final with bedding material placed.
 - 6. Lay pipe in only suitable weather with good trench conditions.
 - a. Never lay pipe in water except where approved by Engineer.
 - 7. Seal open end of line with watertight plug if pipe laying stopped.
 - 8. Remove water in trench before removal of plug.
- F. Lining Up Push-On Joint Piping:
 - 1. Lay piping on route lines shown on Drawings.
 - 2. Deflect from straight alignments or grades by vertical or horizontal curves or offsets.
 - 3. Observe maximum deflection values stated in manufacturer's written literature.
 - 4. Provide special bends when specified or where required alignment exceeds allowable deflections stipulated.
 - 5. Install shorter lengths of pipe in such length and number that angular deflection of any joint, as represented by specified maximum deflection, is not exceeded.
- G. Anchorage and Blocking:
 - 1. Provide reaction blocking, anchors, joint harnesses, or other acceptable means for preventing movement of piping caused by forces in or on buried piping tees, wye branches, plugs, or bends.
 - 2. Place concrete blocking so that it extends from fitting into solid undisturbed earth wall.
 - a. Concrete blocks shall not cover pipe joints.
 - 3. Provide bearing area of concrete in accordance with drawing detail.
- H. Install underground hazard warning tape per Specification Section 10 14 00.
- I. Install insulating components where dissimilar metals are joined together.

3.2 INTERIOR AND EXPOSED EXTERIOR PIPING INSTALLATION

- A. Install piping in vertical and horizontal alignment as shown on Drawings.
- B. Alignment of piping smaller than 4 IN may not be shown; however, install according to Drawing intent and with clearance and allowance for:
 - 1. Expansion and contraction.
 - 2. Operation and access to equipment, doors, windows, hoists, moving equipment.
 - 3. Headroom and walking space for working areas and aisles.
 - 4. System drainage and air removal.
- C. Enter and exit through structure walls, floor, and ceilings using penetrations and seals specified in Specification Section 01 73 20 and as shown on the Drawings.
- D. Install vertical piping runs plumb and horizontal piping runs parallel with structure walls.
- E. Pipe Support:
 - 1. Use methods of piping support as shown on Drawings and as required in Specification Section 40 05 07.
 - 2. Where pipes run parallel and at same elevation or grade, they may be grouped and supported from common trapeze-type hanger, provided hanger rods are increased in size as specified for total supported weight.
 - a. The pipe in the group requiring the least maximum distance between supports shall set the distance between trapeze hangers.
 - 3. Size pipe supports with consideration to specific gravity of liquid being piped.
- F. Locate and size sleeves and castings required for piping system.
 - 1. Arrange for chases, recesses, inserts or anchors at proper elevation and location.
- G. Use reducing fittings throughout piping systems.
 - 1. Bushings will not be allowed unless specifically approved.
- H. Equipment Drainage and Miscellaneous Piping:
 - 1. Provide drip pans and piping at equipment where condensation may occur.
 - 2. Hard pipe stuffing box leakage to nearest floor drain.
 - 3. Avoid piping over electrical components such as motor control centers, panelboards, etc.
 - a. If piping must be so routed, utilize 16 GA, 316 stainless steel drip pan under piping and over full length of electrical equipment.
 - b. Hard pipe drainage to nearest floor drain.
 - 4. Collect system condensate at drip pockets, traps, and blowoff valves.
 - 5. Provide drainage for process piping at locations shown on Drawings in accordance with Drawing details.
 - 6. For applications defined above and for other miscellaneous piping which is not addressed by a specific piping service category in PART 1, provide 304 stainless steel piping and fittings.
 - a. Size to handle application with 3/4 IN being minimum size provided.
- I. Unions:
 - 1. Install in position which will permit valve or equipment to be removed without dismantling adjacent piping.
 - 2. Mechanical type couplings may serve as unions.
 - 3. Additional flange unions are not required at flanged connections.
- J. Install expansion devices as necessary to allow expansion/contraction movement.
- K. Provide full face gaskets on all systems.
- L. Anchorage and Blocking:
 - 1. Block, anchor, or harness exposed piping subjected to forces in which joints are installed to prevent separation of joints and transmission of stress into equipment or structural components not designed to resist those stresses.

M. Equipment Pipe Connections:

1. Equipment - General:

- a. Exercise care in bolting flanged joints so that there is no restraint on the opposite end of pipe or fitting which would prevent uniform gasket pressure at connection or would cause unnecessary stresses to be transmitted to equipment flanges.
- b. Where push-on joints are used in conjunction with flanged joints, final positioning of push-on joints shall not be made until flange joints have been tightened without strain.
- c. Tighten flange bolts at uniform rate which will result in uniform gasket compression over entire area of joint.
 - 1) Provide tightening torque in accordance with manufacturer's recommendations.
- d. Support and match flange faces to uniform contact over their entire face area prior to installation of any bolt between the piping flange and equipment connecting flange.
- e. Permit piping connected to equipment to freely move in directions parallel to longitudinal centerline when and while bolts in connection flange are tightened.
- f. Align, level, and wedge equipment into place during fitting and alignment of connecting piping.
- g. Grout equipment into place prior to final bolting of piping but not before initial fitting and alignment.
- h. To provide maximum flexibility and ease of alignment, assemble connecting piping with gaskets in place and minimum of four bolts per joint installed and tightened.
 - 1) Test alignment by loosening flange bolts to see if there is any change in relationship of piping flange with equipment connecting flange.
 - 2) Realign as necessary, install flange bolts and make equipment connection.
- i. Provide utility connections to equipment shown on Drawings, scheduled or specified.

2. Plumbing and HVAC equipment:

- a. Make piping connections to plumbing and HVAC equipment, including but not limited to installation of fittings, strainers, pressure reducing valves, flow control valves and relief valves provided with or as integral part of equipment.
- b. Furnish and install sinks, fittings, strainers, pressure reducing valves, flow control valves, pressure relief valves, and shock absorbers which are not specified to be provided with or as integral part of equipment.
- c. For each water supply piping connection to equipment, furnish and install union and gate or angle valve.
 - 1) Provide wheel handle stop valve at each laboratory sink water supply.
 - 2) Minimum size: 1/2 IN.
- d. Furnish and install "P" trap for each waste piping connection to equipment if waste is connected directly to building sewer system.
 - 1) Size trap as required by IPC.
- e. Stub piping for equipment, sinks, laboratories, supply and drain fittings, key stops, "P" traps, miscellaneous traps and miscellaneous brass through wall or floor and cap and protect until such time when later installation is performed.

N. Provide insulating components where dissimilar metals are joined together.

O. Instrument Connections:

1. See drawing details.

3.3 CONNECTIONS WITH EXISTING PIPING

- A. Where connection between new work and existing work is made, use suitable and proper fittings to suit conditions encountered.
- B. Perform connections with existing piping at time and under conditions which will least interfere with service to customers affected by such operation.
- C. Undertake connections in fashion which will disturb system as little as possible.
- D. Provide suitable equipment and facilities to dewater, drain, and dispose of liquid removed without damage to adjacent property.

- E. Where connections to existing systems necessitate employment of past installation methods not currently part of trade practice, utilize necessary special piping components.
- F. Where connection involves potable water systems, provide disinfection methods as prescribed in this Specification Section.
- G. Once tie-in to each existing system is initiated, continue work continuously until tie-in is made and tested.

3.4 ACCESS PROVISIONS

- A. Provide access doors or panels in walls, floors, and ceilings to permit access to valves, piping and piping appurtenances requiring service.
- B. Size of access panels to allow inspection and removal of items served, minimum 10 x 14 IN size.
- C. Fabricate door and frame of minimum 14 GA, stretcher leveled stock, cadmium plated or galvanized after fabrication and fitted with screw driver lock of cam type.
- D. Provide with key locks, keyed alike, in public use areas.
- E. Furnish panels with prime coat of HPIC. See Specification Section 09 9600.
- F. Style and type as required for material in which door installed.
- G. Where door is installed in fire-rated construction, provide door bearing UL label required for condition.

3.5 CATHODIC PROTECTION

- A. Isolate, dielectrically, all piping from all other metals including reinforcing bars in concrete slabs, other pipe lines, and miscellaneous metal.
- B. Make all connections from wire or cable by Thermit Cadwelding accomplished by operators experienced in this process.
- C. Install all cables with a loop and overhead knot around each pipe and slack equal to at least 50 PCT of the straight line length.
- D. After cadwelding, coat all exposed metallic surfaces with hot applied tape.

3.6 HEAT TRACING

- A. See Specification Section 4041 13 - Heat Tracing Cable.

3.7 PRESSURE GAGES

- A. Provide at locations shown on the Drawings and specified.
- B. See Specification Section 01 61 03.

3.8 FIELD QUALITY CONTROL

- A. Pipe Testing - General:
 1. Test piping systems as follows:
 - a. Test exposed, non-insulated piping systems upon completion of system.
 - b. Test exposed, insulated piping systems upon completion of system but prior to application of insulation.
 - c. Test concealed interior piping systems prior to concealment and, if system is insulated, prior to application of insulation.
 - d. Test buried piping (insulated and non-insulated) prior to backfilling and, if insulated, prior to application of insulation.
 2. Utilize pressures, media, and pressure test durations as specified in the PIPING SPECIFICATION SCHEDULES.
 3. Isolate equipment which may be damaged by the specified pressure test conditions.

4. Perform pressure test using calibrated pressure gauges and calibrated volumetric measuring equipment to determine leakage rates.
 - a. Select each gage so that the specified test pressure falls within the upper half of the gage's range.
 - b. Notify the Engineer 24 HRS prior to each test.
5. Completely assemble and test new piping systems prior to connection to existing pipe systems.
6. Acknowledge satisfactory performance of tests and inspections in writing to Engineer prior to final acceptance.
7. Bear the cost of all testing and inspecting, locating and remedying of leaks and any necessary retesting and re-examination.

B. Pressure Testing:

1. Testing medium: Unless otherwise specified in the PIPING SPECIFICATION SCHEDULES, utilize the following test media.
 - a. Process systems:

PIPE LINE SIZE	SPECIFIED TEST PRESSURE	TESTING MEDIUM
2 IN and smaller	75 PSI or less	Water
2 IN and smaller	Greater than 75 PSI	Water
Greater than 2 IN	3 PSI or less	Water
Greater than 2 IN	Greater than 3 PSI	Water

- b. Laboratory gases and natural gas systems: Cylinder nitrogen.
 - c. Liquid systems:

PIPE LINE SIZE (DIA)	GRAVITY OR PUMPED	SPECIFIED TEST PRESSURE	TESTING MEDIUM
Up to and including 48 IN	Gravity	25 PSIG or less	Water
Above 48 IN	Gravity	25 PSIG or less	Water
All sizes	Pumped	250 PSIG or less	Water

2. Allowable leakage rates:
 - a. Hazardous gas systems, all exposed piping systems, all pressure piping systems and all buried, insulated piping systems which are hydrostatically pressure tested shall have zero leakage goal at the specified test pressure throughout the duration of the test.
 - b. Hydrostatic exfiltration and infiltration for sanitary and stormwater sewers (groundwater level is below the top of pipe):
 - 1) Leakage rate: 200 GAL per inch diameter per mile of pipe per day at a average head on test section of 3 FT.
 - 2) Average head is defined from groundwater elevation to average pipe crown.
 - 3) Acceptable test head leakage rate for heads greater than 3 FT: Acceptable leakage rate (gallons per inch diameter per mile per day) equals 115 by (actual test head to the 1/2 power).
 - c. Hydrostatic infiltration test for sanitary and stormwater sewers (groundwater level is above the top of pipe):
 - 1) Allowable leakage rate: 200 GAL per inch diameter per mile of pipe per day when depth of groundwater over top of pipe is 2 to 6 FT.
 - 2) Leakage rate at heads greater than 6 FT: Allowable leakage rate (gallons per inch diameter per mile of pipe per day) equals 82 by (actual head to the 1/2 power).
 - d. Large diameter (above 48 IN) gravity plant piping systems shall have a maximum exfiltration of 25 GPD per inch-mile.

- e. Non-hazardous gas and air systems which are tested with air shall have a maximum pressure drop of 5 PCT of the specified test pressure throughout the duration of the test.
- f. For low pressure (less than 25 PSIG) air testing, the acceptable time for loss of 1 PSIG of air pressure shall be:

PIPE SIZE (IN DIA)	TIME, MINUTES/100 FT
4	0.3
6	0.7
8	1.2
10	1.5
12	1.8
15	2.1
18	2.4
21	3.0
24	3.6
27	4.2
30	4.8
33	5.4
36	6.0
42	7.3
48	7.6

- 3. Hydrostatic pressure testing methodology:
 - a. General:
 - 1) All joints, including welds, are to be left exposed for examination during the test.
 - 2) Provide additional temporary supports for piping systems designed for vapor or gas to support the weight of the test water.
 - 3) Provide temporary restraints for expansion joints for a additional pressure load under test.
 - 4) Isolate equipment in piping system with rated pressure lower than pipe test pressure.
 - 5) Do not coat or insulate exposed piping until successful performance of pressure test.
 - b. Soil, waste, drain and vent systems:
 - 1) Test at completion of installation of each stack or section of piping by filling system with water and checking joints and fittings for leaks.
 - 2) Eliminate leaks before proceeding with work or concealing piping.
 - 3) Minimum test heights shall be 10 FT above highest stack inlet.
 - c. Larger diameter (above 36 IN) gravity plant piping:
 - 1) Plug downstream end of segment to be tested.
 - a) Provide bracing as required.
 - 2) Fill segment and upstream structure to normal operating level as per hydraulic profile.
 - 3) Allow 24 HRS for absorption losses.
 - a) Refill to original level.
 - 4) Provide reservoir to maintain constant head over duration of test.
 - 5) Record reservoir water volume at beginning and end of test.

4. Natural gas systems - testing methodology:
 - a. Maintain specified test pressure until each joint has been thoroughly examined for leaks by means of soap suds and glycerine.
 - b. Wipe joints clean after test.
 5. Air testing methodology:
 - a. General:
 - 1) Assure air is ambient temperature.
 - b. Low pressure air testing:
 - 1) Place plugs in line and inflate to manufacturer's designated seal pressure.
 - 2) Check plugs for proper sealing.
 - 3) Introduce low pressure air into sealed line segment until air pressure reaches 4 PSIG greater than ground water or allowable limits of ASTM F1417.
 - a) Use test gage conforming to ASME B40.100 with 0 to 15 PSI scale and accuracy of 1 PCT of full range.
 - 4) Allow 2 minutes for air pressure to stabilize.
 - 5) After stabilization period (3.5 PSIG minimum pressure in pipe) discontinue air supply to line segment.
 - 6) Record pressure at beginning and end of test.
- C. Dielectric Testing Methods and Criteria:
1. Provide electrical check between metallic non-ferrous pipe or appurtenances and ferrous elements of construction to assure discontinuity has been maintained.
 2. Wherever electrical contact is demonstrated by such test, locate the point or points of continuity and correct the condition.

3.9 CLEANING, DISINFECTION AND PURGING

- A. Cleaning:
1. Clean interior of piping systems thoroughly before installing.
 2. Maintain pipe in clean condition during installation.
 3. Before jointing piping, thoroughly clean and wipe joint contact surfaces and then properly dress and make joint.
 - a. Pig high pressure air piping before connecting to valves or instruments.
 4. At completion of work and prior to Final Acceptance, thoroughly clean work installed under these Specifications.
 - a. Clean equipment, fixtures, pipe, valves, and fittings of grease, metal cuttings, and sludge which may have accumulated by operation of system, from testing, or from other causes.
 - b. Repair any stoppage or discoloration or other damage to parts of building, its finish, or furnishings, due to failure to properly clean piping system, without cost to Owner.
 5. After erection of piping and tubing, but prior to installation of service outlet valves, blow digester gas systems clear of free moisture and foreign matter by means of air, nitrogen, or carbon dioxide.
 - a. Oxygen shall never be used.
 6. Clean chlorine piping in accordance with CI Pamphlet 6.
 7. Purge all neat liquid polymer tubing or piping between the neat polymer storage tank or tote and the polymer blending units with mineral oil to remove residual water prior to introducing neat polymer. Following purging, drain as much of the mineral oil out of the system as possible. Dispose of purged fluids and waste mineral oil in accordance with local environmental regulations.
- B. Disinfection of Potable Water Systems:
1. After favorable performance of pressure test and prior to Final Acceptance, thoroughly flush entire potable water piping system including supply, source, and any appurtenant devices and perform disinfection as prescribed.
 2. Perform work, including preventative measures during construction, in full compliance with AWWA C651.

3. Perform disinfection using sodium hypochlorite complying with AWWA B300.
4. Flush each segment of system to provide flushing velocity of not less than 2.5 FT per second.
5. Drain flushing water to sanitary sewer.
 - a. Do not drain flushing water to receiving stream.
6. Use continuous feed method of application.
 - a. Tag system during disinfection procedure to prevent use.
7. After required contact period, flush system to remove traces of heavily chlorinated water.
8. After final flushing and before placing water in service, obtain an independent laboratory approved by the Owner to collect samples and test for bacteriological quality.
 - a. Repeat entire disinfection procedures until satisfactory results are obtained.
9. Secure and deliver to Owner, satisfactory bacteriological reports on samples taken from system.
 - a. Ensure sampling and testing procedures are in full compliance to AWWA C651, local water purveyor and applicable requirements of State of Washington.

C. Purging Natural gas and Digester Gas:

1. Existing piping:
 - a. Turn off gas supply.
 - b. Vent line pressure outdoors.
 - c. If section exceeds the following, then remaining gas shall be displaced with an inert gas.
 - 1) 50 FT for 2-1/2 IN pipe.
 - 2) 30 FT for 3 IN pipe.
 - 3) 15 FT for 4 IN pipe.
 - 4) 10 FT for 6 IN pipe.
 - 5) Any length for 8 IN or larger pipe.
2. New piping:
 - a. Including but not limited to:
 - 1) All fuel gas piping.
 - 2) Digesters.
 - 3) Digester gas equipment.
 - 4) Fuel gas trains.
 - b. Purge air filled system with fuel gas:
 - 1) Providing piping length is less than:
 - a) 30 FT for 3 IN pipe.
 - b) 15 FT for 4 IN pipe.
 - c) 10 FT for 6 IN pipe.
 - d) Any length for 8 IN and larger pipe.
 - 2) Providing a moderately rapid and continuous flow of fuel gas is introduced.
 - a) Introduce fuel gas at one end.
 - b) Vent air at opposite end.
 - 3) Provided fuel gas flow is continuous without interruption until vented gas is free of air.
 - 4) The point of discharge shall not be left unattended during purging.
 - c. If the piping is 3 IN or larger and exceeds lengths stated above.
 - 1) Purge air with inert gas in accordance with NFPA 54 and NFPA 69.
 - 2) Purge inert gas with fuel gas.
3. Discharge of purged gases:
 - a. Open end of piping shall not discharge into confined spaces or areas where there are sources of ignition.

3.10 LOCATION OF BURIED OBSTACLES

- A. Furnish exact location and description of buried utilities encountered and thrust block placement.
- B. Reference items to definitive reference point locations such as found property corners, entrances to buildings, existing structure lines, fire hydrants, and related fixed structures.
- C. Include such information as location, elevation, coverage, supports and additional pertinent information.
- D. Incorporate information on "As-Recorded" Drawings.

3.11 PIPE INSULATION

- A. Insulate pipe and pipe fittings in accordance with Specification Section 40 42 00.

3.12 PIPING SYSTEM SCHEDULES

A. SPECIFICATION SCHEDULE - SYSTEM 2

- 1. General:
 - a. Piping symbol and service:
 - 1) OVFL - Overflow.
 - 2) SUP - Supernatant.
 - b. Test requirements:
 - 1) Test medium: Water.
 - 2) Pressure: 25 PSIG.
 - 3) Duration: 6 HRS.
 - c. Gaskets:
 - 1) Flanged, push-on, and mechanical joints (ductile iron): Rubber, AWWA/ANSI C111/A21.11.
- 2. System components:
 - a. Pipe size 3 IN through 48 IN:
 - 1) Exposed service:
 - a) Material:
 - (1) Flanged: Ductile iron, Class 52.
 - (2) Grooved type joint system: Use pipe thickness per AWWA C606.
 - b) Reference: AWWA/ANSI C115/A21.15.
 - c) Lining: Cement.
 - d) Coating: HPIC; See Specification Section 09 96 00.
 - e) Fittings: Either AWWA/ANSI C110/A21.10 ductile or gray iron.
 - f) Joints: AWWA/ANSI C115/A21.15 flanged joints with flanges at valves and structure penetrations.
 - 2) Buried service:
 - a) Materials: Ductile iron, Class 52.
 - b) Reference: AWWA/ANSI C151/A21.51.
 - c) Lining: Bituminous
 - d) Coating: Bituminous.
 - e) Fittings:
 - (1) Either AWWA/ANSI C110/A21.10 ductile or gray iron.
 - (2) Optional: AWWA/ANSI C153/A21.53 ductile iron compact fittings for sizes 3 IN to 16 IN.
 - f) Joints: Push-on joints with mechanical (stuffing box type) joints at fittings and valves.
 - 3) Buried service: (From 5 FT outside of structure)
 - a) Material: PVC SDR 35 2.
 - b) Reference: ASTM D3034 and ASTM F679,
 - c) Lining: None.
 - d) Coatings: None.
 - e) Fittings: SDR 26

f) Joints: ASTM D3212 with elastomeric gasket joint.

B. SPECIFICATION SCHEDULE - SYSTEM 3

1. General:
 - a. Piping symbol and service:
 - 1) DS - Digested Sludge.
 - 2) HRDS- Heated Return Digested Sludge
 - 3) RDS – Return Digested Sludge
 - 4) WAS - Waste Activated Sludge.
 - 5) TWAS – Thickened Waste Activated Sludge.
 - 6) PS - Primary Sludge.
 - 7) TPS – Thickened Primary Sludge
 - 8) SCM – Scum.
 - b. Test requirements:
 - 1) Test medium: Water.
 - 2) Pressure: 1.25 x working pressure.
 - 3) Duration: 6 HRS.
 - c. Gaskets:
 - 1) Flanged, push-on and mechanical joints (ductile iron): Rubber, AWWA/ANSI C111/A21.11.
 - 2) Flanged joints (steel): AWWA C207.
2. System components:
 - a. Pipe size 3 IN through 24 IN:
 - 1) Exposed service:
 - a) Material:
 - (1) Flanged: Ductile iron, Class 51.
 - b) Reference: AWWA/ANSI C115/A21.15.
 - c) Lining: Glass.
 - d) Coating: HPIC; See Specification Section 09 9600.
 - e) Fittings: Either AWWA/ANSI C110/A21.10 ductile or gray iron.
 - f) Joints:
 - (1) Flanged type mechanical coupling (AWWA C606) joints.
 - (2) With both systems, provide screwed-on flanges at equipment, valves and structure penetrations.
 - 2) Buried service:
 - a) Materials: Ductile iron, Class 51.
 - b) Reference: AWWA/ANSI C151/A21.51.
 - c) Lining: Glass.
 - d) Coating: Bituminous.
 - e) Fittings:
 - (1) Either AWWA/ANSI C110/A21.10 ductile or gray iron.
 - (2) Optional: AWWA/ANSI C153/A21.53 ductile iron compact fittings for sizes 3 IN to 16 IN.
 - f) Joints: Push-on with mechanical (stuffing box type) joints at fittings and valves.

C. SPECIFICATION SCHEDULE - SYSTEM 5

1. General:
 - a. Piping symbol and service:
 - 1) NG - Natural Gas.
 - b. Test requirements:
 - 1) Test medium: Cylinder Nitrogen.
 - 2) Pressure and Duration: Per local code and utility requirements.
2. System components:
 - a. Pipe size through 26 IN:
 - 1) Exposed service:

- a) Material: Steel, Grade B, black, Schedule 40.
 - b) Reference: ASTM A53.
 - c) Lining: None.
 - d) Coating: HPIC; See Specification Section 09 9600.
 - e) Fittings: Malleable iron meeting ASTM A197, ASME B16.3, Class 150.
 - f) Joints: Threaded, ASME B16.9 steel butt- or socket-welded joints.
3. Natural Gas Piping Installation:
- a. Install piping in accordance with NFPA, local gas company regulations, codes and local ordinances, complete with necessary appurtenances.
 - b. Install buried pipe at approximately 30 IN deep.
 - c. Gas cocks:
 - 1) Install before gas utilization equipment connected to system, at each branch main and at connection to meter.
 - 2) Design to operate safely under pressures indicated.
 - 3) Install ground joint unions at intervals to facilitate repairs.
 - 4) Cocks shall be of type and lubricant recommended by manufacturer for this class of service, and as approved by local gas company.
 - d. Pipe drainage:
 - 1) Drain horizontal piping to risers.
 - 2) Locate drains where required for system drainage.
 - 3) Install tee fitting with bottom outlet plugged or provide with threaded, capped nipple at bottom of risers or in accordance with applicable codes.
 - e. Make piping connections with shellacked joints or ground joint unions.
 - f. Provide vents from gas regulators, pressure reducing valves, and other vented devices to the outdoors and terminate in accordance with applicable codes.
 - g. Connect piping to pressure reducing valve outside each building as shown on drawings and schedule.
 - h. Provide flexible connections to vibration isolated equipment suitable for pressures, local and national codes and intended application.
 - i. Remove cutting and threading burrs.
 - j. Plug each gas outlet (including valves) with threaded plugs or caps immediately after installation and retain until the piping or equipment connections are completed.
 - k. Continuously ground gas piping electrically, bond tightly to the grounding connection.
 - l. Install piping parallel to other piping, but maintain a minimum 12 IN clearance between gas piping and any piping that could reach 200 DEGF.
 - m. All gas piping in air plenums to be all-welded and encased in a Schedule 40 pipe sleeve.
 - 1) Ends of the sleeve open to atmosphere or sealed with the annulus vented (gas pipe size) to atmosphere.

D. SPECIFICATION SCHEDULE - SYSTEM 6

- 1. General:
 - a. Piping symbol and service:
 - 1) GLY - Glycol.
 - 2) HWR - Hot Water Return.
 - 3) HWS - Hot Water Supply
 - 4) HW1 - Heated Plant Service Water
 - b. Test requirements:
 - 1) Test medium: Water.
 - 2) Pressure: 1.5 x working pressure.
 - 3) Duration: 6 HRS.
 - c. Gaskets and O-rings: EPDM. Silicon for Hot Water applications.
- 2. System components:
 - a. Pipe size through 26 IN:
 - 1) Exposed service:
 - a) Material:

- (1) Threaded: Steel, Grade B, black, Schedule 40.
- b) Reference: ASTM A53.
- c) Lining: None.
- d) Coating: HPIC; See Specification Section 09 9600.
- e) Fittings: Malleable iron or steel meeting ASME B 16.3 and ASTM A234.
- f) Joints:
 - (1) With both systems, provide rigid flanges at equipment, valves, and structure penetrations above 2 IN and unions at those locations 2 IN and below.
- 2) Buried service:
 - a) Underground, Prefabricated, Insulated, and Jacketed Pipe System, see section 40 05 25.

E. SPECIFICATION SCHEDULE - SYSTEM 7

- 1. General:
 - a. Piping symbol and service:
 - 1) POL - Polymer
 - b. Test requirements pressure lines:
 - 1) Test medium: Water.
 - 2) Pressure: 1.25 x working pressure.
 - 3) Duration: 6 HRS.
 - c. Test requirements vacuum lines:
 - 1) Test medium: Air.
 - 2) Pressure: -27 IN HG.
 - 3) Duration: 6 HRS.
 - d. Gaskets and O-rings:
 - 1) Viton for POL.
- 2. System components:
 - a. Pipe size 12 IN and smaller:
 - 1) Exposed service:
 - a) Material: PVC, Type 1, Grade 1, Schedule 80.
 - b) Reference: ASTM D1785.
 - c) Lining: None.
 - d) Fittings: Solvent welded socket type complying with ASTM D2467.
 - e) Joints: Solvent welded with unions at valves, penetrations through structures and equipment connections for pipe 2 IN and less and flanges at those locations for pipe above 2 IN.
 - 2) Buried service:
 - a) Material: PVC, Type 1, Grade 1, Schedule 40.
 - b) Reference: ASTM D1785.
 - c) Lining: None.
 - d) Coating: None.
 - e) Fittings: Solvent welded socket type complying with ASTM D2466.
 - f) Joints: Solvent welded.

F. SPECIFICATION SCHEDULE - SYSTEM 9

- 1. General:
 - a. Piping symbol and service:
 - 1) NPW – Non-Potable Water
 - 2) W1 – Plant Service Water
 - 3) W2 - Plant Nonpotable water
 - 4) OA (Below 4 IN) – Odorous Air
 - b. Test requirements:
 - 1) Test medium: Water.
 - 2) Pressure: 125 psig.
 - 3) Duration: 6 HRS.

- c. Gaskets and O-rings:
 - 1) O-rings: Neoprene or rubber.
 - 2) Flanged, push-on and mechanical joints (ductile iron): Rubber, AWWA/ANSI C111/A21.11.
 - 3) Flanged joints (steel): Rubber, AWWA C207.
- 2. System components:
 - a. Pipe size to 3 IN:
 - 1) Exposed and Buried Service:
 - a) Materials: PVC, Type 1, Grade 1, Schedule 80.
 - b) Reference: ASTM D1785.
 - c) Lining: None.
 - d) Coating: None.
 - e) Fittings: Solvent welded socket type complying with ASTM D2467.
 - f) Joints: Solvent welded with unions at valves, penetrations through structures and equipment connections.
 - g) Minimum wall thickness:
 - (1) 1/16 IN OD: 0.010 IN.
 - (2) 1/8 to 1/4 IN OD: 0.028 IN.
 - (3) 5/16 to 1/2 IN OD: 0.049 IN.
 - (4) 5/8 to 1 IN OD: 0.065 IN.
 - b. Pipe size 1 IN to 3 IN:
 - 1) Exposed and buried service:
 - a) Material: PVC, Type 1, Grade 1, Schedule 80.
 - b) Reference: ASTM D1785.
 - c) Lining: None.
 - d) Coating: None.
 - e) Fittings: Solvent welded socket type complying with ASTM D2467.
 - f) Joints: Solvent welded.
 - c. Pipe size 3 IN through 24 IN:
 - 1) Exposed service:
 - a) Materials:
 - (1) Flanged: Ductile iron, Class 51.
 - b) Reference: AWWA/ANSI C115/A21.15.
 - c) Lining: Cement.
 - d) Coating: HPIC; See Specification Section 09 9600.
 - e) Fittings: Either AWWA/ANSI C110/A21.10 ductile or gray iron.
 - f) Joints:
 - (1) With both systems, provide screwed-on flanges at valves, equipment, and structure penetration.
 - d. Pipe Size 3 IN through 24 IN
 - 1) Buried service:
 - a) Materials: Ductile iron, Class 51.
 - b) Reference: AWWA/ANSI C151/A21.51.
 - c) Lining: Cement.
 - d) Coating: Bituminous.
 - e) Fittings:
 - (1) Either AWWA/ANSI C110/A21.10 ductile or gray iron.
 - (2) Optional: AWWA/ANSI C153/A21.53 ductile iron compact fittings for sizes 3 IN to 16 IN.
 - f) Joints: Push-on with mechanical (stuffing box type) joint at fittings and valves.
 - e. Pipe Size less than 3 IN
 - 1) Buried Service:
 - a) Material: High Density Polyethylene (HDPE), SDR 13.5
 - b) Reference: ASTM D3350

- c) Lining: None
- d) Coating: None
- e) Joints: Fusion Welded
- f) Provide Flange Fittings at all connections

G. SPECIFICATION SCHEDULE - SYSTEM 10

- 1. General:
 - a. Piping symbol and service:
 - 1) PW - Potable Water.
 - 2) PWC – Potable water, cold.
 - 3) DHW – Domestic water, hot.
 - b. Test requirements:
 - 1) Test medium: Water.
 - 2) Pressure: 100 psig.
 - 3) Duration: 6 HRS.
 - c. Gaskets and O-rings:
 - 1) O-rings: Neoprene or rubber.
 - 2) Flanged, push-on and mechanical joints (ductile iron): Rubber, AWWA/ANSI C111/A21.11.
 - 3) Flanged joints (steel): Rubber, AWWA C207.
- 2. System components:
 - a. All pipe sizes for systems below 100 DegF:
 - 1) Exposed and buried service:
 - a) Material: PVC, Type 1, Grade 1, Schedule 80.
 - b) Reference: ASTM D1785.
 - c) Lining: None.
 - d) Coating: None.
 - e) Fittings: Solvent welded socket type complying with ASTM D2467.
 - f) Joints: Solvent welded.
 - b. All pipe sizes for systems above 100 DegF:
 - 1) Exposed and buried service:
 - a) Material: CPVC, Type 1, Schedule 80.
 - b) Reference: ASTM D2846.
 - c) Lining: None.
 - d) Coating: None.
 - e) Fittings: Solvent welded socket type complying with ASTM F439.
 - f) Joints: Solvent welded.
 - c. 4-inch pipe size for potable water service to Mechanical Building:
 - 1) Buried Service:
 - a) Material: C900 DR 25
 - b) Lining: None
 - c) Coating: None.

H. SPECIFICATION SCHEDULE - SYSTEM 13

- 1. General:
 - a. Piping symbol and service:
 - 1) DG - Digester Gas.
 - b. Test requirements:
 - 1) Test medium: Air.
 - 2) Pressure: 10 PSIG.
 - 3) Duration: 6 HRS.
 - c. Gaskets:
 - 1) Flanged joints: AISI 304 stainless steel, spiral wound, non-asbestos filler, 3/16 IN thick with compression ring to match required flange dimensions.
 - 2) Flanged joints: Neoprene.

2. System components:
 - a. Pipe size 1 IN and greater:
 - 1) Exposed service:
 - a) Material: Stainless steel, Schedule 10S, Grade TP316L.
 - b) References: ASTM A312, ASME B36.19.
 - c) Lining: None.
 - d) Coating: None.
 - e) Fittings: Butt welded stainless meeting ASTM A774.
 - f) Joints: Butt welded with ASTM A182 stainless steel flanges at equipment and valves.
 - 2) Buried service:
 - a) Material: Stainless steel, Schedule 40S, Grade TP316L.
 - b) References: ASTM A312, ASME B36.19.
 - c) Lining: None.
 - d) Coating: None.
 - e) Fittings: Butt welded stainless meeting ASTM A774.
 - f) Joints: Butt welded.

I. SPECIFICATION SCHEDULE - SYSTEM 15

1. General:
 - a. Piping symbol and service:
 - 1) STW - Stormwater.
 - 2) OA – Odorous Air
 - b. Test requirements:
 - 1) See the FIELD QUALITY CONTROL Article in PART 3 of this Specification Section.
 - c. Gaskets:
 - 1) Push-on joints: Rubber, ASTM C443.
2. System components:
 - a. Pipe size 4 IN to 36 IN:
 - 1) Buried service.
 - a) Material: PVC SDR 35.2.
 - b) Reference: ASTM D3034 and ASTM F679,
 - c) Lining: None.
 - d) Coatings: None.
 - e) Fittings: SDR 26
 - f) Joints: ASTM D3212 with elastomeric gasket joint.
 - b. Pipe size 4 IN to 36 IN:
 - 1) Exposed Service.
 - a) Material: FRP.
 - b) Lining: None.
 - c) Coatings: None.
 - d) Joints: Wet wrapped, flanged at equipment.

J. SPECIFICATION SCHEDULE - SYSTEM 17

1. General:
 - a. Piping symbol and service:
 - 1) DR - Drain.
 - b. Test requirements:
 - 1) Test medium: Water.
 - 2) Pressure: None, observed for free flow.
 - 3) Duration: 6 HRS.

2. System components:
 - a. Pipe size up to 1-1/2 IN:
 - 1) Exposed service:
 - a) Material: PVC, Type 1, Grade 1, Schedule 80.
 - b) Reference: ASTM D1785.
 - c) Lining: None.
 - d) Coating: None.
 - e) Fittings: Solvent welded socket type complying with ASTM D2467.
 - f) Joints: Solvent welded.
 - b. Pipe size 2 IN through 4 IN:
 - 1) Exposed service:
 - a) Material: PVC, Type 1, Grade 1, Schedule 80.
 - b) Reference: ASTM D1785.
 - c) Lining: None.
 - d) Coating: None.
 - e) Fittings: Solvent welded socket type complying with ASTM D2467.
 - f) Joints: Solvent welded.
 - 2) Buried service:
 - a) Material: ABS, solid wall, Schedule 40.
 - b) Reference: ASTM F628 or ASTM D2661.
 - c) Lining: None.
 - d) Coating: None.
 - e) Fittings: ABS, socket type.
 - f) Joints: Solvent cement, ASTM D2235.
 - 3) Buried service (From 5 FT outside of structure)
 - a) Material: PVC SDR 35 2.
 - b) Reference: ASTM D3034 and ASTM F679,
 - c) Lining: None.
 - d) Coatings: None.
 - e) Fittings: SDR 26
 - f) Joints: ASTM D3212 with elastomeric gasket joint.
3. Soil and Waste Piping Installation:
 - a. Install horizontal soil or waste lines less than 4 IN diameter with a slope of not less than 1/4 IN/FT or 2 percent toward the point of disposal.
 - b. Install 4 IN and larger piping at 1/8 IN per foot.
 - c. Install as close to construction as possible to maintain maximum head room.
 - d. Make changes of direction with 1/8 bends and junctions with wye fittings.
 - e. Use short wye fittings in vertical pipe only.
 - f. Install handhole test tee at base of each stack.
 - g. Install cleanouts at dead ends, at changes of direction and at 50 FT intervals on horizontal runs.
 - h. Where cleanouts occur in concealed spaces, provide with extensions to floors above or to walls as required.
 - i. Install piping true to grade and alignment.
 - j. Begin at the system low point.
 - k. Locate vertical extensions of underground piping below partition walls for concealment in wall.
 - l. In locations where hubs are wider than partition, set hubs 1 IN below final floor.
 - m. For hub and spigot joints, install hub facing flow.

K. SPECIFICATION SCHEDULE - SYSTEM 21

1. General:
 - a. Piping symbol and service:
 - 1) V - Vent.
 - 2) RD - Roof Drain.

- 3) SAN – Sanitary Sewer.
- 4) SS-Sanitary Sewer
- b. Test requirements:
 - 1) Test medium: Water.
 - 2) Pressure: See the FIELD QUALITY CONTROL Article in PART 3 of this Specification Section.
 - 3) Duration: 6 HRS.
- c. Gaskets: Rubber, ASTM C564.
- 2. System components:
 - a. Pipe size 1-1/4 IN and 1-1/2 IN:
 - 1) Exposed service.
 - a) Material: Galvanized steel, Schedule 40.
 - b) Reference: ASTM A53.
 - c) Lining: Galvanized.
 - d) Coating: HPIC; See Specification Section 09 9600.
 - e) Fittings: Cast iron drainage.
 - (1) ASTM A126, Class B.
 - f) Joints: Threaded.
 - b. Pipe size 2 IN and larger:
 - 1) Exposed service.
 - a) Material: Cast iron soil pipe.
 - b) Reference: ASTM A74, CISPI 301.
 - c) Lining: None.
 - d) Coating: HPIC; See Specification Section 09 9600.
 - e) Fittings: ASTM A74.
 - f) Joints: No-hub with elastomeric sealing sleeve and stainless steel clamp assembly conforming to CISPI 301.
 - 2) Buried service (to 5 FT outside of structure):
 - a) Material: Cast-iron soil pipe.
 - b) Reference: ASTM A74.
 - c) Lining: None.
 - d) Coating: Bituminous.
 - e) Fittings: ASTM A74.
 - f) Joints: Hub and spigot.
 - 3) Buried service (From 5 FT outside of structure)
 - a) Material: PVC SDR 35 2.
 - b) Reference: ASTM D3034 and ASTM F679,
 - c) Lining: None.
 - d) Coatings: None.
 - e) Fittings: SDR 26
 - f) Joints: ASTM D3212 with elastomeric gasket joint.
 - 3. Soil and Waste Piping Installation:
 - a. Install horizontal soil or waste lines less than 4 IN diameter with a slope of not less than 1/4 IN/FT or 2 PCT toward the point of disposal.
 - b. Install 4 IN and larger piping at 1/8 IN per foot.
 - c. Install as close to construction as possible to maintain maximum head room.
 - d. Make changes of direction with 1/8 bends and junctions with wye fittings.
 - e. Use short wye fittings in vertical pipe only.
 - f. Install handhole test tee at base of each stack.
 - g. Install cleanouts at dead ends, at changes of direction and at 50 FT intervals on horizontal runs.
 - 1) Where cleanouts occur in concealed spaces, provide with extensions to floors above or to walls as required.
 - h. Install piping true to grade and alignment.
 - 1) Begin at the system low point.

- i. Locate vertical extensions of underground piping below partition walls for concealment in wall.
 - 1) In locations where hubs are wider than partition, set hubs 1 IN below final floor.
- j. Install concealed in finished structures such as administration and office facilities and at locations shown on Drawings.
- k. For hub and spigot joints, install hub facing flow.
- 4. Vent Piping Installation:
 - a. Run vent stack parallel to each soil or waste stack to receive branch vents from fixtures.
 - b. Originate each vent stack from soil or waste pipe at its base.
 - c. Where possible, combine soil, waste or vent stacks before passing through roof so as to minimize roof openings.
 - d. Offset pipes running close to exterior walls a way from such walls before passing through roof to permit proper flashing.
 - e. Provide pipes passing through roofs with cast iron increasers minimum of 12 IN below roof one size larger than pipe but in no case less than 4 IN.
 - f. Terminate each vent with a approved frostproof jacket.
 - g. Carry vent stacks 4 IN and larger full size through roof.
 - 1) Extend vent stacks at least 12 IN above roofing.
 - h. Pipe vents from pressure regulating devices in compliance with local codes.
 - i. Install concealed in finished structures such as administration and office facilities and at locations shown on Drawings.

L. SPECIFICATION SCHEDULE - SYSTEM 27

- 1. General:
 - a. Piping symbol and service:
 - 1) SAM - Sampler.
 - b. Test requirements pressure lines:
 - 1) Test medium: Water.
 - 2) Pressure: 125 PSIG.
 - 3) Duration: 6 HRS.
 - c. Gaskets and O-rings:
 - 1) Viton for SAM.
 - 2) PVDF (Kynar) for POL.
- 2. System components:
 - a. Pipe size 12 IN and smaller:
 - 1) Exposed service:
 - a) Material: PVC, Type 1, Grade 1, Schedule 80.
 - b) Reference: ASTM D1785.
 - c) Lining: None.
 - d) Coating: HPIC; See Specification Section 09 96 00.
 - e) Fittings: Solvent welded socket type complying with ASTM D2467.
 - f) Joints: Solvent welded with unions at valves, penetrations through structures and equipment connections for pipe 2 IN and less and flanges at those locations for pipe above 2 IN.
 - 2) Buried service:
 - a) Material: PVC, Type 1, Grade 1, Schedule 40.
 - b) Reference: ASTM D1785.
 - c) Lining: None.
 - d) Coating: None.
 - e) Fittings: Solvent welded socket type complying with ASTM D2466.
 - f) Joints: Solvent welded.

3.13 SERVICE SYSTEM SUMMARY

- A. Service Systems as defined in the Drawings.

END OF SECTION

SECTION 40 05 07
PIPE SUPPORT SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Pipe support and anchor systems.
 - 2. Design of Pipe Support Systems as specified.
- B. Related Specification Sections include but are not necessarily limited to:
 - 1. Division 00 - Procurement and Contracting Requirements.
 - 2. Division 01 - General Requirements.
 - 3. Section 01 81 10 - Wind and Seismic Design Criteria
 - 4. Section 03 15 19 - Anchorage to Concrete.
 - 5. Section 05 50 00 - Metal Fabrications.
 - 6. Section 09 96 00 - High Performance Industrial Coatings.
 - 7. Section 40 42 00 - Pipe, Duct and Equipment Insulation.

1.2 QUALITY ASSURANCE

- A. Referenced Standards:
 - 1. American Society of Mechanical Engineers (ASME):
 - a. B31.1, Power Piping.
 - b. B31.3, Process Piping.
 - 2. ANVIL International (ANVIL).
 - 3. ASTM International (ASTM):
 - a. A36, Standard Specification for Carbon Structural Steel.
 - b. A276, Standard Specification for Stainless Steel Bars and Shapes.
 - c. A575, Standard Specification for Steel Bars, Carbon, Merchant Quality, M-Grades.
 - d. A576, Standard Specification for Steel Bars, Carbon, Hot-Wrought, Special Quality.
 - e. A917, Standard Specification for Steel Sheet, Coated by the Electrolytic Process for Applications Requiring Designation of the Coating Mass on Each Surface (General Requirements).
 - f. A918, Standard Specification for Steel Sheet, Zinc-Nickel Alloy Coated by the Electrolytic Process for Applications Requiring Designation of the Coating Mass on Each Surface.
 - g. B633, Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel.
 - 4. American Welding Society (AWS):
 - a. D1.1, Structural Welding Code - Steel.
 - b. D1.6, Structural Welding Code - Stainless Steel.
 - 5. Manufacturers Standardization Society of the Valve and Fittings Industry Inc. (MSS):
 - a. SP-58, Pipe Hangers and Supports - Materials, Design and Manufacture.
 - b. SP-69, Pipe Hangers and Supports - Selection and Application.
- B. Responsibility:
 - 1. Support systems for piping greater than 12 IN DIA, or with internal pressure over 100 PSI, or piping with product temperatures over 200 DEGF, are shown on the Drawings and are not to be designed by Contractor unless indicated in Contract Documents.
 - 2. Design complete support systems for piping 12 IN and smaller where supports are not shown on the Drawings.
 - 3. Provide all labor, materials, equipment and incidentals as shown, specified and required to design, furnish and install the system of hangers, supports, guidance, anchorage and appurtenances.

4. General piping support details may be indicated on the Drawings in certain locations for pipe 12 IN DIA and smaller.
 5. Incorporate those details with requirements of this Specification Section to provide the piping support system.
- C. Each type of pipe hanger or support shall be the product of one manufacturer.
- D. Qualifications:
1. Pipe support designer:
 - a. Licensed Professional Engineer registered in the state the project is located in.
 - b. Minimum of five years experience designing pipe supports for projects of similar size and complexity.

1.3 SUBMITTALS

- A. Shop Drawings:
1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
 2. Product technical data including:
 - a. Acknowledgement that products submitted meet requirements of standards referenced.
 - b. Manufacturer's installation instructions.
 - c. Itemized list of wall sleeves, anchors, support devices and all other items related to pipe support system.
 - d. Scaled drawings showing location, installation, material, loads and forces, and deflection of all hangers and supports.
 - e. Analyze each pipe system for all loads and forces on hangers and supports and their reaction forces to the structure to which they are fastened.
 - f. Where Contract Documents indicate contractor is to design pipe support systems, submit detail design calculations and scaled drawings signed by Pipe support designer.
 3. Certifications.
 - a. Pipe support designer qualifications

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with the Contract Documents, the manufacturers listed in the applicable Articles below are acceptable.
- B. Submit request for substitution in accordance with Specification Section 01 25 13.

2.2 MANUFACTURED UNITS

- A. General:
1. Galvanized components:
 - a. Electro-galvanized components:
 - 1) Bar, forged or cast fabrications: ASTM B633, SC4.
 - 2) Rolled sheet fabrications: ASTM A917 and ASTM A918, 50N50NU.
 - b. Hot-dipped galvanized components: See Specification Section 05 50 00.
 2. Dissimilar metals protection:
 - a. Galvanized-to-galvanized and galvanized-to-aluminum: No protection required.
 - b. All other galvanized-to-dissimilar metal connections: Neoprene or nylon pads, shims, grommets, etc.
- B. Hanger Rods:
1. Material:
 - a. ASTM A36.
 - b. ASTM A575, Grade M1020.
 - c. ASTM A576, Grade 1020.
 - d. Minimum allowable tensile stress of 12,000 PSI at 650 DEGF per MSS SP-58.

2. Continuously threaded.
3. Electro-galvanized or cadmium plated after threads are cut.
4. Load limit:

NOMINAL ROD DIAMETER	MAXIMUM SAFE LOAD, (LBS)
3/8 IN DIA (min)	610
1/2 IN DIA	1,130
5/8 IN DIA	1,810
3/4 IN DIA	2,710
7/8 IN DIA	3,770
1 IN DIA	4,960

C. Hangers:

1. Hangers for use directly on copper pipe: Copper or cadmium plated.
2. Hangers for use other than directly on copper pipe: Cadmium plated or galvanized.
3. Hanger type schedule:

APPLICATION	PIPE SIZE	HANGER TYPE
All except noted	4 IN and less	ANVIL Figure 108 with Figure 114
All except noted	Over 4 IN	ANVIL Figure 590
Steam, condensate and hot water	All	ANVIL Figure 181, Figure 82
Service in chemical storage areas and as indicated on drawings for corrosion resistance	All	CorPro CP - Hanger or equal

D. Concrete Inserts for Hanger Rods:

1. Continuous slots: Unistrut #P1000.
2. Individual inserts: ANVIL Figure 281.
3. See Specification Section 03 15 19, mechanical anchors.

E. Beam Clamps for Hanger Rods:

1. Heavy duty.
2. ANVIL Figure 134.

F. Trapeze Hangers for Suspended Piping:

1. General:
 - a. Material: Steel.
 - b. Galvanized.
 - c. Angles, channels, or other structural shapes.
 - d. Curved roller surfaces at support point corresponding with type of hanger required.
2. In chemical storage and feed areas and as indicated on the drawings:
 - a. Materials: FRP.
 - b. Unistrut fiberglass channel or equal.
3. Corrosive areas:
 - a. Material: 304 stainless steel.
 - b. Angles, channels or other structural shapes.

- G. Vertical Pipe Supports:
 - 1. At base of riser.
 - 2. Lateral movement:
 - a. Clamps or brackets:
 - 1) ANVIL Figure 62.
- H. Expanding Pipe Supports:
 - 1. Spring hanger type.
 - 2. MSS SP-58.
- I. Pipe Support Saddle:
 - 1. For pipe located 3 FT or less from floor elevation, except as otherwise indicated on Drawings.
 - 2. ANVIL Figure 264.
- J. Pipe Support Risers:
 - 1. Schedule 40 pipe.
 - 2. Galvanized.
 - 3. Size: As recommended by saddle manufacturer.
- K. Pipe Support Base Plate:
 - 1. 4 IN larger than support.
 - 2. Collar 3/16 IN thickness, circular in shape, and sleeve type connection to pipe.
 - 3. Collar fitted over outside of support pipe and extended 2 IN from floor plate.
 - 4. Collar welded to floor plate.
 - 5. Edges ground smooth.
 - 6. Assembly hot-dipped galvanized after fabrication.
- L. Pipe Covering Protection Saddle:
 - 1. For insulated pipe at point of support.
 - 2. ANVIL Figure 167, Type B.
- M. Wall Brackets:
 - 1. For pipe located near walls and 8 FT or more above floor elevation or as otherwise indicated on the Drawings.
 - 2. ANVIL Figure 199.
- N. Pipe Anchors:
 - 1. For locations shown on the Drawings.
 - 2. 1/4 IN steel plate construction.
 - 3. Hot-dipped galvanized after fabrication.
 - 4. Designed to prevent movement of pipe at point of attachment.
- O. Pipe Guides:
 - 1. For locations on both sides on each expansion joint or loop.
 - 2. To ensure proper alignment of expanding or contracting pipe.
 - 3. ANVIL Figure 256.

2.3 DESIGN REQUIREMENTS

- A. Supports capable of supporting the pipe for all service and testing conditions.
 - 1. Provide 5 to 1 safety factor.
- B. Allow free expansion and contraction of the piping to prevent excessive stress resulting from service and testing conditions or from weight transferred from the piping or attached equipment.
- C. Design supports and hangers to allow for proper pitch of pipes.
- D. For chemical and waste piping, design, materials of construction and installation of pipe hangers, supports, guides, restraints, and anchors:
 - 1. ASME B31.3.
 - 2. MSS SP-58 and MSS SP-69.

3. Except where modified by this Specification.
- E. For steam and hot and cold water piping, design, materials of construction and installation of pipe hangers, supports, guides, restraints, and anchors:
 1. ASME B31.1.
 2. MSS SP-58 and MSS SP-69.
- F. Check all physical clearances between piping, support system and structure.
 1. Provide for vertical adjustment after erection.
- G. Support vertical pipe runs in pipe chases at base of riser.
 1. Support pipes for lateral movement with clamps or brackets.
- H. Place hangers are to be installed on outside of pipe insulation.
 1. Use a pipe covering protection saddle for insulated pipe at support point.
 2. Insulated piping 1-1/2 IN and less:
 - a. Provide a 9 IN length of high density perlite or high density calcium silicate at saddle.
 - b. See Specification Section 4042 00.
 3. Insulated piping over 1-1/2 IN: Provide a 12 IN length of high density perlite or high density calcium silicate at saddle.
- I. Provide 20 GA galvanized steel pipe saddle for fiberglass and plastic support points to ensure minimum contact width of 4 IN.
- J. Pipe Support Spacing:
 1. General:
 - a. Factor loads by specific weight of liquid conveyed if specific weight is greater than water.
 - b. Locate pipe supports at maximum spacing scheduled unless indicated otherwise on the Drawings.
 - c. Provide at least one support for each length of pipe at each change of direction and at each valve.
 2. Steel, stainless steel, cast-iron pipe support schedule:

PIPE SIZES - IN	MAXIMUM SPAN - FT
1-1/2 and less	5
2 thru 4	10
5 thru 8	15
10 and greater	20

3. Copper pipe support schedule:

PIPE SIZES - IN	MAXIMUM SPAN - FT
2-1/2 and less	5
3 thru 6	10
8 and greater	15

4. PVC pipe support schedule:

PIPE SIZES - IN	MAXIMUM SPAN - FT
1-1/4 and less	3
1-1/2 thru 3	4
4 and greater	5

* Maximum fluid temperature of 120 DEGF.

5. Support each length and every fitting:
 - a. Bell and spigot piping:
 - 1) At least one hanger.
 - 2) Applied at bell.
 - b. Mechanical coupling joints:
 - 1) Place hanger within 2 FT of each side of fittings to keep pipes in a lignment.
6. Space supports for soil and waste pipe and other piping systems not included above every 5 FT.
7. Provide continuous support for nylon tubing.
8. For PVC, FRP and copper piping:
 - a. Provide Unistrut Unicushion wrap of pipe at each support.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Provide piping systems exhibiting pulsation, vibration, swaying, or impact with suitable constraints to correct the condition.
 1. Included in this requirement are movements from:
 - a. Trap discharge.
 - b. Water hammer.
 - c. Similar internal forces.
- B. Weld Supports:
 1. AWS D1.1.
 2. Weld anchors to pipe in accordance with ASME B31.3.
 3. AWS D1.6 for stainless steel supports.
- C. Locate piping and pipe supports as to not interfere with open accesses, walkways, platforms, and with maintenance or disassembly of equipment.
- D. Inspect hangers for:
 1. Design offset.
 2. Adequacy of clearance for piping and supports in the hot and cold positions.
 3. Guides to permit movement without binding.
 4. Adequacy of anchors.
- E. Inspect hangers after erection of piping systems and prior to pipe testing and flushing.
- F. Anchorage to Concrete- reference Section 03 15 19.
- G. Install individual or continuous slot concrete inserts for use with hangers for piping and equipment.
 1. Install concrete inserts as concrete forms are installed.

- H. Welding:
 - 1. Welding rods: ASTM and AWS standards.
 - 2. Integral attachments:
 - a. Include welded-on ears, shoes, plates and angle clips.
 - b. Ensure material for integral attachments is of good weldable quality.
 - 3. Preheating, welding and postheat treating: ASME B31.3, Chapter V.
- I. Field Painting:
 - 1. Comply with Specification Section 09 96 00.

END OF SECTION

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SECTION 40 05 17
PIPE - COPPER

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Copper piping, fittings, and appurtenances.
- B. Related Specification Sections include but are not necessarily limited to:
 - 1. Division 00 - Procurement and Contracting Requirements.
 - 2. Division 01 - General Requirements.
 - 3. Section 31 23 33 - Trenching, Backfilling, and Compacting for Utilities.
 - 4. Section 40 05 00 - Pipe and Pipe Fittings - Basic Requirements.
 - 5. Section 40 05 07 - Pipe Support Systems.
- C. Referenced Standards:
 - 1. American Society of Mechanical Engineers (ASME):
 - a. B 16.22, Wrought Copper and Bronze Solder - Joint Pressure Fittings.
 - b. B 16.23, Cast Bronze Solder Joint Drainage Fittings - DWV.
 - c. B 16.26, Cast Bronze Alloy Fittings for Flared Copper Tubes.
 - 2. ASTM International (ASTM):
 - a. B 32, Standard Specification for Solder Metal.
 - b. B 42, Standard Specification for Seamless Copper Pipe, Standard Sizes.
 - c. B 88, Standard Specification for Seamless Copper Water Tube.
 - d. B 306, Standard Specification for Copper Drainage Tube (DWV).
 - 3. American Welding Society (AWS):
 - a. A 5.8M/A 5.8, Specification for Filler Metals for Brazing and Braze Welding.

1.2 SUBMITTALS

- A. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
- B. See Specification Section 40 05 00.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Copper Tubing:
 - 1. Pressure non-buried: ASTM B 88, Type L hard.
 - 2. Pressure buried: ASTM B 88, Type K.
 - 3. Non-pressure: ASTM B 306.
- B. Copper Pipe: ASTM B 42, regular strength.
- C. Fittings:
 - 1. Pressure non-buried: ASME B 16.22.
 - 2. Pressure buried: ASME B 16.22 or ASME B 16.26.
 - 3. Non-pressure: ASME B 16.23
- D. Soldering and Brazing:
 - 1. Non-buried:
 - a. ASTM B 32 solder with a tin/antimony ratio of 95/5 and non-corrosive flux up to 180 DEGF water temperature.

- b. At 180 DEGF and above, use brazing alloy with melting temperature above 1000 DEGF and suitable flux.
 - 2. Buried: Silver solder per AWS A5.8M/A5.8.
- E. See Piping Schedules in Specification Section 40 05 00.
- F. Unions:
 - 1. Pipe sizes 2 IN and smaller: Copper, ground joint.
 - 2. Pipe sizes 2-1/2 IN and larger: Brass flanged unions.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Comply with Specification Section 40 05 00.

3.2 FIELD QUALITY CONTROL

- A. Test piping systems in accordance with Specification Section 40 05 00.
- B. Utilize only annealed (soft) type tubing where flared joints are used and drawn temper (hard) type tubing where soldered or brazed joints are used.
- C. Support exposed piping in accordance with Specification Section 40 05 00 and Specification Section 40 05 07.
- D. Install buried piping in accordance with Specification Section 31 23 33 and Specification Section 40 05 00.

END OF SECTION

SECTION 40 05 19
PIPE - DUCTILE

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Ductile iron piping, fittings, and appurtenances.
- B. Related Sections include but are not necessarily limited to:
 - 1. Division 00 - Procurement and Contracting Requirements.
 - 2. Division 01 - General Requirements.
 - 3. Section 40 05 00 - Pipe and Pipe Fittings: Basic Requirements.

1.2 QUALITY ASSURANCE

- A. Referenced Standards:
 - 1. American Society of Mechanical Engineers (ASME):
 - a. B 1.1, Unified Inch Screw Threads (UN and UNR Thread Form).
 - b. B 16.1, Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250.
 - 2. ASTM International (ASTM):
 - a. B 695, Standard Specification for Coatings of Zinc Mechanically Deposited on Iron and Steel.
 - 3. American Water Works Association (AWWA):
 - a. C 203, Standard for Coal-Tar Protective Coatings and Linings for Steel Water Pipelines - Enamel and Tape - Hot Applied.
 - b. C 217, Microcrystalline Wax and Petrolatum Tape Coating Systems for Steel Water Pipe.
 - c. C 606, Standard for Grooved and Shouldered Joints.
 - 4. American Water Works Association/American National Standards Institute (AWWA/ANSI):
 - a. C 105/A 21.5, Standard for Polyethylene Encasement for Ductile-Iron Pipe Systems.
 - b. C 110/A 21.10, Standard for Ductile-Iron and Gray-Iron Fittings.
 - c. C 111/A 21.11, Standard for Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
 - d. C 115/A 21.15, Standard for Flanged Ductile-Iron Pipe with Ductile-Iron or Gray-Iron Threaded Flanges.
 - e. C 150/A 21.50, Standard for Thickness Design of Ductile-Iron Pipe.
 - f. C 151/A 21.51, Standard for Ductile-Iron Pipe, Centrifugally Cast, for Water.

1.3 SUBMITTALS

- A. Shop Drawings:
 - 1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
 - 2. See Specification Section 40 05 00.
 - 3. Certification of factory hydrostatic testing.
 - 4. If mechanical coupling system is used, submit piping, fittings, and appurtenant items which will be utilized to meet system requirements.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
1. Flanged adaptors:
 - a. Rockwell (Style 912 (cast)).
 - b. Dresser (Style 127 (cast)).
 2. Compression sleeve coupling:
 - a. Rockwell (Style 431 (cast)).
 - b. Dresser (Style 153 (cast)).
 3. Mechanical coupling:
 - a. Victaulic (Style 31).
 - b. Tyler.
 4. Glass lining:
 - a. Ceramic Coating (Non-Stick Glass Lining).
 - b. Permutit (SG-14 Glass Lining).
 5. Insulating couplings:
 - a. Rockwell (Style 416).
 - b. Dresser (Style 39).
 6. Reducing couplings:
 - a. Rockwell (Style 415).
 - b. Dresser (Style 62).
 7. Transition coupling:
 - a. Rockwell (Style 413).
 - b. Dresser (Style 62).
 8. Polyethylene encasement tape:
 - a. Chase (Chasekote 750).
 - b. Kendall (Polyken 900).
 - c. 3 M (Scotchrap 50).
 9. Restrained joints:
 - a. American (Lock Fast) - 12 IN and below.
 - b. U.S. Pipe (TR-Flex) - 4 IN to 54 IN.
 - c. American (Lock Fast) - Above 12 IN.
- B. Submit request for substitution in accordance with Specification Section 01 25 13.

2.2 MATERIALS

- A. Ductile Iron Pipe:
1. AWWA/ANSI C115/A21.15.
 2. AWWA/ANSI C150/A21.50.
 3. AWWA/ANSI C151/A21.51.
- B. Fittings and Flanges:
1. AWWA/ANSI C110/A21.10.
 2. AWWA/ANSI C115/A21.15.
 3. Flanges drilled and faced per ASME B16.1 for both 125 and 250 PSI applications.
- C. Nuts and Bolts:
1. Buried: Wax Tape Coatings per AWWA C217-16.
 2. Exposed: Mechanical galvanized ASTM B695, Class 40.
 3. Heads and dimensions per ASME B1.1.
 4. Threaded per ASME B1.1.
 5. Project ends 1/4 to 1/2 IN beyond nuts.
- D. Gaskets: See individual piping system requirements in Section 40 05 00.

- E. If mechanical coupling system is used, utilize pipe thickness and grade in accordance with AWWA C606.
- F. Polyethylene Encasement: See AWWA/ANSI C105/A21.5.
- G. See Piping Schedules in Section 40 05 00.

2.3 MANUFACTURED UNITS

- A. Couplings:
 - 1. Flanged adaptors:
 - a. Unit consisting of steel or carbon steel body sleeve, flange, followers, Grade 30 rubber gaskets.
 - b. Provide units specified in the MANUFACTURERS Article.
 - c. Supply flanges meeting standards of adjoining flanges.
 - d. Rate entire assembly for test pressure specified on piping schedule for each respective application.
 - 2. Compression sleeve coupling:
 - a. Unit consisting of steel sleeve, followers, Grade 30 rubber gaskets.
 - b. Provide units specified in the MANUFACTURERS Article.
 - c. Supply flanges meeting standards of adjoining flanges.
 - d. The working pressure rating of the entire assembly shall be greater than or equal to the test pressure specified on piping schedule for each respective piping application.
 - e. Provide field coating for buried couplings per AWWA C203.
 - 3. Mechanical couplings:
 - a. Use of mechanical couplings and fittings in lieu of flanged joints is acceptable where specifically specified in Section 40 05 00.
 - b. Utilize units defined in the MANUFACTURERS Article.

2.4 FABRICATION

- A. Furnish and install without outside coatings of bituminous material any exposed pipe scheduled to be painted.
- B. Furnish cast parts with lacquer finish compatible with finish coat.
- C. Glass Lining:
 - 1. Minimum two-coat process.
 - a. Base coat heated to solidly fuse glass to pipe surface.
 - b. Subsequent coat(s) heated to form integral bond with preceding coat.
 - 2. Final finish parameters:
 - a. Thickness: 8-12 MILS.
 - b. Hardness: Above 5 on MOHS scale.
 - c. Density: 2.5-3.0 grams per cubic centimeter.
 - d. Metal to lining bonding: Capable of withstanding strain of 0.0001 IN/IN without damage to lining.
 - 3. Complete compatibility between fittings and piping.

2.5 LININGS AND COATINGS

- A. Where specified in piping schedule, provide linings to a minimum thickness of 40 MILS.

2.6 SOURCE QUALITY CONTROL

- A. Factory Test:
 - 1. Subject pipe to hydrostatic test of not less than 500 PSI with the pipe under the full test pressure for at least 10 seconds.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Joining Method - Push-On Mechanical (Gland-Type) Joints:
 - 1. Install in accordance with AWWA/ANSI C111/A21.11.
 - 2. Assemble mechanical joints carefully according to manufacturer's recommendations.
 - 3. If effective sealing is not obtained, disassemble, thoroughly clean, and reassemble the joint.
 - 4. Do not overstress bolts.
 - 5. Where piping utilizes mechanical joints with tie rods, align joint holes to permit installation of harness bolts.

- B. Joining Method - Push-On Joints:
 - 1. Install in accordance with AWWA/ANSI C151/A21.51.
 - 2. Assemble push-on joints in accordance with manufacturer's directions.
 - 3. Bevel and lubricate spigot end of pipe to facilitate assembly without damage to gasket.
 - a. Use lubricant that is non-toxic, does not support the growth of bacteria, has no deteriorating effects on the gasket material, and imparts no taste or odor to water in pipe.
 - 4. Assure the gasket groove is thoroughly clean.
 - 5. For cold weather installation, warm gasket prior to placement in bell.
 - 6. Taper of bevel shall be approximately 30 DEG with centerline of pipe and approximately 1/4 IN back.

- C. Joining Method - Flanged Joints:
 - 1. Install in accordance with AWWA/ANSI C115/A21.15.
 - 2. Extend pipe completely through screwed-on flanged and machine flange face and pipe in single operation.
 - 3. Make flange faces flat and perpendicular to pipe centerline.
 - 4. When bolting flange joints, exercise extreme care to ensure that there is no restraint on opposite end of pipe or fitting which would prevent uniform gasket compression or would cause unnecessary stress, bending or torsional strains to be applied to cast flanges or flanged fittings.
 - 5. Allow one flange free movement in any direction while bolts are being tightened.
 - 6. Do not assemble adjoining flexible joints until flanged joints in piping system have been tightened.
 - 7. Gradually tighten flange bolts uniformly to permit even gasket compression.

- D. Joining Method - Mechanical Coupling Joint:
 - 1. Arrange piping so that pipe ends are in full contact.
 - 2. Groove and shoulder ends of piping in accordance with manufacturer's recommendations.
 - 3. Provide coupling and grooving technique assuring a connection which passes pressure testing requirements.

- E. Flange Adaptors 12 IN and Less:
 - 1. Locate and drill holes for anchor studs after pipe is in place and bolted tight.
 - 2. Drill holes not more than 1/8 IN larger than diameter of stud projection.

- F. Cutting:
 - 1. Do not damage interior lining material during cutting.
 - 2. Use abrasive wheel cutters or saws.
 - 3. Make square cuts.
 - 4. Bevel and free cut ends of sharp edges after cutting.

- G. Support exposed pipe in accordance with Section 4005 00.

- H. Install buried piping in accordance with Section 4005 00.

- I. Install restrained joint systems where specified in Section 4005 00 under specific piping system.

3.2 FIELD QUALITY CONTROL

A. Test piping systems in accordance with Section 4005 00.

END OF SECTION

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SECTION 40 05 23
PIPE - STAINLESS STEEL

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Stainless steel tubing, piping, fittings and appurtenances.
- B. Related Specification Sections include but are not necessarily limited to:
 - 1. Division 00 - Procurement and Contracting Requirements.
 - 2. Division 01 - General Requirements.
 - 3. Section 40 05 00 - Pipe and Pipe Fittings - Basic Requirements.

1.2 QUALITY ASSURANCE

- A. Referenced Standards:
 - 1. American Society of Mechanical Engineers (ASME):
 - a. B16.1, Gray Iron Pipe Flanges and Flanged Fittings (Classes 25, 125 and 250).
 - b. B31.1, Power Piping.
 - 2. ASTM International (ASTM):
 - a. A182, Standard Specification for Forged or Rolled Alloy-Steel Pipe Flanges, Forged Fittings, and Valves and Parts for High-Temperature Service.
 - b. A269, Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service.
 - c. A312, Standard Specification for Seamless, Welded, and Heavy Cold Worked Austenitic Stainless Steel Pipes.
 - d. A320, Standard Specification for Alloy-Steel and Stainless Steel Bolting Materials for Low-Temperature Service.
 - e. A530, Standard Specification for General Requirements for Specialized Carbon and Alloy Steel Pipe.
 - f. A774, Standard Specification for As-Welded Wrought Austenitic Stainless Steel Fittings for General Corrosive Service at Low and Moderate Temperatures.
 - g. A778, Standard Specification for Welded, Unannealed Austenitic Stainless Steel Tubular Products.

1.3 SUBMITTALS

- A. Shop Drawings:
 - 1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
 - 2. See Specification Section 40 05 00.
 - 3. Product technical data including:
 - a. Acknowledgement that products submitted meet requirements of standards referenced.
 - 4. Fabrication details and welding procedure specifications for all work to be done under this Specification Section.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Tubing:
 - 1. ASTM A269.
 - 2. Filler material: Extra low carbon (ELC) with 0.03 PCT maximum carbon.

- B. Pipe, unless noted otherwise on individual piping system in Specification Section 40 05 00:
 - 1. ASTM A778.
 - 2. ASTM A312.
- C. Pipe Fittings:
 - 1. ASTM A774.
- D. Flanges, unless noted otherwise on individual piping system in Specification Section 40 05 00:
 - 1. Flat faced.
 - 2. Welding neck or slip on type.
 - 3. ASTM A182, Type 316L.
- E. Nuts, Bolts and Washers, unless noted otherwise on individual piping system in Specification Section 40 05 00:
 - 1. ASTM A320, Type 316.
 - 2. Two (2) nuts provided for 1 IN DIA bolt applications and larger.
- F. Elastomeric Bellows Type Expansion Joint (for hot air service):
 - 1. Refer to Section 40 05 00 for expansion joints for liquid service.
 - 2. Manufacturers:
 - a. Mercer Series 500 or equal.
 - 3. Two Arch construction.
 - 4. Material: EPDM (tube and cover)
 - 5. Restraint: Provide control rods sized to restrain joint at test pressure.
 - a. Materials: 316 stainless steel.
 - 6. Allow for minimum of 1 IN of lateral movement.
 - 7. Pressure Rating: Working pressure of joint equal or greater than test pressure of connecting piping. Provide minimum 25 PSIG rating.
- G. Gasket Material, unless noted otherwise on individual piping system in Specification Section 40 05 00:
 - 1. Rubber or neoprene.
 - 2. Temperature rating of 250 DEGF.
- H. Flexible Metal Hose:
 - 1. General: Braided stainless steel flexible hose.
 - 2. Connections: Provide ANSI 125 flanged connections.
 - 3. Length: Minimum 12 IN or as noted on the Drawings.
 - 4. Pressure: Working pressure of hose equal or greater than test pressure of connecting piping

2.2 FABRICATION

- A. All tube, piping, fitting product to be immersion pickled subsequent to manufacturing and fabrication operations and prior to shipping.
 - 1. Pickling solution of 6-10 PCT nitric acid and 3 - 4 PCT hydrofluoric acid.
 - 2. Temperature and exact concentrations to be such only a modest etch is produced but all oxidation and ferrous contamination is removed from metal surface.
 - 3. All pickling solution residues are to be neutralized after pickling.
- B. Diameter tolerance and wall thickness tolerance are to conform to ASTM A530.
- C. Joints:
 - 1. Shop welded circumferential butt weld joints.
 - 2. ASME B16.1, Class 150.
- D. Elastomeric Bellows Type Expansion Joints:
 - 1. Ensure aerial travel in expansion joints of 3.1 IN minimum for 15,000 cycles or 5.2 IN for 1000 cycles.
 - 2. Furnish each assembly with a minimum of two control tie rods.
 - 3. Fabricate with 125 LB flanged end connections.

- E. Expansion Joints:
 1. Fabricate for 15 PSI internal pressure and 250 DEGF operation.
 2. Ensure aerial travel in expansion joints of 3.1 IN minimum for 15,000 cycles or 5.2 IN for 1000 cycles.
 3. Furnish each assembly with minimum four control tie rods.
 4. Fabricate with 125 LB flanged end connections.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Prior to installation, inspect and verify condition of piping and appurtenances.
 1. Installation constitutes installer's acceptance of condition for satisfactory installation.

3.2 PREPARATION

- A. Correct defects or conditions which may interfere with or prevent a satisfactory installation.
- B. Ensure ends of pipe to be fitted with flanges have all protrusions ground flush.

3.3 INSTALLATION

- A. Ensure all pipe cutting, threading and jointing conforms to requirements of ASME B31.1.
 1. Lubricate all pipe threads with Teflon tape.
- B. Welding:
 1. Provide welds sound and free from embedded scale or slag, and tensile strength at weld not less than pipe.
 2. Perform butt welds only with an inert gas shielded process.
 3. Adequate inert gas protection is to be provided to the top and under or backside of the weld to protect from atmospheric contamination.
 4. Filler metal is to be applied to all manually-performed welds appropriate for the base material being welded.
 5. Only inert gas shielded welding processes are to be used for spool fabrication.
 6. Provide butt welds with 100 PCT penetration to the interior or back side of the weld joint.
 7. Weld reinforcement on both sides of the weld are to be smooth, uniform and no more than 1/16 IN in height.
- C. Joining Method - Flanges:
 1. Leave 1/8 IN to 3/8 IN flange bolts projecting beyond face of nut after tightening.
 - a. Coordinate dimensions and drillings of flanges with flanges for valves, equipment, and other systems.
 - b. Tighten bolts evenly around pipe until following range of torques is achieved:

BOLT SIZE, IN	RANGES OF TORQUE, FT/LBS
5/8	40 - 60
3/4	60 - 90
1	70 - 100
1-1/4	90 - 120

- D. Expansion Joints:
 1. Install in accordance with manufacturer's instructions.
 2. Apply anti-seize compound to all exposed steel threads.

3.4 FIELD QUALITY CONTROL

A. Test piping systems in accordance with Specification Section 4005 00.

3.5 CLEANING

A. Clean in accordance with Specification Section 40 05 00.

END OF SECTION

SECTION 40 05 24

PIPE - STEEL

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Steel pipe, fittings, and appurtenances.
- B. Related Sections include but are not necessarily limited to:
 - 1. Division 00 - Procurement and Contracting Requirements.
 - 2. Division 01 - General Requirements.
 - 3. Section 09 96 00 - High Performance Industrial Coatings.
 - 4. Section 40 05 00 - Pipe and Pipe Fittings - Basic Requirements.

1.2 QUALITY ASSURANCE

- A. Referenced Standards:
 - 1. American Society of Mechanical Engineers (ASME):
 - a. B 1.1, Unified Inch Screw Threads (UN and UNR Thread Form).
 - b. B 1.2, Gages and Gaging for Unified Inch Screw Threads.
 - c. B 16.3, Malleable Iron Threaded Fittings.
 - d. B 16.5, Pipe Flanges and Flanged Fittings.
 - e. B 16.9, Factory-Made Wrought Steel Butt-Welding Fittings.
 - f. B 16.11, Forged Steel Fittings, Socket Welding and Threaded.
 - g. B 31.1, Power Piping.
 - h. B 31.3, Process Piping.
 - i. B 31.9, Building Services Piping.
 - j. Section IX, Qualification Standard for Welding and Brazing Procedures, Welders, Brazers, and Welding and Brazing Operators.
 - 2. ASTM International (ASTM):
 - a. A 36, Standard Specification for Carbon Structural Steel.
 - b. A 53, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
 - c. A 181, Standard Specification for Carbon Steel Forgings, for General-Purpose Piping.
 - d. A 234, Standard Specification for Pipe Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service.
 - e. A 283, Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates.
 - f. A 572, Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel.
 - g. A 1011, 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.
 - h. B 6, Standard Specification for Zinc.
 - 3. American Water Works Association (AWWA):
 - a. C 200, Standard for Steel Water Pipe - 6 IN and Larger.
 - b. C 203, Standard for Coal-Tar Protective Coatings and Linings for Steel water Pipeline - Enamel and Tape - Hot Applied.
 - c. C 205, Standard for Cement-Mortar Lining and Coating for Steel Water Pipe - 4 IN and Larger - Shop Applied.
 - d. C 206, Standard for Field Welding of Steel Water Pipe.
 - e. C 207, Standard for Steel Pipe Flanges for Waterworks Service - Sizes 4 IN through 144 IN.
 - f. C 208, Standard for Dimensions for Fabricated Steel Water Pipe Fittings.

- g. C209, Standard for Cold-Applied Tape Coatings for the Exterior of Special Sections, Connections, and Fittings for Steel Water Pipelines.
- h. C210, Standard for Liquid-Epoxy Coating Systems for the Interior and Exterior of Steel Water Pipelines.
- i. C606, Standard for Grooved and Shouldered Joints.
- j. M11, Steel Pipe - A Guide for Design and Installation.
- 4. Society of Automotive Engineers (SAE):
 - a. AMS-QQ-P-416, Cadmium Plating Electro deposited.

B. Qualifications:

- 1. Application of coal tar lining and coating materials including preparation of surfaces, priming, and lining and coating of pipe, fittings, and specials, in shop, repairs of any damage to lining or coating occurring during shipment or any other time, and field lining and coating of ends where linings or coatings have been held back for welded field joints, shall be done by established and recognized pipe company acceptable to Engineer.
- 2. Use only certified welders meeting procedures and performance outlined in ASME Section IX, AWWA C200 Section 3.3.3 and other codes and requirements per local building and utility requirements.

1.3 SUBMITTALS

A. Shop Drawings:

- 1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
- 2. See Specification Section 40 05 00.
- 3. Factory test reports.
- 4. If mechanical grooved type coupling system is used, submit piping, fittings, and appurtenant items which will be utilized.
- 5. Coating manufacturer's qualifications.
- 6. Welders certificates.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:

- 1. Flanged adaptors:
 - a. Rockwell (Style 912 (cast)).
 - b. Dresser (Style 127 (cast)).
- 2. Insulating couplings:
 - a. Rockwell (Style 416).
 - b. Dresser (Style 39).
- 3. Reducing couplings:
 - a. Rockwell (Style 415).
 - b. Dresser (Style 62).
- 4. Transition coupling:
 - a. Rockwell (Style 413).
 - b. Dresser (Style 62).
- 5. Compression sleeve coupling:
 - a. Rockwell (Style 431 (cast)).
 - b. Dresser (Style 53 (cast)).
- 6. Mechanical couplings and fittings:
 - a. Victaulic (Style 07 or 77).
 - b. S.P. Fittings.
- 7. Vibration isolation equipment connections for natural gas:
 - a. Flexonics (Model 401H).

8. Flexible connectors for hot water equipment:
 - a. Flexonics (FLG Series).
 - b. Thermo Tech (F/J/R Series).
9. Factory-applied plastic or epoxy coatings:
 - a. "Encoat" Division of Energy Coating Company.
 - b. "Scotchkote" Division of 3M Company.

B. Submit request for substitution in accordance with Specification Section 01 25 13.

2.2 MATERIALS

- A. All materials used in steel piping systems defined in Section 4005 00 shall meet or exceed pressure test requirements specified for each respective system.
- B. Steel Pipe (Fabricated Type):
 1. AWWA C200:
 - a. ASTM A36, Grade C steel plate.
 - b. ASTM A283, Grade D steel plate.
 - c. ASTM A572, steel plate.
 - d. ASTM A1011, steel sheet.
- C. Steel Pipe (Mill Type): ASTM A53, Type E or S.
- D. Fittings (For Fabricated Pipe): AWWA C208.
- E. Fittings (For Mill Type Pipe):
 1. ASTM A234.
 2. ASME B16.3, ASME B16.5, ASME B16.9, ASME B16.11.
- F. Flanges (Fabricated Pipe):
 1. Flange material: ASTM A283, Grade C or D, ASTM A181, Grade 1.
 2. Flange finish: Flat faced.
- G. Flanges (Mill Type Pipe):
 1. ASME B16.5.
 2. Flat faced.
 3. Slip-on flanges.
- H. Nuts and Bolts:
 1. Heads and dimensions per ASME B1.1.
 2. Threaded per ASME B1.1.
 3. Project ends 1/4 to 1/2 IN beyond nuts.
- I. Gaskets: See individual piping systems in Section 4005 00.

2.3 MANUFACTURED UNITS

- A. Couplings:
 1. Flanged adaptors:
 - a. Steel or carbon steel body sleeve, flange, followers and Grade 30 rubber gaskets.
 - b. Provide units specified in Article 2.1.
 - c. Flanges meeting standards of adjoining flanges.
 - d. Entire assembly to be rated for test pressure specified on Piping Schedule for each respective application.
 2. Compression sleeve coupling:
 - a. Steel sleeve, followers Grade 30 and rubber gaskets.
 - b. Provide units specified in Article 2.1.
 - c. Flanges meeting standards of adjoining flanges.
 - d. Entire assembly to be rated for test pressure specified on Piping Schedule for each respective application.
 - e. Provide field coating for buried couplings per AWWA C203.

3. Mechanical coupling joint:
 - a. Use of mechanical grooved (AWWA C606) type couplings and fittings in lieu of flanged joints is acceptable where specifically specified in Section 40 05 00.
 - b. Utilize units defined in Article 2.1.

2.4 ACCESSORIES

- A. Heating Water Application:
 1. For steel heating lines, provide braided, flanged stainless steel connectors for connection to equipment.
 2. Provide pump connectors with stainless steel construction, rubber filled bellows and flanged end connections.
- B. Natural Gas Equipment Isolator: 316L stainless steel, T-321 stainless steel braid with connections compatible with joints in piping system.

2.5 FABRICATION

- A. Provide piping (mill or fabricated) for use in this Project with minimum wall thicknesses as follows:
 1. 1/8 - 5 IN DIA pipe: Schedule 40.
 2. 6 - 10 IN DIA pipe: 3/16 IN.
 3. 12 - 14 IN DIA pipe: 7/32 IN.
 4. 16 - 48 IN DIA pipe: 1/4 IN.
 5. 54 - 60 IN DIA pipe: 5/16 IN.
 6. 66 - 72 IN DIA pipe: 3/8 IN.
 7. Sizes through 24 IN are nominal OD.
 - a. Sizes greater than 24 are ID.
 8. Wall thicknesses indicated are for standard weight pipe.
 - a. Design pipe in accordance with operating pressures shown in Piping Schedules for a design stress limited to 50 PCT of yield.
- B. Furnish cast parts with lacquer finish compatible with finish coating.
- C. Furnish without outside coating of bituminous material any exposed pipe scheduled to be painted.
- D. Fabricated Fittings:
 1. AWWA C208.
 2. Assure ratio of radius of bend to diameter of pipe equal to or greater than 1.0.
- E. Taper cement mortar linings as required for valve interfacing.
- F. Protective Coatings and Linings:
 1. Provide enamel linings and coatings in accordance with AWWA C203 and the following:
 - a. Potable water: Provide minimum dry film of 5 MILS of a sphalitic coating non-toxic blend of Gilsonite and brown and steam distilled asphalt.
 - b. Nonpotable fluids: Provide minimum dry film of 5 MILS of acceptable asphalt base material.
 - c. Provide coating in accordance with AWWA C203 and subject to following additional requirements.
 - 1) Do not use enamel lined or coated steel pipe exposed to temperatures below 10 DEGF.
 - 2) Do not handle enamel-lined or coated pipe when temperature of pipe is below 20 DEGF.
 2. Provide cement mortar lining in accordance with AWWA C205.
 3. Provide cement mortar coating in accordance with AWWA C205.
 4. Galvanize surface in accordance with hot-dip method using any grade of zinc acceptable to ASTM B6.
 5. Wrap pipe in accordance with AWWA C209.

6. Field paint pipe in accordance with Section 0996 00.

2.6 SOURCE QUALITY CONTROL

- A. Testing:
 1. Shop hydrostatic test fabricated steel pipe and fittings.
 2. Field hydrostatic test all pipe as specified in Section 40 05 00.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Joining Methods - Flanges:
 1. Facing method:
 - a. Insert slip-on flange on pipe.
 - b. Assure maximum tolerances for flange faces from normal with respect to axis of pipe is 0.005 IN per foot of flange diameter.
 - c. Test flanges after welding to pipe for true to face condition and reface, if necessary, to bring to specified tolerance.
 2. Joining method:
 - a. Leave 1/8 to 3/8 IN of flange bolts projecting beyond face of nut after tightening.
 - b. Coordinate dimensions and drillings of flanges with flanges for valves, pumps, equipment, tank, and other interconnecting piping systems.
 - c. When bolting flange joints, exercise extreme care to assure that there is no restraint on opposite end of pipe or fitting which would prevent uniform gasket compression or cause unnecessary stress, bending or torsional strains being applied to cast flanges or flanged fittings.
 - 1) Allow one flange free movement in any direction while bolts are being tightened.
 - d. Do not assemble adjoining flexible coupled, mechanical coupled or welded joints until flanged joints in piping system have been tightened.
 - e. Gradually tighten flange bolts uniformly to permit even gasket compression.
 - f. Do not overstress bolts to compensate for poor installation.
- C. Joining Method - Welded Joints:
 1. Perform welding in accordance with AWWA C206 and this Section.
 2. For flange attachment perform in accordance with AWWA C207.
 3. Have each welding operator affix an assigned symbol to all his welds.
 - a. Mark each longitudinal joint at the extent of each operator's welding.
 - b. Mark each circumferential joint, nozzle, or other weld into places 180 DEG apart.
 4. Welding for all process piping shall conform to ASME B31.3.
 - a. Welding of utility piping 125 PSI and less shall be welded per ASME B31.9.
 - b. Utility piping above 125 PSI shall conform to ASME B31.1.
 5. Provide caps, tees, elbows, reducers, etc., manufactured for welded applications.
 6. Weldolets may be used for 5 IN and larger pipe provided all slag is removed from inside the pipe.
 7. Weld-in nozzles may be used for branch connections to mains and where approved by Engineer.
 8. Use all long radius welding elbows for expansion loops and bends.
 9. Use long radius reducing welding elbows 90 DEG bends and size changes are required.
- D. Joining Method - Couplings:
 1. Compression sleeve:
 - a. Install coupling to allow space of not less than 1/4 IN but not more than 1 IN.
 - b. Provide harnessed joint.
 - 1) Use joint harness arrangements detailed in AWWA M11.

- c. Design harness assembly with a adequate number of tie rods for test pressures indicated in Section 40 05 00 and allow for expansion of pipe.
 - d. Provide ends to be joined or fitted with compression sleeve couplings of the plain end type.
 - e. Grind smooth welds the length of one coupling on either side of joint to be fitted with any coupling.
 - f. Assure that outside diameter and out-of-round tolerances are within limits required by coupling manufacturer.
2. Mechanical coupling:
- a. Arrange piping so that pipe ends are in full contact.
 - b. Groove and shoulder ends of piping in accordance with manufacturer's recommendations.
 - c. Provide coupling and grooving technique assuring a connection which passes pressure testing requirements.
- E. Joining Method - Threaded and Coupled (T/C):
- 1. Provide T/C end conditions that meet ASME B 1.2 requirements.
 - 2. Furnish pipe with factory-made T/C ends.
 - 3. Field cut additional threads full and clean with sharp dies.
 - 4. Leave not more than three pipe threads exposed at each branch connection.
 - 5. Ream ends of pipe after threading and before assembly to remove burrs.
 - 6. Use Teflon thread tape on male thread in mating joints.
- F. Support exposed piping in accordance with Section 40 05 00.
- G. Install buried piping per Section 40 05 00.

3.2 FIELD QUALITY CONTROL

- A. Test piping systems in accordance with Section 40 05 00.

END OF SECTION

SECTION 40 05 25

PIPE - UNDERGROUND, PREFABRICATED, INSULATED, AND JACKETED

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Underground, prefabricated, insulated and jacketed piping with flexible joints.
- B. Related Sections include but are not necessarily limited to the following:
 - 1. Division 00 - Procurement and Contracting Requirements.
 - 2. Division 01 - General Requirements.
 - 3. Section 31 23 33 - Trenching, Backfilling, and Compacting for Utilities.
 - 4. Section 40 05 00 - Pipe and Pipe Fittings - Basic Requirements.
 - 5. Section 40 05 24 - Pipe - Steel.

1.2 QUALITY ASSURANCE

- A. See Section 40 05 00.
- B. Referenced Standards:
 - 1. American Society of Mechanical Engineers (ASME):
 - a. B31.1, Power Piping.
 - 2. ASTM International (ASTM):
 - a. A53, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
 - b. D1785, Standard Specification for PVC Plastic Pipe, Schedules 40, 80, and 120.

1.3 SYSTEM DESCRIPTION

- A. Provide underground piping for heating water system piping.

1.4 SUBMITTALS

- A. Shop Drawings:
 - 1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
 - 2. See Section 40 05 00.
 - 3. Product technical data including:
 - a. Complete system layout and details:
 - 1) Indicating amount of expansion.
 - 2) Indicating provisions for system expansion.
 - b. Anchorage.
 - c. Component details.
 - d. Location of miscellaneous fittings including anchors and seals.
 - e. Gland seals.
 - f. Field closures.
 - g. Location of field joints.
 - h. Detail of requirement for two flexible joint systems at each structure.
 - 1) Instructions for assembly of these joints.
 - 4. Detailed piping and penetration drawings.
 - a. Minimum scale 1/2 IN equal 1 FT.
 - b. Details to be specific and to include:
 - 1) Flexible joint details.
 - 2) Floor and foundation elevations.
 - 3) Final grades.
 - 4) Anchors.

- 5) Sleeves.
 - 6) Seals.
 - 7) Crossovers and related items.
5. Provide anchor block sizes.
 6. Provide copy of stress analysis for proposed system in accordance with ASME B31.1.
 7. Factory test report.
 8. Field hydrostatic test report.
- B. Contract Closeout Information:
1. Operation and Maintenance Data:
 - a. See Specification Section 01 33 04 for requirements for the mechanics, administration, and the content of Operation and Maintenance Manual submittals.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
1. Ricwil piping systems, Intergy, Inc., Brecksville, Ohio.
 2. Perma-pipe, Midwesco Inc., Niles, Illinois.
 3. Rovanco Corporation, Joliet, Illinois.
- B. Submit request for substitution in accordance with Specification Section 01 25 13.

2.2 MATERIALS

- A. Service Pipe:
1. Steel per Section 40 05 24.
 2. Carbon steel, ASTM A53, Grade B.
- B. Insulation:
1. Foamed urethane.
 2. "K" factor ≤ 0.15 BTU/HR SQFT/DEGF/IN at 75 DEGF.
 3. Density ≥ 1.8 LB/CUFT.
 4. Thickness ≥ 1 IN.
 5. Provide additional thickness in expansion loops to maintain minimum 1-1/2 IN thickness after pipe expansion.
- C. Vapor Seal Jacket:
1. Jacket may be either of the following:
 - a. Fiberglass reinforced plastic:
 - 1) Machine coated.
 - 2) Continuous multi-directional tension filament wound.
 - 3) Polyester resin.
 - 4) Ultra violet inhibitors added.
 - 5) Minimum thickness 0.120 IN.
 - b. Polyvinyl chloride:
 - 1) Type 1, Class 1 PVC.
 - 2) Conforms to ASTM D1785.
 - 3) Minimum thickness 0.120 IN.
 - 4) Ultra violet inhibitors added.
- D. End Seal for Polyvinyl Chloride Jacket:
1. Compression fitted rubber seal.
- E. Flexible Joints:
1. Comply with Section 40 05 00.
 2. 150 LB flanges.
 3. 321 stainless steel inertube.

4. Braided stainless steel wire shield rated for 150 PSI at 250 DEGF.
 5. Shrink wrap outer cover.
- F. Fabricated Manholes:
1. Shell 8 GA corrugated galvanized steel.
 2. Outer corrosion coating:
 3. Interior coating:
- G. Anchors:
1. Steel plate minimum 1/4 IN thick.
 2. Coat exposed steel with jacket material.
 3. Concrete collar.

2.3 ACCESSORIES

- A. Pipe Accessories:
1. End seals.
 2. Gland seals.
 3. Elbows.
 4. Tees.
 5. Field joint closures.
 6. Insulated flexible joint system.
 7. Factory-fabricated expansion/contraction loops and anchors to prevent moisture ingress.
- B. Wall Penetration Accessories:
1. Wall sleeve with water stop and seals per Section 01 73 20.

2.4 FABRICATION

- A. Preinsulated Pipe:
1. Fabricate preinsulated pipe in 40 FT straight lengths without fittings where possible.
 2. Factory fabricate preinsulated pipe sections with fittings capable of absorbing expansion with anchors and other accessories to job dimensions.
 3. Polyvinyl chloride jacketed pipe:
 - a. End seal for each joint.
- B. Manholes:
1. Factory fabricate watertight, vented manholes with 3 IN diameter access hatch with watertight cover and access ladder.
 2. Pipe insulation and jacket in manholes to be the same as the pipe system.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Observe manufacturer's recommendation for handling, cutting, jointing, installing, and testing.
- B. Trenching, Backfilling, and Compaction:
1. See Section 31 23 33.
 2. Comply with manufacturer's recommendations where they are more stringent.
- C. Anchors:
1. Provide anchors at each take-off point, between expansion loops and as required by the system.
 2. Anchors to be welded to the pipe and extend beyond the jacket.
- D. Expansion Loops:
1. Provide expansion loops as required for system integrity.
 2. Provide elbows with flexibility for maximum pipe movement.
 3. Provide pipe guides at expansion loops and between loops to assure longitudinal pipe movement.

3.2 FIELD QUALITY CONTROL

- A. Tests:
 - 1. See Section 40 05 00.
- B. Manufacturer's Field Service:
 - 1. Factory-trained field service person present for minimum of three working days including two site visits.
 - 2. Factory-field service person visits to provide instruction for installation and testing and to verify installation is being performed in accordance with manufacturer's recommendations.

END OF SECTION

SECTION 40 05 26
PIPE - CAST-IRON SOIL

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Cast-iron soil piping, fittings, and appurtenances.
- B. Related Sections include but are not necessarily limited to:
 - 1. Division 00 - Procurement and Contracting Requirements.
 - 2. Division 01 - General Requirements.
 - 3. Section 40 05 00 - Pipe and Pipe Fittings - Basic Requirements.

1.2 QUALITY ASSURANCE

- A. See Section 40 05 00.
- B. Provide joint type specifically approved by applicable plumbing code.
- C. Referenced Standards:
 - 1. ASTM International (ASTM):
 - a. A74, Standard Specification for Cast-Iron Soil Pipe and Fittings.
 - b. C564, Standard Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings.
 - 2. Cast Iron Soil Pipe Institute (CISPI):
 - a. 301, Standard Specification for Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications.
 - b. 310, Standard for Coupling for Use in Connection with Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications.
 - 3. Federal Specifications (FS):
 - a. QQ-C-40, Calking: Lead Wool and Lead Pig.

1.3 SUBMITTALS

- A. Shop Drawings:
 - 1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
 - 2. See Section 40 05 00.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Pipe (General Application):
 - 1. ASTM A74.
 - a. SV service.
 - 2. No hub: CISPI 301.
- B. Joints (General Application):
 - a. 1.
 - 2. Compression joint: Neoprene gasket, ASTM C564.
 - 3. Mechanical: No hub, CISPI 310.
- C. See Piping Schedules in Section 40 05 00.

2.2 FABRICATION

- A. Cast-Iron Soil Pipe:
 - 1. SV service rated.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Observe manufacturer's recommendation for handling, cutting, jointing, installing, and testing.
- B. Install products in accordance with CISPI.
- C. Support exposed piping in accordance with Section 40 05 00.
- D. Install buried piping in accordance with Section 40 05 00.
- E. If "standard joint" is used, assure lead is run in one continuous pour.
 - 1. No second pouring or driving of lead is permitted.
 - 2. Provide minimum of 12 OZ of lead per inch of pipe diameter per joint.

3.2 FIELD QUALITY CONTROL

- A. Test piping systems in accordance with Section 40 05 00.

END OF SECTION

SECTION 40 05 31

PIPE - PLASTIC

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Plastic pipe.
- B. Related Specification Sections include but are not necessarily limited to:
 - 1. Division 00 - Procurement and Contracting Requirements.
 - 2. Division 01 - General Requirements.
 - 3. Section 40 05 00 - Pipe and Pipe Fittings - Basic Requirements.

1.2 QUALITY ASSURANCE

- A. See Specification Section 4005 00.
- B. Referenced Standards:
 - 1. ASTM International (ASTM):
 - a. PVC (polyvinyl chloride) materials:
 - 1) D1784, Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds.
 - 2) D1785, Standard Specification for Poly(Vinyl Chloride) PVC Plastic Pipe, Schedules 40, 80 and 120.
 - 3) D2467, Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80.
 - 4) D2486, Standard Specification for Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Hot- and Cold-Water Distribution Systems.
 - 5) D3034, Standard Specification for Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings.
 - 6) D3139, Standard Specification for Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals.
 - 7) D3212, Standard Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals.
 - 8) F593, Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs.
 - 9) F679, Standard Specification for Poly(Vinyl Chloride) (PVC) Large-Diameter Plastic Gravity Sewer Pipe and Fittings.
 - 10) F794, Standard Specification for Poly(Vinyl Chloride) (PVC) Profile Gravity Sewer Pipe and Fittings Based on Controlled Inside Diameter.
 - 11) F949, Standard Specification for Poly(Vinyl Chloride) (PVC) Corrugated Sewer Pipe with a Smooth Interior and Fittings.
 - b. Installation:
 - 1) D2321, Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications.
 - 2. American Water Works Association (AWWA):
 - a. PVC (polyvinyl chloride) materials:
 - 1) C900, Standard for Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 4 IN Through 12 IN, for Water Distribution.
 - 2) C905, Standard for Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 14 IN through 48 IN, for Water Transmission and Distribution.
 - b. Polyethylene (PE) materials:
 - 1) C901, Standard for Polyethylene (PE) Pressure Pipe and Tubing, 1/2 IN through 3 IN, for Water Service.
 - 3. NSF International (NSF).

1.3 SUBMITTALS

- A. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
- B. See Specification Section 40 05 00.

PART 2 - PRODUCTS

2.1 PVC PRESSURE PIPING (EXPOSED)

- A. General:
 - 1. Provide Schedule 80 pipe with Schedule 80 fittings and appurtenances to locations shown on Drawings.
 - 2. Furnish materials in full compliance to following material specifications:
 - a. Manufacture pipe, fittings and appurtenances from polyvinyl chloride (PVC) compound which meets the requirements of Type 1, Grade 1 (12454-B) Polyvinyl Chloride as outlined in ASTM D1784.
 - b. Manufacture pipe, fittings and valves from materials that have been tested and approved for conveying potable water by the NSF.
- B. Pipe:
 - 1. Furnish pipe meeting requirements of ASTM D1785.
 - 2. Pipe 2 IN and less to be solvent welded.
 - 3. Pipe larger than 2 IN may be either flanged or solvent welded unless shown otherwise on Drawings.
- C. Fittings: Provide ASTM D2467 PVC socket type fittings having the same pressure and temperature rating as the pipe.
- D. Flanges/Unions:
 - 1. Furnish flanges and unions at locations shown on Drawings.
 - 2. Provide either flanges or unions at valves, penetrations through structures and equipment connections.
 - 3. For pipe larger than 2 IN, provide 150LB socket type PVC flange.
 - 4. For pipe 2 IN and less, provide socket type PVC union with Buna O-rings.
 - 5. Use flat, full faced natural rubber gaskets at flanged connections.
 - a. Furnish heavy hex head bolts, each with one heavy hex nut, ASTM F593 Type 316 stainless steel.
 - 6. Use spacers supplied by pipe manufacturer when mating raised-faced flanges to other flanges.
- E. Installation:
 - 1. Field threading PVC will not be permitted.
 - a. Perform required threaded connections or attachments by the use of factory molded socket by threaded adapters.
 - b. Female adapters are not acceptable.
 - 2. Employ installation and pipe support practices and solvent welding all in compliance to the manufacturer's printed recommendation.
 - a. Continuously support PVC piping at liquid operating temperatures in excess of 100 DEGF.
 - b. For vertical piping, band the pipe at intervals to rigidly support load of twice vertical load.
 - c. Support riser clamps on spring hangers.
 - d. Do not clamp PVC tightly or restrict movement for expansion and contraction.

2.2 PRESSURE PIPING (UNDERGROUND)

- A. Materials: Furnish materials in full compliance with following requirements:
 - 1. 1/2-3 IN: AWWA C901 PE with Pressure Class of 200 PSI.
 - 2. 4-12 IN: AWWA C900 PVC with Pressure Class of 200 PSI.
 - 3. 14-36 IN: AWWA C905 PVC DR-18.
 - 4. Joints for polyethylene pipe shall be fusion type in accordance with AWWA C901.
 - 5. Joints for PVC pipe shall be the elastomeric-gasket type with a pressure rating not less than pipe pressure rating meeting performance requirements of ASTM D3139.
- B. Installation:
 - 1. Field threading of PVC pipe will not be permitted.
 - 2. Perform installation procedures, handling, thrust blocking, connections, and other appurtenant operations in full compliance to the manufacturer's printed recommendations and in full observance to plan details when more stringent.

2.3 PVC DRAINAGE, SEWER PIPING AND UNDERGROUND AIR DUCTS

- A. Materials:
 - 1. Furnish materials in full compliance to the following material specification.
 - 2. PVC pipe shall be rigid, unplasticized polyvinyl chloride (PVC) made of PVC plastic having a cell classification of 12454-B or 12454-C as described in specification ASTM D1784.
 - 3. The requirements of this Specification are intended to provide for pipe and fittings suitable for non-pressure drainage of wastewater and surface water.
 - 4. Joining systems shall consist of an elastomeric gasket joint meeting requirements of ASTM D3212.
 - 5. Supply to the Engineer all information and sample of joining method for his evaluation.
 - a. Only jointing methods acceptable to the Engineer will be permitted.
 - 6. Provide pipe and fittings meeting or exceeding the following requirements:
 - a. 4-27 IN DIA: ASTM D3034 and ASTM F679, SDR 35.
 - b. 8-30 IN DIA: ASTM F794.
 - c. 4-18 IN DIA: ASTM F949.
 - 7. Ensure impact strengths and pipe stiffnesses in full compliance to these Specifications.
- B. Installation: Install pipe and fittings in accordance with ASTM D2321 and as recommended by the manufacturer.
 - 1. Provide for a maximum deflection of not more than 5 PCT.

2.4 PVC TUBING

- A. General: Provide nylon tubing with fittings and appurtenances as shown on Drawings.
- B. Materials:
 - 1. Furnish clear outer braided tubing with braid outside the walls.
 - 2. Have tubing manufactured of nylon with working temperatures from 5 to 180 DEGF.
 - 3. Design tubing with a minimum safety factor of 4 to 1 ratio of burst pressure to working pressure at maximum temperature.
 - 4. Provide tubing with working pressure of 75 PSI at 180 DEGF.
 - 5. Ensure that tubing is self-extinguishing and fire resistant.
- C. Fittings:
 - 1. Install tubing with nylon fittings and connectors.
 - 2. Use barbed type adapters with stainless steel clamps.
 - 3. Provide fittings capable of withstanding temperatures from a -70 to 250 DEGF.
 - 4. Ensure fittings have the same pressure and temperature rating as the tubing.

2.5 CPVC PRESSURE PIPING

A. General:

1. Provide Schedule 80 pipe with Schedule 80 fittings and appurtenances to locations shown on Drawings.
2. Furnish materials in full compliance to following material specifications:
 - a. Manufacture pipe, fittings and appurtenances from chlorinated polyvinyl chloride (CPVC) compound which meets the requirements of ASTM D2486.
 - b. Manufacture pipe, fittings and valves from materials that have been tested and approved for conveying potable water by the NSF.

B. Pipe:

1. Furnish pipe meeting requirements of ASTM D2486.
2. Pipe 2 IN and less to be solvent welded.
3. Pipe larger than 2 IN may be either flanged or solvent welded unless shown otherwise on Drawings.

C. Fittings: Provide ASTM D2486 CPVC socket type fittings having the same pressure and temperature rating as the pipe.

D. Installation:

1. Field threading CPVC will not be permitted.
 - a. Perform required threaded connections or attachments by the use of factory molded socket by threaded adapters.
 - b. Female adapters are not acceptable.
2. Employ installation and pipe support practices and solvent welding all in compliance to the manufacturer's printed recommendation.
 - a. Continuously support CPVC piping at liquid operating temperatures in excess of 100 DEGF.
 - b. For vertical piping, band the pipe at intervals to rigidly support load of twice vertical load.
 - c. Support riser clamps on spring hangers.
 - d. Do not clamp CPVC tightly or restrict movement for expansion and contraction.

PART 3 - EXECUTION

3.1 IDENTIFICATION

- #### **A. Identify each length of pipe clearly at intervals of 5 FT or less.**
1. Include manufacturer's name and trademark.
 2. Nominal size of pipe, appurtenant information regarding polymer cell classification and critical identifications regarding performance specifications and NSF approvals when applicable.

3.2 PRESSURE PIPING (UNDERGROUND)

A. Installation:

1. Field threading of PVC pipe will not be permitted.
2. Perform installation procedures, handling, thrust blocking, connections, and other appurtenant operations in full compliance to the manufacturer's printed recommendations and in full observance to plan details when more stringent.

3.3 PVC DRAINAGE, SEWER PIPING AND UNDERGROUND AIR DUCTS

- #### **A. Installation: Install pipe and fittings in accordance with ASTM D2321 and as recommended by the manufacturer.**
1. Provide for a maximum deflection of not more than 5 PCT.

- B. Infiltration and Exfiltration:
 - 1. The maximum allowable infiltration measured by test shall not exceed 100 GAL per inch of pipe diameter per mile per 24 HRS.
 - 2. For exfiltration, all the pipe and fittings shall exceed performance requirements by the test procedure as specified in Section 40 05 00.
 - 3. Observe full instructions of the Engineer for carrying of testing procedures.
 - a. Perform tests only during presence of the Engineer or his authorized representative.
 - 4. Should any test on any section of pipe line disclose either infiltration rates greater than allowed or disclose air loss rate greater than that permitted, locate and repair the defective joints or pipes at no cost to Owner and retest until requirements stated are met.
- C. Deflection:
 - 1. After backfilling, each section of pipe shall be checked for deflection by pulling a mandrel through the pipe.
 - 2. Pipe with deflection exceeding 5 PCT of the inside diameter shall have backfill removed and replaced to provide a deflection of less than 5 PCT.
 - 3. Any repaired pipe shall be retested.

3.4 PVC TUBING

- A. Fittings:
 - 1. Install tubing with nylon fittings and connectors.
 - 2. Use barbed type adapters with stainless steel clamps.
 - 3. Provide fittings capable of withstanding temperatures from a -70 to 250 DEGF.
 - 4. Ensure fittings have the same pressure and temperature rating as the tubing.
- B. Trays:
 - 1. Flat smoothed bottom tray for supporting flexible hoses when there is a chance that the hoses may pulse or move; specify a flat smoothed bottom tray.

END OF SECTION

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SECTION 40 05 51
VALVES - BASIC REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Valving, actuators, and valving appurtenances.
- B. Related Sections include but are not necessarily limited to:
 - 1. Division 00 - Procurement and Contracting Requirements.
 - 2. Division 01 - General Requirements.
 - 3. Section 01 61 03 - Equipment - Basic Requirements.
 - 4. Section 09 96 00 - High Performance Industrial Coatings.
 - 5. Section 40 05 00 - Pipe and Pipe Fittings - Basic Requirements.

1.2 QUALITY ASSURANCE

- A. Referenced Standards:
 - 1. American Society of Mechanical Engineers (ASME):
 - a. B 1.20.1, Pipe Threads, General Purpose.
 - b. B 16.1, Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250.
 - c. B 16.18, Cast Copper Alloy Solder Joint Pressure Fittings.
 - 2. ASTM International (ASTM):
 - a. A 126, Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings.
 - b. D 256, Standard Test Methods for Determining the Izod Pendulum Impact Resistance of Plastics.
 - c. D 638, Standard Test Method for Tensile Properties of Plastics.
 - d. D 648, Standard Test Method for Deflection Temperature of Plastics Under Flexural Load in the Edgewise Position.
 - e. D 695, Standard Test Method for Compressive Properties of Rigid Plastics.
 - f. D 2240, Standard Test Method for Rubber Property-Durometer Hardness.
 - 3. American Water Works Association (AWWA):
 - a. C 207, Standard for Steel Pipe Flanges for Waterworks Service - Sizes 4 IN through 144 IN.
 - b. C 500, Standard for Metal-Seated Gate Valves for Water Supply Service.
 - c. C 504, Standard for Rubber-Seated Butterfly Valves.
 - d. C 507, Standard for Ball Valves, 6 IN through 48 IN (150 MM through 1200 MM).
 - e. C 509, Standard for Resilient-Seated Gate Valves for Water Supply Service.
 - f. C 550, Standard for Protective Coatings for Valves and Hydrants.
 - g. C 606, Standard for Grooved and Shouldered Joints.
 - 4. American Water Works Association/American National Standards Institute (AWWA/ANSI):
 - a. C 111/A 21.11, Standard for Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
 - 5. National Electrical Manufacturers Association (NEMA):
 - a. 250, Enclosures for Electrical Equipment (1000 Volts Maximum).
 - b. MG 1, Motors and Generators.
 - 6. National Fire Protection Association (NFPA):
 - a. 70, National Electrical Code (NEC).

1.3 DEFINITIONS

- A. The following are definitions of abbreviations used in this Specification Section or one of the individual valve sections:
 - 1. CWP: Cold water working pressure.
 - 2. SWP: Steam working pressure.
 - 3. WOG: Water, oil, gas working pressure.
 - 4. WWP: Water working pressure.

1.4 SUBMITTALS

- A. Shop Drawings:
 - 1. See Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
 - 2. Product technical data including:
 - a. Acknowledgement that products submitted meet requirements of standards referenced.
 - b. Manufacturer's installation instructions.
 - c. Valve pressure and temperature rating.
 - d. Valve material of construction.
 - e. Special linings.
 - f. Valve dimensions and weight.
 - g. Valve flow coefficient.
 - h. Wiring and control diagrams for electric or cylinder actuators.
 - i. Short Circuit Current Rating (SCCR) nameplate marking per NFPA 70. Include any required calculations per Section 01 61 03.
 - 3. Test reports.
- B. Contract Closeout Information:
 - 1. Operation and Maintenance Data:
 - a. See Section 01 33 04 for requirements for the mechanics, administration, and the content of Operation and Maintenance Manual submittals.
- C. Informational Submittals:
 - 1. Verification from valve actuator manufacturer that actuators have been installed properly, that all limit switches and position potentiometers have been properly adjusted, and that the valve actuator responds correctly to the valve position command.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with the Contract Documents, refer to individual valve Specification Sections for acceptable manufacturers.
- B. Electric Valve Actuators:
 - 1. Rotork Controls Inc.

2.2 MATERIALS

- A. Refer to individual valve Specification Sections.

2.3 VALVE ACTUATORS

- A. Valve Actuators - General:
 - 1. Provide actuators as shown on Drawings or specified.
 - 2. Counterclockwise opening as viewed from the top.
 - 3. Direction of opening and the word OPEN to be cast in handwheel or valve bonnet.
 - 4. Size actuator to produce required torque with a maximum pull of 80 LB at the maximum pressure rating of the valve provided and withstand without damage a pull of 200 LB on handwheel or chainwheel or 300 FT-pounds torque on the operating nut.

5. Unless otherwise specified, actuators for valves to be buried, submerged or installed in vaults or manholes shall be sealed to withstand at least 20 FT of submergence.
 6. Extension stem:
 - a. Install where shown or specified.
 - b. Solid steel with actuator key and nut, diameter not less than stem of valve actuator shaft.
 - c. Pin all stem connections.
 - d. Center in valve box or grating opening band with guide bushing.
- B. Exposed Valve Manual Actuators:
1. Provide for all exposed valves not having electric or cylinder actuators.
 2. Provide handwheels for gate and globe valves.
 - a. Size handwheels for valves in accordance with AWWA C500.
 3. Provide lever actuators for plug valves, butterfly valves and ball valves 3 IN DIA and smaller.
 - a. Lever actuators for butterfly valves shall have a minimum of five intermediate lock positions between full open and full close.
 - b. Provide at least two levers for each type and size of valve furnished.
 4. Gear actuators required for plug valves, butterfly valves, and ball valves 4 IN DIA and larger.
 5. Provide gearing for gate valves 20 IN and larger in accordance with AWWA C500.
 6. Gear actuators to be totally enclosed, permanently lubricated and with sealed bearings.
 7. Provide chain actuators for valves 6 FT or higher from finish floor to valve centerline.
 - a. Cadmium-plated chain looped to within 3 FT of finish floor.
 - b. Equip chain wheels with chain guides to permit rapid operation with reasonable side pull without "gagging" the wheel.
 - c. For smaller valves with lever or handle operators, provide offset tee handles with attached chain for operation from the operating floor.
 8. Provide cast iron floor stands where shown on Drawings.
 - a. Stands to be furnished by valve manufacturer with actuator.
 - b. Stands or actuator to include thrust bearings for valve operation and weight of accessories.
- C. Electric Actuators (480 V, 3 PH):
1. Provide electric valve actuators with integral control devices and a remote pushbutton station, If valve actuator is more than 6 FT above an operating floor; provide a remote pushbutton station.
 2. Furnish electric actuator integral with valve consisting of:
 - a. Motor.
 - b. Gearing.
 - c. Handwheel.
 - d. Limit and torque switches.
 - e. Lubricants.
 - f. Heating elements.
 - g. Wiring.
 - h. Terminals for motor power and controls.
 - i. Drive nut.
 3. Housing/enclosure:
 - a. Provide cast iron gear housing and cast iron load bearing enclosure.
 - b. Non load bearing enclosure and housing: Aluminum or cast iron.
 - c. Rated for area classification shown on Drawings.
 - d. Provide O-ring seals for covers and entries.
 - e. Terminal and limit switch compartment covers are to be fastened to gear housing by stainless steel fasteners with capture device to prevent loss.

4. Motors:
 - a. Provide motors that are totally enclosed, high torque design made expressly for valve actuator service and capable of operating the valve under full differential pressure for complete open-close and reverse cycle of travel at least twice in immediate succession without overheating.
 - b. Design motors in accordance with NEMA MG 1 standards, with Class B insulation, and to operate successfully at any voltage within 10 PCT above or below rated voltage.
 - c. Provide positive method to ensure motor bearings are permanently lubricated.
 - d. Provide three thermal switches imbedded in windings:
 - 1) 120 DEG apart.
 - 2) Provide motor shutdown at high temperature.
 - e. Motor housing:
 - 1) Aluminum or cast iron.
 - 2) Totally enclosed nonventilated with cooling fins.
 - f. Provide motor capable of operating in any position.
 - g. Provide motor sealed from gearcase to allow any mounting position.
 - h. Provide motors suitable for 480 V, 3 PH, 60 Hz.
5. Gearing:
 - a. Provide power gearing consisting of heat treated steel helical gears, carburized and hardened alloy steel worm, and alloy bronze worm gear, all grease or oil bath lubricated, designed for 100 PCT overload, and effectively sealed against entrance of foreign matter.
 - b. Provide gearing mechanism constructed to permit field changes of reduction gear ratio.
 - c. Design actuators so that motor comes up to speed before stem load is encountered in either opening or closing operation.
 - d. Limit switch gearings and feedback device reduction gearing:
 - 1) Steel or bronze.
 - e. Support rotating shafts with anti-friction bearings.
 - f. Provide separate drive nut/thrust bearing assembly:
 - 1) Mounted to base of actuator.
 - 2) High tensile bronze.
 - 3) Quarter turn actuator: Provide 90 DEG mounting intervals.
 - 4) Provide grease fitting on drive assembly.
6. Handwheel:
 - a. Permanently attached for manual operation.
 - b. Positive declutch mechanism to engage and disengage handwheel.
 - c. Handwheel shall not rotate during motor operation.
 - d. Inoperable motor shall not prevent manual operation.
7. Limit torque and thrust loads in both closing and opening directions by torque limit switches.
 - a. Provide torque switches with micrometer adjustment and reference setting indicator.
 - 1) Assure adjustment variation of approximately 40 PCT in torque setting.
 - b. Provide switches having rating of not less than 6 A at 120 VAC and 2.2 A at 115 VDC.
 - c. Limit and torque switches shall have totally sealed contacts.
8. Furnish electric actuator with two geared limit switch assemblies with each switch assembly having four separate limit switches:
 - a. Assure each limit switch assembly is geared to driving mechanism and is independently adjustable to trip at any point at and between the fully open and fully closed valve position.
 - b. Provide minimum of two normally open contacts and two normally closed contacts at each end of valve travel.
 - c. Provide switches with inductive contact rating of not less than 6 A at 120 VAC, 3 A at 240 VAC, 1.5 A at 480 VAC, 2.2 A at 115 VDC and 1.1 A at 230 VDC.
 - d. Limit switches shall be fully adjustable when power is applied to actuator.

9. Provide space heating elements sized to prevent condensation in both motor and geared limit switch compartment(s).
 - a. Furnish heating elements rated at 120 VAC with heaters continuously energized.
10. Open-close actuator controls:
 - a. Provide control assembly with necessary holding relays, reversing starter, control transformers of sufficient capacity to provide control power, space heating element power and valve position transmitter.
 - b. Provide control assembly in an enclosure rated for the defined area classification.
 - c. Controls for open/close actuator:
 - 1) Provide remote pushbutton station with enclosure rated for area classification shown on Drawings with:
 - a) Open pushbutton.
 - b) Close pushbutton.
 - c) Stop pushbutton.
 - d) Remote/local switch.
 - e) Full open light.
 - f) Full close light.
 - g) Open and close relays as required.
 - 2) Provide control enclosure to accept:
 - a) Remote open/close switches.
 - 3) Provide contacts in control enclosure:
 - a) Remote/local contact.
 - b) Full open contact.
 - c) Full close contact.
 - 4) Wire all components to an internal terminal strip and include mounted wiring diagram inside enclosure.
11. Additional requirements for modulating valve actuators:
 - a. Proportional position servo-amplifier mounted integral with the actuator control compartment.
 - b. Positioning of valve shall be proportional to a 4-20 mA signal input to the position servo-amplifier when remote control has been selected.
 - c. Servo-amplifier adjustments shall include zero, span, gain, and dead-band.
 - d. Provide 4-20 mA signal position control as shown on the Drawings that interfaces with the position control/position feedback instrumentation wiring to and from PLC.
12. Remote and Local pushbutton station:
 - a. Provide control assembly with necessary holding relays, reversing starter, control transformers of sufficient capacity to provide control power, space heating element power and valve position transmitter.
 - b. Provide control assembly in the enclosure rated for the defined area classification shown on the drawings.
 - c. Enclosure: NEMA 4 stainless steel.
 - d. Selector switches shall include controls for Open/Close actuator:
 - 1) Open Pushbutton
 - 2) Close Pushbutton
 - 3) Stop Pushbutton
 - 4) Remote/Local Switch
 - 5) Full Open Light
 - 6) Full Closed Light
 - e. Control relays shall include:
 - 1) Open relay.
 - 2) Closed relay.
 - 3) PLC interface relay.
 - f. Push-to-test indicating lights shall include:
 - 1) Open.
 - 2) Closed.

- 3) Remote.
 - g. Space heater for enclosure.
 - h. Control wiring as shown on control diagrams.
 - i. Wire all components to an internal terminal strip and include mounted wiring diagram inside enclosure.
13. Provide equipment or control panels with Short Circuit Current Rating (SCCR) labeling as required by NFPA 70 and other applicable codes. See Section 01 61 03 for information on how to determine the available fault current, such that, the SCCR rating meets or exceeds the available fault current.
- D. Electric Actuators (120 V, 1 PH):
1. General:
 - a. Self-contained, including motor, gearing, torque switch, limit switches and cast housing.
 - b. Electrical enclosure: NEMA 4 or NEMA 7 to comply with area rating classification shown on Drawings.
 - c. Factory assembled requiring only field connection of power and control wires.
 - d. Comply with Section 01 61 03.
 2. Motors:
 - a. Produce 1.5 times the required torque.
 - b. Sized for two complete open-close cycles without overheating.
 - c. One fully closed to fully open cycle to occur within 60 SEC.
 - d. Class F insulation.
 - e. Operate at plus or minus 10 PCT voltage.
 - f. 120 Volt, single phase, 60 Hz.
 - g. Provide thermal cutout switch and internal heater for actuator enclosure.
 - h. Control wiring as shown on Drawing control diagrams.
 3. Remote and Local pushbutton station:
 - a. Provide control assembly with necessary holding relays, reversing starter, control transformers of sufficient capacity to provide control power, space heating element power and valve position transmitter.
 - b. Provide control assembly in the enclosure rated for the defined area classification shown on the drawings.
 - c. Enclosure: NEMA 4 stainless steel.
 - d. Selector switches shall include controls for Open/Close actuator:
 - 1) Open Pushbutton
 - 2) Close Pushbutton
 - 3) Stop Pushbutton
 - 4) Remote/Local Switch
 - 5) Full Open Light
 - 6) Full Closed Light
 - e. Control relays shall include:
 - 1) Open relay.
 - 2) Closed relay.
 - 3) PLC interface relay.
 - f. Push-to-test indicating lights shall include:
 - 1) Open.
 - 2) Closed.
 - 3) Remote.
 - g. Space heater for enclosure.
 - h. Control wiring as shown on control diagrams.
 - i. Wire all components to an internal terminal strip and include mounted wiring diagram inside enclosure.
 4. Provide equipment or control panels with Short Circuit Current Rating (SCCR) labeling as required by NFPA 70 and other applicable codes. See Section 01 61 03 for information on

how to determine the available fault current, such that, the SCCR rating meets or exceeds the available fault current.

2.4 FABRICATION

- A. End Connections:
 - 1. Provide the type of end connections for valves as required in the Piping Schedules presented in Section 40 05 00 or as shown on the Drawings.
 - 2. Comply with the following standards:
 - a. Threaded: ASME B1.20.1.
 - b. Flanged: ASME B16.1, Class 125 unless otherwise noted or AWWA C207.
 - c. Bell and spigot or mechanical (gland) type: AWWA/ANSI C111/A21.11.
 - d. Soldered: ASME B16.18.
 - e. Grooved: Rigid joints per Table 5 of AWWA C606.
- B. Refer to individual valve Specification Sections for specifications of each type of valve used on Project.
- C. Nuts, Bolts, and Washers:
 - 1. Wetted or internal to be bronze or stainless steel.
 - a. Exposed to be zinc or cadmium plated.
- D. On Insulated Piping: Provide valves with extended stems to permit proper insulation application without interference from handle.
- E. Epoxy Interior Coating: Provide epoxy interior coating for all ferrous surfaces in accordance with AWWA C550.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Painting Requirements: Comply with Section 09 96 00 for High Performance Industrial Coatings.
- C. Setting Buried Valves:
 - 1. Locate valves installed in pipe trenches where buried pipe indicated on Drawings.
 - 2. Set valves and valve boxes plumb.
 - 3. Place valve boxes directly over valves with top of box being brought to surface of finished grade.
 - 4. Install in closed position.
 - 5. Place valve on firm footing in trench to prevent settling and excessive strain on connection to pipe.
 - 6. After installation, backfill up to top of box for a minimum distance of 4 FT on each side of box.
- D. Support exposed valves and piping adjacent to valves independently to eliminate pipe loads being transferred to valve and valve loads being transferred to the piping.
- E. For grooved coupling valves, install rigid type couplings or provide separate support to prevent rotation of valve from installed position.
- F. Install electric or cylinder actuators above or horizontally adjacent to valve and gear box to optimize access to controls and external handwheel.
- G. For threaded valves, provide union on one side within 2 FT of valve to allow valve removal.
- H. Install valves accessible for operation, inspection, and maintenance.

3.2 ADJUSTMENT

- A. Adjust valves, actuators and appurtenant equipment to comply with Section 01 75 00.
 - 1. Operate valve, open and close at system pressures.
- B. For all 120 VAC and 480 VAC electric actuators, employ and pay for services of valve actuator manufacturer's field service representative to:
 - 1. Inspect valve actuators covered by this Specification Section.
 - 2. Supervise adjustments and installation checks:
 - a. Open and close valves electrically under local manual and demonstrate that all limit switches are properly adjusted and that switch contacts are functioning properly by verifying the inputs are received at the remote input/output (RIO) panels or local control panel as appropriate.
 - b. Position modulating valves electrically under local manual control and demonstrate that the valve position feedback potentiometer is properly adjusted and that the feedback signal is received at the RIO panels or local control panel as appropriate.
 - c. Simulate a valve position command signal at the RIO panel or local control panel as appropriate and demonstrate that the valve is controlled to the desired position without excessive hunting.
 - 3. Provide Owner with a written statement that the valve actuator manufacturer has verified that the actuators have been installed properly, that all limit switches and position potentiometers have been properly adjusted and that the valve actuator responds correctly to the valve position command.
- C. Refer to Schedule at end of this section for schedule of valves 4 IN and larger.
 - 1. Valves less than 4 IN are not scheduled but type and size are defined on Drawings in plan, section, or schematic.
 - 2.

Valve Tag	Service	Size	Type	Open/Close or Modulating	P&ID	Notes
FCV-510-01	DS	8 IN	Eccentric Plug Valve	OPEN/CLOSE	000Y-01, 02	
FCV-510-02	DS	8 IN	Eccentric Plug Valve	OPEN/CLOSE	000Y-01, 02	
FCV-510-03	DS	6 IN	Eccentric Plug Valve	OPEN/CLOSE	000Y-01, 02	
FCV-510-04	DS	6 IN	Eccentric Plug Valve	OPEN/CLOSE	000Y-01, 02	
FCV-510-05	TPS/ TWAS	4 IN	Eccentric Plug Valve	OPEN/CLOSE	000Y-04	1
FCV-510-06	DS	6 IN	Eccentric Plug Valve	OPEN/CLOSE	000Y-01, 02	1
FCV-510-07	DS	6 IN	Eccentric Plug Valve	OPEN/CLOSE	000Y-01, 02	
FCV-510-08	DS	6 IN	Eccentric Plug Valve	OPEN/CLOSE	000Y-01, 02	
FCV-510-09	DS	6 IN	Eccentric Plug Valve	OPEN/CLOSE	000Y-01, 02	1
FCV-510-10	TPS/ WAS	4 IN	Eccentric Plug Valve	OPEN/CLOSE	000Y-01, 05	1
FCV-560-01	PS/WAS	4 IN	Eccentric Plug Valve	OPEN/CLOSE	000Y-03	
FCV-560-02	WAS	4 IN	Eccentric Plug Valve	OPEN/CLOSE	000Y-03	
FCV-560-03	PS	4 IN	Eccentric Plug Valve	OPEN/CLOSE	000Y-03	
FCV-560-04	PS	4 IN	Eccentric Plug Valve	OPEN/CLOSE	000Y-03	
FCV-560-05	PS/WAS	4 IN	Ball Valve	OPEN/CLOSE	000Y-03	1
FCV-560-06	PS/WAS	4 IN	Ball Valve	OPEN/CLOSE	000Y-03	1
FCV-560-07	PS	4 IN	Eccentric Plug Valve	OPEN/CLOSE	000Y-03	

Valve Tag	Service	Size	Type	Open/Close or Modulating	P&ID	Notes
FCV-560-08	TPS/ TWAS	4 IN	Eccentric Plug Valve	OPEN/CLOSE	000Y-05	
FCV-560-09	DG	2 IN	Eccentric Plug Valve	OPEN/CLOSE	000Y-09	1
FCV-560-10	DG	2 IN	Eccentric Plug Valve	OPEN/CLOSE	000Y-09	1
FCV-560-11	RDS	6 IN	Eccentric Plug Valve	OPEN/CLOSE	000Y-11	
FCV-560-12	RDS	6 IN	Eccentric Plug Valve	OPEN/CLOSE	000Y-11	
FCV-560-13	RDS	6 IN	Eccentric Plug Valve	OPEN/CLOSE	000Y-11	
FCV-560-14	RDS	6 IN	Eccentric Plug Valve	OPEN/CLOSE	000Y-11	1
FCV-560-15	W2	2 IN	Ball Valve	OPEN/CLOSE		1
FCV-560-16	W2	2 IN	Ball Valve	OPEN/CLOSE		1
FCV-560-18	W1		Ball Valve	OPEN/CLOSE	000Y-12	1
FCV-550-01	W2	¾ IN	Ball Valve	OPEN/CLOSE	000Y-06	1
FCV-560-017	NG	2 in	Eccentric Plug Valve	Open/Close	000Y—9	1
FCV-550-01	W2	1 IN	Solenoid	OPEN/CLOSE	000Y-06	1
Notes: 1. Valves to be supplied by equipment package supplier, see P&ID Drawings and Individual specification sections.						

Notes:

1. Vendor provided, refer to P&ID drawing and specification.

END OF SECTION

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SECTION 40 05 52
MISCELLANEOUS VALVES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Air release and vacuum relief valves.
 - 2. Automatic control valves:
 - a. Pressure relief and pressure-sustaining valves.
 - b. Pressure-reducing valves.
 - 3. Float-operated valves (2 IN and smaller).
 - 4. Pressure-reducing valves (2 IN and smaller).
 - 5. Pressure relief valves (1 IN and smaller).
 - 6. Solenoid valves.
 - 7. Telescoping valves.
- B. Related Specification Sections include but are not necessarily limited to:
 - 1. Division 00 - Procurement and Contracting Requirements.
 - 2. Division 01 - General Requirements.
 - 3. Section 01 61 03 - Equipment - Basic Requirements.
 - 4. Section 40 05 51 - Valves - Basic Requirements.

1.2 QUALITY ASSURANCE

- A. Referenced Standards:
 - 1. American Society of Mechanical Engineers (ASME):
 - a. B 16.1, Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250.
 - 2. American Water Works Association (AWWA):
 - a. C512, Standard for Air-Release, Air-Vacuum, and Combination Air Valves for Waterworks Service.
 - b. C550, Standard for Protective Interior Coatings for Valves and Hydrants.
 - 3. Canadian Standards Association (CSA).
 - 4. National Electrical Manufacturers Association (NEMA):
 - a. 250, Enclosures for Electrical Equipment (1000 Volts Maximum).

1.3 SUBMITTALS

- A. Shop Drawings:
 - 1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
 - 2. See Specification Section 40 05 51.
- B. Contract Closeout Information:
 - 1. Operation and Maintenance Data:
 - a. See Specification Section 01 33 04 for requirements for the mechanics, administration, and the content of Operation and Maintenance Manual submittals.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with the Contract Documents, the manufacturers listed in the applicable Articles below are acceptable.
- B. Submit request for substitution in accordance with Specification Section 01 25 13.

2.2 PRESSURE-REDUCING VALVES (2 IN AND SMALLER)

- A. Water Pressure Regulators:
 - 1. Acceptable manufacturers:
 - a. Fisher, Type 75A.
 - b. Watts Series 25AUB-Z3.
 - 2. Materials:
 - a. Body: Bronze.
 - b. Strainer body: Bronze.
 - c. Strainer screen: Stainless steel.
 - 3. Design requirements:
 - a. Self-contained diaphragm operated.
 - 1) Spring loaded.
 - 2) Field adjustable.
 - b. Strainer: Y-type on supply.
 - c. Size as shown in Schedule or size equal to connecting line size with 125 PSI inlet and 50 PSI outlet pressure.
- B. Air or Gas Pressure Regulators:
 - 1. Acceptable manufacturers:
 - a. Air service:
 - 1) Fisher 64 Series.
 - b. Gas service:
 - 1) Fisher.
 - 2. Design requirements:
 - a. Self-contained, diaphragm operated.
 - 1) Spring loaded.
 - 2) Field adjustable.
 - b. Natural or LP gas service, CSA approved.
 - c. Size for conditions listed in pressure regulator schedule.

2.3 SOLENOID VALVES (1 IN AND SMALLER)

- A. General Service (Air - Water):
 - 1. Acceptable manufacturer:
 - a. ASCO.
 - 2. Materials:
 - a. Body: Brass.
 - b. Seat: Buna-N.
 - c. Insulation: Class F.
 - 3. Design requirements:
 - a. 110 VAC.
 - b. Two-way, normally closed.
 - c. Enclosure: Compatible with area classifications indicated on Drawings.
 - d. Working pressure, air and water: 125 PSIG.
 - 4. Accessories: Provide strainer on supply.

2.4 TELESCOPING VALVES

- A. General: Valve consists of tube which travels inside a flanged ductile iron riser pipe to control water level.
- B. Manufacturers:
 - 1. Trumbull.
 - 2. Troy Valve.
 - 3. Waterman Industries.

- C. Materials:
 1. Tube: Schedule 40, Stainless steel Type 304.
 2. Length: As indicated on the Drawings.
 3. Minimum insert into riser pipe: 6 IN.
 4. Lifting Bail: Stainless steel Type 304.
 5. Yoke: Stainless steel Type 316.
 6. Frame: Stainless steel Type 316.
 7. Stem: Stainless steel Type 316.
 8. Thrust nut: Stainless steel Type 316.
 9. Operating nut: Stainless steel Type 316.
 10. Slip seal gasket: SBR or Buna N.
 11. Floor stand: Ductile iron Grade 65-45-12.
 12. Extension stem: Stainless steel Type 316, maximum L/R or 360.
 13. Stem guides: Stainless steel Type 316.
- D. Provide with rising stem.
- E. Tube top: V-notch funnel.
- F. Accessories:
 1. Provide floor stand assembly for telescoping valves with stems adjacent to basin walkways.
 2. Provide extension stems, floor stands and stem guides as indicated on the drawings.
 3. Provide factory epoxy coating which meets the requirements of Specification Section 09 96 00 for ferrous metal.
 4. Grease fitting.
- G. Slip tube gasket shall be replaceable without removal of the slip tube assembly from the riser pipe, stem, or actuator.

2.5 SPRAY NOZZLES

2.6 ACCESSORIES

- A. Furnish any accessories required to provide a completely operable valve.

2.7 FABRICATION

- A. Completely shop assemble unit including any interconnecting piping, speed control valves, control isolation valves and electrical components.
- B. Provide internal epoxy coating suitable for potable water for all iron body valves in accordance with AWWA C550.

2.8 SOURCE QUALITY CONTROL

- A. Shop hydrostatically test to piping system test pressure.

2.9 MAINTENANCE MATERIALS

- A. Provide one set of any special tools or wrenches required for operation or maintenance for each type valve.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. General: See Specification Section 01 61 03 and Specification Section 40 05 51.
- B. Air Release, Vacuum Relief, and Pressure Relief Valves:
 1. Pipe exhaust to a suitable disposal point.
 2. Where exhausted to a trapped floor drain, terminate exhaust line 6 IN minimum above floor.
- C. Float-Operated Valves: Install baffle around float to minimize turbulence adjacent to float.

3.2 FIELD QUALITY CONTROL

- A. Clean, inspect, and operate valve to ensure all parts are operable and valve seats properly.
- B. Check and adjust valves and accessories in accordance with manufacturer's instructions and place into operation.

3.3 SCHEDULE

TAG NUMBER	BUILDING	Description	Size	P&ID
PRV-560-04	Mechanical Building	Boiler 2 Pressure Relief Valve	1 ¼ in	000Y-09
PRV-560-05	Mechanical Building	Boiler 2 Digester Gas Pressure Regulating Valve	2 in	000Y-09

END OF SECTION

SECTION 40 05 62
PLUG VALVES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Plug valves.
- B. Related Specification Sections include but are not necessarily limited to:
 - 1. Division 00 - Procurement and Contracting Requirements.
 - 2. Division 01 - General Requirements.
 - 3. Section 40 05 51 - Valves - Basic Requirements.

1.2 QUALITY ASSURANCE

- A. Referenced Standards:
 - 1. American Society of Mechanical Engineers (ASME):
 - a. B16.1, Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125 and 250.
 - 2. ASTM International (ASTM):
 - a. A126, Standard Specification for Gray Iron Castings for Valves, Flanges and Pipe Fittings.
 - b. A536, Standard Specification for Ductile Iron Castings.
 - c. D2240, Standard Test Method for Rubber Property-Durometer Hardness.
 - 3. American Water Works Association (AWWA):
 - a. C517 Resilient-Seated Cast-Iron Eccentric Plug Valves

1.3 SUBMITTALS

- A. Shop Drawings:
 - 1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
 - 2. See Specification Section 40 05 51.
- B. Contract Closeout Information:
 - 1. Operation and Maintenance Data:
 - a. See Specification Section 01 33 04 for requirements for the mechanics, administration, and the content of Operation and Maintenance Manual submittals.
 - 2. See Specification Section 40 05 51.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with the Contract Documents, the manufacturers listed under the specific valve types are acceptable.
- B. Submit request for substitution in accordance with Specification Section 01 25 13.

2.2 NON-LUBRICATED ECCENTRIC PLUG VALVES (SEWAGE, SLUDGE, SEWAGE GAS APPLICATIONS)

- A. Manufacturers:
 - 1. DeZurik.
 - 2. Henry Pratt.
 - 3. Millikin.
 - 4. ValMatic.

- B. Materials:
1. Body: Cast-iron ASTM A126, Class B.
 2. Plug: One or two-piece construction ductile iron, ASTM A536 65-45-12 or cast iron, ASTM A126 Class B.
 3. Plug facing: Grease and/or petroleum-resistant resilient Neoprene or Buna-N compound, 70 Type A durometer hardness per ASTM D2240.
 4. Shaft bearing bushings: Permanently lubricated TFE or Delrin sleeve type stainless steel or bronze.
 5. Valve seats: Welded-in overlay of 90 PCT nickel, (minimum 1/8 IN thick).
 6. Stem seal: per AWWA C517, Section 4.4.7.

2.3 LUBRICATED SEAL PLUG VALVES (NATURAL GAS APPLICATIONS)

- A. Manufacturers:
1. Nordstrom.
 2. Walworth.
 3. Millikin.
- B. Materials:
1. Body: Cast iron ASTM A126, Class B.
 2. Plug: Cast iron ASTM A126, Class B.
 3. Plug facing: Teflon on tapered plug.
 4. Valve seats: Gas-resistant lubricant/sealant.

2.4 NON-LUBRICATED ECCENTRIC PLUG (HEATING-COOLING WATER APPLICATIONS)

- A. Manufacturers:
1. DeZurik Figure 499.
 2. Millikin Series 603.
- B. Materials:
1. Body: Cast iron, ASTM A126, Class B.
 2. Plug: Bronze or nickel-plated cast iron.
 3. Bearings: Bronze or nickel.
 4. Plug seal: Isobutene-isoprene (250 DEGF).

2.5 ACCESSORIES

- A. Refer to Drawings and valve schedule for type of actuator.
1. Furnish actuator integral with valve.
- B. Refer to Specification Section 40 05 51 for actuator requirements.

2.6 DESIGN REQUIREMENTS

- A. Non-Lubricated Eccentric Plug Valves (Wastewater, Sludge):
1. Port area:
 - a. Valves 4 IN through 20 IN: Equal to or exceed 80 PCT of full pipe area.
 - b. Valves greater than 20 IN: 100 PCT equivalent full pipe area.
 2. Valve body: Fitted with bolted bonnet.
 3. End connections: See Specification Section 40 05 51.
 4. Stem seal: Adjustable and replaceable without disassembling valve or bonnet.
 5. Designed for seating drip tight in any flow direction.
 6. Rating:
 - a. 1/2 through 12 IN, 175 PSI working pressure.
 - b. 14 through 36 IN, 150 PSI working pressure.
 - c. Three-way valves, 125 PSI working pressure.

7. Actuator:
 - a. Actuator gearing in enclosure suitable for running in oil with seals on shaft to prevent entry of dirt or water.
 - b. Positive identification on actuator indicating valve position.
 - c. Adjustable stop to set closing torque.
- B. Lubricated Plug Valves (Natural Gas):
 1. Pressure lubricated valve with sealed ports and grooves.
 - a. Re-seatable under full pressure in any position.
 2. Pressure rating: 200 PSI WOG.
 3. Port area: Minimum 60 PCT of pipe area.
 4. Acceptable to local gas company.
- C. Non-Lubricated Eccentric Plug Valve-(HVAC):
 1. Port area: Valves 1/2 IN through 2-1/2 IN: Equal to or exceed 100 PCT of full pipe area.
 2. Valve body: Fitted with threaded bonnet or bolted bonnet.
 3. End connections:
 - a. Flanges: In full accordance with ASME B16.1, Class 125 including facing, drilling and thickness.
 - b. Threaded connection: In full compliance with NPT.
 4. Stem seal: Self-adjusting U-cups or multiple O-ring seals.
 5. Shut-off: Designed for setting drip-tight at the full rated pressure.

2.7 FABRICATION

- A. See Specification Section 4005 51.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. See Specification Section 4005 51.
- B. Install valves with valve stem horizontal, plug seat on inlet side and with plug rotating up into the open position for valves in horizontal lines.
- C. Install valve with actuator above pipe or plug centerline.

END OF SECTION

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SECTION 40 05 63
BALL VALVES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Ball valves.
- B. Related Specification Sections include but are not necessarily limited to:
 - 1. Division 00 - Procurement and Contracting Requirements.
 - 2. Division 01 - General Requirements.
 - 3. Section 40 05 51 - Valves - Basic Requirements.

1.2 QUALITY ASSURANCE

- A. Referenced Standards:
 - 1. ASTM International (ASTM):
 - a. A48, Standard Specification for Gray Iron Castings.
 - b. A126, Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings.
 - c. A276, Standard Specification for Stainless Steel Bars and Shapes.
 - d. A351, Standard Specification for Castings, Austenitic, for Pressure-Containing Parts.
 - 2. American Water Works Association (AWWA):
 - a. C507, Standard for Ball Valves, 6 IN through 48 IN.
 - 3. Manufacturers Standardization Society of the Valve and Fittings Industry Inc. (MSS):
 - a. SP-110, Ball Valves; Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends.

1.3 DEFINITIONS

- A. PVDF: Polyvinylidene fluoride.
- B. PTFE: Polytetrafluoroethylene.
- C. RPTFE: Reinforced PolyTetraFluoroEthylene.

1.4 SUBMITTALS

- A. Shop Drawings:
 - 1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
 - 2. See Specification Section 40 05 51.
 - 3. Test results for AWWA valves.
- B. Contract Closeout Information:
 - 1. Operation and Maintenance Data:
 - a. See Specification Section 01 33 04 for requirements for the mechanics, administration, and the content of Operation and Maintenance Manual submittals.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with the Contract Documents, the manufacturers listed in the applicable Articles below are acceptable.
- B. Submit request for substitution in accordance with Specification Section 01 25 13.

2.2 METALLIC BALL VALVES 1/4 TO 3 IN DIA

- A. Comply with MSS SP-110.
- B. Manufacturers:
 - 1. Apollo.
 - 2. Jamesbury.
 - 3. Watts.
 - 4. Stockham.
 - 5. Nibco.
- C. Materials (All Stainless Steel):
 - 1. Body: Three-part stainless steel, ASTM A351 CF8M.
 - 2. Ball: Stainless steel ASTM A276.
 - 3. Seats: RPTFE.
- D. Design Requirements:
 - 1. Rated for a minimum of:
 - a. 500 PSI CWP.
 - b. 150 PSI of saturated steam.
 - c. 29 IN vacuum.
 - 2. Two-position lockable handle.
 - 3. Stem with blowout-proof design.
 - 4. Balancing stop for all applications.
 - 5. Bodies with mounting pad for applications requiring actuators.

2.3 PLASTIC BALL VALVES: 1/2 INTO 4 IN DIA

- A. Manufacturers:
 - 1. Chemtrol/NIBCO.
 - 2. Spears.
 - 3. ASAHI/America.
- B. Materials:
 - 1. Body, stem, ball, handle, end connectors:
 - a. PVC ASTM D1784-12454B.
 - 2. Ball Seat: Teflon.
 - 3. O-rings: Viton.
- C. Design Requirements:
 - 1. Rated at 150 PSI at 75 DEGF.
 - 2. Double or "true union" design.
 - 3. Blocks both directions, upstream and downstream.
 - 4. Union nut capable of compensating for seat wear.
 - 5. Body with mounting pad for actuators where required.
 - 6. Capable of being disconnected at downstream end under full line pressure.

2.4 ACCESSORIES

- A. Refer to Drawings and valve schedule for type of actuators.
 - 1. Furnish actuator integral with valve.
- B. Refer to Specification Section 40 05 51 for actuator requirements.

2.5 SOURCE QUALITY CONTROL

- A. Shop test AWWA C507 ball valves in accordance with AWWA C507.
- B. Furnish record of test.
- C. Product Testing: MSS SP-110.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. See Specification Section 4005 51.

3.2 FIELD QUALITY CONTROL

- A. For AWWA C507 ball valves and in accordance with Specification Section 01 75 00, employ and pay for services of equipment manufacturer's field service representative(s) to:
 - 1. Inspect equipment covered by this Specification Section.
 - 2. Supervise adjustments and installation checks.
 - 3. Provide test equipment, tools, and instruments necessary to accomplish equipment testing.
 - 4. Conduct startup of equipment and perform operational checks.
 - 5. Provide Owner with a written statement that manufacturer's equipment has been installed properly, has been started up, and is ready for operation by Owner's personnel.

END OF SECTION

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SECTION 40 05 64
BUTTERFLY VALVES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Butterfly valves.
- B. Related Sections include but are not necessarily limited to:
 - 1. Division 00 - Procurement and Contracting Requirements.
 - 2. Division 01 - General Requirements.
 - 3. Section 40 05 00 - Pipe and Pipe Fittings - Basic Requirements.
 - 4. Section 40 05 51 - Valves - Basic Requirements.

1.2 QUALITY ASSURANCE

- A. Referenced Standards:
 - 1. American Society of Mechanical Engineers (ASME):
 - a. B16.5, Pipe Flanges and Flanged Fittings - NPS 1/2 Through NPS 24.
 - 2. ASTM International (ASTM):
 - a. A48, Standard Specification for Gray Iron Castings.
 - b. A126, Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings.
 - c. A276, Standard Specification for Stainless Steel Bars and Shapes.
 - d. A395, Standard Specification for Ferritic Ductile Iron Pressure-Retaining Castings for Use at Elevated Temperatures.
 - e. A436, Standard Specification for Austenitic Gray Iron Castings.
 - f. A536, Standard Specification for Ductile Iron Castings.
 - 3. American Water Works Association (AWWA):
 - a. C504, Standard for Rubber-Seated Butterfly Valves.
 - 4. Manufacturers Standardization Society of the Valve and Fittings Industry Inc. (MSS):
 - a. SP-67, Butterfly Valves.

1.3 SUBMITTALS

- A. Shop Drawings:
 - 1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
 - 2. See Specification Section 40 05 51.
 - 3. For valves 8 IN and larger, furnish "Affidavit of Compliance" with Owner in accordance with AWWA C504.
- B. Contract Closeout Information:
 - 1. Operation and Maintenance Data:
 - a. See Specification Section 01 33 04 for requirements for the mechanics, administration, and the content of Operation and Maintenance Manual submittals.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
 - 1. DeZurik.
 - 2. Mueller/Lineal.

3. Pratt a Mueller Water Company.
4. Bray.
5. Pentair/Keystone.

B. Submit request for substitution in accordance with Specification Section 01 25 13.

2.2 HIGH PERFORMANCE BUTTERFLY VALVES:

- A. In locations where reliability is critical, for automated valves that modulate for flow control or actuate periodically in intervals less than 2 HRS, high performance butterfly valves with an offset disc design shall be used.
- B. Design Requirements:
 1. One-piece shaft.
 2. Separate shaft seal.
 3. Minimum shaft diameter to conform to AWWA C504, Class 150B.
- C. Materials of construction:
 1. Disc: 316 stainless steel.
 2. Shaft and pins: 17-4PH stainless steel or 316 stainless steel.
 3. Seals:
 - a. Water: PTFE.
 - b. Process air and high temperature: Graphite rings.
 4. Backing ring: Stainless steel.
 5. Bushings/Bearings: TFE/Glass liner with a 316 Stainless steel shell.
 6. Seat:
 - a. Two part with encapsulated RTFE or PTFE.
 - b. Seat Retainer: Stainless Steel.
 - c. Or Stainless Steel.
 7. End connection: Lugged valves may be used.

2.3 GENERAL USE BUTTERFLY VALVES

- A. For use in all location, except where high performance butterfly valves are required.
- B. Comply only with AWWA C504, as noted in this Specification Section.
- C. Materials:
 1. Valve bodies:
 - a. ASTM A126, Class B or ASTM A536 Grade 65-45-12 ductile iron.
 - b. Wafer valves may be constructed of ASTM A48, Class 40 cast iron.
 2. Valve shafts:
 - a. One-piece stainless steel, Type 304.
 - b. Pins: 304 stainless steel.
 - c. Bushings/Packing/O-rings: EPDM, RTFE or TFE.
 - d. Bearings: Reinforced TFE or equal.
 3. Valve discs:
 - a. Cast iron with welded nicked edge or 304 Stainless Steel disk.
 4. Valve seats:
 - a. Water: EPDM or Hycar.
 - b. Compressed air: Teflon, PTFE.
 - c. Process air: Viton, RTFE, rate for 300 DEGF minimum or higher if required by service.
 5. Shaft bearing: Bronze, TFE-coated stainless steel or reinforced TFE.
 6. Shaft seal in addition to any sealing provided by seat: Suitable synthetic rubber rings or PTFE V-ring suitable for operating conditions.

- D. Design Requirements:
1. Seat type: Resilient.
 2. Body type:
 - a. Wafer Lug (laying length may vary from AWWA C504).
 - b. Equip wafer type with fully tapped anchor lugs drilled per ASME B16.5.
 3. Direct buried valves:
 - a. All valves: Working pressure rated for 150 PSI (Class 150B per AWWA C504).
 4. Shaft diameter: One-piece constant diameter.

2.4 ACCESSORIES

- A. Refer to Drawings and/or valve schedule for type of actuators.
1. Furnish actuator integral with valve.
- B. Refer to Section 40 05 51 for actuator requirements.
- C. Valve Flange Seal Rings:
1. If Steel Slip-on flanges are being used on the process piping, flange seals will be required for proper installation of valves.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. See Section 40 05 51.

END OF SECTION

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SECTION 40 05 66
CHECK VALVES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Check valves.
- B. Related Specification Sections include but are not necessarily limited to:
 - 1. Division 00 - Procurement and Contracting Requirements.
 - 2. Division 01 - General Requirements.
 - 3. Section 40 05 51 - Valves - Basic Requirements.

1.2 QUALITY ASSURANCE

- A. Referenced Standards:
 - 1. American Society of Mechanical Engineers (ASME):
 - a. B16.1, Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250.
 - 2. American Water Works Association (AWWA):
 - a. C508, Standard for Swing-Check Valves for Waterworks Service, 2 IN through 24 IN NPS.
 - 3. Manufacturers Standardization Society of the Valve and Fittings Industry Inc. (MSS):
 - a. SP-71, Cast Iron Swing Check Valves, Flanged and Threaded Ends.
 - b. SP-80, Bronze Gate, Globe, Angle and Check Valves.

1.3 DEFINITIONS

- A. PVDF: Polyvinylidene fluoride.

1.4 SUBMITTALS

- A. Shop Drawings:
 - 1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
 - 2. See Specification Section 40 05 51.
- B. Contract Closeout Information:
 - 1. Operation and Maintenance Data:
 - a. See Specification Section 01 33 04 for requirements for the mechanics, administration, and the content of Operation and Maintenance Manual submittals.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with the Contract Documents, manufacturers listed under the valve with types are acceptable.
- B. Submit request for substitution in accordance with Specification Section 01 25 13.

2.2 CHECK VALVES: 2.5 IN AND SMALLER

- A. Class 125 Bronze Swing Check Valves (Fuel Oil, Compressed Air, Water, Wastewater):
 - 1. Comply with MSS SP-80.
 - 2. Acceptable manufacturers:
 - a. Nibco T413-Y.
 - b. Stockham B-319Y.

3. Materials:
 - a. Body, bonnet, disc: Bronze.
4. Design requirements:
 - a. 125 PSI steam to 406 DEGF, 200 PSI WOG.
 - b. Horizontal swing, renewable disc.

2.3 SWING CHECK VALVES: 3 IN TO 24 IN

- A. Swing Check Valves (Water, Wastewater, Sludge):
 1. Comply with AWWA C508.
 2. Acceptable manufacturers:
 - a. Clow.
 - b. American Darling.
 - c. Golden Anderson.
 3. Materials:
 - a. Body and cover: Cast iron.
 - b. Seat ring, hinge: Bronze.
 - c. Disc:
 - 1) 3 to 4 IN: Bronze.
 - 2) 6 to 24 IN: Cast iron with bronze face.
 - 3) 6 to 24 IN: Cast iron with rubber face.
 - d. Hinge shaft: Stainless steel.
 - e. Bearings, connecting hardware: Bronze.
 4. Design requirements:
 - a. 175 PSI working pressure (3 to 12 IN).
 - b. 150 PSI working pressure (14 to 24 IN).
 - c. Furnish with outside weight and lever or lever and spring.
- B. Class 125 Iron Check Valves (Steam to 125 PSI, Fuel Oil):
 1. Comply with MSS SP-71.
 2. Acceptable manufacturers:
 - a. Nibco F-918B.
 - b. Stockham 373 1/2.
 3. Materials:
 - a. Iron body, bronze mounted.
 - b. Seat ring, disc face: Bronze.
 - c. Hinge pin: Bronze or stainless steel.
 - d. Connecting hardware: Bronze or plated steel.
 4. Design requirements:
 - a. 125 PSI steam to 450 DEGF, 200 PSI WOG.
 - b. Bolted cap.
- C. Class 250 Iron Check Valves (Steam 125 to 250 PSI):
 1. Comply with MSS SP-71, Type 1.
 2. Acceptable manufacturers:
 - a. Nibco F-968-B.
 - b. Stockham F-947.
 3. Materials:
 - a. Iron body, bronze mounted.
 - b. Seat ring, disc face: Bronze.
 - c. Hinge pin: Brass.
 - d. Connecting hardware: Bronze.
 4. Design requirements:
 - a. 250 PSI steam to 450 DEGF, 500 PSI WOG.
 - b. Bolted cap.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. See Specification Section 4005 51.
- B. Install in accordance with manufacturer's instructions.

END OF SECTION

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SECTION 40 10 15
FIBERGLASS REINFORCED PLASTIC DUCT

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Fiberglass reinforced plastic (FRP) ductwork and accessories as specified and as shown on the Contract Documents for Odor Control Ductwork.
- B. Related Sections include but are not necessarily limited to:
 - 1. Division 00 - Procurement and Contracting Requirements.
 - 2. Division 01 - General Requirements.

1.2 QUALITY ASSURANCE

- A. Referenced Standards:
 - 1. Air Movement and Control Association (AMCA):
 - a. 500-D, Laboratory Methods of Testing Dampers for Rating.
 - 2. American National Standards Institute (ANSI).
 - 3. American Society of Mechanical Engineers (ASME).
 - 4. ASTM International (ASTM):
 - a. C582, Standard Specification for Contact-Molded Reinforced Thermosetting Plastic (RTP) Laminates for Corrosion-Resistant Equipment.
 - b. D2310, Standard Classification for Machine-Made "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe.
 - c. D2563, Standard Practice for Classifying Visual Defects in Glass-Reinforced Plastic Laminate Parts.
 - d. D2996, Standard Specification for Filament-Wound "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe.
 - e. D3982, Standard Specification for Contact Molded "Fiberglass" (Glass Fiber Reinforced Thermosetting Resin) Ducts.
 - f. E84, Standard Test Method for Surface Burning Characteristics of Building Materials.
 - 5. Sheet Metal and Air-Conditioning National Contractors Association (SMACNA):
 - a. Thermoset FRP Duct Construction Manual, 1997.
- B. Manufacturer's FRP Quality Assurance Program:
 - 1. Either in-house program or retained from qualified and approved outside source.
 - 2. Independent from manufacturing production personnel.
 - 3. Quality control manager experienced in the FRP industry with at least five years of verifiable experience in fabrication of fiberglass structures.
 - a. QC manager is to be approved by the Engineer
 - 4. All steps of the duct fabrication to be witnessed by the quality control manager
 - 5. Maintain fabrication logs including:
 - a. Record of each level of quality control inspections
 - 6. All areas of the facility where duct is manufactured or stored must be available for inspection by Owner's representative during normal working hours. Inspection will be at the Owner's discretion.
- C. Manufacturer's Qualifications: Manufacturer shall have experience in manufacturing FRP duct of similar size and configuration to the duct specified herein. For a manufacturer to be determined acceptable for providing the FRP duct on this project, they must show evidence of a minimum of five installations and five years' experience in the design and manufacturer of FRP duct of similar size and type as specified herein. Verifiable installations with contact numbers are required for at least three similar applications.

- D. Except where shown in the Contract Documents, the manufacturer is responsible for locating flexible connections and expansion joints to accommodate installation and thermal expansion, respectively.
- E. Provide, coordinate, service, and guarantee duct and duct accessories specified in this Specification, from one supplier.

1.3 SUBMITTALS

- A. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
- B. Shop Drawings and Product Data shall include the following:
 - 1. Technical Data:
 - a. Technical bulletins, technical data sheets from “soft-cover” catalogs with name of the manufacturer and all the manufacturer details for systems and products being provided. Items being provided are to be specifically identified in a summary listing.
 - b. All illustrations, detailed drawings, and instructions necessary for installing, operation, and maintenance repair.
 - c. Drawings for each shop fabricated ductwork assembly, flexible couplings, expansion/contraction joints, dampers, or blast gates.
 - d. Ductwork pressure, vacuum, and temperature ratings.
 - e. Blast gate and damper information including pressure ratings, leakage data and performance data. Include copies of AMCA 500D certified leakage rate test reports for sample dampers of every size.
 - f. Flexible Connections and Expansion Joints: Expansion and contraction characteristics and limits.
 - g. Manufacturer’s recommended spare parts list.
 - h. Manufacturer’s delivery, storage, handling, and installation instructions.
 - i. Acknowledgement that products submitted fully complies with the requirements of referenced standards and specifications.
 - 2. System Design sealed by a Washington Registered Engineer.
 - a. Duct support location Drawings.
 - b. Duct system flexible connectors, expansion joint, fittings and appurtenances location and detail Drawings.
 - c. Duct interfacing requirements with duct accessories and method of fastening or support.
 - d. Duct support reactions at each support for all applicable loads including dead load, live load, wind load and thermal expansion and contraction loads.
 - e. Fabricator’s detailed structural calculations for fiberglass laminate design.
 - 1) Design for pressure, vacuum, expansion, wind, snow loading as well as deflection for support spacing shown on Drawings.
 - 2) Detailed structural calculations for wall thickness, stress and strain support reactions (including expansion/contraction forces) and expected loadings.
 - 3. Scaled installation Drawings for all foul air duct system shown on the Drawings which shall include the following minimum information:
 - a. Dimensioned locations.
 - b. Elevations (centerline).
 - c. Duct and joint description.
 - d. Location of dampers and fittings.
 - e. Location of supports.
 - f. Location of expansion and contraction joints.
 - g. Details of duct supports (frames, stanchions, towers, etc.) including modifications (if any) to details shown on Drawings.
 - 4. Samples of duct materials.
- C. Operation and Maintenance Manuals:
 - 1. Submit for all applicable equipment.
 - 2. See Section 01 33 04.

- D. Warranty Certificate: Submit manufacturer's sample warranty certificate with product data submittal for Engineer's review. Warranty certificate shall reflect the warranty requirements and duration and as specified herein.
- E. Testing:
 - 1. Preliminary source and field quality control testing format to be used as basis for final quality control reporting.
 - 2. Source quality control test reports in accordance with Article 2.4 of this Specification.
 - 3. Field quality control test reports in accordance with Article 3.3 of this Specification.

1.4 SYSTEM DESCRIPTION

- A. Coordinate with the odor control equipment supplier to ensure compatibility of the ductwork with the other components of the odor control system.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
 - 1. Ductwork and Dampers:
 - a. Augusta Fiberglass.
 - b. Belco Manufacturing Company, Inc.
 - c. Daniel Company.
 - d. Viron International Corp.
 - 2. Flexible Connections and Expansion Joints:
 - a. Mercer Rubber Co.
 - b. Holz Rubber Co., Inc.

2.2 SERVICE CONDITIONS

- A. Outdoors and Indoors.
- B. Temperature: -10 to +110 DEGF.
- C. Design operating conditions:
 - 1. Vacuum service, inches water: -20.
 - 2. Pressure service, inches water: 20.
- D. Gases conveyed: Odorous air from municipal wastewater process sources.
- E. Relative humidity: 30 to 100 PCT.
- F. Maximum velocity: 3,000 FT per minute.
- G. Hydrogen sulfide exposure: up to 10 PPM.

2.3 COMPONENTS

- A. Ductwork:
 - 1. Duct shall consist of a filament-wound, exterior, structural layer and an internal corrosion barrier composed of a resin-rich inner surface followed by a layered-up interior layer.
 - 2. The internal corrosion barrier shall be in compliance with ASTM C582, ASTM D3982, and Thermoset FRP Duct Construction Manual, 1997.
 - 3. Resin:
 - a. Hetrion 992FR, Derakane 510B.
 - b. Premium grade and corrosion resistant.
 - c. Shall not contain thixotropic agents or fillers unless specified.
 - d. Shall not contain dyes, pigments, or colorants except in the exterior gel coats.
 - e. Include ultraviolet absorbers added to outer layers to improve weather resistance.

- f. May contain up to 3 PCT antimony oxide in order to meet the class I flame spread rating per ASTM E84.
- 4. Inner surface:
 - a. Minimum of 20 MILS thick and consist of a "C" glass surfacing veil with approximately 90 PCT resin content by weight.
 - b. Free of cracks and crazing with a smooth finish comparable to that achieved by the rotary contact molding method, with an average of not over two pits/SQ FT, providing the pits are less than 1/8 IN DIA and not over 1/32 IN deep. Pits shall be covered with sufficient resin to a void exposure of interior layer.
- 5. Interior layer:
 - a. Reinforced by not less than two plies of 1-1/2 OZ/SQFT chopped strand mat with approximately 75 PCT resin and 25 PCT glass content by weight. Total thickness shall be at least 100 MILS.
- 6. Exterior layer:
 - a. The exterior layer or body of the laminate shall be of chemically resistant construction suitable for operating in the service conditions above and providing additional mechanical strength necessary to meet the tensile and flexural requirements.
 - b. For rectangular duct and transitions, the exterior layer shall conform to the requirements of ASTM D3982 unless otherwise specified and consist of alternating layers of chopped-strand mat or equivalent chopper roving and woven roving to form composite construction of approximately 70 PCT resin by weight. A continuous layer shall be achieved by staggering and lipping layers. The exterior surface shall be relatively smooth and coated to ensure no exposed fiber.
 - c. For round duct, the exterior layer shall conform to the requirements of ASTM D2310 Type I, Grade 2, Class E and be in compliance with ASTM C582 and Thermoset FRP Duct Construction Manual, 1997 unless otherwise specified. The exterior layer shall be constructed of continuous roving by filament winding per ASTM D2996 with a single layer of woven roving to be applied after every 3/8 IN of filament winding to allow for exotherming.
 - d. Woven roving: Type E glass, nominal 24 OZ per square yard, four by five weave, with silane type finish.
 - e. Continuous roving used in chopper gun for spray-up: Type E glass.
 - f. Continuous roving used in filament winding: Type E glass, with silane type finish.
 - g. Shop applied resin gel coat of a color selected by the Engineer shall be provided to the exterior of the duct.
 - h. Color of exterior exposed ductwork shall match color of existing ductwork or a color approved by the Owner.
- 7. Laminate quality: Meet requirements of the visual acceptance criteria in ASTM D2563, Level II for the interior and Level III for the exterior.
- 8. Wall thickness for rectangular duct shall be calculated using a safety factor of five to one for both vacuum and positive pressure per ASTM D3982. Wall thickness for round duct shall be calculated using a safety factor of five to one for vacuum pressure and 10 to 1 for positive pressure per ASTM D3982. Calculations shall be based on the structural fiberglass reinforced portion of the wall only. Where calculated structural wall thickness is less than the corresponding minimum wall thickness provided below, the minimum wall thickness dictated by the schedule shall be used.

Duct Size	Round Ducting (wall thickness, IN)	Rectangular Ducting (wall thickness, IN)
For 18 IN & smaller ducts	0.25	0.375
20 to 36 IN ducts	0.375	0.50
40 to 54 IN ducts	0.50	0.625
60 to 72 IN ducts	0.625	0.75

9. Duct shall be supplied in the largest possible fabricated sections, allowing as few field joints as possible while assuring maximum quality control.
 - a. Minimize the use of flanges with butt wrapped joints where required for installation.
 - b. Shop spool duct and fittings as much as possible.
 10. Reinforcing shall be factory installed with spacing between reinforcing located to avoid all hangers and support saddles.
- B. Flanges:
1. Drill per ASTM D3982 Table 1 for all duct-to-duct connections and drilled to match for all equipment connections.
 2. Spot-faced back, flat and parallel with the flange face, of sufficient diameter to accept a SAE metal washer under the bolt head or nut.
 3. Provide full-faced, 1/8 IN thick, fabricated from ethylene propylene rubber (EPR) gaskets at each flanged connection.
 4. Flat washers shall be provided on all flange back faces.
- C. Fasteners:
1. Bolts for flanges: ASTM A193, Type 316 L stainless steel, Grade B8M hex head bolts fabricated in accordance with ANSI B18.2.
 2. Nuts: ASTM A194, Type 316 L stainless steel, Grade 8M hex head nuts.
 3. Washers: ASME B18.22.1, Type 316 L stainless steel.
 4. Interior bolts for dampers: FRP bolts.
- D. Joints:
1. All joints shall be of the same resin as and equal or superior in strength to the adjacent duct section, and shall have the same internal dimensions as the adjacent duct.
 2. Total width of overlay for butt-wrap joints: 6 IN minimum.
 3. Bell and spigot joints shall be sealed with a standard butt joint overlay as per ASTM D3982. The interior opening between the bell and spigot joint shall be sealed with a resin paste so that no glass fibers are exposed and all voids are filled.
- E. Fittings:
1. All fittings shall be of the same resin as and equal or superior in strength to the adjacent duct section, and shall have the same internal dimensions as the adjacent duct.
 2. Construction: Spray-up/contact molding or mitered/hand lay-up methods.
 3. Unless restricted by space constraints, bends shall have a minimum radius of 1.5 times the duct diameter. Under no circumstances shall bends have a radius less than 1.0 times the duct diameter.
- F. Flexible Connections and Expansion Joints:
1. Flexible connections shall be provided for connections to draw-offs and equipment including as indicated on the Drawings. Supports shall be provided where necessary to avoid strain on the flexible connections.
 2. Flexible connections and expansion joints shall be furnished and installed as determined by the manufacturer and where indicated on the Drawings. Expansion joints shall be used for lateral, torsional, angular and axial movement due to expansion/contraction and vibration or where required to accommodate thermal expansion.
 3. Flexible connections and expansion joints shall be constructed of multiple layers of vulcanized polyester tire cord fabric reinforcement, sandwiched between 60 - 70 durometer EPDM elastomer inner liner and exterior cover. Tire cord fabric shall be layered at an optimal bias angle with Resorcinol Formaldehyde latex for superior rubber-to-fabric bonding.
 4. Flexible connections and expansion joints shall be of seamless construction, built as one continuous piece with integral molded, hollow arched volutes permitting up to 4 IN of axial contraction and expansion.
 5. Type 316 L stainless steel back up retainers and Type 316 L stainless steel nuts, bolts and washers shall be provided.

6. Flexible connections shall be able to withstand the 25 IN water column, positive and negative pressure.
 7. Flexible connections shall be designed to withstand a maximum temperature of 220 DEGF continuous service with 250 DEGF intermittent spikes.
 8. Flexible connections and expansion joints shall be UV resistant.
 9. Flexible connections shall be designed to allow for a minimum of 1 IN of offset movement in any direction.
 10. Flanges shall be provided in accessible locations for removal of flexible connections and expansion joints. Flanges shall be drilled per ASTM D3982 Table 1 for all duct-to-duct connections and drilled to match for all equipment connections.
 11. Manufacturers.
 - a. RM Holtz.
 - b. Mercer.
- G. FRP Butterfly Dampers:
1. Butterfly balancing dampers for odorous air service shall be fiberglass reinforced plastic body, disc, and shaft. All dampers shall be flanged.
 2. Dampers must be suitable for service conditions previously mentioned.
 3. Laminate construction shall conform to ASTM C582. Laminating resins for exposed dampers shall contain compounds for fire retardance. All inner surfaces shall be reinforced with C-glass. All interior layers shall be a minimum of 0.1 IN thick, reinforced with chopped strand mat applied in a minimum of two piles. The structural layer shall be alternating layers of chopped strand mat and woven roving.
 4. The final resin coat color shall be the same as the adjacent ductwork.
 5. Connections to FRP ductwork shall conform to ASTM D3982.
 6. Isolation Dampers are to be bubble tight, no leak. These include dampers to isolate fans and individual scrubber systems.
 7. Construction:
 - a. Round, flange ends matching inside diameter of connecting ductwork.
 - b. Single blade type complete with channel type frame.
 - c. Full circumference blade seal.
 - d. Angle type blade stop.
 - e. Body material: FRP.
 - f. Disc material: FRP.
 - g. Shaft: Type 316 stainless steel.
 - h. Shaft seal: EPDM or Teflon.
 - i. Blade stop: FRP bar or angle.
 - j. Blade seal: EPDM.
 - k. Sleeve bearings: Molded Teflon.
 8. Dampers shall carry the AMCA Certified Ratings Seal for air leakage and shall be tested as specified herein.
 - a. Leakage: 2 CFM/SQFT at 30 IN WG, maximum.
 9. Manufacturers:
 - a. Daniel Mechanical Company.
 - b. Indusco.
 - c. Belco.
 - d. Augusta Fiberglass.
- H. FRP Butterfly Damper Operators:
1. Manual Operator:
 - a. Operator force not to exceed 40 LBS under any operating condition, including initial breakaway. Gear reduction operator when force exceeds 40 LBS.
 - b. Operator self-locking type or equipped with self-locking device.
 - c. Worm and gear operators 1-piece design worm gears of gear bronze material. Worm hardened alloy steel with thread ground and polished. Traveling nut type operators threaded steel reach rods with internally threaded bronze or ductile iron nut.

- d. For dampers less than 30 IN DIA, provide Type 316 stainless steel shaft, lever operators, and accessories. For dampers 30 IN DIA or larger, provide handwheel and necessary hardware in lieu of lever operator.
 - e. Chain wheel operators with tiebacks, extension stem, and other accessories will be required at all FRP dampers with the operator mounted higher than 6 FT.
 - f. All dampers must permit operation from normal operation level. The operator shall maintain the damper in a fixed position, preventing accidental movement.
 - g. Provide damper position indicator such that position can be identified from a distance of 15 FT.
 - h. Provide motorized operators where shown on the drawings.
- 2. Motor Operated Electric Damper Actuator:
 - a. Motor actuators are to be provided and installed as shown in the contract drawings. Operator functionality is to be consistent with P&IDs.
 - b. Damper actuators are to include remote local control panels.
 - 3. Manufacturers:
 - a. Rotork IQT Pro 1000.
- I. Blast Gates:
- 1. Blast gates shall be furnished at all take-off points for odor control ductwork where shown in contract drawings.
 - 2. Material: FRP and of the same resin used for the ductwork.
 - 3. Blast gates shall be single blade, ultra low leak, corrosion resistant and suitable for operating in the service conditions above.
 - 4. All blast gates shall be equipped with manual type operators.
 - a. Provide a means of locking the gate in place once the odor control system has been balanced.
 - 5. Blast gates shall be designed to be serviced without removal from the system.
- J. Accessories:
- 1. Extra Tappings:
 - a. Test port tappings shall be positioned as necessary for air balancing. Manufacturer shall ensure tapping points are accessible for measurement.
 - b. Drain tappings shall be positioned as indicated on Drawings. Drains shall be FRP threaded couplings glassed into the bottom of the duct. The fitting shall be trimmed flush with the interior surface of the duct and the duct shall be recoated at the connection.
 - 2. Hangers and Supports:
 - a. System design for supports shall include snow, wind, thermal and seismic loads as specified in the building code and as indicated on the Drawings.
 - b. All hangers and supports shall be manufactured from aluminum for corrosion resistance, unless shown otherwise on the Drawings.
 - c. Saddles, guides, sleeves, sleeve liners, etc. shall be provided as recommended by the Manufacturer and meeting Design Detail requirements in the Drawings.
 - d. Design the necessary supports to ensure maximum deflection of 1/2 PCT of duct diameter.
 - e. All duct hangers shall be provided per SMACNA recommendations and the requirements of the Manufacturer. Hangers are to be securely fastened to avoid vibration and care shall be taken to install hangers so as to avoid creating conditions of stress in the finished installation.
 - f. Supports shall be designed to accommodate thermal expansion of the FRP ducts for a temperature range of 100 DEGF through the use of sliding surfaces or location of expansion joints.

2.4 SOURCE QUALITY CONTROL

- A. Factory inspection: Inspect fabrications for required construction, intended function, and conformance with referenced standards.
- B. Inspection of products is required prior to shipment, unless specifically waived in writing by Engineer.
- C. Notify Engineer one week prior to estimated date of factory inspection.
- D. Engineer has the option to test FRP duct materials and inspect the manufacturing facility at any time to assure compliance with specifications.

PART 3 - EXECUTION

3.1 DESIGN

- A. Project Engineer's Bidding Drawings contain information on duct support locations which are only estimates. Duct support design shall be the responsibility of the Duct supplier and Contractor. Sealed layout drawings are to be provided for review and approval prior to fabrication and installation.
- B. Coordinate final location of supports may be affected by below grade piping or utilities.

3.2 INSTALLATION

- A. Install duct systems as shown on plans in conformance with duct manufacturer's instructions.
 - 1. The manufacturer shall have a qualified employee at the job site to instruct the Contractor's personnel in proper installation procedures for a minimum of three days.
 - 2. Instruction should include review of material safety data sheets as well as storage and handling of materials.
 - 3. Install to the lines and grades shown on the Drawings and approved duct layout submittals.
 - 4. Whenever duct laying is stopped, close open end of the duct with an end board closely fitting the end of the duct to keep foreign material out of the duct.
- B. Field joints:
 - 1. Field assembly joints must be completed in a neat and orderly manner, in compliance with manufacturer's instructions.
 - 2. Provide material for each field joint in kit form. One kit shall make one joint.
 - 3. Make field joints only when temperature is between 40 and 100 DEGF.
 - 4. Provide craftsmen who are trained and certified by the manufacturer to perform field joints.
 - 5. The Engineer shall inspect the first field joint made for quality purposes. No additional field joints shall be made without approval of the Engineer. The first joint will set the quality standard for all subsequent joints.
- C. After laminate inspection has been completed, touch-up duct with field applied resin gel coat. Match color to factory applied gel coat, using resin supplied from duct manufacturer. Obtain Engineer's approval for uniform quality of field and factory applied gel coats.

3.3 FIELD QUALITY CONTROL

- A. Testing:
 - 1. Testing shall not start without an approved leak testing procedure from the Duct Supplier. Unless otherwise approved in this procedure the following is required.
 - 2. Prior to testing, pressurize system to 1.0 PSI and survey all joints for audible or visual leaks.
 - a. Repair/seal as necessary to seal all audible leaks.
 - 3. After all audible leaks have been eliminated, test duct system at 0.75 PSI pressure with air for one hour.
 - 4. Pressure drop during test shall be less than 5 PCT.
 - 5. Repair all leaks and repeat test.
 - 6. Determine leakage by loss of pressure.

7. Plug or cap branch lines as required during testing.
 8. All testing shall be at the expense of the Contractor.
- B. Identification:
1. Identify each shop fabricated duct section with a permanent marker on the inside near the ends.
 2. Project Engineer has option to test FRP duct during construction to ensure compliance with specifications.
- C. Engineer has the option to require testing of FRP duct materials and inspect the manufacturing facility at any time to assure compliance with specifications.

END OF SECTION

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SECTION 40 41 13
HEAT TRACING CABLE

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Design and provisions of heat tracing cable system as required for heat tracing of systems and piping systems including but not limited to piping, valves, appurtenances, accessories, etc. as indicated on the Drawings and described herein.
- B. Related Sections include but are not necessarily limited to:
 - 1. Division 00 - Procurement and Contracting Requirements.
 - 2. Division 01 - General Requirements.
 - 3. Section 26 05 00 - Electrical - Basic Requirements.
 - 4. Section 40 42 00 - Pipe, Duct and Equipment Insulation.

1.2 QUALITY ASSURANCE

- A. Referenced Standards:
 - 1. NECA 202, Standard for Installing and Maintaining Industrial Heat Tracing Systems (ANSI).
 - 2. National Electrical Manufacturers Association (NEMA):
 - a. 250, Enclosures for Electrical Equipment (1000 Volts Maximum).

1.3 SYSTEM DESCRIPTION

- A. Design and provide complete, fully-functional heat trace system. System includes but is not limited to the following: overcurrent protection, circuit breaker, enclosures, controllers, conduit, required for complete, fully-functional system. Provide and coordinate piping insulation with heat trace. Heat trace is required at the following locations and systems:
 - 1. Digester 4 and Waste Gas Burner Areas:
 - a. Provide heat tracing on all exposed, above grade piping and appurtenances for freeze protection and rated for area classification, as noted on the Drawings.

1.4 SUBMITTALS

- A. Shop Drawings:
 - 1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
 - 2. Product technical data:
 - a. Power requirements for each circuit based upon actual length of heat trace and maintained temperature.
 - b. Circuit breaker:
 - 1) Type.
 - 2) Rating.
 - 3) Rating based upon inrush current at minimum expected start-up temperature.
 - c. Length of heat tape for each pipe size and run.
 - d. Type of heat trace for each system.
 - e. Thermostats.
 - f. Temperature setpoint for each thermostat and system.
 - g. Coordinate and verify length and Watts/FT of heat tape required based upon pipe size, accessories, and insulation thickness.
 - 1) Include the calculations to support the heat tape output.
 - h. Bill of Materials.
 - i. Provide technical data in schedules.

- j. Annotated panelboard schedules showing heat trace system equipment, devices, components, and accessories.
- k. See Section 26 05 00 for additional requirements.
- 3. Fabrication and/or layout drawings:
 - a. Wiring diagrams showing physical locations of thermostats and heat trace power supply.
- B. Contract Closeout Information:
 - 1. Operation and Maintenance Data:
 - a. See Specification Section 01 33 04 for requirements for the mechanics, administration, and the content of Operation and Maintenance Manual submittals.
- C. Informational Submittals:
 - 1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
 - 2. Test reports: Megger test results.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Shall be stored such that they are not exposed to sunlight or other UV rays.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with the Contract Documents, the following Manufacturers are acceptable:
 - 1. Thermon.
 - 2. Chemelex Division; Raychem Corp.
 - 3. Chromalox.
- B. Submit request for substitution in accordance with Specification Section 01 25 13.

2.2 HEAT TRACING

- A. Design Parameters:
 - 1. Pipe diameter, length and material: See Drawings and relevant piping Specifications.
 - 2. Flange, valve, pipe support size: See Drawings and relevant piping Specifications.
 - 3. Pipe insulation type and thickness: See Drawings and relevant piping Specifications.
 - 4. Temperatures requirements:
 - a. Low ambient temperature for the specific location: -40 DEGF.
 - b. Start-up temperature (alarm thermostat set point):
 - 1) Water/wastewater lines: 35 DEGF.
 - c. Maintain temperature:
 - 1) Water/wastewater lines: 40 DEGF.
 - d. Power thermostat setpoint: 45 DEGF.
 - 5. Wind factor for the specific location: 50 MPH.
 - 6. Electrical requirements:
 - a. Voltage: 120 V.
 - b. Circuit breaker: Field coordinate if other than 20A GFEPFI type.
 - 7. Safety factor: 10 PCT.
 - 8. System rated for area classification.
- B. Self-regulating or power-limiting parallel circuit construction consisting of an inner core of conductive material between parallel copper bus wires, with inverse temperature - conductivity characteristics with metal overbraid.
- C. Thermostats adjustable between 0 and 140 DEGF minimum with maximum differential range of 3 DEGF, furnished complete with enclosures (NEMA 4X in unclassified areas and NEMA 7 in classified areas) in all areas, stainless steel temperature bulb and capillary.

- D. End seals:
 - 1. Provide for each run of heat trace.
 - 2. Illuminated.
 - a. Green light shall indicate that heat trace is ready.
 - b. Red light shall indicate the heat trace is energized.
- E. Circuit breaker:
 - 1. GFEPFI Type.
 - 2. Compatible with panelboard.
 - 3. Current ratings as required.
- F. All necessary or required components and accessories, such as power connection boxes, end seals, straps, tape and fitting brackets.
- G. In noncorrosive and nonhazardous locations, insulation shall be Polyolefin.
- H. In corrosive, hazardous and hydrocarbon locations insulation shall be Fluoropolymer (Teflon).
- I. Pilot light indicating alarm status.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Install materials after piping has been tested and approved.

3.2 INSTALLATION

- A. Insulate and heat trace wet pipe systems as indicated on Drawings.
- B. Install materials in accordance with manufacturer's instructions.
 - 1. Each circuit shall not exceed the manufacturer's recommended maximum length.
- C. For Metallic Piping:
 - 1. Heat tracing shall be installed completely wired.
 - 2. Cut heat trace to lengths as required and secure to pipe with glass or polyester fiber tape.
- D. For Nonmetallic Piping:
 - 1. Allow for extra heat trace output because nonmetallic pipe has a lower heat transfer.
 - a. Heat tracing shall be installed completely wired.
 - 2. Cut heat trace to lengths as required and secure to pipe with a aluminum tape throughout the length of the trace.
- E. Protection and Control Requirements:
 - 1. Protection by a GFEPFI circuit breaker.
 - a. Breaker amperage rating shall be coordinated with Contractor when different than the Contract Drawings.
 - 2. Provide two line sensing thermostats, one for power and one for a alarm.
 - 3. The alarm thermostat shall be placed on the opposite end of the circuit from the power thermostat or power connection to allow for an annunciation of partial failure of a circuit or the loss of power from a tripped GFEPFI circuit breaker.
 - 4. Provide a monitoring module that monitors the voltage (circuit breaker status) to each circuit.
 - 5. The alarm from the alarm thermostat and monitor module shall be annunciated on the indicated control system.

3.3 TESTING

- A. Megger the cables at the manufacturers recommended voltage level three times.
 - 1. Before installation.
 - 2. After attachment to pipe but before insulation is installed.
 - 3. After pipe insulation is installed but before energization.

END OF SECTION

SECTION 40 42 00
PIPE, DUCT AND EQUIPMENT INSULATION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Insulation:
 - a. Piping insulation.
 - b. Duct insulation.
 - c. Equipment insulation.
 - 2. Adhesives, mastics, sealants, and finishes.
 - 3. Grease and air ventilation duct wrap fire protection systems.
- B. Related Specification Sections include but are not necessarily limited to:
 - 1. Division 00 - Procurement and Contracting Requirements.
 - 2. Division 01 - General Requirements.
 - 3. Section 23 52 00 - Boilers.
 - 4. Section 40 05 07 - Pipe Support Systems.
 - 5. Section 40 05 25 - Pipe - Underground, Prefabricated, Insulated and Jacketed.

1.2 QUALITY ASSURANCE

- A. Referenced Standards:
 - 1. ASTM International (ASTM):
 - a. C177, Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of Guarded-Hot-Plate Apparatus.
 - b. C411, Standard Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation.
 - c. C423, Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method.
 - d. C553, Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications.
 - e. C612, Standard Specification for Mineral Fiber Block and Board Thermal Insulation.
 - f. C1071, Standard Specification for Fibrous Glass Duct Lining Insulation (Thermal and Sound Absorbing Material).
 - g. D1056, Standard Specification for Flexible Cellular Materials-Sponge or Expanded Rubber.
 - h. E96, Standard Test Methods for Water Vapor Transmission of Materials.
 - i. F25, Standard Test Method for Sizing and Counting Airborne Particulate Contamination in Cleanrooms and Other Dust-Controlled Areas.
 - j. C518, Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus.
 - k. E84, Standard Test Method for Surface Burning Characteristics of Building Materials.
 - l. E119 Standard Method of Fire Tests of Building Construction, 2 Hour Wall Panel Test, 2 Hour External Total Engulfment Test, hose stream evaluation.
 - m. E136, Combustion Characteristics of Building Materials in a Vertical Tube Furnace.
 - n. E162, Surface Flammability of Materials.
 - o. E814, Through-Penetration, 2-Hour Firestop Test.
 - p. E2336: Standard Test Methods Fire Resistive Grease Duct Enclosure Systems.
 - 2. ISO 6944-1985, Method of Determining Fire Resistance of Ventilation Ducts.
 - 3. National Fire Protection Association (NFPA):
 - a. 255, Standard Method of Test of Surface Burning Characteristics of Building Materials.
 - 4. Underwriters Laboratories, Inc. (UL):
 - a. 723, Standard for Test for Surface Burning Characteristics of Building Materials.

5. National Commercial and Industrial Insulation Standards (2013 seventh edition).
 - a. Published by Midwest Insulation Contractors Association (MICA).
 - b. Endorsed by National Insulation Association (NIA).
 - c. MICA plate numbers listed in this specification reference this document.

1.3 SUBMITTALS

- A. Shop Drawings:
 1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
 2. Product technical data including:
 - a. Acknowledgement that products submitted meet requirements of standards referenced.
 - b. Manufacturer's installation instructions.
 - c. Submit complete specification of insulation materials, adhesives, cement, together with manufacturer's recommended methods of application and coverage for coatings and adhesives.
 3. Submit itemized schedule by building of proposed insulation systems showing density, thermal conductivity, thickness, adhesive, jackets and vapor barriers.
 4. Certifications: Products will meet the requirements of the Contract Documents.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
 1. Elastomeric insulation:
 - a. Rubatex.
 - b. Armstrong.
 2. Fiberglass insulation:
 - a. CertainTeed Corporation.
 - b. Johns Manville.
 - c. Owens Corning.
 - d. Knauf.
 3. PVC jacket:
 - a. Ceel-Co.
 - b. PIC Plastics.
 4. Equipment insulation:
 - a. CertainTeed Corporation.
 - b. Johns Manville.
 - c. Owens Corning.
 5. Ductwork insulation:
 - a. CertainTeed.
 - b. Johns Manville.
 - c. Owens Corning.
 6. High density perlite:
 - a. Johns Manville.
 - b. Industrial Insulation Group (LIC).
 7. High density calcium silicate:
 - a. Industrial Insulation Group (LIC).
 8. Adhesives, mastics, sealants, and finishes:
 - a. Foster Products.
 - b. Childers.
 - c. Dow Corning.
 - d. Johns Manville.
 - e. Knauf.

B. Submit request for substitution in accordance with Specification Section 01 25 13.

2.2 PIPING INSULATION - ELASTOMERIC

A. General:

1. Insulation fire and smoke hazard ratings for composite (insulation, jacket or facing, and adhesive used to adhere the facing or jacket to the insulation), as tested by procedure ASTM E84, NFPA 255 and UL 723, not exceeding:
 - a. Flame spread: 25.
 - b. Smoke developed: 50.
2. Accessories (adhesives, mastics, cements, and tapes: Same component ratings as listed above.
3. Indicate on product labels or their shipping cartons: Flame and smoke ratings do not exceed above requirements.
4. Permanent treatment of jackets or facings to impart flame and smoke safety is required.
 - a. Water-soluble treatments are prohibited.
5. Insulated shields at pipe support points.

B. Pipe, Fitting, and Valve Insulation:

1. Flexible elastomeric closed cell pipe insulation.
 - a. Average thermal conductivity not to exceed 0.27 (BTU-IN)/(HR-FT²-DEGF) at mean temperature of 75 DEGF, temperature range -40 to 220 DEGF; permeability not to exceed 0.20 by ASTM E96; water absorption 3 PCT by ASTM D1056 and ozone resistance.
2. Provide minimum insulation thickness conforming to schedules or as shown on the Drawings.

2.3 PIPING INSULATION - FIBERGLASS

A. Pipe and Fitting Insulation:

1. Preformed fiberglass pipe insulation:
 - a. Density: 4 LBS/CUFT.
 - b. Temperature rated: 650 DEGF.
 - c. Average thermal conductivity not to exceed 0.23 (BTU-IN)/(HR-FT²-DEGF) at mean temperature of 75 DEGF.
 - d. Fire hazard rating:
 - 1) UL 723, ASTM E84, NFPA 255.
 - 2) Flame spread not exceeding 25 and smoke developed not exceeding 50.
2. Moisture adsorption:
 - a. ASTM C553.
 - b. Not greater than 5 PCT moisture by volume when exposed to moisture laden air at 120 DEGF and 96 PCT RH.
3. Fungi and bacteria resistance:
 - a. ASTM C665.
 - b. Does not breed or promote growth.
 - c. Flame attenuated glass fibers bonded with thermosetting resin.
4. Piping jackets (general applications):
 - a. Aluminum: 16 MIL embossed aluminum.
 - b. PVC: Preformed 0.028 IN thick PVC jackets fabricated from B.F. Goodrich PVC sheeting V-66 with proven resistance to ultraviolet degradation when temperatures do not exceed the limits of PVC.
 - c. Piping jacket not required on concealed piping.
5. Provide minimum insulation thickness conforming to schedules or as shown on the Drawings.

2.4 PIPE INSULATION INSERTS AT HANGERS

- A. High Density Perlite:
 - 1. Pre-formed.
 - 2. Fire hazard rating:
 - a. UL 723, ASTM E84, NFPA 255.
 - b. Flame spread: Zero.
 - c. Smoke developed: Zero.
 - 3. Average density: 13 LBS/CUFT.
 - 4. Compressive strength: 80 PSI to produce 5 PCT compression.
 - 5. Maximum surface temperature: 1,200 DEGF.
- B. High Density Calcium Silicate:
 - 1. Pre-formed.
 - 2. Fire hazard rating:
 - a. UL 723, ASTM E84, NFPA 255.
 - b. Flame spread: Zero.
 - c. Smoke developed: Zero.
 - 3. Average density: 14 LBS/CUFT.
 - 4. Compressive strength: 100 PSI to produce 5 PCT compression.
 - 5. Maximum surface temperature: 1,200 DEGF.

2.5 EQUIPMENT INSULATION

- A. Insulation for Equipment:
 - 1. Fire hazard classification:
 - a. UL 723, ASTM E84, NFPA 255.
 - b. Flame spread not exceeding 25 and smoke developed not exceeding 50.
 - 2. Provide minimum insulation thickness conforming to Schedules, or as shown on Drawings.

2.6 DUCTWORK INSULATION: FIBERGLASS

- A. Flexible Insulation:
 - 1. Material: Commercial-grade fiberglass thermal insulation, formaldehyde free.
 - 2. Scheduled thickness and installed R-value. Installed R-value when compressed to a maximum of 25 PCT following recommended duct wrap stretch outs.
 - 3. Factory-applied foil scrim vapor barrier facing.
 - 4. Average thermal conductivity not to exceed 0.27 (BTU-IN)/(HR-FT²-DEGF) at a mean temperature of 75 DEGF (installed).
 - 5. Fungi and bacteria resistance:
 - a. ASTM C1338.
 - b. Does not breed or promote growth.
 - 6. Fire hazard classification:
 - a. UL 723, ASTM E84, NFPA 255.
 - b. Flame spread not exceeding 25 and smoke developed not exceeding 50.
 - 7. Basis of design: Johns Manville Microlite fiberglass duct wrap insulation.
- B. Semi-Rigid Insulation for Indoor Installation:
 - 1. Scheduled thickness and R-value.
 - 2. Factory applied vapor barrier facing-white scrim foil.
 - 3. Average thermal conductivity not to exceed 0.23 (BTU-IN)/(HR-FT²-DEGF) at a mean temperature of 75 DEGF.
 - 4. Fungi and bacteria resistance:
 - a. ASTM C1338.
 - b. Does not breed or promote growth.
 - 5. Moisture adsorption:
 - a. ASTM C553.
 - b. Not greater than 0.5 PCT moisture by volume when exposed to moisture laden air at 120 DEGF and 96 PCT RH.

- C. Semi-Rigid Insulation for Outdoor Installation:
 1. Scheduled thickness and R-value.
 2. Factory-applied foil scrim vapor barrier facing.
 3. Average thermal conductivity not to exceed 0.23 (Btu-IN)/(HR-FT²-DegF) at mean temperature of 75 DEGF.
 4. Minimum density: 3 LBS/CUFT.
 5. Fungi and bacteria resistance:
 - a. ASTM C1338.
 - b. Does not breed or promote growth.
 6. Basis of Design: JohnsManville #815 SPIN-GLASS fiberglass duct insulation.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. General:
 1. Piping below ground covered with earth will not be insulated except as specified in Specification Section 4005 25.
 2. Consider ductwork, piping and equipment as exposed, except as otherwise indicated.
 3. Consider ductwork, piping and equipment in walls, partitions, floors, pipe chases, pipe shafts and duct shafts as concealed.
 - a. Consider ductwork, piping and equipment above ceilings as concealed.
 4. Provide release for insulation application after installation and testing is complete.
 - a. Apply insulation on clean, dry surfaces after inspection.
 5. Provide insulation continuous through wall, roof and ceiling openings, pipe hangers, supports and sleeves.
 6. Provide insulation with vapor barrier for piping, ductwork and equipment where surfaces may be cooler than surrounding air temperatures.
 - a. Provide vapor barrier (0.17 perm-IN; ASTM C553) continuous and unbroken.
 - b. Hangers, supports, anchors, and related items that are secured directly to cold surfaces must be adequately insulated and vapor-sealed to prevent condensation.
 7. Apply specified adhesives, mastics and coatings at the manufacturer's recommended coverage per unit volume.
- C. Piping Insulation - Elastomeric:
 1. Do not insulate until satisfactory completion of required pressure testing.
 2. Apply insulation to clean, dry surfaces.
 3. Slip insulation on pipe prior to connection.
 - a. Whenever the slip-on technique is not possible provide insulation neatly slit and snapped over the pipe.
 4. Fabricate and install fitting cover insulation according to manufacturer's recommendations.
 5. Seal joints, slits, miter-cuts and other exposed edges of insulation with a adhesive, recommended by the insulation manufacturer, to ensure complete vapor barrier.
- D. Piping Insulation - Fiberglass:
 1. Apply over clean dry pipe.
 - a. Butt all joints together firmly.
 2. Seal joints, slits, miter-cuts and other exposed edges of insulation as recommended by the insulation manufacturer.
 3. Insulate fittings, valves, and flanges with insulation thickness equal to adjacent pipe.
 4. PVC pipe jacket:
 - a. Apply jacketing with a minimum of 1 IN overlap.
 - 1) Weld longitudinal and circumferential seams with a adhesives as recommended by manufacturer.

- b. Provide slip-joints every 30 FT and between fittings if distance exceeds 8 FT.
 - 1) Construct slip-joints by overlapping jacket sections 6 to 10 IN.
- c. Provide pre-molded PVC covers of same material and manufacturer as jacket for fittings, valves, flanges, and related items in insulated piping systems.
- 5. Aluminum pipe jacket:
 - a. Field-applied aluminum jacket with vapor-sealed longitudinal and butt joints.
 - b. Provide smooth and straight joint with a minimum 2 IN overlap.
 - c. Secure joints with corrosion-resistant screws spaced 0.25 to 0.50 IN back from edge.
 - d. Center spacing of screws 5 IN maximum or as required to provide smooth tight-fitted joints.
 - e. Place joints on least exposed side of piping to obtain neat appearance.
- E. Equipment: Install per manufacturer's instructions.
- F. Ductwork Insulation - Fiberglass:
 - 1. Flexible insulation:
 - a. Butt edges tightly.
 - 1) Secure insulation with Benjamin Foster 85-20 adhesive applied in 6 IN strips on 12 IN centers and/or pins, applied on not more than 18 IN centers so that the insulation conforms to the duct surfaces uniformly and firmly.
 - b. Seal joints with facing overlap or 4 IN wide strips of like facing material adhered and stapled in place.
 - c. Properly seal any penetration in vapor barrier facing with Benjamin Foster 85-20.
 - d. Cut insulation slightly longer than the perimeter of the duct to ensure full thickness at corners.
 - 2. Semi-rigid insulation and duct interior lining board:
 - a. Impaling over pins.
 - 1) Apply insulation with edges tightly butted.
 - 2) Apply insulation with mechanically welded fasteners to the duct and secured with speed clips.
 - 3) Clip pins off close to clip.
 - 4) Space pins as required to hold insulation firmly against duct surface but not less than one pin per 1.5 SQFT.
 - 5) Seal joints and speed clips with 3 IN wide strip of facing adhered with Benjamin Foster 85-20 adhesive.
 - b. If the welded pin method is impossible, secure insulation to the duct with Benjamin Foster 85-20 adhesive.
 - 1) Cover the entire surface of duct with adhesive.
 - 2) Use corner metal angle to protect edge of insulation.
 - 3) Protect edge of insulation.
 - 4) Seal joints as above.
 - c. For outdoor application finish with Benjamin Foster #4610 weatherproof mastic with white glass fabric membrane.
- G. Install interior duct lining board as indicated above.
 - 1. Overall length shall be as indicated on the Drawings or a minimum of 10 LF past any type of air supply fan.

3.2 REPAIR

- A. Whenever any factory applied insulation or job-applied insulation is removed or damaged, replace with the same quality of material and workmanship.

3.3 SCHEDULES

- A. Refrigeration Lines (35-60 DEGF):
 - 1. Elastomeric.
 - 2. 1/2 IN thickness for lines 1 IN and smaller.

B. Pipe, Fittings and Valves:
 1. Fiberglass.

APPLICATION	PIPE SIZE	THICKNESS	JACKET
Roof Drainage	2-1/2 to 6 IN	1/2 IN	PVC
Hot Water (domestic)	1-1/2 IN and less	1 IN	PVC
	Over 1-1/2 IN	1-1/2 IN	PVC
Cold Water (domestic)	All sizes	1 IN	PVC
Heating Water (120 - 230 DEGF)	1-1/2 IN and less	1-1/2 IN	Alum
	Over 1-1/2 IN	2 IN	Alum
Refrigeration Lines (35 - 60 DEGF)	All	1 IN	PVC
Exterior Exposed Water (hot or cold)	2 IN and less	2 IN	Alum
Exterior Digester Piping (digester gas, foam separator drain, hot recirculated digester sludge, and digester overflow)	6 IN and less	2 IN	Alum

C. Equipment:

EQUIPMENT	INSULATION SYSTEM
Hot water and steam, heating equipment, heat exchangers, air separators, strainers, condensate, receivers	2 IN fiberglass insulation. Glass mesh jacket adhered and coated with two coats of Foster 30-36 white insulation coatings.
Hot water pumps, flash tanks, compression tanks	Uninsulated
Below drain pans serving cooling coils, pre-heat systems, domestic water heaters	1 IN flexible elastomeric closed cell sheet.
Emergency generator exhaust pipe and muffler and boiler breeching	2-1/2 IN mineral wool 1200 DEGF or equal held in place with stainless steel bands. Field applied 0.05 IN aluminum jacket. Aluminum jacket not to exceed 150 DEGF.
Cold water meter	Uninsulated
Boiler and smoke stack	Conform to Specification Section 23 52 00

- D. Ductwork:
 1. Fiberglass.

DUCT SERVICE	INSULATION AND THICKNESS	MINIMUM R-VALUE (HR-FT ² -DEGF)/BTU
Outside air ducts, inside building, including intake and exhaust plenums between louver and fan.	2-1/2 IN semi-rigid with vapor barrier	12.0
Supply air ducts inside building	2 IN flexible with vapor barrier	6.0
All other ductwork	Uninsulated	N/A

END OF SECTION

SECTION 40 61 13
PROCESS CONTROL SYSTEMS GENERAL REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Basic requirements for complete instrumentation system for process control.
- B. Related Specification Sections include but are not necessarily limited to:
 - 1. Division 00 - Procurement and Contracting Requirements.
 - 2. Division 01 - General Requirements.
 - 3. Section 10 14 00 - Identification Devices.
 - 4. Section 40 67 00 - Control System Equipment Panels and Racks.

1.2 QUALITY ASSURANCE

- A. Referenced Standards:
 - 1. The International Society of Automation (ISA):
 - a. 7.0.01, Quality Standard for Instrument Air.
 - b. S5.1, Instrumentation Symbols and Identification.
 - c. S5.3, Graphic Symbols for Distributed Control/Shared Display Instrumentation, Logic and Computer Systems.
 - d. S20, Standard Specification Forms for Process Measurement and Control Instruments, Primary Elements and Control Valves.
 - 2. National Electrical Manufacturers Association (NEMA):
 - a. 250, Enclosures for Electrical Equipment (1000 Volts Maximum).
 - 3. National Fire Protection Association (NFPA):
 - a. 70, National Electrical Code (NEC).
 - 4. Underwriters Laboratories, Inc. (UL):
 - a. 913, Standard for Safety, Intrinsically Safe Apparatus and Associated Apparatus for Use in Class I, II, and III, Division 1, Hazardous (Classified) Locations.
- B. Qualifications:
 - 1. System Integrator:
 - a. The Control System Integrator shall be selected by the Contractor from the following acceptable companies (Alphabetical Listing):
 - 1) ControlFreek Inc. – Spokane Valley, Washington
 - 2) Industrial Systems, Inc. – Vancouver, Washington
 - 3) L2 Systems LLC – Everett, Washington
 - 4) Process Solutions Inc. – Stanwood, Washington
 - 5) Quality Control Corporation (QCC) – Lynnwood, Washington
 - 6) Systems Interface Inc. – Mukilteo, Washington
 - 7) Taurus Power and Controls, Inc. – Tualatin, Oregon
 - 8) Technical Systems, Inc. – Lynnwood, Washington
 - 9) TotalEnergy Management Inc. – Richland, Washington
 - b. Alternative system integrators not listed above shall be considered for acceptability by the Owner and Control System Programmer prior to award. For consideration, submit sufficient materials showing completion of projects in the last 5 years of similar magnitude in scope including references from the projects, show the manufacturing and assembly is within a 175-mile drive from Wenatchee, Washington, provide documentation showing all employees to perform work on the project have 5 years of experience with included resumes, and other information ascertaining the company's ability to perform the work.

- C. Miscellaneous:
 - 1. Comply with electrical classifications and NEMA enclosure types shown on Drawings.

1.3 DEFINITIONS

- A. Calibrate: To standardize a device so that it provides a specified response to known inputs.
- B. Hazardous Areas: Class I, II or III areas as defined in NFPA 70.
- C. Highly Corrosive and Corrosive Areas: Rooms or areas identified on the Drawings where there is a varying degree of spillage or splashing of corrosive materials such as water, wastewater or chemical solutions; or chronic exposure to corrosive, caustic or acidic agents, chemicals, chemical fumes or chemical mixtures.
- D. Intrinsically Safe Circuit: A circuit in which any spark or thermal effect is incapable of causing ignition of a mixture of flammable or combustible material in air under test conditions as prescribed in UL 913.
- E. System Integrator: A single company subcontracted by the Contractor, who shall design and furnish the system, provide the instrument panels; provide the PLCs, RTU, startup, training services, and other instrument components.
- F. Control System Programmer: A single firm, pre-selected and contracted by the owner, who shall furnish all programming, startup and training services related to programming. The Control System Programmer shall be RH2 Engineering, Inc.

1.4 SYSTEM DESCRIPTION

- A. Control System Requirements:
 - 1. This Specification Section provides the general requirements for the control system.
 - 2. The control system consists of all primary elements, transmitters, switches, controllers, computers, communication devices, recorders, indicators, panels, signal converters, signal boosters, amplifiers, special power supplies, special or shielded cable, special grounding or isolation, auxiliaries, software, wiring, and other devices required to provide complete control of the plant as specified in the Contract Documents.
- B. Utilization of System Integrator:
 - 1. Utilize a System Integrator to provide a fully functioning control system.
 - a. The System Integrator shall be responsible for the provision of an integrated control system fully functioning in accordance with the requirements of the Contract Documents. Responsibilities include:
 - 1) Provision of, and the detailed design of, custom control panels. The plans show general layout of the control panels. The Integrator shall provide detailed scaled design of all components on and in the control panels and determine specific requirements.
 - 2) The design of all interconnecting wiring of control equipment including remote control panels, packaged equipment panels, mechanical equipment with control components, etc.
 - 3) Testing of the control panels in the Control System Integrator's shop.
 - 4) Coordinate with the Contractor for specific requirements and locations of raceway penetrations and field wiring in control panels.
 - 5) The Control System Integrator shall supply the Contractor with all necessary detailed installation plans and/or written instruction for installation of all control components and sensing devices for proper system operation.
 - 6) Coordinate with the Control System Programmer who has been selected by the Owner and are under separate contract with the Owner, to allow in-shop testing of the programming of all control devices and to execute the functions listed in the control strategies.
 - 7) Develop an assembly and testing schedule, with the Control System Programmer to allow for testing of all new programs in the Control System Integrator's shop.

- 8) Provide installation assistance.
2. Provide all required coordination of instrumentation with other work to ensure that necessary wiring, conduits, contacts, relays, converters, and incidentals are provided in order to transmit, receive, and control necessary signals to other control elements, to control panels, and to receiving stations.

1.5 SUBMITTALS

A. Shop Drawings:

1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
2. Submittals shall be original printed material or clear unblemished photocopies of original printed material.
 - a. Facsimile information is not acceptable.
3. Limit the scope of each submittal to one Specification Section.
 - a. Each submittal must be submitted under the Specification Section containing requirements of submittal contents.
 - b. Do not provide any submittals for Specification Section 40 61 13.
4. Product technical data including:
 - a. Equipment catalog cut sheets.
 - b. Instrument data sheets:
 - 1) ISA S20 or approved equal.
 - 2) Separate data sheet for each instrument type.
 - c. Materials of construction.
 - d. Minimum and maximum flow ranges.
 - e. Pressure loss curves.
 - f. Physical limits of components including temperature and pressure limits.
 - g. Size and weight.
 - h. Electrical power requirements and wiring diagrams.
 - i. NEMA rating of housings.
 - j. Submittals shall be marked with arrows to show exact features to be provided.
5. Comprehensive asset inventory of all networked components:
 - a. Provide in Excel spreadsheet format.
 - b. Coordinate with the Owner or Engineer to determine the preferred method of delivery to assure security of information contained in a asset inventory.
 - c. Include:
 - 1) Device ID.
 - 2) Manufacturer.
 - 3) Model Number.
 - 4) Serial Number.
 - 5) MAC Address.
 - 6) IP Address; to be provided by the Control System Programmer.
 - 7) Device Use description.
 - 8) Firmware.
6. Comprehensive set of wiring diagrams as specified in Section 40 67 00.
7. Panel fabrication drawings as specified in Section 40 67 00.
8. RTU equipment drawings.
9. Nameplate layout drawings.
10. Drawings, systems, and other elements are represented schematically in accordance with ISA S5.1 and ISA S5.3.
 - a. The nomenclature, tag numbers, equipment numbers, panel numbers, and related series identification contained in the Contract Documents shall be employed exclusively throughout submittals.
11. All panel and wiring drawings shall be provided in both hardcopy and softcopy.
 - a. Furnish electronic files on owner's designated electronic media.
 - b. Drawings in AUTOCAD format.

12. Provide a parameter setting summary sheet for each field configurable device.
 13. Certifications:
 - a. Documentation verifying that calibration equipment is certified with NIST traceability.
 - b. Approvals from independent testing laboratories or approval agencies, such as UL, FM or CSA.
 - 1) Certification documentation is required for all equipment for which the specifications require independent agency approval.
 14. Testing reports: Source quality control reports.
- B. Qualifications Submittal:
1. Documentation verifying contractor/subcontractor adherence to specified certifications and qualifications
- C. Contract Closeout Information:
1. Operation and Maintenance Data:
 - a. See Specification Section 01 33 04 for requirements for the mechanics, administration, and the content of Operation and Maintenance Manual submittals.
 2. All Shop Drawings shall be modified with as-built information/corrections.
 3. Instrumentation and Control Equipment Operation and Maintenance Manual Content:
 - a. Provide a printed copy of the following sheets following the Equipment Record sheets or ISA Data Sheets.
 - 1) Loop Check-out Sheet.
 - 2) Instrument (calibration) Certification Sheet.
 - 3) Final Control Element (i.e. control valve) Certification Sheet.
 - b. Provide the following detailed information:
 - 1) Use equipment tag numbers from the Contract Documents to identify equipment and system components.
 - 2) As-constructed fabrication or layout drawings and wiring diagrams.
 - 3) Spreadsheet containing all network devices and their associated MAC and IP addresses and username/password list.
 - a) Coordinate with the Owner or Engineer to determine the preferred method of delivery to assure security of this information.
 - c. Additional information as required in the associated equipment or system Specification Section.
 4. Warranties: Provide copies of warranties and list of factory authorized service agents.
 5. Schedules:
 - a. The Contractor shall prepare factory and field test procedures to demonstrate conformance of the complete system to this specification. The Contractor shall submit the detailed test procedures within eight weeks after the notice to proceed for the Engineer's review and approval.
 - b. The Contractor shall furnish all labor, materials, tools, equipment, instruments and services necessary to perform all specific functional testing of all installed equipment and systems at no additional cost.
 - c. The Control System Integrator and Contractor shall notify the Owner and Engineer (Control System Programmer) of the factory testing date 30 days before testing.
 - d. The Contractor and Control System Integrator shall include in the schedule 3 consecutive working days as part of the factory testing for the Control System Programmer to test the control system software with the hardware supplied by the Control System Integrator at the Control System Integrator's shop.
 - e. The Control System Integrator and Contractor shall submit to the Engineer (Control System Programmer) a detailed field testing schedule identifying each day that both the Control System Integrator and Control System Programmer will need to be on site for field testing of equipment. A preliminary schedule shall be submitted to the Engineer for review 60 days before testing. A final schedule shall be submitted to the Engineer for review 30 days before testing.

- f. The Contractor and Control System Integrator shall include in the construction schedule 10 consecutive working days between the completion of field testing and the startup phase for the Control System Programmer to perform field software testing. Startup shall not proceed until the software field testing is complete.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. See Specification Section 01 65 50.
- B. Do not remove shipping blocks, plugs, caps, and desiccant dryers installed to protect the instrumentation during shipment until the instruments are installed and permanent connections are made.

PART 2 - PRODUCTS

2.1 NEMA TYPE REQUIREMENTS

- A. Provide enclosures/housing for control system components in accordance with the area designations provided on the Drawings.
 - 1. Areas designated as wet: NEMA Type 4X.
 - 2. Areas designated as wet and/or corrosive: NEMA Type 4X.
 - 3. Areas designated as Class I hazardous, Groups A, B, C, or D as defined in NFPA 70:
 - a. NEMA Type 7 unless all electrical components within enclosure utilize intrinsically safe circuitry.
 - 1) Utilize intrinsically safe circuits to the maximum extent practical and as depicted in the Contract Documents.
 - 4. Areas designated as Class II hazardous, Groups E, F, or G as defined in NFPA 70:
 - a. NEMA Type 9 unless all electrical components within enclosure utilize intrinsically safe circuitry.
 - 1) Utilize intrinsically safe circuits to the maximum extent practical and as depicted in the Contract Documents.
 - 5. Either architecturally or non-architecturally finished areas designated as dry, noncorrosive, and nonhazardous: NEMA Type 12.
 - 6. Areas designated to be subject to temporary submersion: NEMA 6P.

2.2 PERFORMANCE AND DESIGN REQUIREMENTS

- A. Unless stated otherwise, system operating criteria are as follows:
 - 1. Stability: After controls have taken corrective action, as result of a change in the controlled variable or a change in setpoint, oscillation of final control element shall not exceed two cycles per minute or a magnitude of movement of 0.5 PCT full travel.
 - 2. Response: Any change in setpoint or change in controlled variable shall produce a corresponding corrective change in position of final control element and become stabilized within 30 seconds.
 - 3. Agreement: Setpoint indication of controlled variable and measured indication of controlled variable shall agree within 3 PCT of full scale over a 6:1 operating range.
 - 4. Repeatability: For any repeated magnitude of control signal, from either an increasing or decreasing direction, the final control element shall take a repeated position within 0.5 PCT of full travel regardless of force required to position final element.
 - 5. Sensitivity: Controls shall respond to setpoint deviations and measured variable deviations within 1.0 PCT of full scale.
 - 6. Performance: All instruments and control devices shall perform in accordance with manufacturer's specifications.

2.3 ACCESSORIES

- A. Provide identification devices for instrumentation system components in accordance with Specification Section 10 14 00.
- B. Provide corrosion resistant spacers to maintain 1/4 IN separation between equipment and mounting surface in wet areas, on below grade walls and on walls of liquid containment or processing areas such as Clarifiers, Digesters, Reservoirs, etc.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Wherever feasible, use bottom entry for all conduit entry to instruments and junction boxes.
- B. Install electrical components per the requirements of the Electrical design.
- C. Panel-Mounted Instruments:
 - 1. Mount and wire so removal or replacement may be accomplished without interruption of service to adjacent devices.
 - 2. Locate all devices mounted inside enclosures so terminals and adjustment devices are readily accessible without use of special tools and with terminal markings clearly visible.

3.2 FIELD QUALITY CONTROL

- A. Maintain accurate daily log of all startup activities, calibration functions, and final setpoint adjustments.
- B. In the event that instrument air is not available during calibration and testing, supply either filtered, dry, instrument quality air from a portable compressor or bottled, dry, instrument quality air.
 - 1. Do not, under any circumstances, apply hydrostatic test to any part of the air supply system or pneumatic control system.
- C. Pneumatic Signal Tubing Testing:
 - 1. Before the leak test is begun, blow clean with dry air.
 - 2. Test signal tubing per ISA 7.0.01, except for tubing runs of less than 10 FT where simple soap bubble testing will suffice.
 - 3. If a leak is detected, repair the leak and repeat the leak test.
 - 4. After completion of the leak test, check each signal line for obstructions.
 - a. If any are indicated, remove and retest.
- D. Instrumentation Calibration:
 - 1. Verify and document that all instruments and control devices are calibrated to provide the performance required by the Contract Documents.
 - a. Utilize the Instrument Certification Sheet located at the end of this Specification Section (or Engineer approved equivalent) to document on-site calibration checks.
 - 2. Factory furnished calibration certifications are acceptable for the following:
 - a. Flow meters.
 - b. Pressure sensors utilized with annular sleeve.
 - c. Temperature sensors.
 - 3. On-site calibration verification is required for all other instruments, including "smart" transmitters that have been factory calibrated.
 - a. Provide calibration checks at 0 PCT, 25 PCT, 50 PCT, 75 PCT and 100 PCT of span for pressure transmitters and gauges.
 - 1) Check for both increasing and decreasing input signals to detect hysteresis.
 - b. In addition to factory calibration certification, temperature sensors and gauges shall be checked at a single point for conformance to required accuracy.
 - c. Level transducers/transmitters shall be checked at two points in addition to zero.

- d. Analytical sensors shall be calibrated in accordance with manufacturer's recommendations.
 - e. Check operation of all switches to verify actuation occurs in accordance with manufacturer's specified accuracy.
 - f. Replace any instrument which cannot be properly adjusted.
 - g. Stroke pneumatic control valves with clean dry air to verify control action, positioner settings, and solenoid functions.
 - 4. Calibration equipment shall be certified by an independent agency with traceability to NIST.
 - a. Certification shall be up-to-date.
 - b. Use of equipment with expired certifications shall not be permitted.
 - 5. Calibration equipment shall be at least three times more accurate as the device being calibrated.
- E. Loop check-out requirements are as follows:
- 1. Check control signal generation, transmission, reception and response for all control loops under simulated operating conditions by imposing a signal on the loop at the instrument connections.
 - a. Use actual signals where available.
 - b. Closely observe controllers, indicators, transmitters, HMI displays, recorders, alarm and trip units, remote setpoints, ratio systems, and other control components.
 - 1) Verify that readings at all loop components are in agreement.
 - 2) Make corrections as required.
 - a) Following any corrections, retest the loop as before.
 - 2. Stroke all control valves, cylinders, drives and connecting linkages from the local control station and from the control room operator interface.
 - 3. Check all interlocks to the maximum extent possible.
 - 4. Utilize the Loop Check-Out Sheet located at the end of this Specification Section (or Engineer approved equivalent) to document on-site calibration checks.
 - 5. In addition to any other as-recorded documents, record all setpoint and calibration changes on all affected Contract Documents and turn over to the Owner.

3.3 HANDS-ON TRAINING

- A. The Control System Integrator shall conduct specifically organized training sessions in operation and maintenance of the control system for personnel employed by the Owner. The training sessions shall be conducted to educate and train the personnel in maintenance and operation of all components of the control system. Training shall include, but not be limited to, the following.
 - 1. Preventative maintenance procedures
 - 2. Trouble-shooting
 - 3. Calibration
 - 4. Testing
 - 5. Replacement of components
- B. At least two separate training sessions, each at least 4 hours in duration, shall be conducted at the facility after start-up of the system.

END OF SECTION



Loop Check-out Sheet

Project Name:		Owner's Project No. (if applicable):	Page _____ of _____
Project Owner:		Regulatory Agency Project No. (if applicable):	
HDR Project No.:		Date:	

LEAK AND TERMINATION/CONTINUITY CHECKS

DESCRIPTION	FIELD					CONTROL CAB	
	LEAK CHECK ₍₁₎			TERM/CONT CHECK ₍₂₎		TERM/CONT CHECK ₍₂₎	
	Device Tag No.	Process Conn.	Signal Tube	Device Tag No.	Termination Ident.	Device Tag No.	Termination Ident.

1. Leak check for pneumatic signal tubing to be per ISA-PR7.1.
2. Termination/continuity check includes check at terminated equipment for: (a) correct polarity, (b) appropriate signal generation, transmission and reception, and (c) correct shield & ground terminations.

OPERATOR INTERFACE CHECK-OUT

MONITORING POINTS OBSERVED

PARAMETER TYPE	TAG NO.	TAG NO.	TAG NO.	TAG NO.	TAG NO.	TAG NO.
PROCESS VAR						
EQUIP STATUS						
ALARM POINT						

OPERATOR CONTROL FUNCTIONS CHECKED

FUNCTION TYPE	TAG NO.	LOCATION	TAG NO.	LOCATION	TAG NO.	LOCATION

FINAL CONFIGURED SETTINGS

TAG NO.	SWITCH & ALARM SP	CONTROLLERS			
		Gain	Reset, rpm	Deriv. (rate), min	PV Set Point

Describe all interlocks checked, equipment started/stopped, valves/operators stroked. Describe modes of operation checked, and location of operator interface (local/remote).

I certify that the control loop referenced on this page has been completely checked and functions in accordance with applicable drawings and specifications.

Certified by: _____
(Work Performed By)

Date: _____



Instrument Certification Sheet

Project Name:	Owner's Project No. (if applicable):
Project Owner:	Regulatory Agency Project No. (if applicable):
HDR Project No.	Date:
Control Loop No.:	
Instrument Tag No.	Transmitter/gauge span:
Manufacturer:	Switch set-point:
Model No.	Switch dead band:
Serial No.	Switch range:

TRANSMITTERS AND INDICATORS

% OF SPAN	INCREASING INPUT			DECREASING INPUT		
	INPUT	OUTPUT	ERROR (% of span)	INPUT	OUTPUT	ERROR (% of span)
0%						
25%						
50%						
75%						
100%						
Other (if applicable)						
Other (if applicable)						

SWITCHES

ACTUATION POINT	INCREASING INPUT			DECREASING INPUT		
	INPUT	OUTPUT	ERROR (% of range)	INPUT	OUTPUT	ERROR (% of range)
High (Increasing input)						
Low (Decreasing input)						

Maximum allowable error (per Contract Documents): _____

Remarks: _____

CALIBRATION EQUIPMENT UTILIZED

DEVICE TYPE	MFR/MODEL NO.	ACCURACY	NIST TRACEABILITY?

Certified by: _____

Date Certified: _____



Final Control Element Certification Sheet

Project Name:	Owner's Project No. (if applicable):
Project Owner:	Regulatory Agency Project No. (if applicable):
HDR Project No.:	Date:
Control Loop No.:	

Tag No.
Description:
Manufacturer:
Model No.
Serial No.

Actuator:	Pneumatic: _____	Electric: _____
Positioner:	Direct: _____	Reverse: _____
Positioner:	Input: _____	Output: _____
I/P Converter:	Input: _____	Output: _____
Valve to	_____ on air failure	
Valve to	_____ on power failure	

I/P CONVERTER

% OF SPAN	INCREASING INPUT			DECREASING INPUT		
	INPUT	OUTPUT	ERROR (% of span)	INPUT	OUTPUT	ERROR (% of span)
0%						
25%						
50%						
75%						
100%						

Specified I/P converter accuracy: _____ % of span.

FINAL CONTROL ELEMENT

% OF SPAN	INCREASING INPUT			DECREASING INPUT		
	INPUT	TRAVEL	ERROR (% of full travel)	INPUT	TRAVEL	ERROR (% of full travel)
0%						
25%						
50%						
75%						
100%						

Remarks: _____

CALIBRATION EQUIPMENT UTILIZED

DEVICE TYPE	MFR/MODEL NO.	ACCURACY	NIST TRACEABILITY?

Certified by: _____

Date Certified: _____

SECTION 40 61 96
PROCESS CONTROL DESCRIPTIONS

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section is intended to describe the functional and operational requirements of the process being monitored and controlled by the process control system, and to define the Contractor's responsibilities related to the work described herein.
- B. Section Includes:
 - 1. Document Maintenance and Content Requirements.
 - 2. Process Control Description content and structure.
 - a. Process Control Description for each system includes:
 - 1) Reference Documents.
 - 2) Major Equipment and Field Instruments.
 - 3) Overview Description.
 - 4) Detailed Process Control Descriptions.
 - 5) Response to Instrument or Equipment Failures.
 - 6) Displays at HMI/OIT.
 - 7) Report Descriptions.
- C. Related Sections include but are not necessarily limited to:
 - 1. Division 00 - Procurement and Contracting Requirements.
 - 2. Division 01 - General Requirements.
 - 3. Section 40 61 13 – Process Control Systems General Requirements.

1.2 SYSTEM DESCRIPTION

- A. The control loop descriptions provide the functional requirements of the control loops represented in the Contract Documents:
 - 1. Descriptions are provided as follows:
 - a. Control system overview and general description.
 - b. Major equipment to be controlled.
 - c. Major field-mounted instruments (does not include local gauges).
 - d. Manual control functions.
 - e. Automatic control functions/interlocks.
 - f. Major indications provided at local control panels and motor starters/VFD's.
 - g. AUTO indications and alarms.
- B. The Process Control Descriptions describe the operational interface and functional requirements of the Process Control System (PCS) and of the control loops and other PCS functions represented in the Contract Documents.
- C. The Process Control Descriptions do not necessarily address every PCS point or alarm point associated with the process or equipment. Provide and incorporate all hard-wired, networked and internal equipment alarms as shown on the P&IDs, the I/O Lists, the Instrument Lists, or elsewhere within the Contract Documents, as well as other points required to meet the intent of the system control.
- D. The Process Control Descriptions shall not be considered equal to a bill of materials.
- E. Provide instrumentation hardware and software as necessary to perform control functions specified herein and shown on Drawings.

- F. The control loop descriptions are not intended to be an inclusive listing of all elements and appurtenances required to execute loop functions, but are rather intended to supplement and complement the Drawings and other Specification Sections:
- G. Functional descriptions contained are for informational purposes intended to supplement and complement instrumentation control schematics and other details when included in drawings and specifications. Provide instrumentation hardware and software as necessary to perform control functions specified herein and shown on drawings. Ensure coordination of instrumentation manufacturer with other work to ensure that necessary wiring, conduits, contacts, interposing relays, loop-isolators, converters, and incidentals are provided in order to transmit, receive, and control necessary signals to other control elements, to control panels, and to receiving stations.
- H. Operator Interface Software/PLC Configuration:
1. General:
 - a. All calculations, trip points from analog values, timers, numeric manipulations, etc. will be accomplished in the PLC and not in the operator interface software.
 - b. Alarms: All open/close valves and on/off motors monitored by the PLC system will have a maximum time value allowed to either fully open/close or start/stop. Failure to achieve the control function within this maximum time value will result in a time out alarm for each piece of equipment. An alarm will be generated from the PLC to the operator interface software for indication of the control function time out failure (i.e. PUMP XXX-XXX FAIL TO START or VALVE XXX-XXX FAIL TO CLOSE, etc.). Other specific alarms are designated in the control loop descriptions. All alarms are to be sealed in at the PLC until acknowledged via the operator interface
 - c. Analog inputs:
 - 1) All analog inputs to the PLC will be configured in the operator interface software for historical trending, unless noted otherwise.
 - 2) All analog inputs from primary elements and transmitters shall be monitored for transmitter fail conditions. Transmitter fail conditions are conditions when the 4-20ma signal is out of range (i.e., below 3.5ma or above 20.5 ma). A TRANSMITTER FAIL alarm will be generated when a signal is out of the proper operating range.
 - d. Analog outputs: All setpoints for minimum and maximum values will be operator adjustable via the operator interface software.
 - e. Operator Entries: entries made by the operator (such as operation modes, setpoints, etc.) shall be displayed on the process screens for information.
 - f. The PLC shall keep track of daily equipment run-times. The run-time values shall be automatically reset once a day, at 8:30am after the values have been automatically recorded.
 2. Screens:
 - a. General: The screens for process control/observation shall be configured using a three level hierarchy plus an alarm screen, PLC System status screen, Report Selection screen, and real-time/historical trend displays. The top level is the plant overview. The second level is the process screens with the equipment control detail screens the bottom level.
 - b. Plant overview: The process overview screen shall consist of a full schematic of the process and contain active displays for the major plant flows and levels. Each process area shall be "active" so that clicking with the mouse will take the operator to a process screen showing full status for all of the items in that process area. At the bottom of the process overview screen shall be a button to move to the alarm screen, a button to move to the historical/real time trend display screen, a button to move to report generation, and a button to move to the PLC system status screen.

- c. Process screens: The Process Screens shall be developed to show the full status for each piece of equipment within the process displayed. The color of the equipment shall vary as well as a text indicator to show the status of each valve, pump, etc. All analog values associated with the process displayed shall be shown. Each piece of equipment which can be controlled shall be "active" and allow the operator to click on the equipment and bring up a pop-up equipment control detail screen. There shall be three buttons in the same location at the bottom of each process screen to move back to the plant overview screen, the alarm screen, and the trend screen.
- d. Equipment control detail pop-up: Develop a set of standard equipment control detail pop-ups to be used for each type of equipment controlled from the OIS. Each pop-up shall include a DONE button which hides the pop-up when done. Equipment symbol elements in the pop-up shall be animated to show when the equipment changes state to the command state.
- e. Alarm screen: Regardless of which screen an operator is on, a flashing red ALARM box will come up on the current screen directing the user to the alarms screen. The flashing red ALARM box will not go away until the alarm is acknowledged by a user. All alarms will have a time date stamp and will be printed to a dedicated printer. Alarm designation names are called out in the respective control loop description. By clicking the alarm box on any screen, the operator will view the Alarm Screen.
- f. Trend screen: The trend screens shall include an adjustable 4 pen display with adjustable time scales and adjustable process value scales. The four variables shall be selected by use of the mouse from a plain English pull-down menu for each pen. The trend screen shall include the capability to show both real-time and historical trend information on a continuous graph.
- g. PLC system status screen: The PLC system status screen shall depict a block diagram of the plant PLC system and the communication links to the PLCs and I/O Bases distributed throughout the plant. The status of the communication links shall be indicated by color and the status of the individual I/O racks shall also be indicated by color. Colors: Gray - nominal, Yellow flashing - alarm/failed.
- h. Screen list:
 - 1) Plant Overview.
 - 2) Process Screens:
 - a) Mechanical and Solids Building Biosolids Flow Overview
 - b) Digester Feed - Parallel Flow Operation
 - c) Digester Feed -Series Flow Operation
 - d) Digester Feed Control Setpoints
 - e) Digester Feed Mode Valve Control Validation Screen Mode 1
 - f) Digester Feed Mode Valve Control Validation Screen Mode 2
 - g) Digester Feed Mode Valve Control Validation Screen Mode 3
 - h) Mechanical and Solids Buildings Digester Gas and Waste Gas Burner.
 - i) Mechanical and Solids Building Boiler Operation
 - j) Biosolids Thickening – Sludge Feed, Polymer Feed and Flocculation Tanks.
 - k) Biosolids Thickening – Rotary Screens and Thickened Sludge Pumps.
 - l) Biosolids Thickening – Gravity Belt Thickening
 - m) Biosolids Dewatering – Belt Filter Press Dewatering
 - n) Polymer Blending and Feed Operation
 - o) HVAC Monitoring. (flow switches, CGD, Alarms)
 - 3) Plant Data Screen (Current major process variables values).
 - 4) Screens (Flow Totalizers and Run-Time Counters).
 - 5) Equipment Detail Control Pop-ups:
 - a) Open/Close Valve.
 - b) Modulating Valve.
 - c) Loop Controller (with Auto/Manual selection).
 - d) Pump Start/Stop.
 - e) Trend Screen.

- f) Four-Pen Selectable Trend.
 - g) PLC System Screen.
 - h) Report Selection Screen.
3. Reports: Two daily, two monthly, and one annual report shall be configured and accessed by selecting the type of report from a Report Selection Screen. The report selection screen shall contain a button for each type of report. Once the button is selected, the operator shall be prompted for any additional entries, and the report will be generated using either Microsoft Excel or Microsoft Access and then printed. The reports each contain up to 40 numbers in any combination of operator entry, historical values, average historical values, current values, or calculated values based on the types above. The Owner and Engineer will fully define the reports after the screens and databases have been submitted for review.
 4. OIS/PLC database: Configure all PLC I/O points into the OIS/PLC database. Do not read inputs or control outputs directly from the OIS. Create memory areas using internal coils and word memory for exchanging information between the PLC and OIS. Configure any additional points required for communication between the OIS and PLC in this memory area. Allow for 25 percent expansion of each type of point.
 5. The OIS displays shall be animated as necessary to clearly convey equipment status, operation modes, process displays, alarms, etc:
 - a. Equipment status colors:
 - 1) ON-Green.
 - 2) OFF-Red.
 - 3) OPEN-Green.
 - 4) CLOSED-Red.
 - 5) FAIL-Amber (flashing).
 - 6) VALVE IN TRANSITION-Yellow.
 - 7) RUN COMMAND GIVEN-Yellow.
 - b. Provide numeric representation of process signals in engineering units. Graphical animation shall also be used to depict levels in tanks, wetwells, and sumps where these signals are available.
 - c. All OIS displays shall use consistent styles to convey information to operator, and for operator entry.
 6. Unless otherwise specified, the following general requirements apply to all process control descriptions.
 - a. Analog control loops shall operate based on a standard PID controller, with the controller faceplate incorporated on the PCS HMI graphic display. The PID controller faceplate includes (but is not limited to) the following functions:
 - 1) Bar graphs for setpoint, process variable and percent output, poke point buttons for Auto/Manual Mode selection, and a numeric entry field with popup keypad for Operator entered values.
 - a) Auto/Manual Mode selection: In Auto Mode, the output of the controller is based on the PID controller calculation. In Manual Mode, the output of the controller is operator adjustable. Switching between the PID controller's operational modes shall be configured with setpoint tracking and bump-less transfer.
 - b) Compound Mode, where applicable: In the Compound Mode, the setpoint is trimmed by a remote setpoint input. This mode is used in applications requiring a cascade control loop such as level/flow.
 - 2) When in the Automatic Mode, PID algorithms shall monitor the margin of error between the setpoint value and the actual process variable. A deviation of +/- 10 PCT between setpoint and process variable generates a Deviation Alarm notifying the operator of the condition. The % of deviation is an adjustable value.
 - b. All motors (constant and variable speed) must be monitored for the associated Run, Stop, and Fail status. When the PCS initiates a run command output, the PCS logic monitors the running status feedback from the motor (starter or variable speed drive)

and produces a "Fail to Run" or "Fail to Stop" alarm (as applicable) if the motor feedback does not correspond with the status of the PCS initiated command output. A PCS internal delay timer with typical preset of 15 SEC (individually adjustable) shall be configured for each logic statement to allow the motor control a adequate time to comply with the output command.

- 1) The PCS output command is de-energized subsequent to the expiration of the alarm delay time period, i.e. a timed-out command.
- c. Valves or gates with limit switch functions for position feedback: when the PCS initiates an Open/Close command output, the PCS logic monitors the position feedback and produces a "Failure to Open" or "Failure to Close" Alarm (as applicable) if the valve/gate feedback does not correspond with the status of the PCS initiated command output. A PCS internal delay timer preset of 60 SEC (operator adjustable to match actual valve actuator speed) is configured for each logic statement allowing the valve/gate actuator time to comply with the output command. The timer preset requires adjustment at startup depending on the type of valve or gate and the full open to close travel time for each.
 - 1) The PCS output command is de-energized subsequent to the expiration of the alarm delay time period, i.e. a timed-out command.
- d. Analog inputs shall have a signal Out Of Range Alarm generated via a PCS internal timer when the PCS input is $< 3.8 \text{ mADC}$ or $> 20.5 \text{ mADC}$. The alarm delay timer preset is initially set at 20 SEC. The delay preset value is operator adjustable.
- e. All flow inputs shall be totalized (integrated) and logged on the PCS historian. All totalized values are displayed on the PCS HMI graphic display in the appropriate engineering units as required. Provide daily flow totals for all measured flows.
- f. All equipment run times shall be totalized, displayed and logged on the PCS historian. Run times shall have a resolution of one minute and be displayed in hours and tenths of hours on the appropriate PCS HMI graphic display.
- g. For each piece of process equipment controllable by the PCS, an equipment "ready" or control mode permissive signal is needed to indicate to the PCS control logic PCS control is allowed. The PCS shall monitor the Local Control Panel mounted L/R mode selector switch and control the equipment that is in the Remote mode.
- h. Non-modulating motorized valves or gates shall be controllable via Open-Stop-Close buttons on HMI and OIT faceplates. The valves/gates shall be controlled in the Open and Close directions by separate PCS control signals. The PCS shall stop the Open or Close command to the actuator when the actuator reaches the respective end of travel.
- i. I/O points shown on the P&IDs, I/O List or elsewhere within the Contract Documents shall be incorporated into the PCS HMI and OIT graphic displays as indicated by their function.
- j. Operator entry of setpoints shall be limited to values within upper and lower operating limits corresponding to the valid operating range of the equipment. An operator-entered setpoint outside the valid range must be rejected by the PCS and the original setpoint shall be maintained until a valid value is entered. When an invalid setpoint is entered into the system, an Invalid Value message shall appear in the setpoint entry faceplate, alerting the operator to the condition. The upper and lower range limits are adjustable.
- k. In addition to the requirements specifically stated within each Process Control Description, all control software and hardware shall be provided as required to ensure the safe and reliable operation of all controlled equipment.
- l. All "soft" alarms on analog signal shall reside in the PLC logic with de-bounce timers. Provide the capability to modify the soft setpoints through the HMI system with appropriate security.
- m. All alarm and trip time delays shall be adjustable from the HMI system by an operator with appropriate security.
- n. All process values, ranges, and setpoints described herein shall be considered "Initial values" and may be changed during installation and start-up.

- o. All measured analog values shall be logged and available for trending via Operator selection at the HMI.

1.3 DEFINITIONS/ABBREVIATIONS

A. Abbreviations are defined as listed below:

A/M	Auto/Manual
ATS	Automatic Transfer Switch
DCS	Distributed Control System
DPU	Distributed Processing Unit
H/O/A	Hand-Off-Auto
H/O/R	Hand-Off-Remote
HMI	Human-Machine Interface
L/O/R	Local-Off-Remote
L/R/O	Local/Remote/Off
L/R	Local/Remote
LCP	Local Control Panel
LCS	Local Control Station
MCC	Motor Control Center
O/C	Open/Close
OI	Operator Interface (valve actuator, VFD)
OIT	Operator Interface Terminal
P&ID	Process and Instrumentation Diagram
PCS	Process Control System
PID	Proportional-Integral-Derivative
PFD	Process Flow Diagram
PLC	Programmable Logic Controller
RIO	Remote DCS or PLC Input/Output Equipment
RTU	Remote Terminal Unit
RVSS	Reduced Voltage Solid-state Starter
S/S	Start/Stop
UPS	Uninterruptible Power Supply
VFD	Variable Frequency Drive

1.4 SUBMITTALS

A. Contract Closeout Information:

1. Operation and Maintenance Data:

- a. See Specification Section 01 33 04 for requirements for the mechanics, administration, and the content of Operation and Maintenance Manual submittals.

1.5 ADMINISTRATIVE REQUIREMENTS

- A. Coordination with vendor-furnished control packages
 - 1. Where vendor packages are supplied as part of the Contract, the vendor packages that are supplied with PLC-based controls shall be programmed by the respective vendors. Provide all programming as required to integrate Vendor-furnished controls into the PCS as described in the Contract Documents.
 - 2. Coordinate with the Control System programmer as necessary for IP addresses.
 - 3. Coordinate with the Control System programmer for array User Defined Tag (UDT) templated for remote information messaging between PLCs.

PART 2 - PRODUCTS - (NOT USED)

PART 3 - EXECUTION

3.1 PROCESS CONTROL DESCRIPTIONS

- A. The following Appendices to this Section contain the process control descriptions that define the PCS procedural and operational requirements of the processes included in the Work:
 - 1. 40 61 96 - Appendix A - Process Control Descriptions.

END OF SECTION

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40 61 96 - APPENDIX A: PROCESS CONTROL DESCRIPTIONS

1.1 CONTROL LOOP DESCRIPTIONS

A. Control Loop 1: Digester Feed and Transfer Operations:

1. PID Reference: 000Y-01, 000Y-02, 000Y-03, 000Y-04 and 000Y-05.
2. Background
 - a. Three anaerobic digesters (Digesters 1, 2 and 3) are currently used for digesting thickened solids from primary and secondary treatment. The effective volume of Digesters 1, 2 and 3 are 297,000 gallons each. This project will construct the addition of a fourth digester, Digester No. 4 with an effective volume of 297,300 gallons. The total effective volume of all digesters is 1,189,000 gallons.
3. Current Operation
 - a. The digesters are currently operated in series mode with Digesters 1 and 3 as the primary digesters and Digester 2 as the secondary digester/holding tank. In this mode, Digester 2 is used for storage upstream of the Blend Tank and Dewatering Operation.
 - b. Thickened solids feed to Digester 3 is pumped from hoppers in the Rotary Screen Thickeners and Mechanical Building using progressive cavity pumps. Digester 3 effluent is pumped to a secondary digester (Digester 2) using level control.
 - c. In contrast to Digester 3, digested solids from Digester 1 flow by gravity to Digester 2. Digester 2 is used as storage, operations staff manually pump (Sludge Transfer Pump No.1 P-8021) from Digester No.2 to the Blend Tank. However, normal operation is to overflow from Digester No.1 to Digester No.2 and pump to the blend tank.
4. Digester Operation
 - a. The Digestion Parallel Flow Improvements project will provide the additional ability to operate digesters in parallel in an automated mode which is currently not possible with the current installation and programming. The current series operation modes and existing programming will be retained as part of future operation.
 - b. Improvements will include the addition of motorized feed valves to Digester 1, 3, and 4 influent piping for automated feed control.
 - c. Existing Digester 1 and 3 level measurement will be replaced and used for controlling pumping out of Digesters 1 and 3 with the addition of new programming to Digester 2. The Digester 4 level control will be similar for pumping out of Digester 4 to Digester 2.
5. Operating Modes
 - a. The following automated operating modes shown in Table 1 will be possible for digester operation.

Table 1: Digester Operation Modes

Mode	Description	Existing or New Mode
1	Series Operation with Digester 3 or 1 as Primary with gravity flow, Digester 2 as Secondary.	Existing
2	Parallel Operation with Digester 1, 3, and 4 as Primary Digesters and with pumped transfer to Digester 2 as Secondary/Holding Configuration	New

B. Control Loop 2: Digester Feed

- a. Description: Thickened primary sludge and thickened secondary sludge are combined in a common digester feed pipe. The combined thickened sludge is pumped through a single flow meter (FE/FIT 550-05) located in the Existing Solids Building, and is then fed sequentially to Digesters 1, 3, and 4 through motor-operated control valves (Digester Feed Valves) associated with each digester.

- b. The flow to each digester is controlled by one of two operator selectable modes, either totalized volume or elapsed time to any combination of digesters identified to be on-line on the SCADA system. The preferred operating mode is based using the flow meter (FE/FIT 550-05) totalized volume feed of thickened primary and thickened waste activated sludge (WAS) to each of the operating digesters. Elapsed time is a backup control mode, in the event the totalized volume mode does not provide adequate distribution of volume to each “on-line” digester. Motorized plug valves at each digester sequentially open to feed the associated digester if noted as on-line on the SCADA system.
 - c. Selection of which digesters are on-line shall be at the HMI screen by the operator. Refer to the Screen List described in Section 40 61 96.
2. Thickened Sludge Feed Control to Digesters Valve Schedule:
- a. Digester No.4 Feed Operation

Valve Tag	Service	Open/Close Condition	P&ID	Notes
FCV-560-08	DS	OPEN	000Y-005	Feed to Digester No.4
FCV-510-10	DS	CLOSE	000Y-05	
FCV-510-05	DS	CLOSE	000Y-04	

- b. Digester No.3 Feed Operation

Valve Tag	Service	Open/Close Condition	P&ID	Notes
FCV-560-08	DS	CLOSE	000Y-005	
FCV-510-10	DS	OPEN	000Y-05	Feed to Digester No.3
FCV-510-05	DS	CLOSE	000Y-04	

- c. Digester No.1 Feed Operation

Valve Tag	Service	Open/Close Condition	P&ID	Notes
FCV-560-08	DS	CLOSE	000Y-005	
FCV-510-10	DS	CLOSE	000Y-05	
FCV-510-05	DS	OPEN	000Y-04	Feed to Digester No.1

3. Digester Sludge Transfer Control Valve Schedule:
- a. Digester No.4 Transfer Operation

Valve Tag	Service	Open/Close Condition	P&ID	Notes
FCV-510-01	DS	OPEN	000Y-02	Transfer to Digester No.2
FCV-510-02	DS	CLOSE	000Y-02	
FCV-510-03	DS	CLOSE	000Y-02	
FCV-510-04	DS	OPEN	000Y-02	Transfer to Digester No.2
FCV-510-06	DS	CLOSE	000Y-02	
FCV-510-08	DS	CLOSE	000Y-02	

b. Digester No.3 Transfer Operation

Valve Tag	Service	Open/Close Condition	P&ID	Notes
FCV-510-01	DS	CLOSE	000Y-02	
FCV-510-02	DS	OPEN	000Y-02	Transfer to Digester No.2
FCV-510-03	DS	OPEN	000Y-02	Transfer to Digester No.2
FCV-510-04	DS	CLOSE	000Y-02	
FCV-510-06	DS	CLOSE	000Y-02	
FCV-510-08	DS	CLOSE	000Y-02	

c. Digester No.1 Transfer Operation

Valve Tag	Service	Open/Close Condition	P&ID	Notes
FCV-510-01	DS	CLOSE	000Y-02	
FCV-510-02	DS	CLOSE	000Y-02	
FCV-510-03	DS	CLOSE	000Y-02	
FCV-510-04	DS	CLOSE	000Y-02	
FCV-510-06	DS	OPEN	000Y-02	Transfer to Digester No.2
FCV-510-08	DS	OPEN	000Y-02	Transfer to Digester No.2

4. Equipment Schedule:

Description	Location	Equipment No.
Thickened Sludge Pump #1	Mechanical Bldg	PMP-560-01
Thickened Sludge Pump #2	Mechanical Bldg	PMP-560-02
Flow Meter	Solids Bldg	FE/FIT 550-05
Digester #1 Feed Valve	Solids Bldg	FCV 510-05
Digester #3 Feed Valve	Solids Bldg	FCV 510-10
Digester #4 Feed Valve	Mechanical Bldg	FCV 560-08

5. Equipment Protection: Existing

6. Local Controls: Existing

a. Automatic Controls:

- 1) Programming for Digester 1, 3 and 4 will provide PLC ladder logic to "jump" past a digester when it is out of service through the SCADA system.

b. MANUAL Mode:

- 1) Each digester feed valve can be open or closed from the SCADA HMI screen.
- 2) Each digester feed valve can be open or closed from the Local valve control station.

c. OPEN-CLOSE ACTUATOR CONTROLS:

- 1) Selector switches shall include controls for Open/Close actuator:
 - a) Open Pushbutton
 - b) Close Pushbutton

- c) Stop Pushbutton
 - d) Remote/Local Switch
 - e) Full Open Light
 - f) Full Closed Light
 - 2) Control relays shall include:
 - a) Open relay.
 - b) Closed relay.
 - c) PLC interface relay.
 - 3) Push-to-test indicating lights shall include:
 - a) Open.
 - b) Closed.
 - c) Remote.
 - 4) Provide Contacts in control enclosure.
 - d. AUTO Mode:
 - 1) Provide operator selectable volume or time mode selection for digester system for all digesters in service.
 - 2) Provide operator selectable in-service selection for each digester.
 - 3) Volume and Time Mode:
 - a) Digester feed valves are designated as being out of service if the valve actuator Local/Remote selector switch is in the Local position.
 - 4) Digester feed valve on the SCADA HMI is in Manual.
 - 5) or if the valve as failed (failed to fully open or close).
 - 6) If a digester is out of service, skip that digester in the feed sequence
 - 7) Each preceding digester feed valve in the sequence will close only after the next valve in the sequence is fully open in order to always have a valve open, otherwise no two valves are open simultaneously.
 - 8) If a digester feed valve fails to open, provide a fail to open alarm and advance the sequence to the next digester feed valve.
 - a) Volume Mode:
 - (1) Digester feed valves open in digester 1-3-4 sequence for the amount of time necessary to feed the setpoint volume to the associated digester that is in-service. SCADA HMI entry of an individual volume less than the minimum values noted below will default to the minimum value.
 - b) Time Mode:
 - (1) Digester feed valves open in digester 1-3-4 sequence for the time setpoint for the associated digester. SCADA/HMI entry of an individual time less than the minimum values noted below will default to the minimum value.
7. HMI Configuration:
- a. Display Status:
 - b. Valve local/remote status.
 - c. Valve open/close status.
 - d. Digester feed time setpoint for each digester.
 - e. Digester feed volume setpoint for each digester
 - f. Recommended minimum and maximum feed volumes and times for individual digesters:

Description	Minimum	Maximum
Volume (gal):		
Digesters 1, 3 and 4	1500	5,000
Time (min)		
Digester 1, 3 and 4	5	30

Digester Feed Volume ratio when all three Digesters are in service is:
 Digesters 1, 3, and 4 = 33% each

Digester Feed Volume ratio when only two Digesters are in service is:
 1 and 3 or 1 and 4, each set at 50%
 Or 3 and 4 together, each set at 50%

- g. Operator Entries:
 - 1) Volume or Time Mode selection for each digester feed valve.
 - 2) Totalized volume setpoint for each digester feed valve.
 - 3) Elapsed time setpoint for each digester feed valve.
- h. Alarms:
 - 1) Valve fail.
 - 2) Valve fail to open – 70 second timeout
 - 3) Valve fail to close – 70 second timeout
- i. Historical Trending:
 - 1) Daily total volume fed to each digester.
 - 2) Daily total volume fed to all digesters.

C. Control Loop 3: Digester Level Control

1. Description: The level in the Digesters is controlled with the digester transfer pumps. Currently digested solids can be transferred from Digester 3 to Digester 2 or to the Blend Tank; from Digester 1 to Digester 2 or the Blend Tank; or from Digester 4 to Digester 2 or the Blend Tank.
2. Digester No.1 can overflow by gravity to Digester No.2 in a series operation with Digester No.1 as the primary digester and Digester No.2 as a holding tank upstream of the dewatering process.
3. Digester No.3 can flow by gravity to Digester No.2 in a series mode or pumped to Digester No.2 in a parallel mode with the other two digesters (1 and 4) as selected by the operator.
4. The proposed level control for the digesters operating in parallel mode will be to maintain a dead band level in each digester with the transfer pumps pumping directly to the Digester #2 or to the Blend Tank.
5. Equipment Schedule

Description	Location	Equipment Number
Digester #1 Suction Transfer Valve	Solids Building - Common header between Digesters 1 and 2	FCV-510-06
Digester #3 Suction Transfer Valve	Solids Building	FCV-510-02
Digester #4 Suction Transfer Valve	Solids Building	FCV-510-01
Digester 1 or 2 Transfer Pump #1	Solids Building - Common header between Digesters 1 and 2	PMP-510-01
Digester 1 or 2 Transfer Pump #4	Solids Building - Common header between Digesters 1 and 2	PMP-510-04
Digester 3 Transfer Pump #2	Solids Building	P-8002
Digester 4 Transfer Pump #3	Solids Building	PMP-510-3
Transfer Pump 1 Discharge Valve	Discharge of Pump #1	FCV-510-09
Transfer Pump 2 Discharge Valve	Discharge of Pump #2	FCV-510-03
Transfer Pump 3 Discharge Valve	Discharge of Pump #3	FCV-510-04
Transfer Pump 4 Discharge Valve	Discharge of Pump #4	FCV-510-08

1.2 EQUIPMENT PROTECTION:

- A. Local Controls:
 - 1. The local control panel at each pump has a HAND/OFF/AUTO switch. The operator can start or stop the pump by placing the switch in HAND or OFF respectively.
 - 2. Each control valve has a LOCAL/REMOTE selector switch. The operator can open and close the valve from the local control station.
- B. Automatic Controls:
 - 1. Program transfer pumps to pump digested solids to the Digester 2 or Blend Tank from each Digester to maintain the level in each digester within the operator selected dead band. When a Digester is not in-service, as determined by the Digester Feed Valve, the transfer of digested solids from the off-line digester to the Digester 2 or Blend Tank will be inhibited.
- C. SCADA MANUAL Mode:
 - 1. The operator can start and stop the pump from the SCADA screen.
 - 2. The operator can open and close the valves from the SCADA screen.
- D. AUTOMATIC Mode:
 - 1. Pumping transfer from Digesters 1 and 3 or 4 cannot occur concurrently.
 - 2. Pumps start and stop to maintain level in each digester within the dead band, provided the predetermined level in the Blend Tank has not been exceeded. Pumping sequence for digesters in service will be Digesters 1-3-4.
 - 3. If the level in Digester #2 or Blend Tank has reached the high level, a high level alarm will be indicated on the SCADA HMI and the automatic transfer of digested solids will stop.
 - 4. Interlocks and necessary valve orientations:
 - a. Transfer from Digester #1 (in order noted below – first valves must be closed before the transfer valve is opened):
 - 1) Transfer valve from Digester #3, – FCV-510-02 Closed
 - 2) Transfer valve from Digester #4, – FCV-510-01 Closed
 - 3) Transfer valve from Digester #1, FCV-510-06 Open
 - b. Transfer from Digester #3 (in order below – first valve must be closed before second valve is opened):
 - 1) Transfer valve from Digester #4, – FCV-510-01 Closed
 - 2) Transfer valve from Digester #1, FCV-510-06 Closed
 - 3) Transfer valve from Digester #3, – FCV-510-02 Open
 - c. Transfer from Digester #4 (in order below – first valve must be closed before second valve is opened):
 - 1) Transfer valve from Digester #1, FCV-510-06 Closed
 - 2) Transfer valve from Digester #3, – FCV-510-02 Closed
 - 3) Transfer valve from Digester #4, – FCV-510-01 Open
 - 5. Pumps alternate sequentially if they are in AUTO.
- E. HMI Configuration:
 - 1. Display Status:
 - a. Pump local/remote status.
 - b. Pump suction and discharge valve open/closed status.
 - c. Pump running status
 - 2. Operator Entries:
 - a. Pump start/stop command.

3. Digester Dead band levels (these levels shall be operator adjustable)

Description	Upper Level	Lower Level	Overflow Level
Digester #1	652.5	651.5	653.2
Digester #2	650.0	644.5	650.9
Digester #3	653.5	652.5	654.4
Digester #4	653.5	652.5	654.9

4. Alarms:
- Transfer Pump fail.
 - Valves fail
5. HMI Historical Trending:
- Transfer Pump run time (hours).
 - Level in Digester 1
 - Level in Digester 2
 - Level in Digester 3
 - Level in Digester 4
 - Level in Blend Tank (ft)
 - Digester 2 Digester Feed Quantities (gallons per day)
 - Digester 1, 3, and 4 Feed Quantities (gallons per day)
 - Digester Feed Solids Concentration (%) and Loading (pounds/day)
 - Calculated HRT (days)

F. Control Loop 4: Digester Gas System:

- PID Reference: 000Y-06 and 000Y-09.
- Description:
 - The digestion process generates digester gas. Digesters No. 1, 2, 3 measure the gas flow either to the waste gas burner or to the boilers. Digester No. 4 will meter its own gas production. Digester 2 is a holding tank with a floating digester gas cover. The gas is comprised primarily of methane and will be used to fuel the existing boiler and new boiler (BO-560-01) that provides heat water to Digesters No. 1, 3 and 4. The gas pressure is measured by a manometer and a pressure element transmitter (PE/PIT-510-10). The pressure element transmitter will be used to alarm high and low pressure levels in the digesters.
 - The gas production from Digesters No. 1, 2, 3 and 4 is tied into a common header where the pressure is maintained between 7-9 IN of water column pressure in the digesters. When the set point pressure is exceeded in the gas header between 8-9 IN of water column pressure (adj), a valve will open and will feed the waste to the new waste gas burner (WBG-550-01). An existing flow meter (FE/FIT-8832) (located in the compressed gas room) upstream of the burner measures the quantity of gas burned and signals the SCADA HMI and lets the operator know if the gas is being burned.
 - When Digester No. 2 is used as a holding tank, the digester will hold a large volume of gas which will help to regulate and steady the pressure in the biogas system.
 - During periods when the boilers have exhausted the gas pressure in the header to 7.5 IN of water column pressure, the pressure regulators on the natural gas supply line will open to augment the biogas supply.
- Equipment Schedule:

Description	Location	Equipment No.
Flow Element	Solids Building	FE/FIT 510-02
Pressure Element	Digester	PE/PIT 510-01
Pressure Element	Solids Building	PE/PIT 510-10

Description	Location	Equipment No.
Waste Gas Flare	Digester Gas	WGB-510-01
Hot Water Boiler	Mechanical Building	BO-560-01

4. Local Controls:
 - a. Self-contained unit that comes equipped with the manufacturer furnished local control panel.
5. Local Operation:
 - a. The waster gas burner can be operated locally only when the regulator valve opens up. No control is possible from SCADA. In AUTO Mode, the burner only signals the PLC that digester gas is being burned; otherwise it is off.
6. Hardwired Interlocks:
 - a. None.
7. Software Interlocks:
 - a. Interlock signal for alarm when digester gas pressure (PE/PIT-510-10) falls below 3 inches water column causing existing and new pressure control valves to introduce natural gas augmentation.
 - b. Interlock signal for alarm when digester gas pressure (PE/PIT-510-10) is at or above 15 inches of water column pressure.
8. SCADA Controls:
 - a. None.
9. SCADA System Monitors:
 - a. AUTO / MANUAL / STANDBY functions.
 - b. Waste Gas Burner ON.
 - c. Waste Gas Burner STANDBY.
 - d. Digester Gas flow to Waste Gas Burner.
 - e. Digester Gas flow from Digester No. 1
 - f. Digester Gas flow from Digester No. 2
 - g. Digester Gas flow from Digester No. 3
 - h. Digester Gas flow from Digester No. 4
 - i. Gas pressure
10. Historical Logging:
 - a. Daily gas usage by burner.
 - b. Daily gas production by each Digesters No. 1, 2, 3 and 4.
 - c. Gas Pressure.
 - d. Natural Gas Augmentation Volume.
11. SCADA Operation:
 - a. None.
12. Alarms:
 - a. Natural gas augmentation.
 - b. Boiler on natural gas fuel.
 - c. Boiler FAIL.
 - d. High Gas Pressure.
 - e. Low Gas Pressure.

G. Control Loop 5: Gas Detection Analyzers:

1. PID Reference: None
2. Description:
 - a. Combustible gas sensors and analyzers have been provided in Solids Building in compliance with National Fire Protection Association 820. Analyzers receive signals from interior rooms within each facility and trigger warning devices to warn personnel of the presence of methane gas in concentrations at and above 10% of its lower explosive limit (LEL). Warning devices include audible horns and single and dual lights. In general a gas detector, horn, and a flashing light have been provided in spaces that are directly connected to a potential source of methane such as digester gas piping

within the space and/or a wall that is common with a digester wall, and dual lights have been provided outside of these spaces.

- b. Following is a summary of gas detectors and warning devices in each Digester Complex. Horns and single lights are located in the area listed for warning personnel within the space that methane gas is present, and dual lights are outside of the area to warn someone not to enter because methane gas is present. Dual lights would show a lighted green lens if the space has a methane level less than 10 percent of LEL and red if the methane level is at or above 10 percent of LEL. Each horn has a silencer at the exterior of the room they are in for acknowledging and silencing the horn.

	Combustible Gas Detector	Warning Device		
		Horn	Single Alarm Light	Go/No Go Light
Solids Building				
Sludge Pump Room	X	X	X	
Belt Filter Press Room	X	X	X	
Boiler Room	X	X	X	
Chemical/Polymer Room	X	X	X	
Mechanical Room Between Dig 1 and 2	X	X	X	
All Exterior Entrances to Solids Building		X		X

- c. There is no control through SCADA for the combustible gas detection analyzers or detectors. Only alarms will be monitored by SCADA.
- 3. PID Reference: None
- 4. Equipment:
- 5. Local Controls:
 - a. Each analyzer includes for each detector LED displays of:
 - 1) Gas concentration.
 - 2) Analyzer TROUBLE
 - 3) HIGH Gas Level.
 - 4) HIGH HIGH Gas Level.
- 6. Local Operation:
 - a. None, observation only.
- 7. SCADA Controls:
 - a. None.
- 8. Hardwired Interlocks:
 - a. None.
- 9. Software Interlocks:
 - a. None.
- 10. SCADA System Monitors:
 - a. Gas concentrations at each detector.
- 11. Alarms.
- 12. SCADA Operation:
 - a. None.
- 13. Alarms:
 - a. Analyzer TROUBLE.
 - b. HIGH Gas Level.
 - c. HIGH HIGH Gas Level.

H. Control Loop 6: Boiler

- 1. Description:
 - a. Existing Boiler (BO-8331) shall provide heated water to heat the existing buildings and digester No.1 and 3 and is a back-up heating source to heat Digester No.4 using Heat Exchanger No.2.

- b. The boiler is a dual fuel boiler. It uses digester gas as the primary fuel with natural gas as backup. Normally, only one boiler is on-line at a time. The second boiler is provided for redundancy. The following major automatic functions are provided:
 - c. An automatic valve is provided to switch from digester gas to natural gas if the digester gas pressure measured by the internal pressure transmitter drops below a set point (7.5 inches W.C.).
2. Equipment Schedule:

Description	Location	Equipment No.
Primary Heat Loop Pump No.1	Solids Building	PMP 510-06
Primary Heat Loop Pump No.2	Solids Building	PMP 510-07

- 3. Local Controls:
 - a. The hot water boiler is a self-contained unit and comes equipped with the manufacturer furnished local control panel.
- 4. Local Operation:
 - a. The hot water boiler can be operated locally only. No control is possible from SCADA.
- 5. Hardwired Interlocks:
 - a. The boiler is interlocked with its hot water pumps (PMP-510-01). The boiler can operate only if one of its hot water pumps is operating. If the pump stops or fails, the boiler operation stops.
- 6. Software Interlocks:
 - a. None.
- 7. SCADA Controls:
 - a. None.
- 8. SCADA System Monitors:
 - a. Boiler Ready.
 - b. Boiler ON.
 - c. Digester Gas to Boiler ON.
 - d. Natural Gas to Boiler ON.
 - e. Flame FAIL.
 - f. Pressure FAIL
- 9. SCADA Operation:
 - a. None.
- 10. Historical Logging:
 - a. Pressure Fail
 - b. Flame Fail
 - c. Boiler On
- 11. Alarms:
 - a. Boiler Flame FAIL.
 - b. Pressure Fail

I. Control Loop 7: Heat Loop Pumps

- 1. PID Reference:000Y-08
- 2. Description:
 - a. The primary heat loop pumps (PMP 510-06 and PMP 510-07) normally operate in parallel to supply the flow. Under all conditions, always one pump is running continuously. Both pumps shall have a local ON/OFF switch.
 - b. When one pump is pumping in series, that pump will pump approximately 65% of the flow.
- 3. Equipment Schedule:

Description	Location	Equipment No.
Primary Heat Loop Pump 1	Solids Building	PMP 510-06

Description	Location	Equipment No.
Primary Heat Loop Pump 2	Solids Building	PMP 510-07

4. Local Controls:
 - a. The local control panel at each pump has:
 - 1) An ON/OFF selector switch.
5. Local Operation:
 - a. The pump can be turned ON or OFF locally only and cannot be controlled from SCADA.
6. Hardwired Interlocks:
 - a. None.
7. Software Interlocks:
 - a. Pump FAIL
8. SCADA Controls:
 - a. None.
9. SCADA System Monitors:
 - a. Pump running status.
10. SCADA Operation:
 - a. None.
11. Alarms:
 - a. Pump FAIL.

J. Control Loop 8: Combination Boiler/Heat Exchanger System

1. P&ID Sheet 000Y-09
2. Description:
 - a. The combination boiler/heat exchanger shall be called to run by the SCADA Station and plant SCADA system.
 - b. The boiler/heat exchanger local control panel shall contain a burner controller, circuit breaker and magnetic starter for the induced draft fan motor, controls for hot water bath recirculation pumps, and digester temperature controls.
 - c. Boiler control, run command and boiler fire rate, will also be provided by the local Boiler/Heat Exchanger supplier boiler control panel. The run command (discrete) will determine on/off status for the boiler and the fire rate (4-20 mA; analog) will provide a setpoint for the boiler to operate between its minimum 6:1 turndown (4 mA) and maximum (20 mA) fire rate. The local control panel will then modulate the burner valves and any other components as necessary to meet the requested setpoint.
3. Digester temperature control shall be provided as follows:
 - a. Manual control of digester temperature shall be permitted by the hand/off/auto switch mounted on the control panel.
 - b. Automatic control of digester temperature within plus or minus ½ °F shall be by means of a sensor located at the sludge inlet of the unit. The water circulation pumps for sludge heating and burner equipment shall be automatically controlled by the temperature of the sludge passing the sensor at the sludge inlet. A 24 hr. repeating cycle time switch shall be provided for periodic starting of digester sludge circulation pump(s) (PMP-560-11 and PMP560-12) with controls arranged such that the sludge circulation pump will continue to operate until the digester heating requirements are satisfied or shall stop after a short cycle in case heat is not required by the digester.
4. Digital temperature indicators with a range from shall be mounted on the face of the control panel. The sludge temperature indicators shall be connected to sensors located in the sludge inlet and outlet of the heat exchanger. The water bath temperature indicator shall be connected to a sensor located in the boiler water bath through the rear tube sheet. Each sensor shall be provided with a mounting socket to enable the removal of the sensor without draining the sludge tubes or water bath, respectively.
5. The following safety controls shall be provided:
 - a. Operating temperature controller with high/low set points.
 - b. High temperature shutdown with manual reset.

- c. Low water cutoff switch.
 - d. Air proving switch with time delay on exhaust breech to shut down boiler in event of induced draft fan failure.
 - e. Two (2) E-Stop Buttons for room entrance way.
6. Induced Draft Fan System
- a. All air for combustion shall be provided by an induced draft fan connected to the boiler exhaust breech. The fan shall be designed to maintain a negative pressure of at least 1 - inch water column in the furnace throughout boiler operation to prevent the leakage of combustion products to the surrounding room and to permit dependable operation at the low digester gas pressures listed herein. Burner mounted fans or forced draft burners will not be permitted. The induced draft fan shall have a capacity in excess of the maximum air requirements for combustion.
 - b. The induced draft fan shall draw air in at the burner inlet and at the top of the exhaust breech. The burner inlet shall permit adjustment of combustion air volume and the exhaust stack inlet shall allow adjustment of negative furnace pressure.
 - c. The induced draft fan shall be belt driven to permit field adjustment of the air capacity. The drive belts and open drip proof motor shall be enclosed in a removable housing.
 - d. An exhaust gas temperature gauge shall be provided on the exhaust stack.
7. Equipment Schedule:

Description	Location	Equipment No.
Boiler/Heat Exchanger	Mechanical Building	BO-560-01

8. Equipment Protection: To be provided by the local control panel for Boiler/Heat Exchanger
9. Local Controls:
- a. The existing Boiler No. 1 temperature setpoints will continue to be manually set at the respective boiler.
 - b. The rate of burner valve modulation for Boiler/Heat Exchanger shall be field adjustable at the local boiler control panel to avoid rapid changes in pressure to the upstream digester gas supply system.
 - c. The operating train (NG or DG) will be selected at boiler local control panels and for Boiler/Heat Exchanger at the local control panel only.
 - d. The local boiler control panel will control the associated boiler recirculation pump (supplied by the boiler/heat exchanger supplier) via communications with SCADA. When there is a call to run the pumps will be started and the boiler will then be permitted to run.
 - e. The local boiler shall monitor all internal alarms, commands, and conditions as necessary to provide a fully operational system.
10. Automatic Controls:
- a. The SCADA Station control loop shall be programmed with an operator adjustable rate of change for the fire rate command for Boiler/Heat Exchanger. Any change in the firing rate command set point shall occur at the indicated rate, measured in seconds/mA. Initial setpoint = 10 seconds/mA.
 - b. Boiler will have the ability to be called to run manually from the SCADA Station.
11. OIS Configuration:
- a. An isolated common alarm circuit shall be provided for remote annunciation of the following:
 - 1) Induced draft fan fail.
 - 2) Flame failure.
 - 3) Low boiler water.
 - b. Display Status:
 - 1) Auto – Boiler/Heat Exchanger (BO-560-01 only)
 - 2) Fault – Boiler/Heat Exchanger (BO-560-01 only)
 - 3) Ready – Boiler/Heat Exchanger (BO-560-01 only))
 - 4) Pump Running – Boiler/Heat Exchanger

- 5) Boiler Running - Boiler/Heat Exchanger
- 6) Boiler Run Command
- 7) Boiler Fire Rate
- 8) Fuel Type – Boiler/Heat Exchanger (BO-560-01 only).
- c. Historical Trending:
 - 1) Boiler/Heat Exchanger Run Time
 - 2) Boiler/Heat Exchanger Sludge Supply Temperature (TIT-560-04)
 - 3) Boiler/Heat Exchanger sludge Return Temperature (TIT-560-07)
- 12. Two emergency shut off switches for new boiler. Switches shall be located at each entrance to the room where the boiler is located and wired to the boiler local control panel.

K. Control Loop 9: Rotary Screen Thickeners:

- 1. PID Reference: 000Y-03 and 000Y-07.
- 2. Description:
 - a. The operator shall select RST (Rotary Screen Thickener) operation or GBT (Gravity Belt Thickener) operation either locally at the RST or GBT control panel or at the OIS Screen.
 - b. The Operator can thicken WAS or Primary Sludge in the RST(s). The operator must select which mode is desired (1) WAS Thickening and RST Number, or Primary Sludge Thickening and corresponding RST selection.
 - c. Typically, primary sludge will be thickened in the primary clarifier (2% to 5% solids and pumped directly to the digesters from the primary sludge pump station. If the operator is having difficulty thickening in the primary clarifier, the operator has the option to thicken primary sludge in the RST System.
 - d. WAS pump or Primary Sludge Pumps flow enters the Rotary Screen Thickener through a dedicated flocculation tank (s).
 - e. The Thickened Sludge Pumps are progressive cavity (positive-displacement type) pumps operated with a VFD.
 - f. The rate of flow through the flow meter also controls the speed of the associated polymer pumps that feed into the flocculation tank supply pipe.
- 3. Equipment Schedule:

Description	Location	Equipment No.
Rotary Screen Thickener No.1	Mechanical Building	RST-560-01
Rotary Screen Thickener No.2	Mechanical Building	RST-560-02
TWAS Hopper Level Element	Mechanical Building	LE/LIT-560-01
TWAS Hopper Level Element	Mechanical Building	LE/LIT-560-01
Flocculation Tank No.1	Mechanical Building	TNK-560-01
Flocculation Tank No.2	Mechanical Building	TNK-560-02
Flocculation Tank Mixer	Mechanical Building	MX-560-01
Flocculation Tank Mixer	Mechanical Building	MX-560-02

- 4. Local Controls:
 - a. When in Local mode, the Rotary Screen Thickeners will be started from the manufacturer supplied control panel. When started, the press speed will be as selected by the manual speed potentiometer.
 - b. The Emergency Stop Pushbutton at the unit immediately stops the press.
 - c. When in Remote mode, the Rotary Screen Thickener will be started and stopped from the Operator Interface System (OIS). The press speed will be according to the operator entered value.
 - d. In AUTO, the WAS pump or Primary Sludge Pumps, shall operate with variable speed drive and flow rate. The flow will be determined by the setting in the Rotary Screen Thickener Control Panel or OIS.
- 5. Hardware Interlocks:
 - a. None.

6. Software Interlocks:
 - a. The Polymer Makedown System interlocked to be in Auto when the Rotary Screen Thickener is in AUTO.
 - b. Interlock the Polymer Makedown System to be turned ON when the sludge WAS pump or Primary Sludge Pumps, is ON.
 - c. Interlock the Polymer Makedown system to shut down and be OFF when the WAS pump or Primary Sludge Pumps, are OFF.
 - d. Interlock the Polymer Makedown System to shut down and be in PAUSE when the WAS pump or Primary Sludge Pumps, are in PAUSE.
 - e. The Flocculation tank mixer motor interlocked to be in Auto when Rotary Screen Thickener is in Auto.
 - f. Interlock the flocculation Tank mixer Motor to be turned ON when the WAS pump or Primary Sludge Pumps, are ON.
 - g. Interlock the flocculation tank mixer motor to shut down tank to be turned OFF when the WAS pump or Primary Sludge Pumps, are off.
 - h. Interlock the flocculation tank mixer motor to shut down and be in Pause the WAS pump or Primary Sludge Pumps, are in Pause.
 - i. The Rotary Screen Thickeners Shower Water Valve Shall be:
 - 1) Interlocked to Auto when the Screw Press is set to Auto. The valve will initially open in Auto.
 - 2) The valve shall be interlocked to close when the Rotary Screen Thickeners motor is OFF.
 - 3) When the valve OPENS it shall remain Open for a certain amount of minutes according to the "RST Wash Water Off Cycle Time" set point. The cycle then repeats it's self by opening the valve.
 - 4) If the "RST Wash Water Off Cycle Time" set point is Set to Zero and the "RST Wash Water On cycle Time" Set Point is Greater Than Zero, The valve shall remain Open as long as the RST Motor is ON.
 - 5) If the "RST Wash Water On Cycle Time" set point is set to zero, then the valve shall remain CLOSED as Long as the RST motor is ON.
 - 6) In the Open Mode, the Process loop will be disabled and the valve can be open with no interlocking shut-off.
7. SCADA System Monitors:
 - a. Flocculation Tank
 - b. Rotary Screen Thickener No.1
 - c. Rotary Screen Thickener No.1
 - d. Emergency Stop Buttons.
 - e. Polymer make-down System.
 - f. Flocculation Tank Mixer.
 - g. Rotary Screen Thickener Shower Water.
8. SCADA System Controls:
 - a. WAS Pump.
 - b. Primary Sludge Pump
 - c. Rotary Screen Thickener(s).
 - d. Emergency Stop Buttons.
 - e. Polymer Make-down System.
 - f. Flocculation Tank Mixer.
 - g. Rotary Screen Thickener Shower Water.
9. SCADA System Operation:
 - a. MANUAL Mode:
 - 1) When in Local mode, the Rotary Screen Thickener will be started from the manufacturer supplied control panel by selecting RST (versus GBT). When started, the press speed will be as selected by the manual speed potentiometer.
 - 2) The Emergency Stop Pushbutton at the unit immediately stops the press.

- 3) When in Remote mode, the Rotary Screen Thickener will be started and stopped from the Operator Interface System (OIS). The press speed will be according to the operator entered value.
- 4) When “Rotary Screen Thickener HI Load Alarm” setpoint is reached:
 - a) Show “Rotary Screen Thickener Screw Press Hi Load” on alarm screen and sound a lam.
 - b) Rotary Screen Thickener will shut down and be off.
- 5) When the WAS pump or Primary Sludge Pumps are set to Hand:
 - a) The WAS pump or Primary Sludge Pumps, will be set by the “Manual Sludge Pump Speed” Set point.
- 6) The Polymer System Pump Speed in Hand Mode:
 - a) The polymer system pump speed will be set by the “Manual Polymer Pump Speed” set point.
- 7) If the Conveyor motion detector senses no movement on the conveyor then:
 - a) Display “Conveyor Failure” on alarm screen.
 - b) Shut down conveyor and set to OFF.
- 8) If Emergency Stop Button NO. 1, 2, or 3 is pushed:
 - a) Display “Emergency Stop Button Pressed” on a alarm screen.
- 9) Shut down and set all equipment to OFF.
- b. AUTO Mode:
 - 1) When the Rotary Screen Thickener is started, a Process ON contact (monitored by the PLC) will close. The PLC will then energize the selected sludge pump and polymer pumps.
 - 2) When the STOP pushbutton is pressed, the Process ON contact will de-energize signaling the PLC to stop the selected sludge and polymer pumps. After a adjustable time delay (to allow the press to clear all residual solids) the press drive will shut down.
 - 3) After a short time-delay to allow equipment start-up, the PLC will interlock the selected Sludge pump and Polymer pumps so that if one was stopped the other would also stop. This is to prevent feeding only polymer or sludge to the presses.
 - 4) WAS pump or Primary Sludge Pumps, In Auto Mode:
 - a) The WAS pump or Primary Sludge Pumps, are interlocked to be in auto when Rotary Screen Thickener is in auto.
 - b) The WAS pump or Primary Sludge Pumps, are Interlocked to be OFF when the Rotary Screen Thickener is OFF.
 - c) When the system is set in Auto Constant Flow Control Scheme:
 - (1) The primary control of the WAS pump or Primary Sludge Pumps, will be based on the “Auto Sludge Pump Speed” set point.
 - 5) The Polymer System Pump Speed in Auto Mode:
 - a) If the Polymer Make down system alarms, then:
 - (1) Display “Polymer System Alarm” on a alarm screen.
 - (2) Perform auto shutdown sequence.
 - 6) The HI-Temp Probe Alarm Relay to PLC:
 - a) If the WAS pump or Primary Sludge Pumps, HI-Temp sensor activates, then:
 - (1) Display “Sludge Pump Hi-Heat” on Alarm Screen.
 - 7) The Polymer Makedown System interlocked to be in Auto when the Rotary Screen Thickener is in AUTO.
 - 8) Interlock the Polymer Makedown System to be turned ON when the WAS pump or Primary Sludge Pumps, are ON.
 - 9) Interlock the Polymer Makedown system to shut down and be OFF when the WAS pump or Primary Sludge Pumps, are OFF.
 - 10) Interlock the Polymer Makedown System to shut down and be in PAUSE when the WAS pump or Primary Sludge Pumps Pump are in PAUSE.
 - 11) The Flocculation tank mixer motor interlocked to be in Auto when Rotary Screen Thickener is in Auto.

- 12) Interlock the flocculation Tank mixer Motor to be turned ON when the sludge pump is ON.
 - 13) Interlock the flocculation tank mixer motor to shut down tank to be turned OFF when the sludge pump is off.
 - 14) Interlock the flocculation tank mixer motor to shut down and be in Pause when the WAS Pump or Primary Sludge Pumps, are in Pa use.
 - 15) The Rotary Screen Thickeners Shower Water Valve Shall be:
 - a) Interlocked to Auto when the Screw Press is set to Auto. The valve will initially open in Auto.
 - b) The valve shall be interlocked to close when the Rotary Screen Thickeners motor is OFF.
 - c) When the valve OPENS it shall remain Open for a certain amount of minutes according to the “RST Wash Water Off Cycle Time” set point. The cycle then repeats it’s self by opening the valve.
 - d) If the “RST Wash Water Off Cycle Time” set point is Set to Zero and the “RST Wash Water On Cycle Time” Set Point is Greater Than Zero, The valve shall remain Open as long as the RST Motor is ON.
 - e) If the “RST Wash Water On Cycle Time” set point is set to zero, then the valve shall remain CLOSED as Long as the RST motor is ON.
 - f) In the Open Mode, the Process loop will be disabled and the valve can be open with no interlocking shut-off.
- c. Alarms:
- 1) When “Rotary Screen Thickener HI Load Alarm” setpoint is reached:
 - a) Show “Rotary Screen Thickener Hi Load” on alarm screen and sound alarm.
 - b) Rotary Screen Thickener will shut down and be off.
 - 2) If Emergency Stop Button is pushed:
 - a) Display “Emergency Stop Button Pressed” on a alarm screen.
 - b) Shut down and set all equipment to OFF.

L. Control Loop 10: Thickened Sludge Pumps:

1. Description:
 - a. The purpose of the Thickened Sludge Pumps is to pump thickened sludge feed to Digesters No. 1, 3 or 4.
2. PID Reference: 000Y-03
3. Equipment Schedule:

Description	Location	Equipment No.
Thickened Sludge Pump No.1	Mechanical Building	PMP-560-01
Thickened Sludge Pump No.2	Mechanical Building	PMP-560-02
Thickened Sludge Hopper Level	Mechanical Building	LE/LIT-560-01
Thickened Sludge Hopper Level	Mechanical Building	LE/LIT-560-02
Thickened Sludge Discharge Pressure	Mechanical Building	PE/PIT-560-07
Thickened Sludge Flow Rate	Mechanical Building	FE/FIT-560-05

4. Local Controls:
 - a. The Thickened Sludge Pump is equipped with a local control station that includes the following devices:
 - 1) LOCAL/ REMOTE selector switch.
 - 2) START/STOP pushbuttons.
5. Local Operation:
 - a. A pump can be started or stopped.
 - b. The Thickened Sludge Pump can be used to transfer sludge from the Rotary Screen Thickener to Digesters No. 1, 3, or 4. The transfer is made to these areas based on a selection of which digesters are in operation/configuration. (See previous Digester Feed Control Loop).

6. Interlocks:
 - a. High discharge pressure stops the pump (PE/PIT-560-07).
 - b. Low Level in Sludge Hopper (LE/LIT-560-01, LE-LIT-560-02)
 - c. Low Polymer Flow
7. Software Interlocks:
 - a. Interlocks with Rotary Screw Thickener must have a “Sludge Feed READY” permissive signal prior to or the pump start.
 - b. Selection of AUTO/Rotary Screen Thickener Modes, automatically places the Thickened Sludge Pumps in Auto.
 - c. In AUTO/Rotary Screen Thickener, the Thickened Sludge Pumps, speed is modulated according to the level in the sludge hopper.
 - d. In AUTO/Rotary Screen Thickener Mode:
 - 1) On HIGH Level alarm at the sludge hopper, Sound Alarm, Stop the WAS or Primary Sludge Pumps and modulate the Thickened Sludge Pumps.
 - 2) On Rotary Screen Thickener system FAIL, stop the WAS or Primary Sludge Pumps.
 - 3) If the level in the sludge hopper is at a low level, stop the Thickened Sludge Pumps.
8. SCADA Monitors:
 - a. Remote status.
 - b. Pump running status.
 - c. Sludge feed rate measured at the Rotary Screw Thickener flow meter (FE/FIT 560-05).
 - d. Accumulated sludge flow volume from start of pumping cycle.
9. SCADA Controls:
 - a. MANUAL Mode functions:
 - 1) START / STOP functions.
 - b. AUTO Mode functions:
 - 1) Rotary Screw Thickener.
 - 2) WAS Pump.
 - 3) Primary Sludge Pump
 - 4) Sludge Hopper Level(s).
10. SCADA Operation:
 - a. MANUAL Mode:
 - 1) Each pump can be started or stopped.
 - b. AUTO Mode:
 - 1) When one of the Thickened Sludge Pumps locations is READY, the pump in AUTO/ THICKENED SLUDGE PUMP is enabled.
 - 2) The Thickened Sludge Pumps speed is varied to maintain a level set point in the sludge hopper.
 - 3) The operator must manually change the AUTO pump and manual valve to continue pumping if a pump running in AUTO fails.
11. Alarms:
 - a. High Pressure Switch.

END OF SECTION

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SECTION 40 63 43
PROGRAMMABLE LOGIC CONTROLLER (PLC) CONTROL SYSTEM

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Programmable logic controller (PLC) control system(s), including Hardware, documentation, and training.
- B. Related Sections include but are not necessarily limited to:
 - 1. Division 00 - Procurement and Contracting Requirements.
 - 2. Division 01 - General Requirements.
 - 3. Section 01 61 03 - Equipment - Basic Requirements.
 - 4. Section 10 14 00 - Identification Devices.
 - 5. Section 26 05 19 - Wire and Cable - 600 Volt and Below.
 - 6. Section 40 61 13 - Process Control Systems General Requirements.
 - 7. Section 40 67 00 - Control System Equipment Panels and Racks.

1.2 QUALITY ASSURANCE

- A. Referenced Standards:
 - 1. The Institute of Electrical and Electronics Engineers, Inc. (IEEE):
 - a. C37.90.2, Withstand Capability of Relay Systems to Radiated Electromagnetic Interference from Transceivers.
 - b. C62.41.2, Recommended Practice on Characterization of Surges in Low-Voltage (1000 V and Less) AC Power Circuits.
 - 2. National Electrical Manufacturers Association (NEMA):
 - a. ICS 1, Industrial Control and Systems General Requirements.
- B. Qualifications:
 - 1. Installation supervisor shall have had experience in overseeing installation and startup of at least three similar installations within the last five years.

1.3 SUBMITTALS

- A. Shop Drawings:
 - 1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
 - 2. See Specification Section 40 61 13.
 - 3. Product technical data including:
 - a. Results of factory testing or simulation procedures.
 - b. Drawings containing the following information to be submitted as part of Specification Section 40 67 00 (control panels) submittals:
 - 1) Arrangement drawings for PLC system components.
 - 2) Panel and enclosure plans, sections and details.
 - 3) Access opening locations and required clearances for each panel and enclosure.
 - 4) Enclosure internal wiring and terminal blocks.
 - c. DIP Switch and Jumper Settings, if applicable.
 - d. I/O Rack and I/O Module Layout.
 - e. Wiring and Interconnection diagrams.
 - 1) Power Supplies.
 - 2) I/O Points.
 - 3) Communications.
 - f. Catalog cut sheets containing information on PLC components to be submitted as part of these Specification Section submittals.

4. Certifications:
 - a. Qualifications of installation supervisor.
- B. Operation and Maintenance Data:
 1. See Specification Section 01 33 04 for requirements for:
 - a. The mechanics and administration of the submittal process.
 - b. The content of Operation and Maintenance Manuals.
 2. Submit maintenance procedures available to Owner.
 - a. Include the location and phone numbers of service centers (including 24 HR "hot lines").
 - b. Provide specific information including operation and maintenance requirements, , troubleshooting guide, parts ordering, field service personnel requests, and service contracts.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
 1. Rockwell Automation: Allen-Bradley.
- B. Submit request for substitution in accordance with Specification Section 01 25 13.
- C. Products nearing their "End of Life" shall not be used. "Used" hardware shall also not be used.

2.2 PERFORMANCE AND DESIGN REQUIREMENTS

- A. See Specification Section 40 61 13.
- B. The PLC system shall accomplish the control requirements of the Process Control Descriptions (Specification Section 40 61 96), Drawings, and Specifications.
- C. The PLC system shall operate in ambient conditions of 32 to 140 DEGF temperatures and 5 to 95 PCT relative humidity without the need for purging or air conditioning.
- D. Environmental Controls:
 1. Furnish circulation fans in solid state control system enclosures.
 2. Over-temperature switches shall be utilized to provide special cooling if required to maintain operating temperatures within the manufacturer's specified range.
 3. Air conditioning applications shall include means of preventing moisture condensation.
- E. Where the PLC is utilized to control multiple trains of equipment and where the equipment in each train operates as a unit relatively independent of other equipment trains (e.g., facility with multiple boiler units or filter trains), the PLC components (I/O modules, power supplies, etc.) shall be assigned so that the failure of any one component does not affect equipment on all trains.
 1. I/O modules shall be segregated on a train basis unless required otherwise for safety reasons.
 2. Where several equipment units operate in parallel, but are not considered assigned to a particular equipment train (e.g., multiple raw water pumps or chemical feed pumps all discharging into a common system), the PLC I/O modules associated with each equipment unit shall be assigned so that the failure of any one I/O module does not affect all of the parallel operating equipment units.

2.3 HARDWARE

- A. Processor shall include diagnostic indicators for power, mode, low battery, communications ports, and memory and I/O errors.
- B. I/O modules shall be capable of being replaced while under power.

- C. All I/O modules shall report to the CPU should a terminal block fail or be removed.
- D. Analog output modules shall have a resolution of at least 12 bits.
- E. Provide electric isolation between logic and field device.
- F. Field wiring shall not be disturbed when removing or replacing an I/O module.
- G. Power Supply Units:
 - 1. Electrical service to PLC system is 105 to 125 V, 60 Hz, ± 10 PCT, 1 PH power.
- H. All PLC control system components shall be capable of meeting or exceeding electromagnetic interference tests per IEEE C37.90.2.
- I. Incorporate the following minimum safety measures:
 - 1. Watchdog function to monitor:
 - a. Internal processor clock failure.
 - b. Processor memory failure.
 - c. Loss of communication between processor and I/O modules.
 - d. Processor ceases to execute logic program.
 - 2. Safety function wiring: Emergency shutdown switches shall not be wired into the controller.
 - 3. Safe wiring:
 - a. Unless otherwise specified, activation of alarms and stopping of equipment shall result from the de-energization of control circuits, rather than the energization of control circuits.
 - b. Low voltage control signal wires:
 - 1) Place in conduit segregated for that purpose only.
 - 2) Twisted shielded wire pair.
 - 3) Not located in the same conduit or bundle with power wiring.
 - 4. Initial safety conditions:
 - a. Utilize program module to dictate output states in a known and safe manner prior to running of control program.
 - b. Utilize program each time PLC is re-initiated and the control program activated.
 - 5. Monitoring of internal faults and display:
 - a. Internal PLC system status and faults shall be monitored and displayed.
 - 1) Monitored items shall include:
 - a) Memory ok/loss of memory.
 - b) Processor ok/processor fault.
 - c) Scan time overrun.
 - 6. Control of programs: Protect access to PLC program loading with password protection or with locked, key operated selector switches.
 - a. Provide passwords and/or keys to owner at Substantial Completion.
 - 7. Design PLC system with high noise immunity to prevent occurrence of false logic signals resulting from switching transients, relay and circuit breaker noise or conducted and radiated radio frequency interference.
 - 8. Operator intervention:
 - a. Logic system failure shall not preclude proper operator intervention.
 - b. Safety shutdown of equipment or a system shall require manual operator intervention before the equipment or system operation may be reestablished.

2.4 COMPONENTS

- A. PLC System Central Processor Unit (CPU):
 - 1. CPU shall provide communications with other control systems and man-machine interfaces as specified.
 - 2. CPU shall include capability to modify logic via an Ethernet port without taking processor off line.

3. Memory:
 - a. Battery-backed RAM.
 - b. Non-volatile program storage via flash EEPROM:
 - 1) Automatically download to RAM in the event RAM is corrupted.
 4. Memory battery backup shall be capable of 180 days memory retention with fresh battery.
 - a. Provide visual indication of battery status and a low battery voltage.
 - b. Memory battery backup shall be capable of 28 days memory retention after the "Battery Low" indicating LED is on.
 5. Plug-in card designed to allow quick field replacement of faulty devices.
 - a. Provide unit designed for field replacement and expansion of memory without requiring rewiring or use of special tools.
 6. 20 PCT minimum spare useable memory capacity after all required programming is in place and operating.
 7. Capable of executing all control functions required by the Specifications and Drawings.
 8. Built-in three-mode (proportional-integral-derivative) control capabilities.
 - a. As directly selectable algorithms requiring no user knowledge of programming languages.
 9. Lighted status indicators for "RUN" and "FAILURE".
 10. Capable of manual or automatic control mode transfer from the operating console stations or from within the control strategy.
 - a. Transfer shall be bumpless and balanceless.
- B. Input/output (I/O) Modules:
1. Provide plug-in modular-type I/O racks with cables to connect to all other required PLC system components.
 2. Provide I/O system with:
 - a. I/O solid state boards with status lights indicating I/O status.
 - b. Electric isolation between logic and field device.
 - c. Capability of withstanding low energy common mode transient to 1000 V without failure.
 - d. Incorporate noise suppression design.
 - e. Capable of meeting or exceeding electrical noise tests, NEMA ICS 1-109.60-109.66.
 - f. Capable of being removed and inserted into the I/O rack under power, without affecting any other I/O modules in the rack.
 - g. Install 20 PCT spare I/O points for each type.
 3. Input/output connection requirements:
 - a. Make connections to I/O subsystem by terminating all field wiring on terminal blocks within the I/O enclosure.
 - b. Prewire I/O modules to terminal blocks.
 - c. Provide terminal blocks with continuous marking strip.
 - d. Size terminals to accommodate all active data base points and spares.
 - e. Provide terminals for individual termination of each signal shield.
 - f. Field wiring shall not be disturbed when removing or replacing an I/O module.
 4. Discrete I/O modules:
 - a. Interface to ON/OFF devices.
 - b. I/O status indicator on module front.
 - c. Voltage rating to match circuit voltage.
 - d. Output module current rating:
 - 1) Match maximum circuit current draw.
 - 2) Minimum 1.0 continuous A/point for 120 VAC applications.
 - e. Isolated modules for applications where one module interfaces with devices utilizing different sources of power.
 5. Discrete outputs shall be fused:
 - a. Provide one fuse per common or per isolated output.
 - b. Provide blown fuse indication.
 - c. External fusing shall be provided if output module does not possess internal fusing.

- d. Fuses provided external to output module shall:
 - 1) Be in accordance with module manufacturer's specifications.
 - 2) Be installed at terminal block.
 - 6. Analog I/O modules:
 - a. Input modules to accept signals indicated on Drawings or Specifications.
 - b. Minimum 12 bit resolution.
 - c. I/O chassis supplied power for powering connected field devices.
 - d. Differential inputs and outputs.
 - e. User configurable for desired fault-response state.
 - f. Provide output signals as indicated on Drawings and Specifications.
 - g. Individual D/A converter for each output module.
 - h. Individual A/D converter for each input module.
- C. Power Supply Units:
- 1. Provide regulated power units:
 - a. Designed to operate with PLC system and shall provide power to:
 - 1) All components of PLC system.
 - 2) All two-wire field instruments.
 - 3) Other devices as indicated on Drawings or Specifications.
 - b. Capable of supplying PLC system when all of the specified spare capacity is utilized.
 - c. Each power supply shall be sized such that it will carry no more than 75 PCT of capacity under normal loads.
 - 2. Electrical service to PLC system is 105 to 125 V, 60 Hz, +1 PCT, 1 PH power.
 - 3. Separate AC circuit breakers shall be provided for each power supply.
 - 4. If the PLC system is field expandable beyond the specified spare capacity, and if such expansion requires power supply modification, note such requirements in the submittals and allow room for power supply modification in the PLC system enclosure.
 - 5. Capable of meeting or exceeding electrical noise tests, NEMA ICS 1-109.60-109.66.
 - 6. Power distribution:
 - a. Immune to transients and surges resultant from noisy environment.
 - b. Shall provide constant voltage level DC distribution to all devices.
 - 7. Provide uninterruptible power supply (UPS) to sustain full power to UPS powered loads listed below for a minimum of 30 minutes following loss of primary power and to ensure that the transient power surges and dips do not affect the operation of the PLC system.
 - a. UPS powered loads:
 - 1) All rack mounted PLC components.
 - 2) Local operator consoles.
 - 3) All power supplies furnished with the PLC and associated loads.
 - b. Input:
 - 1) 120 VAC +10 PCT.
 - 2) 60 Hz.
 - 3) Line fuse protection.
 - c. Output:
 - 1) 120 VAC 5 PCT.
 - 2) 60 Hz.
 - 3) Short circuit protected.
 - 4) Instantaneous transfer time.
 - d. IEEE C62.41 Class A voltage surges of 6000 V attenuated to less than 50 V on the output.
 - e. Battery: Maintenance free lead acid.
- D. PLC System Enclosure:
- 1. In accordance with Specification Section 40 67 00 - Control Panels.
 - 2. Component placement:
 - a. Mount all controller components vertically within the enclosure to allow maximum convection cooling.

- b. Either install power supplies above all other equipment with at least 10 IN of clearance between the power supply and the enclosure top, or adjacent to other components, but with sufficient spacing for circulation of cooling air.
 - c. Do not place I/O racks directly above the CPU or power supply.
 - d. Locate incoming line devices (isolation or constant voltage transformers, local power disconnects, surge suppressors, etc.) so as to keep power wire runs within an enclosure as short as possible.
 - e. If items such as magnetic starters, contactors, relays, and other electromagnetic devices must be located within the same enclosure as the PLC system components, place a barrier with at least 6 IN of separation between the magnetic area and the control area.
 - f. Place circulating fans close to major heat generating devices.
 - g. Segregate input/output modules into groups of identical type.
3. Wiring and grounding to be in accordance with Specification Section 40 6700.
 4. Termination requirements:
 - a. In accordance with Specification Section 40 6700.
 - b. Make connections to I/O subsystem by terminating all field wiring on terminal blocks within the enclosure.
 - c. Prewire I/O modules to terminal blocks.
 - d. Size terminals to accommodate all active database points and spares.
 - e. Provide terminals for individual termination of each signal shield.
 - f. Field wiring shall not be disturbed when removing or replacing an I/O module.
- E. Graphical Operator Interface
1. The data entry and display module shall consist of a 10-inch color screen display.
 2. The unit shall be capable of reading PLC data table register values and pre-defined messages and writing into PLC memory to modify register values.
 3. The readout module will be used as a local operator interface device for entering operational parameters and reading out process data including display of all alarms by tag number.
 4. A complete index of parameters and corresponding memory locations and a complete cross reference of alarms will be permanently attached to each PLC enclosure.
 5. The unit will be self-contained, 24 VDC powered and rated minimum NEMA 12 suitable for panel mounting.
 6. Communications will be direct with the Ethernet Switch via shielded CAT 6 Ethernet Cable.
 7. The touch screen panel shall be an Allen-Bradley PanelView Plus 7 Performance Terminal, 10-inch Color Display, Part Number 2711P-T10C22D9PK, No Substitutions.
- F. Ethernet Switches
1. Ethernet switches shall have the following:
 - a. Rated for a 5-30VDC power supply.
 - b. UL listed.
 - c. Designed for an industrial environment.
 - d. Operating temperature of -40 degrees Fahrenheit to 167 degrees Fahrenheit.
 - e. Fiber SFP modules with jumper cables as shown on the plans.
 2. All switches shall be DLINK Gigabit Smart Managed Industrial Switch – Wide Temp model DIS-200G-12SW or equal. For equal submissions, the contractor shall provide site management software and training on setup, maintenance, and alarming.
- G. PLC System Software and Programming:
1. Provide all hardware required to provide communication between the PLC and the human-machine interface.

2.5 ACCESSORIES

- A. Provide all accessories required to install and test a complete PLC control system to accomplish the requirements of the Drawings and Specifications.

2.6 SOURCE QUALITY CONTROL

- A. Provide a performance test after factory completion and prior to shipment.
 - 1. Conduct a test where the system is operated continuously and checked for correct operation including loop controls, displays, printing, keyboard functions, alarm responses, and on/off sequencing control.
 - 2. Conduct testing with simulated I/O to verify each control loop operation.
 - 3. Allow for Owner and Engineer representatives to witness program testing.
 - a. Provide minimum of 15 days notice prior to testing.
 - 4. Do not ship prior to successful completion of this testing program.

2.7 MAINTENANCE MATERIALS

- A. Furnish Owner with the following extra materials:
 - 1. Two (2) spares of each part, component, or assembly, if more than ten (10) of those components are normally in use in the system.
 - 2. One (1) box of each fuse type provided on this project. If ten (10) or more of a fuse type is provided for the project, then two (2) spare boxes shall be provided.
 - 3. One (1) spare circuit breaker of each rating type provided on this project.
 - 4. One (1) spare relay of each rating type provided on this project.
 - 5. One (1) spare of each type of DC power supply and UPS module.
 - 6. One (1) spare of each type of PLC module and processor.
 - 7. One (1) spare ethernet switch.
 - 8. Two (2) spare SFP modules with fiber jumpers.
- B. Include a complete bill of materials indicating detailed part model number.
- C. Include a complete set of all special tools required to install, maintain and test the PLCs.

PART 3 - EXECUTION

3.1 FUNCTIONALITY

- A. Complete System.
 - 1. Provide all coordination, integration, and testing required for furnishing a fully functioning system.

3.2 FACTORY TESTING

- A. After assembly, wiring, configuration, and prior to shipment of the control system to the project site, verify system functionality by applying test signals to all input points and observing system response at output points.
- B. Submit a factory test report indicating how the system was tested and which items were tested.
- C. After Owner has had sufficient time to review the factory test report, provide an opportunity for Owner and Owner's technical representative to witness a factory acceptance test.
- D. Retain the system in test configuration until approval of the factory acceptance test.

3.3 INSTALLATION

- A. Install PLC control system in accordance with manufacturer's written instructions.

3.4 FIELD QUALITY CONTROL

- A. Employ and pay for services of equipment manufacturer's field service representative(s) to:
 - 1. Inspect equipment covered by these Specifications.
 - 2. Supervise adjustments and installation checks.
 - 3. Maintain and submit an accurate daily or weekly log of all commissioning functions.
 - a. All commissioning functions may be witnessed by the Engineer.
 - b. All reports shall be cosigned by the Contractor and the Engineer if witnessed.

4. Conduct startup of equipment and perform operational checks.
5. Provide Owner with a written statement that manufacturer's equipment has been installed properly, started up, and is ready for operation by Owner's personnel.

3.5 COMMISSIONING AND ACCEPTANCE

- A. Commission system in accordance with Specification Section 01 75 00, System Startup.
- B. Demonstrate system in accordance with Specification Section 26 08 13, Acceptance Testing.

3.6 TRAINING

- A. Employee of the manufacturer or certified representative to provide two, 4-hour training sessions, of operation and maintenance training at the Project site after the system has successfully undergone all field testing and acceptance procedures.
- B. As a minimum, training shall cover:
 1. Hardware overview.
 2. Software overview.
 3. Documentation.
 4. Maintenance.
 5. Trouble shooting.
 6. Operation, e.g., changing set points, passwords, etc.

3.7 DOCUMENTATION

- A. Update O&M manuals to reflect as-built conditions.

3.8 SUPPORT

- A. Provide on-call technical support for a period of one year after substantial completion. Include a minimum of two site visits to work with owner on any final modifications to the logic.

END OF SECTION

SECTION 40 67 00
CONTROL SYSTEM EQUIPMENT PANELS AND RACKS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Requirements for control panels and enclosures utilized as follows:
 - a. Unless noted otherwise, all control panels and enclosures housing control components that are specified in Section 40 66 40, Section 40 71 00, Section 40 72 00, Section 40 73 00, Section 40 63 43, Section 40 97 00, or Section 40 61 43.
- B. This Section is only applicable to panels furnished with Division 11 equipment packages when so stated in the applicable Division 11 Section.
- C. This Section is only applicable to panels housing Division 26 specified equipment (e.g., motor starters, lighting controls, etc.) when so stated in the applicable Division 26 section.
- D. Related Sections include but are not necessarily limited to:
 - 1. Division 00 - Procurement and Contracting Requirements.
 - 2. Division 01 - General Requirements.
 - 3. Section 10 14 00 - Identification Devices.
 - 4. Division 11 - Equipment.
 - 5. Division 26 - Electrical.
 - 6. Section 40 61 13 - Process Controls Systems General Requirements.
 - 7. Section 40 61 96 - Process Control Descriptions.
 - 8. Section 40 63 43 - Programmable Logic Controller (PLC) Control System.
 - 9. Section 40 71 00 - Flow Measurement.
 - 10. Section 40 72 00 - Level Measurement.
 - 11. Section 40 73 00 - Pressure, Strain, and Force Measurement.
 - 12. Section 40 74 00 - Temperature Measurement.
 - 13. Section 40 78 00 - Panel Mounted Instruments.
 - 14. Section 40 91 10 Primary Meters and Transmitters

1.2 QUALITY ASSURANCE

- A. Referenced Standards:
 - 1. American National Standards Institute (ANSI).
 - 2. ASTM International (ASTM):
 - a. B75, Standard Specification for Seamless Copper Tube.
 - 3. National Electrical Manufacturers Association (NEMA):
 - a. 250, Enclosures for Electrical Equipment (1000 Volts Maximum).
 - b. ICS 4, Industrial Control and Systems: Terminal Blocks.
 - 4. National Fire Protection Association (NFPA):
 - a. 70, National Electrical Code (NEC):
 - 1) Article 409, Industrial Control Panels.
 - 2) Article 504, Intrinsically Safe Systems.
 - 5. Underwriters Laboratories, Inc. (UL):
 - a. 508A, Standard for Safety Industrial Control Panels.
 - b. 698A, Standard for Industrial Control Panels Relating to Hazardous (Classified) Locations.
 - c. 913, Standard for Safety Intrinsically Safe Apparatus and Associated Apparatus for Use in Class I, II, and III, Division 1, Hazardous (Classified) Locations.

- B. Miscellaneous:
 1. Approved supplier of Industrial Control Panels under provisions of UL 508A or UL 698A.
 - a. Entire assembly shall be affixed with a UL 508A or UL 698A label "Listed Enclosed Industrial Control Panel" prior to shipment to the jobsite.
 - b. Control panel(s) without an affixed UL 508A or UL 698A label shall be rejected and sent back to the Contractor's factory.

1.3 DEFINITIONS

- A. Panel: Control panels or enclosures listed in the schedule included in this Specification Section.
- B. Foreign Voltages: Voltages that may be present in circuits when the panel main power is disconnected.
- C. Intrinsically Safe:
 1. A device, instrument or component that will not produce sparks or thermal effects under normal or abnormal conditions that will ignite a specified gas mixture.
 2. Designed such that electrical and thermal energy limits inherently are at levels incapable of causing ignition.
- D. Intrinsically Safe Circuit: A circuit in which any spark or thermal effect is incapable of causing ignition of a mixture of flammable or combustible material in air under test conditions as prescribed in UL 913.
- E. Cable: Multi-conductor, insulated, with outer sheath containing either building wire or instrumentation wire.
- F. Instrumentation Cable:
 1. Multiple conductor, insulated, twisted or untwisted, with outer sheath.
 2. Instrumentation cable is typically either TSP (twisted-shielded pair) or TST (twisted-shielded triad), and is used for the transmission of low current or low voltage signals.
- G. Ground Fault Circuit Interrupter (GFCI): A type of device (e.g., circuit breaker or receptacle) which detects an abnormal current flow to ground and opens the circuit preventing a hazardous situation.
- H. Programmable Logic Controller (PLC): A specialized industrial computer using programmed, custom instructions to provide automated monitoring and control functions by interfacing software control strategies to input/output devices.
- I. Remote Terminal Unit (RTU): An industrial data collection device designed for location at a remote site, that communicates data to a host system by using telemetry such as radio, dial-up telephone, or leased lines.
- J. Input/Output (I/O): Hardware for the moving of control signals into and/or out of a PLC or RTU.
- K. Supervisory Control and Data Acquisition (SCADA): Used in process control applications, where programmable logic controllers (PLCs) perform control functions but are monitored and supervised by computer workstations.
- L. Highway Addressable Remote Transducer (HART): An open, master-slave protocol for bus addressable field instruments.
- M. Digital Signal Cable: Used for the transmission of digital communication signals between computers, PLCs, RTUs, etc.
- N. Uninterruptible Power Supply (UPS): A backup power unit that provides continuous power when the normal power supply is interrupted.
- O. Loop Calibrator: Portable testing and measurement tool capable of accurately generating and measuring 4-20ma DC analog signals.

1.4 SUBMITTALS

- A. Shop Drawings:
1. See Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
 2. See Section 40 61 13.
 3. Prepared with computer aided design (CAD) software.
 4. Printed on 11 by 17 IN sheets.
 5. Drawings shall include a title block containing the following:
 - a. Plant or facility name where panel(s) are to be installed.
 - b. Drawing title.
 - c. Drawing number.
 - d. Revision list with revision number and date
 - e. Drawing date.
 - f. Drawing scale.
 - g. Manufacturer name, address, and telephone number.
 6. Cover sheet for each drawing set shall indicate the following:
 - a. Plant or facility name.
 - b. Project name.
 - c. Submittal description.
 - d. Revision number.
 - e. Issue date.
 7. Table of contents sheet(s) shall indicate the following for each drawing in the set:
 - a. Drawing number.
 - b. Drawing title.
 - c. Sheet number.
 8. Legend and abbreviation sheet shall indicate the following:
 - a. Description of symbols and abbreviations used.
 - b. Panel construction notes including enclosure NEMA rating, finish type and color, wire type, wire color strategy, conductor sizes, and wire labeling strategy.
 - c. Confirmation that the panel(s) are to be affixed with a UL 508A or UL 698A label prior to shipment from the factory.
 9. Bill of Material for each panel shall include the following component information:
 - a. Instrument tag number.
 - b. Quantity.
 - c. Functional name or description.
 - d. Manufacturer.
 - e. Complete model number.
 - f. Size or rating.
 10. Panel exterior layout drawings to scale and shall indicate the following:
 - a. Panel materials of construction, dimensions, and total assembled weight.
 - b. Panel access openings.
 - c. Conduit access locations.
 - d. Front panel device layout.
 - e. Nameplate schedule:
 - 1) Nameplate location.
 - 2) Legend which indicates text, letter height and color, and background color.
 - 3) Short Circuit Current Rating (SCCR) marking per NFPA 70 or statement of exception. Include any required calculations.
 - f. Alarm annunciator window engraving schedule.
 - g. Layouts of graphic panels or mosaic displays.
 11. Panel interior layout drawings shall be drawn to scale and shall indicate the following:
 - a. Sub-panel or mounting pan dimensions.
 - b. Interior device layouts.
 - c. PLC/RTU general arrangement layouts.
 - d. Wire-way locations, purpose, and dimensions.

- e. Terminal strip designations.
 - f. Location of external wiring and/or piping connections.
 - g. Location of lighting fixtures, switches and receptacles.
12. Wiring diagrams shall consist of the following:
- a. Panel power distribution diagrams.
 - b. Control and instrumentation wiring diagrams.
 - c. PLC/RTU I/O information:
 - 1) Model number of I/O module.
 - 2) Description of I/O module type and function.
 - 3) Rack and slot number.
 - 4) Terminal number on module.
 - 5) Point or channel number.
 - 6) Programmed point addresses.
 - 7) Signal function and type.
 - d. Wiring diagrams shall identify each wire as it is to be labeled.
- B. Manufacturer catalog cut sheets for enclosure, finish, panel devices, control auxiliaries, and accessories.
- C. Electrical load calculations for each panel:
- 1. Total connected load.
 - 2. Peak electrical demand for each panel.
- D. Climate control calculations for each panel:
- 1. Verify that sufficient dissipation and/or generation of heat is provided to maintain interior panel temperatures within the rated operating temperatures of panel components.
- E. Contract Closeout Information:
- 1. Operation and Maintenance Data:
 - a. See Section 01 33 04 for requirements for the mechanics, administration, and the content of Operation and Maintenance Manual submittals.
 - 2. See Section 40 61 13.
- F. Informational Submittals:
- 1. Record Drawings:
 - a. Updated panel drawings delivered with the panel(s) from the Contractor's factory.
 - b. Drawings shall be enclosed in transparent plastic and firmly secured within each panel.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
- 1. Enclosures:
 - a. Hoffman Engineering Co.
 - b. Rittal.
 - c. Hammond Manufacturing.
 - d. Millbank Mfg. Co.
 - 2. Panel heaters:
 - a. Hoffman Enclosures, Inc.
 - b. Rittal.
 - c. Hammond Manufacturing.
 - 3. Heat exchangers and air conditioners:
 - a. Hoffman Enclosures, Inc.
 - b. Rittal.
 - c. Hammond Manufacturing.

4. Cooling fans and exhaust packages:
 - a. Hoffman Enclosures, Inc.
 - b. Rittal.
5. Internal corrosion inhibitors:
 - a. Hoffman Enclosures, Inc.; Model A-HCI.
 - b. Northern Technologies International Corporation (NTIC); Model Zerust VC.
 - c. Cortec Corporation; Model VpCI Emitting Systems.

B. Submit request for substitution in accordance with Section 01 25 13.

2.2 ACCESSORIES

- A. Panel Nameplates and Identification:
1. See Section 10 14 00.

2.3 FABRICATION

- A. General:
1. Fabricate panels with instrument arrangements and dimensions identified in the Contract Documents.
 2. Provide panel(s) with the required enclosure rating per NEMA 250 to meet classifications identified in the Contract Documents.
 3. Devices installed in panel openings shall have a NEMA enclosure rating at least equal to the panel enclosure rating.
 - a. Devices that cannot be obtained with a adequate NEMA rating shall be installed behind a transparent viewing window.
 - b. The window shall maintain the required NEMA rating of the enclosure.
 4. Panel(s) shall be completely assembled at the Contractor's factory.
 - a. No fabrication other than correction of minor defects or minor transit damage shall be performed on panels at the jobsite.
 5. Painting:
 - a. Panels fabricated from steel shall have their internal and external surfaces prepared, cleaned, primed, and painted.
 - 1) Mechanically abrade all surfaces to remove rust, scale, and surface imperfections.
 - 2) Provide final surface treatment with 120 grit abrasives or finer, followed by spot putty to fill all voids.
 - 3) Utilize solvent or chemical methods to clean panel surfaces.
 - 4) Apply surface conversion of zinc phosphate prior to painting to improve paint adhesion and to increase corrosion resistance.
 - 5) Electrostatically apply polyester urethane powder coating to all inside and outside surfaces.
 - 6) Bake powder coating at high temperatures to bond coating to enclosure surface.
 - a) Panel interior shall be white with semi-gloss finish.
 - b) Panel exterior shall be ANSI #61 gray with flat finish.
 - 7) Application of alkyd liquid enamel coating shall be allowed in lieu of polyester urethane powder for wall mounted NEMA 1 or NEMA 12 rated panels.
 - b. Panels fabricated from stainless steel, aluminum, or fiberglass shall not be painted.
 6. Finish opening edges of panel cutouts to smooth and true surface conditions.
 - a. Panels fabricated from steel shall have the opening edges finished with the panel exterior paint.
 7. Panels shall meet all requirements of UL 508A or UL 698A.
 - a. If more than one disconnect switch is required to disconnect all power within a panel or enclosure, provide a cautionary marking with the word "CAUTION" and the following or equivalent, "Risk of Electric Shock-More than one disconnect switch required to de-energize the equipment before servicing."
 8. Provide control panel in accordance with NFPA 70, Article 409.
 - a. In the event of any conflict between NFPA 70, Article 409 and UL 508A or UL 698A, the more stringent requirement shall apply.

9. Provide equipment or control panels with Short Circuit Current Rating (SCCR) labeling as required by NFPA 70 and other applicable codes.
 - a. Determine the SCCR rating by one of the following methods:
 - 1) Method 1: SCCR rating meets or exceeds the available fault current of the source equipment when indicated on the Drawings.
 - 2) Method 2: SCCR rating meets or exceeds the source equipment's Amp Interrupting Current (AIC) rating as indicated on the Drawings.
 - 3) Method 3: SCCR rating meets or exceeds the calculated available short circuit current at the control panel.
 - b. The source equipment is the switchboard, panelboard, motor control center or similar equipment where the control panel circuit originates.
 - c. For Method 3, provide calculations justifying the SCCR rating. Utilize source equipment available fault current or AIC rating as indicated on the Drawings.
- B. Free-Standing Panels:
 1. Welded construction.
 2. Completely enclosed, self-supporting, and gasketed, dust-tight.
 3. Rolled lip around all sides of enclosure door opening.
 4. Seams and corners welded and ground smooth to touch and smooth in visual appearance.
 5. Full height, fully gasketed flush panel doors.
 6. Full length piano hinges rated for 1.5 times door plus instrument weight.
 7. Doors with keyed alike locking handles and three-point catch.
 8. Appropriate conduit, wiring, and instrument openings shall be provided.
 9. Lifting eyebolts to allow simple, safe rigging and lifting of panel during installation.
- C. Wall Mounted Panels:
 1. Seams continuously welded and ground smooth.
 2. Rolled lip around all sides of enclosure door opening.
 3. Gasketed dust tight.
 4. [Door clamps and hasp/staple for padlocking] [Three-point latching mechanism operated by oil tight key-locking handle].
 5. Key doors alike.
 6. Continuous heavy GA hinge pin on doors.
 - a. Hinges rated for 1.5 times door plus instrument weight.
 7. Front full opening door.
 8. Brackets for wall mounting.
- D. Internal Panel Wiring:
 1. Panel wire duct shall be installed between each row of components, and adjacent to each terminal strip.
 - a. Route wiring within the panel in wire-duct neatly tied and bundled with tie wraps.
 - b. Follow wire-duct manufacturer's recommended fill limits.
 - c. Wire-duct shall have removable snap-on covers and perforated walls for easy wire entrance.
 - d. Wire-duct shall be constructed of nonmetallic materials with rating in excess of the maximum voltage carried therein.
 2. Wiring shall be installed such that if wires are removed from one device, source of power will not be disrupted to other devices.
 3. Splicing and tapping of wires permitted only at terminal blocks.
 4. Wire bunches to doors shall be secured at each end so that bending or twisting will be around longitudinal axis of wire.
 - a. Protect bend area with sleeve.
 5. Arrange wiring neatly, cut to proper length, with surplus wire removed.
 - a. Arrange wiring with sufficient clearance.
 - b. Provide a abrasion protection for wire bundles that pass through openings or across edges of sheet metal.

6. AC circuits shall be routed separate from analog signal cables and digital signal cables.
 - a. Separate by at least 6 IN, except at unavoidable crossover points, and at device terminations.
7. Separation of intrinsically safe circuit conductors and non-intrinsically safe circuit conductors:
 - a. Secure conductors so that any intrinsically safe circuit conductor that might come loose from a terminal is unlikely to come into contact with another terminal.
 - b. Separate non-intrinsically safe circuit conductors from intrinsically safe circuit conductors by one of the following methods:
 - 1) Separation of non-intrinsically safe circuit conductors from intrinsically safe circuit conductors by at least 2 IN (50 MM).
 - 2) Separation of non-intrinsically safe circuit conductors from intrinsically safe circuit conductors by use of a grounded metal partition 0.0359 IN (0.91 MM) or thicker.
 - 3) Separation of non-intrinsically safe circuit conductors from intrinsically safe circuit conductors by use of an approved insulating partition that extends to within 0.0625 IN (1.5 MM) of the enclosure walls.
 - 4) Where either (1) all of the intrinsically safe circuit conductors or (2) all of the non-intrinsically safe circuit conductors are in grounded metal-sheathed or metal-clad cables where the sheathing or cladding is capable of carrying fault current to ground.
8. Separate different intrinsically safe circuit conductors from each other by one of the following means:
 - a. The conductors of each circuit are within a grounded metal shield.
 - b. The conductors of each circuit have insulation with a minimum thickness of 0.01 IN (0.25 MM).
9. Provide minimum clearance of 0.125 IN (3 MM) between uninsulated parts of intrinsically safe field wiring conductors connected to terminals and grounded metal or other conducting parts.
10. Wiring to pilot devices or rotary switches shall be individually bundled and installed with a "flexible loop" of sufficient length to permit the component to be removed from panel for maintenance without removing terminations.
11. Conductors for AC and DC circuits shall be type MTW stranded copper listed for operation with 600 V at 90 DEG C.
 - a. Conductor size shall be as required for load and 16 AWG minimum.
 - b. Internal panel wiring color code:
 - 1) AC circuits:
 - a) Power wiring: Black.
 - b) Control interconnections: Yellow.
 - c) Neutral: White.
 - d) Ground: Green.
 - 2) Low voltage DC circuits:
 - a) Power wiring: Blue.
 - b) Control interconnections: Violet.
 - 3) Foreign voltage circuits: Pink.
 - 4) Annunciator circuits: Red.
 - 5) Intrinsically safe circuits: Light Blue.
12. Analog signal cables shall be of 600 V insulation, stranded copper, twisted-shielded pairs.
 - a. Conductor size: 18 AWG minimum.
 - b. Terminate shield drain conductors to ground only at one end of the cable.
13. High precision 250 ohm resistors with 0.25 PCT accuracy shall be used where 4 - 20 mA DC analog signals are converted to 1 - 5 VDC signals.
 - a. Resistors located at terminal strips.
 - b. Resistors terminated using individual terminal blocks and with no other conductors.

- c. Resistor leads shall be un-insulated and of sufficient length to allow test or calibration equipment (e.g., HART communicator, loop calibrator) to be properly attached to the circuit with clamped test leads.
 - 14. Analog signals for devices in separate enclosures shall not be wired in series.
 - a. Loop isolators shall be used where analog signals are transmitted between control enclosures.
 - 15. Wire and cable identification:
 - a. Wire and cables numbered and tagged at each termination.
 - b. Wire tags:
 - 1) Slip-on, PVC wire sleeves with legible, machine-printed markings.
 - 2) Adhesive, snap-on, or adhesive type labels are not acceptable.
 - c. Markings as identified in the Shop Drawings.
- E. Grounding Requirements:
1. Equipment grounding conductors shall be separated from incoming power conductors at the point of entry.
 2. Minimize grounding conductor length within the enclosure by locating the ground reference point as close as practical to the incoming power point of entry.
 3. Bond electrical racks, chassis and machine elements to a central ground bus.
 - a. Nonconductive materials, such as paint, shall be removed from the area where the equipment contacts the enclosure.
 4. Bond the enclosure to the ground bus.
 5. It is imperative that good electrical connections are made at the point between the ground bus and enclosure.
 6. Panel-mounted devices shall be bonded to the panel enclosure or the panel grounding system by means of locknuts or pressure mounting methods.
 7. Sub-panels and doors shall be bonded to ground.
 8. Associated apparatus (connected to intrinsically safe circuits) and associated cable shields:
 - a. Ground in accordance with the associated control drawing (drawing provided for the intrinsically safe circuit and which contains manufacturer's entity parameters).
- F. Termination Requirements:
1. Wiring to circuits external to the panel connected to interposing terminal blocks.
 2. Terminal blocks rigidly mounted on DIN rail mounting channels.
 3. Terminal strips located to provide adequate space for entrance and termination of the field conductors.
 4. One side of each strip of terminal blocks reserved exclusively for the termination of field conductors.
 5. Terminal block markings:
 - a. Marking shall be the same as associated wire marking.
 - b. Legible, machine-printed markings.
 - c. Markings as identified in the shop drawings.
 6. Terminal block mechanical characteristics, and electrical characteristics shall be in accordance with NEMA ICS 4.
 7. Terminal blocks with continuous marking strips.
 - a. Each terminal block shall be identified with machine printed labels.
 8. Terminals shall facilitate wire sizes as follows:
 - a. 120 VAC applications: Conductor size 12 AWG minimum.
 - b. Other: Conductor size 14 AWG minimum.
 9. Analog signal cable shield drain conductors shall be individually terminated.
 10. Install minimum of 20 PCT spare terminals.
 11. Bladed, knife switch, isolating type terminal blocks where control voltages enter or leave the panel.
 12. Fused terminal blocks shall be used in the following circuits:
 - a. Control voltage is used to energize a solenoid valve.
 - b. DC power is connected to 2-wire, loop-powered instruments.

13. Fused terminal blocks shall be provided with blown fuse indicators.
 14. When control circuits require more than one field conductor connected to a single wiring point, a sufficient number of terminal points shall be connected internally to allow termination of only one field conductor per terminal block.
 15. DIN rail mounting channels shall be installed along full length of the terminal strip areas to facilitate future expansion.
 16. Connections to devices with screw type terminals shall be made using spade-tongue, insulated, compression terminators.
 17. Intrinsically safe circuit termination:
 - a. Provide at least 0.25 IN (6 MM) clearance between two terminals for connection of field wiring of different intrinsically safe circuits, unless this clearance is permitted to be reduced by the control drawing this is provided for the intrinsically safe circuit and which contains manufacturer's entity parameters.
 - b. Identify intrinsically safe circuits at terminal and junction locations in a manner that is intended to prevent unintentional interference with the circuits during testing and servicing as required by NEC, Article 504.
- G. Component Mounting and Placement:
1. Components shall be installed per manufacturer instructions.
 2. Mount and wire so removal or replacement may be accomplished without interruption of service to adjacent devices.
 3. Control relays and other control auxiliaries shall be mounted on DIN rail mounting channels where practical.
 4. Front panel devices shall be mounted within a range of 40 to 70 IN above the finished floor, unless otherwise shown in the Contract Documents.
 5. PLC/RTU and I/O rack installation:
 - a. Located such that the LED indicators and switches are readily visible with the panel door open.
 - b. Located such that repair and/or replacement of component can be accomplished without the need to remove wire terminations or other installed components.
 6. Locate power supplies with sufficient spacing for circulation of air.
 7. Where components such as magnetic starters, contactors, relays, and other electromagnetic devices are installed within the same enclosure as the PLC/RTU system components, provide a barrier of at least 6 IN of separation between the "power area containing the electromagnetic devices" and the "control area".
 8. Components mounted in the panel interior shall be fastened to an interior sub-panel using machine screws.
 - a. Fastening devices shall not project through the outer surface of the panel enclosure.
 9. Excess mounting space of at least 20 PCT for component types listed below to facilitate future expansion:
 - a. Fuse holders.
 - b. Circuit breakers.
 - c. Control relays.
 - d. Time delay relays.
 - e. Intrinsically safe barriers and relays.
 10. Components installed on sub-panels shall be provided with a minimum spacing between component and wire duct of 1 IN.
 - a. Minimum of 2 IN separation between terminal strips and wire ducts.
 11. Pneumatic tubes and appurtenances:
 - a. Connect panel air piping and tubing penetrations with bulkhead fittings.
 - b. Pneumatic control tubing shall be 1/4 IN OD.
 - 1) Tubing material: Either soft annealed ASTM B75 copper or flame-resistant polyethylene.
 - c. Main headers within panels shall be minimum 1 IN.
 - d. Compression-type pressure fittings.
 - e. Equip panel instrument leads with ball type isolation valve.

- f. Route tubing neatly and mount securely.
 - g. Do not route tubing in front of or in wire ducting.
 - h. Code terminal plates.
 - i. Pneumatic devices shall be served by a dual function filter regulator.
12. In addition to the requirements above, mount and wire so removal or replacement may be accomplished without interruption of service to adjacent devices.
- H. Power Distribution:
- 1. Main incoming power circuits shall be protected with a thermal magnetic circuit breaker.
 - a. Limit load to maximum of 80 PCT of circuit breaker rating.
 - 2. Component types listed below shall be individually fused so that they may be individually de-energized for maintenance:
 - a. PLC/RTU power supply modules.
 - b. Single-loop controllers.
 - 3. Line protection units shall be provided to protect I&C electronics from current and voltage surges. For High current, the minimum continuous operating current shall be 30 amps or larger, a minimum of 80kA of peak surge current rating, LED indicator for diagnostics, and a response time of less than or equal to 1 nanosecond required.
 - 4. Each control panel with PLC/RTU components shall be furnished with power protection as shown on the plans.
 - 5. Equip each panel with necessary power supplies with ratings required for installed equipment and with minimum 25 PCT spare capacity.
 - 6. Constant voltage transformers, balancing potentiometers, and rectifiers as necessary for specific instrument requirements.
- I. Internal Panel Lighting and Service Receptacles:
- 1. Panels less than or equal to 4 FT wide:
 - a. One electrical GFCI duplex receptacle.
 - b. One compact fluorescent light fixture with manual switch(es).
 - 2. Panels or panel faces greater than 4 FT wide:
 - a. One duplex electrical GFCI receptacle per 6 FT of length.
 - b. Continuous fluorescent lighting strip with manual switches.
- J. Environmental Controls:
- 1. Indoor panels located in a designated electrical room or control room:
 - a. Thermostat controlled cooling fans with exhaust louvers if required to maintain temperature inside panel(s) below the maximum operating temperature rating of the internal components.
 - b. Internal corrosion inhibitors.
 - 2. Indoor panels not located within a designated electrical room or control room:
 - a. Thermostat controlled heaters to maintain temperature approximately 10 DEGF above ambient for condensation prevention inside the panels.
 - b. Automatically controlled, closed-loop heat exchangers or closed-loop air conditioners where required to maintain temperature inside each enclosure below the maximum operating temperature rating of the components inside the panel(s).
 - c. Internal corrosion inhibitors.
 - 3. Outdoor panels:
 - a. Outdoor temperature range of 0 DEGF through 120 DEGF.
 - b. Thermostat controlled heaters to maintain temperature approximately 10 DEGF above ambient dew point for condensation prevention inside the panels.
 - c. Outdoor temperature range of 0 DEGF through 120 DEGF.
 - d. Thermostat controlled closed-loop heat exchangers or closed-loop air conditioners if required to maintain temperature inside each enclosure below the maximum operating temperature rating of the components inside the panel.
 - e. Internal corrosion inhibitors.

4. Environmental control components:
 - a. Panel heaters:
 - 1) Thermostat controlled.
 - 2) Fan driven.
 - 3) Components mounted in an anodized aluminum housing.
 - 4) Designed for sub-panel mounting.
 - 5) Powered from 120 VAC and protected with a dedicated circuit breaker.
 - b. Cooling fans and exhaust packages:
 - 1) Cooling fan with louver or grill and replaceable filter.
 - 2) Designed to be mounted within a panel cutout to provide positive airflow through the panel.
 - 3) Cooling fan and exhaust louvers shall be designed and listed to maintain a NEMA 12 enclosure rating.
 - 4) Fitted with replaceable, high-density foam or synthetic fiber.
 - 5) Cooling fan controlled with a separately mounted thermostat with bi-metal sensor and adjustable dial for temperature setting.
 - 6) Powered from 120 VAC and protected with a dedicated circuit breaker.
 - c. Heat exchangers and air conditioners:
 - 1) Dual-loop design to isolate panel interior air from exterior air.
 - 2) Thermostat controlled.
 - 3) Operate from 120 VAC and protected with a dedicated circuit breaker.
 - d. Internal corrosion inhibitors:
 - 1) Contains chemical which vaporizes and condenses on surfaces in the enclosure.
 - 2) Inhibitor shall be applied in accordance with manufacturer instructions for the enclosure volume.
 - 3) Inhibitor shall be applied in the panel(s) prior to shipment from the Contractor's factory.

2.4 MAINTENANCE MATERIALS

- A. Extra Materials:
 1. Quantity of 25 PCT replacement lamps for each type installed (minimum of 12 of each type).
 2. Minimum 12 replacement filters for each type installed.
 3. 1 QT of exterior finish touch-up paint.
 4. One complete set of replacement corrosion inhibitors in sealed packages for each panel.

PART 3 - EXECUTION

3.1 FACTORY TESTING

- A. Scope: Inspect and test entire panel assembly to verify readiness for shipment.
- B. Location: System Integrator's Facility.
- C. Factory Tests:
 1. The completed control system shall be tested in the shop by the Control System Integrator and the Control System Programmer. Testing shall be conducted in two phases. The initial hardware testing shall include, but not be limited to, operation of all input and output (I/O) points. The subsequent testing shall include, but not be limited to, testing of RTU programming and Operator Interface provided by the Control System Programmer.
 - a. The entire assembled panels shall be meggered and tested to be free from grounds and shorts.
 - b. Energize each discrete input and output and simulating each analog input and output using a loop simulator and calibrator. Circuits not energized shall be tested for continuity. Discrete input signals shall be tested in both the "on" and "off" state. Analog signals shall be tested at a minimum of three values (4 mA, 12 mA, and 20 mA). The test results shall be documented by the Control System Integrator in checklist

- format. The final test results shall be signed by both the Engineer and Control System Integrator prior to shipment of equipment to the job site.
- c. Provide signal generators, multimeters, and other test equipment as required to verify proper operation of the assembled panels.
 - d. Correct, replace, or repair control panel wiring, and/or components until testing demonstrates proper operation. Control panels shall not be shipped to the job site until testing has demonstrated complete operation of the panels.
 - e. Provide updated and complete as-built drawings for the control panels at the time of final factory testing. The Engineer shall review the drawings against the panel construction at the time of final factory testing. Drawings which do not reflect the actual construction of the panel shall be revised and reviewed again by the Engineer. As-built drawings that require revisions shall be submitted to the Engineer for review prior to shipment of equipment to the job site. This review process shall be repeated as necessary so that as-built drawings reflect the actual construction of the panels at the time of shipment. Panels shall not be shipped to the job site until the as-built drawings are updated, complete, and reflect the actual as-shipped status of the equipment.
2. Upon completion of the initial hardware testing, Control System Programmer shall conduct software testing for final inspection by the Owner. The Control System Integrator shall provide for time, equipment and support in their shop for Control System Programmer to completely demonstrate the functions of the entire control system. All control functions and all status and alarm monitoring and indication shall be demonstrated under simulated operating conditions. Simulating equipment shall be provided and wired into the control system for this testing. Testing shall be continued for the time period required by the Owner to observe and verify any revisions and as described above in the scheduling portion of this specification.

3.2 INSTALLATION

- A. Install free-standing panels on 4 IN high concrete housekeeping pads.
- B. Anchor panels in a manner to prevent the enclosure from racking, which may cause the access doors to become misaligned.
- C. Obtain approved panel layouts prior to installation of conduits.
- D. Install products in accordance with manufacturer's instructions.

END OF SECTION

SECTION 40 71 00
FLOW INSTRUMENTATION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Flow Transmitters:
 - a. Magnetic Flow Meters (Inline).
 - b. Thermal Mass Flow Meters.
 - 2. Flow Switches:
 - a. Thermal Dispersion Type Flow Switches
 - 3. Flow Indicators:
 - a. Rotameters - General Performance.
- B. Related Specification Sections include but are not necessarily limited to:
 - 1. Division 00 - Procurement and Contracting Requirements.
 - 2. Division 01 - General Requirements.
 - 3. Section 40 61 13 - Process Control Systems General Requirements.

1.2 QUALITY ASSURANCE

- A. Referenced Standards:
 - 1. American Gas Association (AGA):
 - a. Gas Measurement Committee Report #3.
 - 2. American Society of Mechanical Engineers (ASME):
 - a. A126, Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings.
 - b. A240, Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.
 - c. B16.5, Pipe Flanges and Flanged Fittings.
 - d. B626, Standard Specification for Welded Nickel and Nickel-Cobalt Alloy Tube.
 - e. PTC 19.5, Application of Fluid Meters, Part 2.
 - 3. ASTM International (ASTM):
 - a. A126, Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings.
 - 4. American Water Works Association (AWWA).
 - 5. National Sanitation Foundation (NSF).
 - 6. US Department of Interior Bureau of Reclamation (USDIBR):
 - a. Water Measurement Manual.

1.3 SUBMITTALS

- A. Shop Drawings:
 - 1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
 - 2. See Specification Section 40 61 13.
- B. Operation and Maintenance Manuals:
 - 1. See Specification Section 01 33 04 for requirements for:
 - a. The mechanics and administration of the submittal process.
 - b. The content of Operation and Maintenance Manuals.

1.4 SYSTEM DESCRIPTION

- A. The instruments specified in this Specification Section are the primary element components for the control loops shown on the "I" series Drawings and specified in Specification Section 4090 05.
- B. These instruments are integrated with other control system components specified under Specification Section 4061 13 series to produce the functional control defined in the Contract Documents.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with the Contract Documents, the manufacturers listed in the Articles describing the elements are acceptable.
- B. Submit request for substitution in accordance with Specification Section 0125 13.

2.2 FLOW TRANSMITTERS

- A. Magnetic Flow Meters (Inline):
 - 1. Acceptable manufacturers:
 - a. Endress + Hauser (ProMag).
 - b. Or Equal.
 - 2. Accessories:
 - 3. Design and fabrication:
 - a. Utilize characterized field principle of electromagnetic induction to produce signal directly proportional to flow rate.
 - b. High input impedance pre-amplifiers.
 - 1) Minimum impedance: 10^{10} ohms.
 - c. Provide flanged end connections per ASME B16.5 up to 24 IN rated for piping system operating and test conditions. Meter body shall be rated to same pressure as the flanges.
 - d. Grounding requirements:
 - 1) Nonmetallic or lined pipe:
 - a) Inlet and outlet grounding rings of same material as electrode or as recommended by manufacturer to meet process requirements.
 - 2) Conductive piping:
 - a) Conductive path between the meter and the piping flanges.
 - e. Provide cable between magnetic flow meter and transmitter.
 - 1) Cable shall be potted and fitted by manufacturer at the factory.
 - f. Pulsed DC magnetic field excitation.
 - g. Automatic zero.
 - h. Adjustable low flow cutoff.
 - i. Minimum signal lock (empty tube zero) to prevent false measurement when tube is empty.
 - j. Inaccuracy: ± 0.4 PCT of rate.
 - k. Each magnetic flow meter shall be equipped with an RJ45 EtherNet/IP communications port. The Flowmeter shall have an add-on-profile compatible with Rockwell Automation Studio 5000 PLC programming software.
 - l. 4-20 mA DC isolated output into maximum 800 ohms.
 - m. Power supply: $117\text{ V} \pm 10$ PCT, 60 Hz.
 - n. Indication of flow rate and totalized flow at transmitter.
 - o. Meter operable as specified in liquids with 5.0 micro mho/cm or more conductivity.
 - p. Transmitter electronics shall use microprocessor based architecture and be configured using parameters.
 - q. All meters for drinking water service shall be NSF 61 certified.

4. Schedule:

TAG NUMBER	SERVICE	FLOW RANGE	METER SIZE (IN)	NEMA (IP) RATING
FE/FIT 560-03	RST 2 Feed Flowmeter	0-50 gpm	3"	IP66
FE/FIT 560-04	RST 2 Polymer Feed Flowmeter	0 - 45 gph	1"	IP66
FE/FIT 560-05	Combined RST Discharge	0-100 gpm	3"	IP66
FE/FIT-510-01	Dewatering/Digested Sludge	0-1200 gpm	6"	IP66
FE/FIT-560-01	RST 1 Feed Flowmeter	0-50 gpm	3"	IP66
FE/FIT-560-02	RST 1 Polymer Feed Flowmeter	0 - 45 gph	1"	IP66

A. Thermal Mass Flowmeters:

1. Acceptable manufacturer:
 - a. Fluid Components, Inc.
 - b. Sierra
 - c. Endress + Hauser
 - d. Or approved equal.
2. Design and fabrication:
 - a. Materials:
 - 1) All wetted surfaces: Hastelloy C.
3. Design and fabrication:
 - a. Microprocessor based electronics with field adjustable instrument performance parameters and build-in testing and diagnostics and nonvolatile memory.
 - b. Provide digital LCD display at transmitter.
 - c. Precisely matched RTDs and a heating element.
 - d. Turndown ratio: 10:1 to 100:1.
 - 1) Accuracy: ± 1 PCT of reading +0.5 PCT of calibrated full scale.
 - e. Repeatability: ± 0.5 PCT of reading.
 - f. Operating temperature:
 - 1) Sensor: -40 to 250 DEGF.
 - 2) Transmitter electronics: 0 to 150 DEGF.
 - g. Process connection: 1/2 IN NPT or 3/4 IN NPT
 - h. Field adjustable insertion length.
 - i. Transmitter shall be integrally mounted to the sensor, unless shown otherwise.
 - j. Output: Isolated 4-20 mA.
 - k. Power supply: 115 VAC, 60 Hz
 - l. Provide with suitable length of cable between sensor and transmitter.
 - m. Supply one (1) programmer to allow reconfiguration of process parameters, if required.
 - n. Provide N.I.S.T. traceable calibration certificate.
 - o. In-line flow conditioner:
 - 1) Required where shown in schedule.
 - 2) Stainless steel pipe section with flanged end sections. Pipe schedule and flange connections to match installed piping.
 - 3) Flow conditioner to be approximately seven pipe diameters long.
 - 4) Flow conditioner section to include radial swirl and profile conditioning tabs.

- 5) Flow conditioner to include provision for sensor installation.
4. Schedule:

TAG NUMBER	SERVICE	FLOW RANGE (SCFM)	PROCESS			PIPE SIZE (IN)	OPTIONS
			MEDIUM	TEMP	PRESSURE		
FE/FIT-510-02	Digester Gas	0 – 175	Gas	95 F – 98 F	10 in WC	6	In-line flow conditioner

2.3 FLOW SWITCHES

- A. Thermal Dispersion Type Flow Switches:
1. Acceptable manufacturer:
 - a. Fluid Components, Inc.
 - b. Kurz Instruments, Inc.
 2. Materials:
 - a. All wetted surfaces: Hastelloy C.
 - b. Enclosure: Cast iron or aluminum.
 3. Design and fabrication:
 - a. Solid state electronics.
 - b. Inaccuracy, liquids: ± 0.5 PCT of reading or ± 0.4 FPS.
 - c. Inaccuracy, gas: ± 0.5 PCT of reading or ± 2 SFPS.
 - d. Repeatability: ± 1 PCT of full signal.
 - e. Response time: Adjustable down to 1 second.
 - f. Utilize two platinum RTD's in thermowells in flow stream for differential temperature measurement.
 - g. SPDT switch points.
 - 1) Contacts rated:
 - 2) 1 amp inductive at 125 VDC.
 - 3) 5 amp inductive at 120 VAC.
 - h. Process connections: 1 IN MNPT.
 - i. Power supply: 24 VDC.
 - j. Process temperature: -40 to 350 DEGF.
 4. Schedule:

TAG NUMBER	SERVICE	FLOW RANGE (GPM)	PROCESS			PIPE SIZE (IN)	NEMA (IP) RATING
			MEDIUM	TEMP	PRESSURE		
FSL-560-01	Boiler 2 Heat Loop	0-10	Water	50 - 200 deg. F	20 in WC	6"	IP66

2.4 FLOW INDICATORS

- A. Rotameters - General Performance:
1. Acceptable manufacturers:
 - a. ABB.
 - b. Brooks Instrument.
 - c. Krohne.
 2. Materials:
 - a. Tube/Body: Acrylic plastic.
 - b. Float: Glass or 316 stainless steel.
 - c. End fittings: 316 stainless steel.

3. Design and fabrication:
 - a. Integral needle valve.
 - b. Direct reading scale.
 - c. Clean-out plugs.
 - d. Accuracy: ± 10 PCT.
4. Schedule:

TAG NUMBER	SERVICE	FLUID	SIZE (IN)	FLOW (GPM)	DESIGN PRESSURE (PSI)
FI-550-01	NPW	Water	3/4"	0-25	0-100
FI-550-02	Foam Separator Drain	Water	4"	0-25	0-100

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.

3.2 TRAINING

- A. Provide on-site training in accordance with Specification Section 40 61 13.

END OF SECTION

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SECTION 40 72 00
LEVEL INSTRUMENTATION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Level Transmitters:
 - a. Non-contact Radar Level Sensor and Transmitter.
 - 2. Level Switches:
 - a. Float-Tilt Type Level Switch.
- B. Related Specification Sections include but are not necessarily limited to:
 - 1. Division 00 - Procurement and Contracting Requirements.
 - 2. Division 01 - General Requirements.
 - 3. Section 40 61 13 - Process Control Systems General Requirements.

1.2 QUALITY ASSURANCE

- A. Referenced Standards:
 - 1. American Society of Mechanical Engineers (ASME):
 - a. B 16.5, Pipe Flanges and Flanged Fittings.
 - 2. ASTM International (ASTM):
 - a. A 106, Standard Specification for Seamless Carbon Steel Pipe for High Temperature Service.
 - 3. American National Standards Institute (ANSI).

1.3 SUBMITTALS

- A. Shop Drawings:
 - 1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
 - 2. See Specification Section 40 61 13.
- B. Operation and Maintenance Manuals:
 - 1. See Specification Section 01 33 04 for requirements for:
 - a. The mechanics and administration of the submittal process.
 - b. The content of Operation and Maintenance Manuals.

1.4 SYSTEM DESCRIPTION

- A. The instruments specified in this Specification Section are the primary element components for the control loops shown on the "I" series Drawings and specified in Specification Section 40 90 05.
- B. These instruments are integrated with other control system components specified under Specification Section 40 61 13 series to produce the functional control defined in the Contract Documents.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with the Contract Documents, the manufacturers listed in the Articles describing the elements are acceptable.
- B. Submit request for substitution in accordance with Specification Section 01 25 13.

2.2 LEVEL TRANSMITTERS

A. Non-Contact Type Radar Level Transmitter:

1. Acceptable manufacturers:
 - a. Emerson Rosemount (5400 Series).
 - b. Endress + Hauser (*Micropilot* FMR51/52).
 - c. Siemens (*Sitrans* LR).
2. Specifications:
 - a. General:
 - 1) Measurement Principle: Short radar pulses transmitted from the antenna at the top of the tank to a media with a different dielectric constant.
 - a) Level Measurement.
 - b) No compensation needed for foam or turbulence.
 - c) Connection on top of tank.
 - d) Blanking Distance: Up to 12 IN.
 - e) Application: Liquids or Solids that are viscous or corrosive.
 - 2) Measurement Range (see Schedule):
 - a) Varies according to Antenna (High or Low) and Beam Angle (9 to 37 DEG).
 - b) Maximum range: 10 to 115 FT.
 - 3) Accuracy:
 - a) ± 0.1 IN (low frequency).
 - b) ± 0.4 IN (high frequency).
 - 4) Resolution: 0.04 IN.
 - 5) Temperature Stability: ± 0.05 PCT.
 - 6) Response Time: 1 second.
 - b. Process Connection:
 - 1) Threaded (NPT): See Schedule.
 - 2) Flange (ASME): See Schedule.
 - c. Display and Configuration:
 - 1) Integral Display for live measurement and configuration.
 - 2) Adjustable zero and span.
 - 3) Output variable: Level.
 - 4) Output Units: Feet, inches, meters, or millimeters (mm).
 - d. Electrical:
 - 1) Signal Power: Loop-powered, 2-wire, 24 VDC.
 - 2) Current Output: Analog 4-20 Ma into a 400 ohm loop.
 - 3) High/Low signal alarms (<4.0 mA and >20.0 mA).
 - 4) Optional Communication: Bluetooth
 - 5) Configuration: With remote hand-held configurator.
 - 6) Cable entry: 1/2 IN NPT connection.
 - 7) Complies with FCC Part 15.
 - e. Materials of Construction:
 - 1) Antenna:
 - a) Dielectric rod: 316 L SST
 - b) Cone Antenna: 316 L SST.
 - 2) Housing: Polyurethane-covered Aluminum.
 - 3) O-rings: EPDM.
 - 4) Flanges (ASME B16.5): Plastic.
 - f. Environment:
 - 1) Ambient Temperature: -40 to 158 DEGF (-40 to 70 DEGC).
 - 2) Humidity: Up to 99 PCT.
 - 3) Process Temperature: -4 to 185 DEGF (-20 to 85 DEGC).
 - 4) Process Pressure: 0 to 150 PSIG.
 - 5) Protection: Refer to Area Classification Drawings.

3. Schedule (or Instrument List):

TAG NUMBER	SERVICE	ANTENNA TYPE and SIZE (IF HORN)	SPAN	MOUNT TYPE and SIZE
LE/LIT-560-03	W-1 Tank		0-10'	Screw In Flange 4"

2.3 LEVEL SWITCHES

- A. Float-Tilt Type Level Switch:
1. Acceptable manufacturers:
 - a. Anchor Scientific Inc.
 - b. Consolidated Electric.
 - c. Contegra.
 2. Materials:
 - a. Float material: Polypropylene or Teflon coated type 316 stainless steel.
 - b. Cable jacket: PVC, neoprene.
 - c. Cable clamp: Polypropylene or 316 stainless steel.
 3. Design and fabrication:
 - a. Mercury-free switch.
 - b. Provide switch complete with flexible electrical cables.
 - c. DPST contact rated at 1 amp at 120 VAC.
 - d. Direct acting float switch:
 - 1) Switch actuates on rising level.
 - 2) Switch de-actuates when liquid falls 1 IN below actuation level.
 - e. Terminate cables in junction box.
 - f. Process temperature: max. 120 DEGF.
 - g. Install floats per drawing details.
 4. Schedule (or Instrument List):

TAG NUMBER	SERVICE	CONTACT NO / NC / NO-NC	MOUNTING ELEVATION	MOUNTING (Suspended or Pipe)
LSH-550-01	Foam Separator	NO-NC	Adjusted in Field	Pipe
LSL-550-01	Foam Separator	NO-NC	Adjusted in Field	Pipe

2.4 ACCESSORIES

- A. Furnish all mounting brackets, hardware and appurtenances required for mounting primary elements and transmitters.
1. Materials, unless otherwise specified, shall be as follows:
 - a. Bolts, nuts, washers, expansion anchors: 316 stainless steel.
 - b. Mounting brackets:
 - 1) Standard: 316 stainless steel.
 - 2) Highly corrosive areas: Aluminum.
 - c. Mounting plates, angles:
 - 1) Standard: Carbon steel.
 - 2) Corrosive areas: 316 stainless steel.
 - d. Instrument pipe stands:
 - 1) Standard: Hot-dip galvanized 2 IN schedule 40, ASTM A106, Grade B carbon steel.
 - 2) Corrosive areas: 316 stainless steel.

- B. Provide handheld communicator compatible for all intelligent transmitters furnished.
 - 1. Hand held communicator shall provide capability to check calibration, change transmitter range, and provide diagnostics.
 - 2. If these features are provided with the intelligent transmitter that is accessible, the hand held communicator is not required.
- C. Cable lengths between sensors and transmitters shall be continuous (without splices) and as required to accommodate locations as shown on Drawings.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Install instrument mounting pipe stands level and plumb.
- C. Instrument Valves:
 - 1. Orient stems for proper operation.
 - 2. Install arrays orderly and neat in appearance with true horizontal and vertical lines.
 - 3. Provide a minimum of 2 IN clearance between valve handle turning radii where there are multiple valve handles appearing in a straight line.
 - 4. Valves shall have bonnets and any soft seals removed during welding or soldering into the line.
 - a. When cool, reassemble the valves.
 - 5. Support each valve individually.
 - a. The tubing system does not qualify as support for the valve.
- D. Locate instrument piping and tubing so as to be free of vibration and interference with other piping, conduit, or equipment.
- E. Keep foreign matter out of the system.
- F. Remove all oil on piping and tubing with solvent before piping and tubing installation.
- G. Plug all open ends and connections to keep out contaminants.
- H. Threaded Connection Seals:
 - 1. Use Tite-Seal or acceptable alternate.
 - 2. Use of lead base pipe dope or Teflon tape is not acceptable.
 - 3. Do not apply Tite-Seal to tubing threads of compression fittings.
- I. Instrument Mounting:
 - 1. Mount all instruments where they will be accessible from fixed ladders, platforms, or grade.
 - 2. Mount all local indicating instruments with face forward toward the normal operating area, within reading distance, and in the line of sight.
 - 3. Mount instruments level, plumb, and support rigidly.
 - 4. Mount to provide:
 - a. Protect from heat, shock, and vibrations.
 - b. Provide accessibility for maintenance.
 - c. Free from interference with piping, conduit and equipment.

3.2 TRAINING

- A. Provide on-site training in accordance with Specification Section 40 61 13.

END OF SECTION

SECTION 40 73 00
PRESSURE INSTRUMENTATION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Pressure Transmitters.
 - a. Pressure Transmitters (Gauge and Absolute).
 - 2. Pressure Switches.
 - a. Electro-Mechanical.
 - b. Solid-state / Electronic.
 - 3. Pressure Indicators.
 - a. Pressure Gauges – Mechanical.
 - b. Pressure Gauges - Digital.
 - 4. Isolation Devices.
 - a. Diaphragm Seals.
 - b. In-Line Isolation Sleeve (Annular Seal).
- B. Related Specification Sections include but are not necessarily limited to:
 - 1. Division 00 - Procurement and Contracting Requirements.
 - 2. Division 01 - General Requirements.
 - 3. Section 40 61 13 - Process Control Systems General Requirements.

1.2 QUALITY ASSURANCE

- A. Referenced Standards:
 - 1. American Society of Mechanical Engineers (ASME):
 - a. B 16.5, Pipe Flanges and Flanged Fittings
 - 2. ASTM International (ASTM):
 - a. A 106/A 106M, Standard Specification for Seamless Carbon Steel Pipe for High-Temperature Service.

1.3 SUBMITTALS

- A. Shop Drawings:
 - 1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
 - 2. See Specification Section 40 61 13.
- B. Operation and Maintenance Manuals:
 - 1. See Specification Section 01 33 04 for requirements for:
 - a. The mechanics and administration of the submittal process.
 - b. The content of Operation and Maintenance Manuals.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with the Contract Documents, the manufacturers listed in the Articles describing the elements are acceptable.
- B. Submit request for substitution in accordance with Specification Section 01 25 13.

2.2 PRESSURE TRANSMITTERS

- A. Pressure Transmitters (Gauge and Absolute):
1. Acceptable manufacturers:
 - a. Ashcroft.
 - b. Endress + Hauser (Cerabar S).
 - c. Siemens (SISTRANS P500).
 2. Materials:
 - a. Process flanges and adapters: 316 stainless steel.
 - b. Vent/drain valve: 316 stainless steel.
 - c. Isolating diaphragm: Hastelloy C.
 - d. Housing: Aluminum.
 - e. Fill fluid:
 - 1) Utilize halocarbon fill for process applications involving strong oxidizing agents.
 - a) Agents include but are not limited to: Cl₂, KMN0₄, FeCl, NaOH, and NaOCl.
 - 2) Utilize manufacturer's standard fill for other applications.
 - a) Ensure fill is suitable for application temperatures.
 3. Design and fabrication:
 - a. LED Digital Display with local setup buttons
 - b. Smart transmitters utilizing microprocessor based electronics.
 - c. Signal Output: 4-20 mA DC proportional to pressure.
 - d. Nonvolatile EEPROM memory.
 - e. Power supply: 24 VDC Loop Power.
 - f. Adjustable zero and span.
 - g. Temperature limits:
 - 1) -20 to 180 DEGF (without digital display).
 - 2) -4 to 175 DEGF (with digital display).
 - h. Overpressure limits: Withstand 150 PCT of stated maximum service pressure without damage.
 - i. Humidity limits: 0 to 100 PCT relative humidity.
 - j. Damping: Adjustable between 0 and 60 seconds.
 - k. Accuracy (includes effects of linearity, repeatability and hysteresis): ± 0.10 PCT of calibrated span for 15:1 rangeability.
 - l. Stability: ± 0.2 PCT of upper range limit for 12 months.
 - m. Temperature effect:
 - 1) Total effect including span and zero errors: +0.2 PCT of upper range limit per 100 DEGF for minimum 15:1 rangeability.
 - n. Minimum 1/2 IN pressure connection.
 - o. Equip with test jacks or accessible terminals for testing output.
 - p. Equip with isolation valve and test connections with isolation valves and/or plugs.
 4. Schedule: (or Instrument List).

TAG NUMBER	SERVICE	RANGE	PROCESS CONNECTION
LE/LIT-510-01	Digester 1 Level Sensor	0-50 FT	Diaphragm Seal
LE/LIT-510-02	Digester 2 Level Sensor	0-50 FT	Diaphragm Seal
LE/LIT-510-03	Digester 3 Level Sensor	0-50 FT	Diaphragm Seal
LE/LIT-510-04	Digester 4 Level Sensor	0-50 FT	Diaphragm Seal
LE/LIT-560-01	RST 1 Sludge Hopper Level Sensor	0-5 PSI	Annular seal
LE/LIT-560-02	RST 2 Sludge Hopper Level Sensor	0-5 PSI	Annular seal
PE-510-01	Transfer Pump 2 Discharge	0 - 50 psi	Diaphragm Seal
PE-510-02	Transfer Pump 3 Discharge	0 - 50 psi	Diaphragm Seal
PE-510-04	Transfer Pump 4 Discharge	0 - 50 psi	Diaphragm Seal
PE-510-05	Boiler Circulation Pump 1	0 - 50 psi	

TAG NUMBER	SERVICE	RANGE	PROCESS CONNECTION
PE-510-06	Primary Hot Water Circulation Pump 1	0 - 100 psi	
PE-510-07	Primary Hot Water Circulation Pump 2	0 - 100 psi	
PE-510-08	Heat Exchanger Circulation Pump 1 Discharge	0 - 50 psi	
PE-510-09	Heat Exchanger Circulation Pump 2 Discharge	0 - 50 psi	
PE/PIT-510-10	Digester Gas	0-15" WC	
PE-510-11	Transfer Pump 1 Discharge	0 - 50 psi	Diaphragm Seal
PE/PIT-550-01	Digester 4 Gas	0-15" WC	
PE-560-04	Digester 4 Sludge Circulation Pump 1 Discharge	0 - 50 psi	Diaphragm Seal
PE-560-05	Digester 4 Sludge Circulation Pump 2 Discharge	0 - 50 psi	Diaphragm Seal
PE/PIT-560-06	W-1 Pumping System Discharge	0 - 50 psi	
PE/PIT-560-07	Combined RST Discharge	0 - 100 psi	Diaphragm Seal

2.3 PRESSURE SWITCHES

- A. Electro-Mechanical:
1. Acceptable manufacturers:
 - a. Allen-Bradley.
 - b. Emerson/Rosemount.
 2. Materials:
 - a. Wetted switch elements: 316 stainless steel.
 - b. Diaphragm seal housing: 316 stainless steel.
 3. Accessories:
 - a. Provide ball valve to isolate pressure switch from source.
 - b. Utilize pressure snubber with porous metal discs to provide pulsation dampening on pressure switch as shown on schedule.
 - c. On applications where a pressure switch and a pressure gauge are used at the same location, it is permissible to utilize one pulsation dampener and diaphragm seal to isolate both elements from the process fluid.
 - d. Provide with adjustable screw.
 4. Design and fabrication:
 - a. Utilize "Snap Action" type contact switches.
 - b. No external power needed.
 - c. One SPDT contact rated:
 - 1) 0.5 amps inductive at 125 VDC.
 - 2) 5 amps inductive at 120 VAC.
 - d. Switch set points:
 - 1) Above 1,000 PSI:
 - a) Between 30 and 35 PCT of switch rated working range.
 - b) Operating pressure range not to exceed 35 PCT of switch rated working pressure.
 - 2) Below 1,000 PSI:
 - a) Set points between 30 and 70 PCT of switch rated working range.
 - b) Operating pressure not to exceed 75 PCT of switch rated working range.
 - e. Accuracy: ± 1 PCT of full scale.
 - f. Process connection: Minimum of 1/4 IN.
 - g. Conduit connection: Minimum of 1/2 IN.

5. Schedule:

TAG NUMBER	SERVICE	LOW SETTING	HIGH SETTING	ENCLOSURE RATING
PSH-560-01	Polymer Pump 1 Discharge		50 PSI	C1 D2
PSH-560-02	Polymer Pump 2 Discharge		50 PSI	C1 D2
PSH-560-03	Polymer Pump 3 Discharge		50 PSI	C1 D2
PSH-560-04	W-1 System Pressure		100 PSI	C1 D2
PSH-560-11	Boiler 2 Digester Gas Pressure		20" WC	C1 D1
PSL-560-01	Boiler 2 Digester Gas	0" WC		C1 D1
PSL-560-02	W-1 System	20 PSI		C1 D2

2.4 PRESSURE INDICATORS

A. Pressure Gauge - Mechanical:

1. Acceptable manufacturers:
 - a. Ametek / USGauge (Solfrunt Model 1980).
 - b. Ashcroft (Type 1279 or 1379).
2. Materials:
 - a. Bourdon tube, socket, connecting tube: 316 stainless steel.
 - b. Case: Phenolic.
3. Accessories:
 - a. Provide valve at point of connection to equipment and at panel if panel mounted.
 - b. Utilize pressure snubber with porous metal discs to provide pulsation dampening on gauge applications as shown on schedule.
 - c. Provide 1/2 IN stainless steel anti-siphon pigtail inlet connection for hot water and steam applications.
4. Design and fabrication:
 - a. All components suitable for service at:
 - 1) 250 DEGF.
 - 2) The maximum process temperature to which the gauge is to be exposed.
 - b. Provide viewer protection from element rupture.
 - c. Calibrate gauges at jobsite for pressure and temperature in accordance with manufacturer's instructions.
 - d. Unless otherwise required by codes, provide stem mounted or flush mounted, as required, with dial diameter as follows:

PIPE SIZE	DIAL SIZE	GAUGE CONNECTION
1-1/2 IN or less	2-1/2 IN	1/4 IN
Larger than 1-1/2 IN	4-1/2 IN	1/2 IN

- e. Equip with white faces, black numerals and black pointers.
- f. Gauge tapping position to be clear of equipment functions and movements, and protected from maintenance and operation of equipment.
 - 1) Gauge to be readable from an accessible standing position.
- g. Gauge accuracy: 1 PCT of full range.
- h. Select gauge range so that:
 - 1) The normal operating value is in the middle third of the dial.
 - 2) Maximum operating pressure does not exceed 75 PCT of the full scale range.

5. Schedule:

TAG NUMBER	SERVICE	PRESSURE RANGE (PSI)	CASE SIZE (IN)	PROTECTOR REQUIREMENTS
PI-510-05	Boiler Circulation Pump No. 1	0 - 50 psi	4.5"	Boot
PI-510-06	Primary Hot Water Circ. Pump No. 1	0 - 100 psi	4.5"	Boot
PI-510-07	Primary Hot Water Circ. Pump No. 2	0 - 100 psi	4.5"	Boot
PI-510-08	Heat Exchanger Circ. Pump No. 1	0 - 100 psi	4.5"	Boot
PI-510-09	Heat Exchanger Circ. Pump No. 2	0 - 100 psi	4.5"	Boot
PI-560-05	W1	0 - 50 psi	4.5"	Boot
PI-560-06	W1	0 - 50 psi	4.5"	Boot

2.5 ISOLATION DEVICES

A. Diaphragm Seal:

1. Acceptable manufacturers:
 - a. Ametek.
 - b. Ashcroft.
 - c. Emerson Rosemount.
2. Materials:
 - a. Lower housing: 316 stainless steel.
 - b. Diaphragm material: 316 stainless steel.
3. Design and fabrication:
 - a. Isolates instrument from process fluids which are corrosive or contain solids.
 - b. Upper housing with bleed screw.
 - c. Lower housing with flushing connection.
 - d. Fill fluid:
 - 1) Utilize halocarbon fill for process applications involving strong oxidizing agents.
 - a) Agents include but are not limited to: Cl₂, KMNO₄, FeCl, NaOH, and NaOCl.
 - 2) Utilize manufacturer's standard fill for other applications.
 - a) Ensure fill is suitable for application temperatures.
 - e. Process connections:
 - 1) Instrument: 0.25 IN female NPT or 1/2 IN NPT.
 - 2) Process: 0.5 IN female NPT.
 - 3) PVC pipe applications: Use a socket weld connection.
4. Installed where specified or shown on Drawings.

B. In-Line Isolation Sleeve (Annular Seal) for non-Sludge or Scum applications:

1. Acceptable manufacturers:
 - a. Ametek.
 - b. Red Valve.
2. Materials:
 - a. Body: 316 stainless steel.
 - b. Flanges: 316 stainless steel.
 - c. Flexible liner: Buna-N.
3. Design and fabrication:
 - a. Provide full 360 degree annular pressure sensor with flexible in-line sleeve.
 - b. Sensor shall not restrict the process flow (non-intrusive).
 - c. Seal shall have ANSI Class 150 flanges.
 - 1) Line size as shown on the Drawings.
 - d. Instrument connection: 0.25 IN female NPT.
 - e. Fill fluid:

- 1) Utilize halocarbon fill for process applications involving strong oxidizing agents.
 - a) Agents include but are not limited to: Cl₂, KMNO₄, FeCl, NaOH, and NaOCl.
 - 2) Utilize manufacturer's standard fill for other applications.
 - a) Ensure fill is suitable for application temperatures.
 - f. Pressure rating: To meet requirements of schedule.
- C. Sludge or Scum Service Instrument Isolators:
- 1. Acceptable manufacturers:
 - a. Ashcroft, Inc. (Model 106).
 - b. Or equal.
 - 2. Materials:
 - a. Diaphragm: 316 stainless steel.
 - b. Lower Housing: 316 stainless steel.
 - 3. Design and fabrication:
 - a. Isolates instruments from process fluids which are corrosive or contain solids.
 - b. Upper housing with bleed screw.
 - c. Lower housing with flushing connection.
 - d. Fill fluid:
 - 1) Utilize halocarbon fill for process applications involving strong oxidizing agents.
 - a) Agents include but are not limited to: Cl₂, KMNO₄, FeCl, NaOH, and NaOCl.
 - 2) Utilize manufacturer's standard fill for other applications.
 - a) Ensure fill is suitable for application temperatures.
 - e. Process connections:
 - 1) 0.5 IN female NPT.
 - 2) Process: In-lined flanged, match line size

2.6 ACCESSORIES

- A. Furnish all mounting brackets, hardware and appurtenances required for mounting primary elements and transmitters.
- 1. Materials, unless otherwise specified, shall be as follows:
 - a. Bolts, nuts, washers, expansion anchors: 316 stainless steel.
 - b. Mounting brackets:
 - 1) Standard: 316 stainless steel.
 - 2) Highly corrosive areas: Aluminum.
 - c. Mounting plates, angles:
 - 1) Standard: Carbon steel.
 - 2) Corrosive areas: 316 stainless steel.
 - d. Instrument pipe stands:
 - 1) Standard: Hot-dip galvanized 2 IN schedule 40, ASTM A106, Grade B carbon steel.
 - 2) Corrosive areas: 316 stainless steel.
- B. Tubing Support Angles and Brackets:
- 1. Any of the following materials are acceptable:
 - a. Aluminum support with dielectric material between support and tubing.
 - b. Type 316 stainless steel.
 - c. Fiberglass.
- C. Tubing Tray or Channel:
- 1. Aluminum.
 - 2. Provide dielectric material between tray or channel and tubing.
- D. Provide handheld communicator compatible with all intelligent transmitters furnished.
- 1. Hand held communicator shall provide capability to check calibration, change transmitter range, and provide diagnostics.

2. If these features are provided with the intelligent transmitter, the hand held communicator is not required.
- E. Cable lengths between sensors and transmitters shall be continuous (without splices) and as required to accommodate locations as shown on Drawings.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Install instrument mounting pipe stands level and plumb.
- C. Instrument Valves:
 1. Orient stems for proper operation.
 2. Install arrays orderly and neat in appearance with true horizontal and vertical lines.
 3. Provide a minimum of 2 IN clearance between valve handle turning radii where there are multiple valve handles appearing in a straight line.
 4. Valves shall have bonnets and any soft seals removed during welding or soldering into the line.
 - a. When cool, reassemble the valves.
 5. Support each valve individually.
 - a. The tubing system does not qualify as support for the valve.
- D. Locate instrument piping and tubing so as to be free of vibration and interference with other piping, conduit, or equipment.
- E. Keep foreign matter out of the system.
- F. Remove all oil on piping and tubing with solvent before piping and tubing installation.
- G. Plug all open ends and connections to keep out contaminants.
- H. Threaded Connection Seals:
 1. Use Tite-Seal or acceptable alternate.
 2. Use of lead base pipe dope or Teflon tape is not acceptable.
 3. Do not apply Tite-Seal to tubing threads of compression fittings.
- I. Instrument Mounting:
 1. Mount all instruments where they will be accessible from fixed ladders, platforms, or grade.
 2. Mount all local indicating instruments with face forward toward the normal operating area, within reading distance, and in the line of sight.
 3. Mount instruments level, plumb, and support rigidly.
 4. Mount to provide:
 - a. Protection from heat, shock, and vibrations.
 - b. Accessibility for maintenance.
 - c. Freedom from interference with piping, conduit and equipment.

3.2 TRAINING

- A. Provide on-site training in accordance with Specification Section 40 61 13.

END OF SECTION

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SECTION 40 74 00
TEMPERATURE INSTRUMENTATION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Temperature Transmitters.
 - 2. Temperature Indicators.
 - a. Thermometers.
 - 3. Thermowells.
- B. The instruments specified in this Specification Section are the primary element components for the control loops shown on the "I" series Drawings and specified in Specification Section 40 90 05. Integrate these instruments with other control system components specified under Specification Section 40 61 13 series to produce the functional control defined in the Contract Documents.
- C. Related Specification Sections include but are not necessarily limited to:
 - 1. Division 00 - Procurement and Contracting Requirements.
 - 2. Division 01 - General Requirements.
 - 3. Section 40 61 13 - Process Control System General Requirements.

1.2 QUALITY ASSURANCE

- A. Referenced Standards:
 - 1. American Iron and Steel Institute (AISI):
 - a. Type 316 Stainless Steel.
 - 2. American Society of Mechanical Engineers (ASME):
 - a. PTC 19.3, TW – 2016 Thermowells.
 - b. B40.200, Thermometers, Direct Reading and Remote Reading.
 - 3. ASTM International (ASTM):
 - a. A182/A182M, Standard Specification for Forged or Rolled Alloy and Stainless-Steel Pipe Flanges, Forged Fittings, and Valves and Parts for High-Temperature Service.
 - b. F316, Austenitic Stainless Steel.
 - 4. American National Standards Institute (ANSI):
 - a. MC96.1, Temperature Measurement Thermocouples.

1.3 SUBMITTALS

- A. Shop Drawings:
 - 1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
 - 2. See Specification Section 40 61 13 - Process Control Systems General Requirements.
- B. Operation and Maintenance Manuals:
 - 1. See Specification Section 01 33 04 for requirements for:
 - a. The mechanics and administration of the submittal process.
 - b. The content of Operation and Maintenance Manuals.

PART 2 - PRODUCTS

2.1 TEMPERATURE TRANSMITTER

- A. Temperature Transmitters:
1. Manufacturers:
 - a. Emerson Rosemount (3144).
 - b. Endress + Hauser (Omnigrad).
 - c. Siemens (SITRANS T).
 2. Materials:
 - a. Housing: 316SS.
 3. Design and fabrication:
 - a. LED Display with setup buttons
 - b. Smart transmitter utilizing microprocessor-based electronics.
 - c. Input: RTD, thermocouple or millivolt, as specified in schedule.
 - d. Signal Output: 4-20 mA DC signal linearly proportional to temperature.
 - e. Power supply: 24 VDC Loop Power.
 - f. Adjustable zero and span.
 - g. Temperature limits:
 - 1) -20 to 158 DEGF (with digital display)
 - h. Humidity limits: 0 to 99 PCT relative humidity.
 - i. Damping: Adjustable between 0 and 60 SEC.
 - j. D/A accuracy: ± 0.02 PCT.
 - k. Transmitter accuracy (including linearity, repeatability, and hysteresis) shall be in accordance with the following:
 - 1) RTD (100 ohm platinum): ± 0.18 DEGF (Range: -328 to 1022 DEGF).
 - 2) Thermocouple (Type E): ± 0.36 DEGF (Range: -58 to 1832 DEGF).
 - 3) Thermocouple (Type J): ± 0.45 DEGF (Range: -292 to 1400 DEGF).
 - 4) Thermocouple (Type K): ± 0.45 DEGF (Range: -292 to 2501 DEGF).
 - 5) Thermocouple (Type N): ± 0.72 DEGF (Range: -328 to 2372 DEGF).
 - 6) Thermocouple (Type R): ± 1.08 DEGF (Range: 32 to 3214 DEGF).
 - 7) Thermocouple (Type S): ± 0.90 DEGF (Range: 32 to 3214 DEGF).
 - 8) Thermocouple (Type T): ± 0.45 DEGF (Range: -328 to 752 DEGF).
 - 9) Millivolt input: ± 0.015 mV (Range: -10 to 100 mV).
 - l. Stability:
 - 1) Any of the following drift limits are acceptable:
 - a) Greater of: 0.1 PCT of reading or 0.18 DEGF per 12 months.
 - b) 0.05 PCT of input reading plus 0.043 PCT of span per 12 months.
 - c) 0.05 PCT of maximum span per 12 months.
 - m. Ambient temperature effects (including digital, D/A conversion, and cold junction effects):
 - 1) Any of the following effects per 50 DEGF change are acceptable:
 - a) One-half reference inaccuracy ± 0.18 DEGF.
 - b) Effects in accordance with the following inputs:
 - (1) RTD (100 platinum): ± 0.0027 DEGF.
 - (2) Thermocouple (Type E): ± 0.0072 DEGF + 0.000043 PCT of reading.
 - (3) Thermocouple (Type J):
 - (a) Readings > 32 DEGF: ± 0.0072 DEGF + 0.00029 PCT of reading.
 - (b) Readings < 32 DEGF: ± 0.0072 DEGF + 0.02 PCT of absolute value of reading.
 - (4) Thermocouple (Type K):
 - (a) Readings > 32 DEGF: ± 0.0090 DEGF + 0.00054 PCT of reading.
 - (b) Readings < 32 DEGF: ± 0.0090 DEGF + 0.0002 PCT of absolute value of reading.
 - (5) Thermocouple (Type N): ± 0.0090 DEGF + 0.00036 PCT.

- (6) Thermocouple (Type R):
 - (a) Readings >392 DEGF: ± 0.027 DEGF.
 - (b) Readings <392 DEGF: ± 0.038 DegF - 0.0032 PCT of reading.
- (7) Thermocouple (Type S):
 - (a) Readings >392 DEGF: ± 0.027 DEGF.
 - (b) Readings <392 DEGF: ± 0.038 DegF - 0.0032 PCT of reading
- (8) Thermocouple (Type T):
 - (a) Readings >32 DEGF: ± 0.009 DEGF.
 - (b) Readings <32 DEGF: ± 0.009 DEGF + 0.0036 PCT of absolute value of reading.
- (9) Millivolt input: ± 0.00025 Mv.

4. Schedule:

TAG NUMBER	SERVICE	INPUT TYPE	OUTPUT SIGNAL	TEMPERATURE RANGE
TE/TIT-560-04	Heat Exchanger 3 Sludge Feed	RTD	4-20mA	50 - 200 degree F
TE/TIT-560-07	Heat Exchanger 3 Sludge Discharge	RTD	4-20mA	50 - 200 degree F

2.2 TEMPERATURE INDICATORS

A. Thermometer:

- 1. Manufacturers:
 - a. Ashcroft (EI Series).
 - b. Pyromation (Code BM01).
 - c. U.S. Gauge / Ametek (Model BAC).
- 2. Materials:
 - a. Case: 316 stainless steel.
 - b. Ring: 316 stainless steel.
 - c. Stem: 316 stainless steel.
 - d. Thermowell: ASTM A182, F316 stainless steel.
 - e. Bulb: AISI 316 stainless steel.
- 3. Design and fabrication:
 - a. Type:
 - 1) Bimetallic for applications not exceeding 800 DEGF.
 - 2) Inert gas filled for applications exceeding 800 DEGF.
 - b. Every angle case connection.
 - c. Hermetically sealed case with external adjustment.
 - d. Dial:
 - 1) Minimum 4-1/2 IN.
 - 2) White face.
 - 3) Black numbers and pointer.
 - e. Thermometer well:
 - 1) Extension neck for insulated lines.
 - f. Accuracy ± 1 PCT of full span.
 - g. Shatterproof glass.

4. Schedule:

TAG NUMBER	SERVICE	INPUT TYPE	OUTPUT SIGNAL	TEMPERATURE RANGE
TI-560-01	Boiler 2 HWR	N/A	N/A	50 - 200 degree F
TI-560-02	Boiler 2 HWS	N/A	N/A	50 - 200 degree F

2.3 THERMOWELLS:

1. Manufacturers:
 - a. Emerson Rosemount.
 - b. Endress + Hauser.
 - c. Schneider Electric / Foxboro.
 - d. Siemens.
 - e. Ashcroft.
 - f. SOR.
 - g. United Electric (120 Series).
 - h. U.S. Gauge / Ametek (Model DT).
2. Materials:
 - a. Well: ASTM A182, F316 stainless steel.
 - b. Head: Cast iron.
3. Design and fabrication:
 - a. Constructed in accordance with ASME PTC 19.3, Part 3, Chapter 1, Paragraphs 8-19.
 - b. Lagging extension sufficient to provide wrench clearance above lagging.
 - c. Seal welded on applications where process pressure exceeds 450 PSI.
 - d. Test Thermowells shall be supplied with watertight cap and chain.

2.4 ACCESSORIES

- A. Furnish all mounting brackets, hardware and appurtenances required for mounting primary elements and transmitters.
 1. Materials, unless otherwise specified, shall be as follows:
 - a. Bolts, nuts, washers, expansion anchors: 316 stainless steel.
 - b. Mounting brackets:
 - 1) Standard: Carbon steel.
 - 2) Corrosive areas: 316 stainless steel.
 - c. Mounting plates, angles:
 - 1) Standard: Carbon steel.
 - 2) Corrosive areas: 316 stainless steel.
 - d. Instrument pipe stands:
 - 1) Standard: carbon steel.
 - 2) Corrosive areas: 316 stainless steel.
- B. Provide handheld communicator compatible with all intelligent transmitters furnished.
 1. Handheld communicator shall provide capability to check calibration, change transmitter range, and provide diagnostics.
 2. If these features are provided with the intelligent transmitter, the handheld communicator is not required.
- C. Cable lengths between sensors and transmitters shall be continuous (without splices) and as required to accommodate locations as shown on Drawings.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Install instrument mounting pipe stands level and plumb.
- C. Keep foreign matter out of the system.
- D. Threaded Connection Seals:
 1. Use Tite-Seal or acceptable alternate.
 2. Use of lead base pipe dope or Teflon tape is not acceptable.
 3. Do not apply Tite-Seal to tubing threads of compression fittings.

- E. Capillary Tubing:
 - 1. Route capillary tubing in tubing tray.
 - 2. Install capillary tubing with a 2 IN minimum bend radius which does not kink or pinch the capillaries.
 - 3. Do not cut or disconnect at any point.
 - 4. Coil excess capillary tubing and secure at the instrument.
- F. Temperature Elements:
 - 1. Assemble in the following sequence:
 - a. Remove temperature sensor sheaths and terminal blocks from the head and nipple assembly.
 - b. Connect nipple and head to thermowell installed in the pipe.
 - c. Insert sheath and terminal block until it seats in the thermowell.
 - d. Connect to the head.
- G. Instrument Mounting:
 - 1. Mount all instruments where they will be accessible from fixed ladders, platforms, or grade.
 - 2. Mount all local indicating instruments with face forward toward the normal operating area, within reading distance, and in the line of sight.
 - 3. Mount instruments level, plumb, and support rigidly.
 - 4. Mount to provide:
 - a. Protection from heat, shock, and vibrations.
 - b. Accessibility for maintenance.
 - c. Freedom from interference with piping, conduit and equipment.

3.2 TRAINING

- A. Provide on-site training in accordance with Specification Section 40 61 13.

END OF SECTION

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SECTION 40 78 00
PANEL MOUNTED INSTRUMENTS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Pilot devices:
 - a. Selector switches.
 - b. Pushbuttons.
 - c. Indicating lights.
 - d. Potentiometer.
 - 2. Relays/timers:
 - a. Program timers.
 - b. Reset timers.
 - c. Control relay.
 - d. Time delay relays.
 - 3. Termination equipment:
 - a. Terminal blocks.
 - b. Fuse holders.
 - 4. Power supplies:
 - a. DC power supplies.
 - b. Isolation transformers.
 - 5. Voltage surge protection devices.
 - 6. Running time indicator.
 - 7. Instrument air compressor.
 - 8. Clocks.
 - 9. Intrinsic Safety Isolators.
 - 10. Alarm Beacons.
 - 11. Horns.
- B. Related Sections include but are not necessarily limited to:
 - 1. Division 00 - Procurement and Contracting Requirements.
 - 2. Division 01 - General Requirements.
 - 3. Section 26 43 13 - Low Voltage Surge Protective Devices (SPD).
 - 4. Section 40 61 13 - Process Control Systems General Requirements.

1.2 QUALITY ASSURANCE

- A. Referenced Standards:
 - 1. The International Society of Automation (ISA):
 - a. S18.1, Annunciator Sequences and Specifications.
 - b. ANSI/ISA-12.02.02-2014, Recommendations for the Preparation, Content, and Organization of Intrinsic Safety Control Drawings.
 - 2. National Electrical Manufacturers Association (NEMA):
 - a. 250, Enclosures for Electrical Equipment (1000 Volts Maximum).
 - b. ICS 2, Industrial Control and Systems: Controllers, Contactors, and Overload Relays Rated 600 Volts.
- B. Miscellaneous:
 - 1. Assure units comply with electrical area classifications and NEMA enclosure type shown on Drawings.

1.3 SUBMITTALS

- A. Shop Drawings:
 - 1. Control Drawings for intrinsically safe systems:
 - a. Print on 8-1/2 x 11 IN sheets.
 - b. In accordance with recommendations of ANSI/ISA-12.02.02-2014.
 - c. One control drawing per sheet.
 - d. Identify model numbers of both the associated apparatus and the intrinsically safe apparatus.
 - e. Include wiring diagram showing interconnections of the intrinsically safe apparatus and the associated apparatus.
 - f. Provide entity parameters for both the associated apparatus and the intrinsically safe apparatus.
 - g. Identify line of demarcation between classified (hazardous) and unclassified (nonhazardous) locations and identify equipment that is installed in each location.
 - h. Identify hazardous areas by class, groups, and divisions.
 - i. Show maximum nonhazardous location voltage that may be used with the associated apparatus.
 - j. Include any specific conditions that are necessary to maintain the intrinsic safety protection.
- B. Contract Closeout Information:
 - 1. Operation and Maintenance Data:
 - a. See Section 01 33 04 for requirements for the mechanics, administration, and the content of Operation and Maintenance Manual submittals.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with the Contract Documents, the manufacturers listed in the applicable Articles below are acceptable.
- B. Provide similar components from the same manufacturer for uniformity of appearance, operations, and maintenance.
- C. Submit request for substitution in accordance with Section 01 25 13.

2.2 PILOT DEVICES

- A. Selector Switches:
 - 1. Manufacturers:
 - a. Eaton.
 - b. Rockwell Automation (Allen-Bradley) Bulletin 800H.
 - c. Schneider Electric Class 9001.
 - 2. Design and fabrication:
 - a. Heavy-duty type.
 - b. Oiltight NEMA 4X.
 - c. For Class I Division 2 hazardous locations use Rockwell Automation (Allen Bradley) 800TC-XAF contact blocks.
 - d. Rotary cam units conforming to NEMA ICS 2-216.22.
 - e. Mounting hole: 30.5 MM.
 - f. Supply switches having number of positions required with contact blocks to fulfill functions shown and specified.
 - g. UL listed.
 - h. Maintained contact type.
 - i. Lever type operators.
 - j. Black colored operators.
 - k. Designed with cam and contact block with approximate area of 2 IN SQ.

- l. Legend plate marked per Contract Documents.
 - m. Contact block requirements:
 - 1) Dry and indoor locations: Standard contact blocks rated for 10 A continuous current.
 - 2) Wet or outside locations: Hermetically sealed contact blocks.
- B. Pushbuttons:
1. Manufacturers:
 - a. Eaton.
 - b. Rockwell Automation (Allen-Bradley) Bulletin 800H.
 - c. Schneider Electric Harmony 9001K Series.
 2. Materials:
 - a. Backing diaphragm: Buna-N.
 3. Design and fabrication:
 - a. Heavy-duty type.
 - b. Oiltight NEMA 4X.
 - c. Conforming to NEMA ICS 2-216.22.
 - d. Mounting hole: 30.5 MM.
 - e. Diaphragm backed.
 - f. UL listed.
 - g. Emergency stop pushbuttons to have mushroom head operator and two sets of maintained normally open (NO) and normally closed (NC) contacts. Emergency stop pushbutton shall be NEMA 4X rated. E-stops shall be push to engage and twist and pull to release.
 - h. Non-illuminated type:
 - 1) Momentary contact with necessary contact blocks.
 - 2) Molded, solid color melamine buttons.
 - 3) Long, mushroom operators with half shroud.
 - 4) Green colored buttons for START or ON and red color for STOP or OFF.
 - 5) Appropriate contact blocks to fulfill functions shown or specified.
 - i. Contact block requirements:
 - 1) Dry and indoor locations: Standard contact blocks rated for 10 A continuous current.
 - 2) Wet or outside locations: Hermetically sealed contact blocks.
 - 3) Legend plate marked per Contract Documents.
 - j. Illuminating type:
 - 1) Momentary contact with necessary contact blocks.
 - 2) Serves as both pushbutton control and indicating light.
 - 3) Green colored lenses for start or on and red for STOP or OFF.
 - 4) Resistor-type full voltage light unit with lens and panel gasket.
 - 5) Legend plate marked per Contract Documents.
 - 6) Appropriate contact blocks to fulfill functions shown or specified.
- C. Indicating Lights:
1. Manufacturers:
 - a. Eaton.
 - b. Rockwell Automation (Allen-Bradley) Bulletin 800H.
 - c. GE CR104P.
 2. Design and fabrication:
 - a. Heavy duty.
 - b. Oiltight NEMA 4X.
 - c. Type allowing replacement of bulb without removal from control panel.
 - d. LED.
 - e. UL listed.
 - f. Legend plate marked per Contract Documents.
 - g. Nominal 2 IN SQ face.

- h. Mounting hole: 30.5 MM.
 - i. Push-to-test indicating lights.
 - j. Plastic lens.
 - k. Color code lights as follows:
 - 1) Green: ON or running; valve open.
 - 2) Amber: Standby; auto mode; ready.
 - 3) Red: OFF or stopped; valve closed.
- D. Potentiometer:
- 1. Manufacturers:
 - a. Eaton.
 - b. Allen-Bradley.
 - 2. Design and fabrication:
 - a. Heavy-duty, NEMA type.
 - b. Mounting hole: 30.5 MM.
 - c. UL listed.
 - d. Linear adjustment through 0-1000 ohms with 1 PCT resolution.
 - e. 3-wire interface.
 - f. Dial plate with 0-100 PCT scale.
 - g. Panel mounted.
 - h. One-turn adjustment knob.

2.3 RELAYS/TIMERS

- A. Program Timers:
- 1. Manufacturers:
 - a. Tork.
 - b. Paragon Electric Company, Inc.
 - 2. Design and fabrication:
 - a. Microprocessor based.
 - b. Serve as time program actuator control of final control elements.
 - c. 24 HR time control.
 - d. Up to 6 operations per day.
 - e. Programmable from panel face keys.
 - f. Skip-A-Day feature allowing schedule to be skipped for an entire day or days.
 - g. DPDT switch contacts rated at 15 amps at 120 VAC.
 - h. Battery carryover to maintain time and program during power outage for 275 HRS.
- B. Reset Timer:
- 1. Acceptable manufacturer:
 - a. Eagle Signal Controls.
 - 2. Design and fabrication:
 - a. Heavy duty.
 - b. Consisting of a adjustable time delay with a automatic reset feature when period is timed out.
 - c. Auxiliary relays as required to perform functions specified or shown on Drawings.
 - d. Operate on 117 VAC (+10 PCT) power source.
 - e. Nominal dimensions: 4 x 4 IN.
 - f. Switch rating: 10 amps.
 - g. Dial range: 60 minutes.
- C. Control Relays:
- 1. Manufacturers:
 - a. Idec RH Series.
 - b. TE Connectivity (Potter & Brumfield).
 - c. Rockwell Automation (Allen-Bradley) Bulletin 700-HC.

2. Design and fabrication:
 - a. Plug-in general purpose ice cube relay.
 - b. Blade connector type.
 - c. Switching capacity: 10 A.
 - d. Contact material: Silver cadmium oxide.
 - e. Provide relays with a minimum of 2 DPDT contacts.
 - f. Coil voltage: 120 VAC or 24 VDC.
 - g. Relay sockets are DIN rail mounted.
 - h. Internal neon or LED indicator is lit when coil is energized.
 - i. Clear polycarbonate dust cover with clip fastener.
 - j. Check button.
 - k. Temperature rise:
 - 1) Coil: 85 DEGF max.
 - 2) Contact: 65 DEGF max.
 - l. Insulation resistance: 100 Meg min.
 - m. Frequency response: 1800 operations/hour.
 - n. Operating temperature: -20 to +150 DEGF.
 - o. Life expectancy:
 - 1) Electrical: 500,000 operations or more.
 - 2) Mechanical: 50,000,000 operations or more.
 - p. UL listed.
- D. Time Delay Relays:
 1. Manufacturers:
 - a. Rockwell Automation (Allen Bradley) Bulletin 700-HNC.
 - b. Idec GT Series.
 - c. Eaton TR Series.
 2. Design and fabrication:
 - a. Meet design test and performance requirements of NEMA ICS 2-218.
 - b. Heavy-duty.
 - c. Solid-state construction.
 - d. DPDT contacts.
 - e. External adjusting dial.
 - f. Auxiliary relays as required to perform functions specified or shown on Drawings.
 - g. Operates on 117 VAC (± 10 PCT) power source.
 - h. Contact rating: A150 per NEMA ICS 2-125.
 - i. Furnish with "on" and "timing out" indicators.

2.4 TERMINATION EQUIPMENT

- A. Terminal Blocks:
 1. Manufacturers:
 - a. Phoenix Contact
 - b. Rockwell Automation (Allen-Bradley).
 - c. Weidmuller.
 2. Design and fabrication:
 - a. Modular type with screw compression clamp.
 - b. Screws: Stainless steel.
 - c. Current bar: Nickel-plated copper alloy.
 - d. Thermoplastic insulation rated for -40 to +90 DEGC.
 - e. Wire insertion area: Funnel-shaped to guide all conductor strands into terminal.
 - f. Install end sections and end stops at each end of terminal strip.
 - g. Install machine-printed terminal markers on both sides of block.
 - h. Spacing: 6 MM.
 - i. Wire size: 22-12 AWG.
 - j. Rated voltage: 600 V.
 - k. Din rail mounting.

1. UL listed.
 3. Standard-type block:
 - a. Rated current: 30 A.
 - b. Color: Gray body.
 4. Bladed-type block:
 - a. Terminal block with knife blade disconnect which connects or isolated the two (2) sides of the block.
 - b. Rated current: 10 A.
 - c. Color:
 - 1) Panel control voltage leaves enclosure - normal: Gray body, orange switch.
 - 2) Foreign voltage entering enclosure: Orange body, orange switch.
 5. Grounded-type block:
 - a. Electrically grounded to mounting rail.
 - b. Use to terminal ground wires and analog cable shields.
 - c. Color: Green and yellow body.
- B. Fuse Holders:
1. Manufacturers:
 - a. Phoenix Contact.
 - b. Rockwell Automation (Allen-Bradley).
 - c. Weidmuller.
 - d. Eaton.
 2. Design and fabrication:
 - a. Modular-type with screw compression clamp.
 - b. Screws: Stainless steel.
 - c. Current bar: Nickel-plated copper alloy.
 - d. Thermoplastic insulation rated for -40 to +105 DEGC.
 - e. Wire insertion area: Funnel-shaped to guide all conductor strands into terminal.
 - f. Blocks can be ganged for multi-pole operation.
 - g. Install end sections and end stops at each end of terminal strip.
 - h. Install machine-printed terminal markers on both sides of block.
 - i. Spacing: 9.1 MM.
 - j. Wire size: 30-12 AWG.
 - k. Rated voltage: 300 V.
 - l. Rated current: 12 A.
 - m. Fuse size: 1/4 x 1-1/4.
 - n. Blown fuse indication.
 - o. DIN rail mounting.
 - p. UL listed.

2.5 POWERSUPPLIES

- A. DC Power Supplies:
1. Manufacturers:
 - a. Sola Hevi-Duty.
 - b. Phoenix Contact.
 - c. Rockwell Automation.
 2. Design and fabrication:
 - a. Converts 120 VAC input to DC power at required voltage.
 - b. DIN rail mount with enclosure (i.e., not open frame).
 - c. Switching type.
 - d. Provide redundant 24 VDC modules with diode redundancy module for automatic switchover to standby module on failure of primary module.
 - e. Hardwire module fault dry contact to associated PLC input for alarm at Plant SCADA.
 - f. AC input: 120 VAC \pm 15 PCT, nominal 60 Hz.
 - g. Efficiency: Minimum 86 PCT.
 - h. Rated mean time between failure (MTBF): 500,000 HRS.

- i. Voltage regulation:
 - 1) Static: Less than 1.0 PCT V_{out} .
 - 2) Dynamic: ± 2 PCT V_{out} overall.
 - j. Output ripple/noise: Less than 100 mV peak to peak (20 MHz).
 - k. Overload, short circuit and open circuit protection.
 - l. Temperature rating: 0 to 60 DEGC full rated, derated linearly to 50 PCT at 70 DEGC.
 - m. Humidity rating: Up to 90 PCT, non-condensing.
 - n. LED status indication for DC power.
 - o. UL listed.
- B. Isolation Transformers:
- 1. Manufacturers:
 - a. Topaz Noise Suppressor Noise Isolator.
 - b. MGE UPS Systems, Topaz T1.
 - 2. Design and fabrication:
 - a. Protects sensitive electronic equipment from electrical noise.
 - b. Common-mode noise attenuation: 146 dB at 0.0005 pF coupling capacitance.
 - c. Normal-mode attenuation: 60 dB.
 - d. Input voltage range: ± 10 PCT of rated.
 - e. Regulation: 3.5 PCT or less from full-load to no-load.
 - f. Dielectric strength: 2,500 VAC minimum.
 - g. Harmonic distortion: 1 PCT maximum.
 - h. Electromagnetic interference: 0-1 gauss maximum at 18 IN.
 - i. UL listed.

2.6 VOLTAGE SURGE PROTECTION DEVICES

- A. See Specification Section 2643 13.

2.7 RUNNING TIME INDICATORS

- A. Acceptable Manufacturer:
 - 1. Eagle Signal Controls.
- B. Design and Fabrication:
 - 1. Six-digit wheels including a 1/10 digit.
 - 2. Non-reset type.
 - 3. Time range in hours.
 - 4. Automatic recycle at zero.
 - 5. Accuracy: 1 PCT.
 - 6. Sealed against dirt and moisture.
 - 7. Tamper-proof.

2.8 INSTRUMENT AIR COMPRESSOR

- A. Acceptable Manufacturer:
 - 1. Gast.
- B. Design and Fabrication:
 - 1. Suitable for mounting in control panels.
 - 2. Include compressor, receiver, motor, controls, and dryer.
 - 3. Operate on 117 VAC (+10 PCT) power source.
 - 4. Oil-free units.
 - 5. Include a discharge pressure gauge and automatic condensate drain.
 - 6. Provide air filter, pressure regulator and pressure gauge on discharge.
 - a. Provide units manufactured by Gast.
 - 7. Capacity (free air): 1.3 CFM.
 - 8. Discharge pressure: 70 PSIG.
 - 9. Receiver: 2 GAL.
 - 10. Motor size: 1/3 HP.

2.9 CLOCKS

- A. Manufacturers:
 - 1. Newport.
 - 2. Kessler-Ellis.
- B. Design and Fabrication:
 - 1. Panel/face mounted.
 - 2. Electronic digital.
 - 3. Main panel locations:
 - a. Red LED dot matrix digits with 1-1/2 IN minimum height.
 - 4. Secondary panels:
 - a. Red LED dot matrix digits with 0.6 IN minimum height.
 - 5. Format: 12 HR.
 - 6. Standby power with internal battery for main panel locations.

2.10 INTRINSIC SAFETY ISOLATORS

- A. Manufacturers:
 - 1. Phoenix Contact.
 - 2. Pepperl and Fuchs.
 - 3. MTL Instruments Group.
 - 4. R. Stahl.
- B. Design and fabrication:
 - 1. Utilize in all circuits required to be intrinsically safe.
 - 2. All instruments installed in hazardous locations per Section 40 67 00 shall be provided with intrinsic safety isolators.
 - 3. DIN rail mountable.
 - 4. Provide galvanic isolation; use of passive zener diode type barriers is not permitted.
 - 5. Limit voltage and current so that no spark or thermal effect can cause a potentially explosive atmosphere to ignite.
 - 6. Provide redundant 24 Vdc power supplies in accordance with Paragraph 2.5 A of this Specification. Power supplies shall be installed in the same enclosure as the intrinsic safety isolators. Power supplies shall be sized based on the active load of the associated loop powered field instruments.
 - 7. Furnish and install in accordance with requirements of NEC Article 504, Intrinsically Safe Systems.
 - 8. Certified to be in accordance with latest edition of UL 913 for application.
 - 9. Operating temperature: 0 to 122 DEGF.

2.11 ALARM BEACONS

- A. Manufacturers:
 - 1. Edwards Signaling.
 - 2. Federal Signal.
- B. Design and fabrication:
 - 1. LED beacons with snap-on high impact polycarbonate base.
 - 2. NEMA 4X enclosure.
 - 3. 120 VAC powered.
 - 4. Beacon shall be suitable for indoor and outdoor installations and shall be panel or conduit mountable.
 - 5. Beacon housing shall be capable of withstanding vibration.
 - 6. Dual-mode design which shall be field adjustable between steady-on OR flashing mode by changing a dipswitch inside the beacon housing.
 - 7. Shatter resistant polycarbonate lens. Lens color shall be Red. Black color base.
 - 8. For outdoor locations provide manufacturer supplied gasket kit for weatherproofing.
 - 9. For wall mount installations provide manufacturer supplied wall mount bracket

10. For panel mount installations provide manufacturer supplied mounting accessories.
11. UL listed.

2.12 HORNS

- A. Manufacturers:
 1. Edwards Signaling.
 2. Federal Signal.
 3. Rockwell Automation (Allen Bradley) [Bulletin 855H High Performance]
- B. Design and fabrication:
 1. PLC compatible model.
 2. NEMA 4X enclosure.
 3. Hazardous locations use Rockwell Automation (Allen Bradley) Bulletin 855X model.
 4. Volume adjustable.
 5. Coded or sustained tones.
 6. Shall be completely assembled. NO site assembly required.
 7. Corrosion resistant finish.
 8. Designed for semi-flush panel mount.
 9. Manufacturer supplied mounting accessories.
 10. Minimum 100 dBa sound at 10 FT.
 11. 120 VAC powered.
 12. Beacon shall be suitable for indoor and outdoor installations and shall be panel or conduit mountable.
 13. Beacon housing shall be capable of withstanding vibration.
 14. Dual-mode design which shall be field adjustable between steady-on OR flashing mode by changing a dipswitch inside the beacon housing.
 15. Shatter resistant polycarbonate lens. Lens color shall be Red. Black color base.
 16. For outdoor locations provide manufacturer supplied gasket kit for weatherproofing.
 17. For wall mount installations provide manufacturer supplied wall mount bracket.
 18. For panel mount installations provide manufacturer supplied mounting accessories.
 19. UL listed.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Mount adder/subtractors, multiplier/dividers, square root extractors, transducers and program timers on separate subpanel in control panel.
- C. Instrument Air Compressors:
 1. Pipe condensate outside panel to nearest floor drain.
 2. Mount compressors with rubber vibration isolators.

END OF SECTION

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SECTION 40 91 10
PRIMARY METERS AND TRANSMITTERS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Analytical components.
 - 2. Pipe, tubing and fittings.
 - 3. Instrument valves.
- B. Related Specification Sections include but are not necessarily limited to:
 - 1. Division 00 - Procurement and Contracting Requirements.
 - 2. Division 01 - General Requirements.
 - 3. Section 40 61 13 - Process Control Systems General Requirements.

1.2 QUALITY ASSURANCE

- A. Referenced Standards:
 - 1. American Gas Association (AGA):
 - a. Gas Measurement Committee Report #3.
 - 2. American Iron and Steel Institute (AISI).
 - 3. American National Standards Institute (ANSI).
 - 4. American Society of Mechanical Engineers (ASME):
 - a. B 16.5, Pipe Flanges and Flanged Fittings.
 - b. B 31.1, Power Piping.
 - c. PTC 19.3, Instruments and Apparatus, Part 3 Temperature Measurement.
 - d. PTC 19.5, Application of Fluid Meters, Part 2.
 - e. Section II, Part A SA-182, Forged or Rolled Alloy Steel Pipe Flanges, Forged Fittings, and Valves and Parts for High-Temperature Service.
 - f. Section II, Part A SA-479, Stainless Steel Bars and Shapes for Use in Boilers and Other Pressure Vessels.
 - 5. ASTM International (ASTM):
 - a. A 106, Standard Specification for Seamless Carbon Steel Pipe for High-Temperature Service.
 - b. A 126, Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings.
 - c. A 182, Standard Specification for Forged or Rolled Alloy and Stainless Steel Pipe Flanges, Forged Fittings, and Valves and Parts for High-Temperature Service.
 - d.
 - e.
 - f. A 269, Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service.
 - g. A 276, Standard Specification for Stainless Steel Bars and Shapes.
 - h. A 479, Standard Specification for Stainless Steel Bars and Shapes for Use in Boilers and Other Pressure Vessels.
 - i. B 16, Standard Specification for Free-Cutting Brass Rod, Bar and Shapes for Use in Screw Machines.
 - j. B 75, Standard Specification for Seamless Copper Tube.
 - k. B 124, Standard Specification for Copper and Copper Alloy Forging Rod, Bar, and Shapes.
 - l. B 283, Standard Specification for Copper and Copper-Alloy Die Forgings (Hot-Pressed).
 - m. B 453, Standard Specification for Copper-Zinc-Lead Alloy (Leaded-Brass) Rod, Bar, and Shapes.

6. Federal Communications Commission (FCC)
 - a. 47 CFR 15, Radio Frequency Devices.
7. The International Society of Automation (ISA):
 - a. MC96.1, Temperature Measurement Thermocouples.
8. National Electrical Manufacturers Association (NEMA):
 - a. 250, Enclosures for Electrical Equipment (1000 Volts Maximum).
9. US Department of Interior Bureau of Reclamation (USDIBR):
 - a. Water Measurement Manual.

1.3 SYSTEM DESCRIPTION

- A. The instruments specified in this Specification Section are the primary element components for the control loops shown on the "Y" series Drawings.
 1. These instruments are integrated with other control system components specified under Specification Section 4061 13 series to produce the functional control defined in the Contract Documents.

1.4 SUBMITTALS

- A. Shop Drawings:
 1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
 2. See Specification Section 4061 13.
- B. Contract Closeout Information:
 1. Operation and Maintenance Data:
 - a. See Specification Section 01 33 04 for requirements for the mechanics, administration, and the content of Operation and Maintenance Manual submittals.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with the Contract Documents, the manufacturers listed in the Articles describing the elements are acceptable.
- B. Submit request for substitution in accordance with Specification Section 01 25 13.

2.2 ANALYTICAL ELEMENTS

- A. Combustible and Toxic Gas Detectors:
 1. Acceptable manufacturers:
 - a. Sensidyne.
 - b. Bacharach.
 - c. MSA Instruments.
 2. Control unit:
 - a. Front mounted indication.
 - 1) Minimum three-digit display of gas concentration associated with each sensor.
 - 2) Alarm status indicators for each gas sensing channel:
 - a) Trouble.
 - b) High gas level detected.
 - c) High high gas level detected.
 - b. Alarm relay outputs:
 - 1) Separate contacts for each alarm or trouble condition associated with each gas sensing channel.
 - 2) Separate "system trouble" contact to indicate trouble in the event any of the following conditions are true:
 - a) System power loss.
 - b) Signal loss from any sensor.

- c) Signal out of appropriate range.
 - d) Control module malfunction or removal.
 - 3) Each output contact shall be Form C, SPDT, rated for 3 amps resistive at 120 VAC.
- c. Output signals: 4-20 mA signal representing gas concentration for each gas sensor.
- d. Temperature range: 32 to 158 DEGF.
- e. Relative humidity range: 0-95 PCT non-condensing.
- 3. Sensor and transmitter design and fabrication:
 - a. Sensor mounting type shall be as indicated on schedule: Either diffusion mounted, duct mounted, or sample draw mounted.
 - b. For sensors required by schedule to be sample draw type:
 - 1) Provide a compressed air aspirator or motorized pump to draw a sample past the sensor.
 - 2) Utilize a flow switch to provide annunciation of low sample flow rate to the sensor.
 - c. Duct mounted gas sensor shall be able to monitor gas flow rates up to 85 fps.
 - d. Combustible gas sensor shall be catalytic bead type with demonstrated resistance to poisoning by silicones and hydrogen sulfide gases.
 - e. Toxic gas sensor shall be the electrochemical type and shall not require the periodic addition of reagents.
 - f. Interconnect wiring from sensor to transmitter (if not integral) or control unit shall be 3-wire shielded cable.
 - g. Sensing element shall have minimum useful life of one year.
 - h. Transmitter output: 4-20 mA signal proportional to measured gas level.
 - 1) Capable of driving 600 ohm load at 24 VDC supply voltage.
 - i. Accuracy:
 - 1) Combustible gas detection:
 - a) +3 PCT LEL to 50 PCT full scale.
 - b) +5 PCT LEL, 50 to 100 PCT full scale.
 - 2) Toxic gas detection:
 - a) +10 PCT full scale or 2 PPM, whichever is greater.
 - j. Environmental:
 - 1) Ambient operating temperature: -40 to 185 DEGF.
 - 2) Relative humidity: 0-95 PCT non-condensing.
 - k. Housing: In accordance with the area classification shown on Drawings.
 - l. Provide nonintrusive means of calibration.
 - m. Local displays:
 - 1) 3-1/2 digit LCD or LED display of measured gas level.
 - 2) Fault LED.
 - n. Stand alone sensors and transmitters (without central control unit):
 - 1) Provide relay contacts rated at 1/2 amps at 120 VAC for each of the following conditions:
 - a) High gas level (warning level).
 - b) High high gas level (alarm level).
 - c) Sensor fault condition.
 - o. Relay contacts shall be normally energized (normally closed); contacts shall open in the event of a warning, alarm or trouble condition.
 - p. Minimum detector response time when exposed to 100 PCT LEL gas concentration:
 - 1) 10 seconds to 50 PCT LEL.
 - 2) 30 seconds to 90 PCT LEL.
 - q. Store calibration data in nonvolatile memory or backup with battery.
- 4. Provide one calibration kit for each type of gas monitored.
 - a. Calibration kits shall be furnished complete with all tubing, regulators, fittings, communication devices, and accessories required to calibrate sensors.
 - b. Calibration kit shall utilize nonintrusive means of calibrating sensors/transmitters.

5. Provide two full cylinders of each type of calibration check gas.
 - a. Cylinder size: 17 liters.
6. Provide the same quantity of zero air cylinders as the total required number of calibration check gas cylinders (of all types).
7. Schedule:

TAG NO	SERVICE	GAS	MOUNT TYPE	RANGE	SETPOINTS	
					WARN (HI)	ALARM (HI HI)
ASH-8770	Truck Loading	Combustible Gas	D	0-100% LEL	3% LEL	10% LEL
ASH-8771	Gas Piping Room	Combustible Gas	D	0-100% LEL	3% LEL	10% LEL
ASH-8801	Compressor Room	Combustible Gas	D	0-100% LEL	3% LEL	10% LEL
ASH-8820	Boiler Room	Combustible Gas	D	0-100% LEL	3% LEL	10% LEL

MOUNT TYPE: D - diffusion type, DM - duct mounted, SD - sample draw.

2.3 PIPE, TUBING, AND FITTINGS

- A. Manufacturers:
 1. Tube fittings:
 - a. Parker CPI.
 - b. Swa gelok.
- B. Instrument Tubing and Fittings:
 1. Material:
 - a. Tubing: ASTM A269, Grade TP 316 stainless steel.
 - b. Straight fittings: 316 stainless steel per ASME SA-479 or ASTM A276.
 - c. Shaped bodies: ASME SA-182 F316 stainless steel.
 2. Design and fabrication:
 - a. Tubing:
 - 1) Seamless.
 - 2) Fully annealed.
 - 3) Maximum hardness: 80 Rb.
 - 4) Free from surface scratches and imperfections.
 - 5) Diameter: 1/2 IN OD unless specified otherwise.
 - 6) Wall thickness:
 - a) Meet requirements of ASME B31.1, Paragraph 122.3.
 - b) Minimum 0.049 IN for 1/2 IN OD tubing.
 - b. Fittings:
 - 1) Flareless.
 - 2) Compression type.
- C. Instrument Piping:
 1. For applications where the instrument is supported solely by the sensing line, (e.g., pressure gauge directly mounted to process line) utilize piping as specified below.
 - a. Diameter: 1/2 IN unless specified otherwise.
 - b. Schedule 80.
 - c. 316 stainless steel.
- D. Pneumatic Signal Tubing:
 1. Material: Copper per ASTM B75.
 2. Design and fabrication:
 - a. Soft annealed.
 - b. Free from surface scratches and imperfections.

- c. Wall thickness:
 - 1) 0.030 IN for 1/4 IN OD.
 - 2) 0.035 IN for 3/8 IN OD.
- E. Pneumatic Tube Fittings:
 - 1. Material:
 - a. Straight fittings: Brass per ASTM B16 and ASTM B453.
 - b. Shaped bodies: Brass per ASTM B124 Alloy 377 or ASTM B283.
 - 2. Design and fabrication:
 - a. Flareless.
 - b. Compression type.

2.4 INSTRUMENT VALVES

- A. Process instrument multi-valve manifolds, isolation, vent and blow-down valves:
 - 1. Acceptable manufacturers:
 - a. Whitey Co.
 - b. Anderson-Greenwood USA, Inc.
 - 2. Materials:
 - a. Packing:
 - 1) 450 DEGF and above: Graphite.
 - 2) Below 450 DEGF: Graphite or Teflon.
 - b. Body: 316 stainless steel per ASTM A479.
 - c. Stem: 316 stainless steel per ASTM A276.
 - d. Ball: 316 stainless steel per ASTM A276.
 - e. Support rings: 316 stainless steel per ASTM A276.
 - f. Seats:
 - 1) Metal:
 - a) 316 stainless steel per ASTM A276.
 - 2) Soft:
 - a) Teflon, Delrin.
 - b) Only utilized on applications where manufacturer's temperature and pressure ratings exceed process design conditions.
 - 3. Design and fabrication:
 - a. Either of the following:
 - 1) Ball valve with 1/4 turn activation.
 - 2) Free-swiveling ball stem.
 - b. Provide body wall thickness sufficient for process design conditions per ASME B31.1.
 - c. Temperature: Manufacturer's temperature rating for all components shall exceed process design conditions.
- B. Isolation Valves in Copper Instrument Air Tubing:
 - 1. Acceptable manufacturer:
 - a. Whitey Co.
 - 2. Materials:
 - a. Packing: Graphite or Teflon.
 - b. Body: Brass per ASTM B16.
 - c. Stem: 316 stainless steel per ASTM A276.
 - d. Ball: 316 stainless steel per ASTM A276.
 - e. Support rings: 316 stainless steel per ASTM A276.
 - f. Seats:
 - 1) Metal: 316 stainless steel per ASTM A276.
 - 2) Soft:
 - a) Teflon, Delrin.
 - b) Only utilized on applications where manufacturer's temperature and pressure ratings exceed process design conditions.

3. Design and fabrication:
 - a. Ball valve with 1/4 turn activation.
 - b. Provide body wall thickness sufficient for process design conditions per ASME B31.1.

2.5 ACCESSORIES

- A. Furnish all mounting brackets, hardware and appurtenances required for mounting primary elements and transmitters.
 1. Materials, unless otherwise specified, shall be as follows:
 - a. Bolts, nuts, washers, expansion anchors: 316 stainless steel.
 - b. Mounting brackets:
 - 1) Standard: 316 stainless steel.
 - 2) Highly corrosive areas: Aluminum.
 - c. Mounting plates, angles:
 - 1) Standard: Carbon steel.
 - 2) Corrosive areas: 316 stainless steel.
 - d. Instrument pipe stands:
 - 1) Standard: Hot-dip galvanized 2 IN schedule 40, ASTM A106, Grade B carbon steel.
 - 2) Corrosive areas: 316 stainless steel.
- B. Tubing Support Angles and Brackets:
 1. Any of the following materials are acceptable:
 - a. Aluminum support with dielectric material between support and tubing.
 - b. Type 316 stainless steel.
 - c. Fiberglass.
- C. Tubing Tray or Channel:
 1. Aluminum.
 2. Provide dielectric material between tray or channel and tubing.
- D. Provide handheld communicator compatible with all intelligent transmitters furnished.
 1. Hand held communicator shall provide capability to check calibration, change transmitter range, and provide diagnostics.
 2. If these features are provided with the intelligent transmitter, the hand held communicator is not required.
- E. Cable lengths between sensors and transmitters shall be continuous (without splices) and as required to accommodate locations as shown on Drawings.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Install instrument mounting pipe stands level and plumb.
- C. Instrument Valves:
 1. Orient stems for proper operation.
 2. Install arrays orderly and neat in appearance with true horizontal and vertical lines.
 3. Provide a minimum of 2 IN clearance between valve handle turning radii where there are multiple valve handles appearing in a straight line.
 4. Valves shall have bonnets and any soft seals removed during welding or soldering into the line.
 - a. When cool, reassemble the valves.
 5. Support each valve individually.
 - a. The tubing system does not qualify as support for the valve.

- D. Locate instrument piping and tubing so as to be free of vibration and interference with other piping, conduit, or equipment.
- E. Keep foreign matter out of the system.
- F. Remove all oil on piping and tubing with solvent before piping and tubing installation.
- G. Plug all open ends and connections to keep out contaminants.
- H. Tubing Installation:
 - 1. General:
 - a. Install such that tube shows no sign of crumpling, bends of too short a radius, or flattening, etc.
 - b. Make tube runs straight and parallel or perpendicular to the floor, equipment and piping runs.
 - c. For liquid and steam applications, slope continuously from the process to the instrument with a minimum slope of 0.50 IN per foot.
 - d. For gas and air applications, slope continuously from the instrument to the process with a minimum slope of 0.50 IN per foot.
 - e. If the sensing line cannot be continuously sloped, install high point vents and low point drains.
 - f. Keep instrument tubing clean during all phases of work.
 - g. Blow out with clean, dry, oil-free air immediately before final assembly.
 - h. Cut by sawing only and debur.
 - 2. Bending:
 - a. Make each bend with tube bender of the correct size for the tube.
 - b. Make all bends smooth and continuous.
 - c. Rebending is not permitted.
 - d. Make bends true to angle and radius.
 - e. Maintain a true circular cross section of tubing without buckling or undue stretch of tube wall.
 - f. Allowable tolerance for flattening out of tubing bends: Maximum of 8 PCT of the OD for stainless steel tubing.
 - g. Minimum bending radius for stainless steel tubing:

TUBE OD, IN	MINIMUM BENDING RADIUS, IN
1/4	9/16
3/8	15/16
1/2	1-1/2

- h. Minimum bending radius for type L, hard (drawn) copper:

TUBE OD, IN	MINIMUM BENDING RADIUS, IN
3/8	1-3/4
1/2	2-1/2

- 3. Tubing support:
 - a. Intermittently support by clamping to support angle.
 - b. Install supports to be self-draining, supported by hangers, or cantilevered from walls or structural beams.
 - c. Support at 5 FT-0 IN maximum spans for horizontal or vertical runs.
 - d. Use tubing trays in areas where spans between supports are greater than 5 FT and for all signal tubing support.
 - e. Support each tubing tray at 10 FT maximum spans.

- f. Align tubing in orderly rows and retain in the tray by bolted clips.
 - 1) The use of spring or speed clips is not acceptable.
 - g. Maintain order of the tubing throughout the length of the tray.
 - h. Locate an angle, channel and tray installation to protect tubing from spills and mechanical damage.
 - i. Locate support members to clear all piping, conduit, equipment, hatchways, monorails, and personnel access ways and allow access for equipment operation and maintenance.
 - j. Support trays to prevent torsion, sway or sag.
 - k. Permanently attach supports to building steel or other permanent structural members.
 - l. Arrange supports and trays so that they do not become a trough or trap.
4. Routing and orientation:
- a. Route to maintain a minimum headroom clearance of 8 FT.
 - b. Locate and orient valves and specialties so that they are accessible for operation and maintenance from the operating floor.
 - 1) Do not route through or over equipment removal areas, below monorails or cranes nor above or below hatches.
5. Expansion and vibration provisions:
- a. Provide horizontal expansion loops at the process connections.
 - b. Route tubing parallel to relative motion through sleeved supports that allow linear tube movement.
 - c. Cold springing of tubing to compensate for thermal expansion is prohibited.
 - d. Utilize flexible hoses to connect pneumatic tubing to air users which may move or vibrate.
- I. Air Supply:
- 1. Connect all instruments requiring air to air supply piping and tubing.
 - 2. Provide connections as follows:
 - a. Terminate branch supply line not more than 36 IN from the device with a 1/2 IN isolation valve.
 - b. For remaining line, use 1/4 or 3/8 IN tubing of a length to allow for normal equipment movement and vibration.
 - c. Use flexible hoses to connect pneumatic tubing to air users which may experience significant movement or vibration.
 - d. Make branch connections to individual instruments from the top of the supply header.
 - e. Purge instrument air piping of extraneous material by blowing clean, dry, oil-free air through the system prior to final connection.
- J. Threaded Connection Seals:
- 1. Use Tite-Seal or acceptable alternate.
 - 2. Use of lead base pipe dope or Teflon tape is not acceptable.
 - 3. Do not apply Tite-Seal to tubing threads of compression fittings.
- K. Capillary Tubing:
- 1. Route capillary tubing in tubing tray.
 - 2. Install capillary tubing with a 2 IN minimum bend radius which does not kink or pinch the capillaries.
 - 3. Do not cut or disconnect at any point.
 - 4. Coil excess capillary tubing and secure at the instrument.
- L. Temperature Elements:
- 1. Assemble in the following sequence:
 - a. Remove temperature sensor sheaths and terminal blocks from the head and nipple assembly.
 - b. Connect nipple and head to thermowell installed in the pipe.
 - c. Insert sheath and terminal block until it seats in the thermowell.
 - d. Connect to the head.

M. Instrument Mounting:

1. Mount all instruments where they will be accessible from fixed ladders, platforms, or grade.
2. Mount all local indicating instruments with face forward toward the normal operating area, within reading distance, and in the line of sight.
3. Mount instruments level, plumb, and support rigidly.
4. Mount to provide:
 - a. Protection from heat, shock, and vibrations.
 - b. Accessibility for maintenance.
 - c. Freedom from interference with piping, conduit and equipment.

3.2 TRAINING

- A. Provide on-site training in accordance with Specification Section 40 61 13.

END OF SECTION

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DIVISION 41

**MATERIAL PROCESSING AND HANDLING
EQUIPMENT**



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SECTION 41 22 23
HOISTS, TROLLEYS, MONORAILS, AND DAVIT CRANES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Hoists, trolleys, monorails, and davit cranes
- B. Related Sections include but are not necessarily limited to:
 - 1. Division 00 - Procurement and Contracting Requirements.
 - 2. Division 01 - General Requirements.
 - 3. Section 01 61 03 - Equipment - Basic Requirements.

1.2 QUALITY ASSURANCE

- A. Referenced Standards:
 - 1. American Bearing Manufacturers Association (ABMA).
 - 2. American Society of Mechanical Engineers (ASME):
 - a. B30.11, Safety Code for Underhung Cranes and Monorail Systems.
 - b. B30.16, Safety Code for Overhead Hoists.
 - 3. ASTM International (ASTM):
 - a. A36, Standard Specification for Carbon Structural Steel.
 - 4. National Fire Protection Association (NFPA):
 - a. 70, National Electrical Code (NEC).
- B. Comply with ASME B30.11 and ASME B30.16.

1.3 DEFINITIONS

- A. Hook Height: The minimum acceptable distance in feet from bottom of hook in full raised position to the nearest floor surface.
- B. Lift Height: The distance in feet from the bottom of the hook in full raised position to the surface of the lowest floor from which items may be hoisted.
- C. Total Trolley Capacity: The ultimate load-carrying capacity of the trolley based on the ultimate strength of the material used (with a 5:1 safety factor) and the bearing life.
- D. Ultimate Load-Carrying Capacity: Live load, weights of all equipment and an allowance for impact.

1.4 SUBMITTALS

- A. Shop Drawings:
 - 1. See Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
 - 2. See Section 01 61 03.
 - 3. Product technical data including:
 - a. Acknowledgement that products submitted meet requirements of standards referenced.
 - b. Short Circuit Current Rating (SCCR) nameplate marking per NFPA 70. Include any required calculations per Section 01 61 03.
 - 4. Fabrication and/or layout drawings.
 - a. Track layout including supports, splices, connections, switches, and end trucks.
 - 5. Test reports verifying strength of inserts and rail.
 - 6. Load test results.

- B. Contract Closeout Information:
 - 1. Operation and Maintenance Data:
 - a. See Section 01 33 04 for requirements for the mechanics, administration, and the content of Operation and Maintenance Manual submittals.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
 - 1. Hoists:
 - a. Yale.
 - b. Acco.
 - c. Robbins and Myers.
 - d. Wright.
 - 2. Trolleys:
 - a. Yale.
 - b. Acco.
 - c. Wright.
 - 3. Monorails:
 - a. Spanmaster.
 - b. Twin City Monorail.
 - 4. Davit Crane:
 - a. Thern.
 - b. Or Equal.
- B. Submit request for substitution in accordance with Section 01 25 13.

2.2 MANUFACTURED UNITS

- A. Trolleys:
 - 1. Hand-gearred.
 - 2. Completely compatible with hoists, cranes, and monorails specified.
 - 3. Meet NEC standards according to classifications shown on Drawings.
 - 4. Capable of maneuvering curves without binding or scraping the track.
 - 5. Minimum ABMAL-10 bearing life of 5000 HRS based on 75 PCT of the wheel load, excluding impact.
 - 6. Plain trolleys:
 - a. Frame consisting of thick rolled steel sections extending beyond wheel flanges to protect wheels.
 - b. Alloy steel hardened axles, ball-bearings and pressed steel wheels.
 - 1) Carburized and hardened ball tread wheels.
 - 2) Factory lubricated requiring no additional lubrication.
- B. Hoists:
 - 1. Hand chain hoists:
 - a. Spur-gearred.
 - b. Design load-carrying parts so that the calculated static stress in the material, based on rated capacity, does not exceed 25 PCT of the average ultimate strength of the material.
 - c. For all hand chain hoists, provide hook-type mounting.
 - d. Load chain and wheels:
 - 1) Close link coil or roller-type chain.
 - 2) Links of uniform size and shape and free from scale.
 - 3) Manufacture load chain wheels from steel, pearlitic malleable iron or modular cast-iron.
 - a) Form load and idler sheaves to fit chain.

- e. Hand chain and wheels:
 - 1) Hand chain of the endless coil-type with a drop that is about 2 FT less than the specified lift of the hoist.
 - 2) Chain yield point at least three times the required hand chain pull for rated load.
 - 3) Manufacture hand chain wheels from steel, malleable iron, high strength cast iron, or aluminum alloy.
 - 4) Equip hand wheel with suitable chain guard to prevent the hand chain from slipping or jumping the wheel rim.
 - f. Hooks:
 - 1) Forged steel.
 - 2) Bottom hook free to swivel in the loaded condition without twisting the chain.
 - 3) Gate or swing type latch hooks.
 - g. Automatic mechanical load brake which will prevent lowering of the load unless manual power is applied to the hand chain.
 - h. Sleeve or antifriction type bearings.
 - i. Enclose gearing in sealed construction and provide life-time lubrication.
 - j. Load limit clutch to automatically prevent hoist from lifting loads greater than rated capacity.
2. For Class I, Division 1 or 2, Group D locations, provide spark and corrosion-resistant models with bronze hooks, stainless steel load chains, bronze or aluminum hand chain, and bronze trolley wheels.
 3. Mark each hoist with the following information:
 - a. Name and address of manufacturer.
 - b. Manufacturer's unit identification number.
 - c. Rated load.
- C. Monorails:
1. Straight track: ASTM A36 steel I beams.
 2. Where track curves are required, supply straight track and curves which are standard items of monorail manufacturer.
 3. Design track to support hoist capacity plus 25 PCT for impact load plus the weight of hoist and accessories without exceeding allowable working stress of track material with maximum deflection of 1/450 of span.
 4. Brace track to prevent sideways movement under full load conditions.
 5. Provide end stops at all track ends.
 6. Assure that track splices have been designed by track supplier and are located at support points.
- D. Portable Davit Crane and Appurtenances
1. Materials:
 - a. Mast and Boom: Galvanized Steel.
 - b. Provide one (1) pedestal (floor style) socket bases in Solids Handling Building: Galvanized Steel.
 - a) Provide pedestal(s) with weep hole for drainage.
 - 2) Provide two (2) embedded mount bases in Mechanical Building: Galvanized Steel
 - c. Hand Winch: Stainless Steel Spur Gear.
 - d. Wire Rope; Stainless Steel.
 2. Two (2) portable davit cranes shall be provided to remove pumps and equipment.
 - a. Contractor shall field locate for optimal location to remove pumps.
 3. The portable davit cranes shall be equivalent to Thern Admiral 3000, 5PT30 Series, or approved equal.
 4. The portable davit cranes shall have a boom extension of 72 to 112 IN from base when it is extended horizontally.
 5. Winch shall be of the Stainless Steel Spur Gear Hand Winch type. Supply 45 FT (min) of 3/16 IN diameter galvanized aircraft cable with swivel hook and swaged ball fitting.

6. Portable Davit Cranes shall have a minimum capacity of 1000 lbs at the fully extended position and a minimum capacity of 1000 lbs at the minimum extended position.
7. Field verify location of bases with Engineer.

2.3 ACCESSORIES

- A. Trolley stops design to engage the trolley frame rather than trolley wheels.
- B. Furnish chain containers for hand hoists.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Support track as shown on Drawings.
- B. Arrange supports for easy removal of track for repair or replacement.
- C. Align track true and level.
- D. Warning Signs:
 1. Affix to the hoist or the lower load block or the controls in a readable position a durable label or labels displaying the following information concerning safe operating procedures:
 - a. The word WARNING or other legend designed to bring the label to the attention of an operator.
 - b. Cautionary language against:
 - 1) Lifting more than rated load.
 - 2) Operating hoist when hook is not centered under hoist.
 - 3) Operating hoist with twisted, kinked or damaged rope or chain.
 - 4) Operating damaged or malfunctioning hoist.
 - 5) Operating hoist with a rope that is not properly seated in its groove (if applicable).
 - 6) Lifting people or lifting loads over people.
 - 7) Removing or obscuring warning label.

3.2 FIELD QUALITY CONTROL

- A. Test each hoist, trolley, monorail, and davit crane using 110 PCT rated load.
- B. Employ and pay for services of equipment manufacturer's field service representative(s) to:
 1. Inspect equipment covered by this Specification Section.
 2. Supervise pre-start-up adjustments, installation checks and all field tests.
 3. Conduct initial start-up of equipment and perform operational checks.
 4. Provide a written statement that manufacturer's equipment has been installed properly, started up and is ready for operation by Owner's personnel.
 5. Instruct Owner's personnel for 8 HRS at jobsite on operation and maintenance of the hoist, trolley, monorail and crane equipment.

3.3 SCHEDULE

A. Hoist, trolley, and monorail systems include but are not necessarily limited to the following:

TAG NUMBER	LOADING (TONS)	HOIST	TROLLEY	DAVIT	HOOK HEIGHT (FT)*	LIFTING HEIGHT (FT)*	HP	OPERATING SPEED FPM
HST-560-01	½	C	HG		12	13	NA	NA
HST-560-02	½	C	HG		12	13	NA	NA
DVT-510-01	½			HG	12	13	NA	NA
DVT-560-01	½			HG	12	13	NA	NA

* Distances listed are approximate as they will vary depending on hoist and trolley selection.

C = Chain
HG = Hand Geared
WR = Wire Rope
NA = Not Applicable

END OF SECTION

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DIVISION 43

**PROCESS GAS AND LIQUID HANDLING,
PURIFICATION, AND STORAGE EQUIPMENT**



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SECTION 43 21 00
PUMPING EQUIPMENT - BASIC REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Pumping equipment.
- B. Related Specification Sections include but are not necessarily limited to:
 - 1. Division 00 - Procurement and Contracting Requirements.
 - 2. Division 01 - General Requirements.
 - 3. Section 09 96 00 - High Performance Industrial Coatings.
 - 4. Section 01 61 03 - Equipment - Basic Requirements.
 - 5. Section 43 24 16 - Pumping Equipment - Sump.
 - 6. Section 43 23 17 - Pumping Equipment - Vortex (Torque-Flow). Section 43 23 57 - Pumping Equipment - Progressive Cavity.

1.2 QUALITY ASSURANCE

- A. Referenced Standards:
 - 1. ANSI/Hydraulic Institute (ANSI/HI):
 - a. 9.6.3, Rotodynamic (Centrifugal and Vertical) Pumps – Guideline for Allowable Operating Region.
 - b. 9.6.4, Rotodynamic Pumps for Vibration Measurements and Allowable Values.
 - c. 9.6.6, Rotodynamic Pumps for Pump Piping.
 - d. 11.6, Rotodynamic Submersible Pump for Hydraulic Performance, Hydrostatic Pressure, Mechanical, and Electrical Acceptance Tests.
 - e. 14.6, Rotodynamic Pumps for Hydraulic Performance Acceptance Tests.
- B. Coordinate all mechanical seal systems specified to ensure pump and seal compatibility.
- C. Pump/motor and VFD coordination: See Specification Section 01 61 03.

1.3 DEFINITIONS

- A. The abbreviations used in this section are defined as follows:
 - 1. AOR: Allowable Operating Range.
 - 2. BEP: Best Efficiency Point.
 - 3. IPS: Iron Pipe Size.
 - 4. NPSH3: Net Positive Suction Head for 3 PCT head loss.
 - 5. POR: Preferred Operating Range.
 - 6. TDH: Total Dynamic Head.
 - 7. TEFC: Totally Enclosed Fan Cooled.
 - 8. VFD: Variable Frequency Drive.
- B. Pump Service Category: Pump or pumps having identical names (not tag numbers) used for specific pumping service.

1.4 SUBMITTALS

- A. Shop Drawings:
 - 1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
 - 2. See Specification Section 01 61 03.

3. Product technical data including:
 - a. Performance data and curves with flow (GPM), head (FT), horsepower, hydraulic efficiency, rotating speed (RPM), AOR, BEP, POR, NPSH3 requirements, minimum bowl submergence requirements for vertical mixed flow, axial and turbine pumps.
 - b. Pump accessory data.
 - c. Bearing supports, shafting details and lubrication provisions.
 - 1) Bearing life calculations.
 - 2) Critical speed calculations.
 - d. Solids passage information.
 4. Certifications:
 - a. Certified pump performance curves as described in the SOURCEQUALITY CONTROL Article.
 - b. Verification of Primary and Secondary conditions in POR and AOR.
 5. Test reports:
 - a. Factory hydrostatic test.
- B. Contract Closeout Information:
1. Operation and Maintenance Data:
 - a. See Specification Section 01 33 04 for requirements for the mechanics, administration, and the content of Operation and Maintenance Manual submittals.
- C. Informational Submittals:
1. Certifications:
 - a. Provide a written statement that manufacturer's equipment has been installed properly, started up and is ready for operation by Owner's personnel.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
1. Pumps:
 - a. See individual pump Specification Sections.
 2. Mechanical seals:
 - a. Chesterton.
 - b. John Crane.
 - c. Garlock.
 - d. Or as noted in the individual pump Specification Sections.
- B. Submit request for substitution in accordance with Specification Section 01 25 13.

2.2 CENTRIFUGAL PUMP DESIGN

- A. Provide units with increasing head characteristics from the end run out portion of the curve to:
1. Shut-off condition.

2.3 ACCESSORIES

- A. See Specification Section 01 61 03.
- B. Each Unit:
1. Lifting eye bolts or lugs.
 2. Plugged gage cock connection at suction and discharge nozzles.
 3. Tapped and plugged openings for casing and bearing housing vents and drains.
 4. Fittings for properly adding flushing lubricant.
 5. Pressure relief fittings for grease lubrication.

- C. Packing Seal:
 1. Provide packing unless mechanical seal is specified in narrow-scope pump sections.
 2. Minimum of five rings graphite impregnated synthetic packing.
 3. Provide minimum 1/4 IN DIA supply tap and 1/2 IN DIA minimum drain tap.
 4. Provide split Teflon or bronze water seal ring.
 5. Adjustable split follower cast iron or bronze gland.
- D. Mechanical Seals:
 1. Provide as specified in the narrow-scope pump sections.

2.4 FABRICATION

- A. Pump Support:
 1. Design base to support weight of drive, shafting and pump.
 2. Comply with HI vibration limitations.
 3. Mount horizontal pump, motor and coupling on single piece drip lip type baseplate.
 4. Mount vertical pumps on single piece pedestal baseplate.
 5. Fabricate to withstand all operating loads transmitted from the pump and drive.
 6. On vertically configured end suction centrifugal pumps when supplied with a fabricated steel mounting frame and suction elbow, the suction elbow shall be a long radius reducing elbow with greater than 50 PCT area reduction to comply with Table 9.6.6.3.2 of ANSI/HI 9.6.6 standard for straight pipe lengths.

2.5 SOURCE QUALITY CONTROL

- A. Verification primary design condition in POR.
- B. Verification secondary design condition in AOR.
- C. Factory hydrostatic test all pumps at 150 PCT of shut-off head for a minimum of five minutes.
- D. If specifically required in the individual pump specification sections, provide factory tests:
 1. All units:
 - a. Conduct tests in accordance with HI.
 - 1) Shut-off head and design condition: Positive unilateral performance tolerance meeting Grade 1U per ANSI/HI 14.6 for Rotodynamic Pumps.
 - 2) Shut-off head and design conditions: Positive unilateral performance tolerances meeting Grade 1U per ANSI/HI 11.6 for Rotodynamic Submersible Pumps.
 2. All pumps:
 - a. Head (FT) versus flow (GPM) pump curves:
 - 1) Efficiencies along curve.
 - 2) Brake horsepower along each curve.
 3. Results certified by a registered professional engineer.
- E. Statically and dynamically balance each pump per ANSI/HI standards.
 1. If specifically required in the individual pump specification sections or in Specification Section 01 61 03, field vibration test pumps:
 - a. To meet requirements of ANSI/HI 9.6.4 for Rotodynamic Pumps at any point on the pumps and motor.
- F. To meet requirements of ANSI/HI 11.6 for Submersible Pumps.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. See Specification Section 01 61 03.
- B. Floor or Pad-Mounted Units (Non-Submersible):
 1. Align vertically and horizontally level, wedge and plumb units to match piping interfaces.
 2. Assure no unnecessary stresses are transmitted to equipment flanges.

3. Tighten flange bolts at uniform rate and manufacturer's recommended torque for uniform gasket compression.
 4. Support and match flange faces to uniform contact over entire face area prior to bolting pipe flange and equipment.
 5. Permit piping connecting to equipment to freely move in directions parallel to longitudinal centerline when and while bolts in connection flange are tightened.
 6. Grout equipment into place prior to final bolting of piping but not before initial fitting and alignment.
 7. Assemble connecting piping with gaskets in place and minimum of four bolts per joint installed and tightened.
 - a. Test alignment by loosening flange bolts to see if there is any change in relationship of piping flange with equipment connecting flange.
 - b. Realign as necessary, install flange bolts and make equipment connection.
 8. Field paint units as defined in Specification Section 09 96 00.
 9. Provide pressure gage, visible from grade or operating floor, on discharge of all pumps and on suction and discharge of all non-submersible units.
- C. Submersible Units:
1. Assemble connecting piping with gaskets in place and minimum of four bolts per joint installed and tightened.
 - a. Test alignment by loosening flange bolts to see if there is any change in relationship of piping flange with equipment connecting flange.
 - b. Realign as necessary, install flange bolts and make equipment connection.
 2. Field paint units as defined in Specification Section 09 96 00.
 3. Provide discharge pressure gage visible from grade or operating floor.

3.2 FIELD QUALITY CONTROL

- A. Provide services of equipment manufacturer's field service representative(s) to:
1. Inspect equipment covered by this Specification Section.
 2. Supervise pre-start adjustments and installation checks.
 3. Conduct initial start-up of equipment and perform operational checks.
 4. Instruct Owner's personnel for the specified minimum of 4 hours at jobsite per Specification Section 01 30 00 on operation and maintenance of each of following pumping equipment:
 - a. Section 43 24 16 - Pumping Equipment - Sump
 - b. Section 43 23 17 - Pumping Equipment - Vortex (Torque-Flow)
 - c. Section 43 23 57 - Pumping Equipment - Progressive Cavity
 - d. Section 23 21 00 - Hydronic Specialties

END OF SECTION

SECTION 43 23 17
PUMPING EQUIPMENT - VORTEX (TORQUE-FLOW)

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Vortex (torque-flow) pumps.
- B. Related Sections include but are not necessarily limited to:
 - 1. Division 00 - Procurement and Contracting Requirements.
 - 2. Division 01 - General Requirements.
 - 3. Section 43 21 00 - Pumping Equipment - Basic Requirements.

1.2 QUALITY ASSURANCE

- A. Referenced Standards:
 - 1. American Bearing Manufacturers Association (ABMA).
 - 2. American Iron and Steel Institute (AISI):
 - a. Steel Products Manual.
 - 3. American National Standards Institute (ANSI).
 - 4. ASTM International (ASTM):
 - a. A48, Standard Specification for Gray Iron Castings.
 - 5. Hydraulic Institute (HI).

1.3 SUBMITTALS

- A. Shop Drawings:
 - 1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
 - 2. See Specification Section 43 21 00.
- B. Contract Closeout Information:
 - 1. Operation and Maintenance Data:
 - a. See Specification Section 01 33 04 for requirements for the mechanics, administration, and the content of Operation and Maintenance Manual submittals.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
 - 1. Severe duty pumps:
 - a. Wemco (Model C).
 - b. Or approved equal
- B. Submit request for substitution in accordance with Specification Section 01 25 13.

2.2 MATERIALS

- 1. DS Transfer Pumps (PMP-510-01, PMP-510-03, PMP-510-04) and Digester 4 Sludge Circulation Pumps (PMP 560-11, PMP 560-12):
 - a. No. of Units: 5
 - b. Casing: Super Ni-Hard, ASTM A532, (minimum Brinell Hardness of 650)
 - c. Impeller: Same as casing.
 - d. Wearplate: Same as casing.
 - e. Suction piece: Same as casing.

2.3 EQUIPMENT

- A. Performance and Configuration Requirements:
1. DS Transfer Pumps (PMP-510-01, PMP-510-03, PMP-510-04):
 - a. No. of Units: 3
 - b. Design condition: 300 GPM at 37 FT TDH efficiency of 30 PCT.
 - c. Shutoff condition: 0 GPM at 48 FT TDH.
 - d. Pump configuration: Horizontal
 - e. Maximum pump speed: 1700 RPM.
 - f. Nameplate driver horsepower: 15
 - g. Drive type: Constant speed.
 - h. Drive configuration: Side mount with V-belt sheeves.
 - i. Minimum solids passage: 3 IN.
 - j. Maximum Net Positive Suction Head Required (NPSHR): 0 FT.
 - k. Suction 3 IN DIA minimum, discharge 3 IN DIA minimum.
- B. Performance and Configuration Requirements:
1. Digester 4 Sludge Circulation Pumps (PMP 560-11, PMP 560-12):
 - a. Design condition: 250 GPM at 27 FT TDH with minimum pump efficiency of 30 percent.
 - b. Shutoff condition: 0 GPM at 48 FT TDH.
 - c. Pump configuration: Horizontal.
 - d. Maximum pump speed: 1700 RPM.
 - e. Nameplate driver horsepower: 15 hp.
 - f. Drive type: Constant speed.
 - g. Drive configuration: Side mount with V-belt sheeves.
 - h. Minimum solids passage: 3 IN.
 - i. Maximum Net Positive Suction Head Required (NPSHR): 0 FT.
 - j. Suction 3 IN DIA minimum, discharge 3 IN DIA minimum.
 2. Assure increasing head characteristic from secondary design condition to shutoff condition.
 3. Provide pumps with net positive suction head requirements that are less than the available net positive suction head available at design condition specified.

2.4 ACCESSORIES

- A. See Section 43 21 00.

2.5 FABRICATION

- A. General:
1. Two-piece radial split design casing. The pump casing shall consist of one piece casting with integral suction and discharge nozzles plus a back plate with integral wear element. The casing will have cast on feet, which fully support the volute, to allow removal of the complete rotating assembly, without disturbing suction and discharge piping.
 2. Casing: Super Ni-Hard, ASTM A532, (minimum Brinell Hardness of 650).
 - a. Impeller: Same as casing.
 - b. Wearplate: Same as casing.
 - c. Suction piece: Same as casing.
 3. Separate and removable suction pieces.
 4. Completely open from suction to discharge requiring no impeller face plates.
 5. Allow removal of impeller without disturbing the piping.
 6. Cast case of the following minimum thickness for severe duty units:
 - a. 3 IN pump size: 9/16 IN.
 7. Support vertical dry pit pumps by a pedestal base with openings large enough to permit access to the suction line and to the inspection opening in the suction elbow.
 - a. Assure legs of pedestal are of such a length that the suction elbow of the pump will not touch the floor or level foundation upon which it stands.

- B. Suction and Discharge:
 - 1. ANSI, Class 150 flanged.
- C. Impeller:
 - 1. Mount completely out of flow path between inlet and outlet so that solids do not flow through impeller.
 - 2. Key to shaft and secure with impeller bolt locked against reverse rotation.
 - 3. Recessed type with semi-open design.
 - 4. Cup-type such that blade ends are surrounded by an integral rim.
 - a. Flow must be directed to center of volute, minimizing particle impact and reducing wear and degradation.
 - 5. Taper rim from a maximum thickness of at least 7/8 IN at the tip of the discharge portion of the impeller vane to a minimum thickness of at least 1/2 IN on the backside of the vane.
 - 6. Taper vane from a minimum thickness of 1-1/8 IN at the bottom of the cup to a minimum thickness of 1/2 IN at the top of the vane.
 - 7. Provide removable wearplate back of impeller designed to direct flow from behind impeller to center of volute for maximum protection of casing.
 - 8. Provide wearplate separate from stuffing box.
 - 9. Statically and dynamically balance per HI standards.
- A. Shaft Seal:
 - 1. Utilize slurry mechanical seal. Arranged to not require water lubrication.
 - 2. Constructed of CD4 and 316 stainless steel metal components.
 - 3. Viton elastomer and tungsten carbide seal faces.
 - 4. Seal chamber: 600 Brinell abrasion-resistant.
 - 5. WEMCO Slurry Seal, or approved equal.
- B. Shaft Sleeve:
 - 1. No Shaft Sleeve.
- C. Bearings:
 - 1. Provide oil bath lubricated bearings with oil reservoir.
 - 2. Seal oil reservoir with labyrinth seal at both ends.
 - 3. Ball-type bearings.
 - 4. Design to safely handle radial and thrust loads.
 - 5. Equip bearing housing with a pressure venting device and oil fill, level and drain taps.
 - 6. Minimum ABMA L-10 life of 100,000 HR.
 - 7. As an alternative, provide grease-lubricated bearings contained in dust-proof and moisture-proof housing.

2.6 SOURCE QUALITY CONTROL

- A. All Pumps:
 - 1. Hydrostatically test volute at 150 PCT of shut off head.
 - a. Furnish documentation of test.

2.7 MAINTENANCE MATERIALS

- A. Extra Materials:
 - 1. Furnish Owner the following extra parts for each pump service category:
 - a. One full gasket set.
 - b. One bearing set.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Comply with requirements of Section 43 21 00.

3.2 FIELD QUALITY CONTROL

A. See Section 43 21 00.

END OF SECTION

SECTION 43 23 57
PUMPING EQUIPMENT - PROGRESSIVE CAVITY

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Material, design, fabrication and installation requirements for progressive cavity pumps.
 - 2. RST Sludge Hopper Thickened Sludge Pumps to be provided by RST manufacturer per Section 46 71 33.
- B. Related Sections include but are not necessarily limited to:
 - 1. Division 00 - Procurement and Contracting Requirements.
 - 2. Division 01 - General Requirements.
 - 3. Section 43 21 00 - Pumping Equipment - Basic Requirements.
 - 4. Section 46 71 33 – Rotary Screen Thickeners

1.2 QUALITY ASSURANCE

- A. Referenced Standards:
 - 1. American Bearing Manufacturers Association (ABMA).
 - 2. American National Standards Institute (ANSI).
 - 3. Hydraulic Institute (HI).

1.3 SUBMITTALS

- A. Shop Drawings:
 - 1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process
 - 2. Requirements in Specification Section 43 21 00.
 - 3. Source quality control test reports.
- B. Operation and Maintenance Manuals:
 - 1. See Specification Section 01 33 04 for requirements for:
 - a. The mechanics and administration of the submittal process.
 - b. The content of Operation and Maintenance Manuals.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with the Contract Documents, the following Manufacturers are acceptable:
 - 1. Progressive cavity pumps:
 - a. Seepex.
- B. Submit request for substitution in accordance with Specification Section 01 25 13.

2.2 MATERIALS

- A. Polymer Pumps (PMP-510-10, PMP-510-11, PMP-510-12):
 - 1. Pump body: Cast iron, ASTM A351.
 - 2. Rotor: AISI 316 stainless steel.
 - 3. Stator:
 - a. Buna-N or nitrile rubber.
 - 4. Base plate: Fabricated steel.
 - 5. Stuffing box gland: Ductile iron.
 - 6. Lantern ring: 316 stainless steel.

- B. RST Sludge Hopper Thickened Sludge Pumps (PMP-560-01, PMP-560-02):
 - 1. Pump body: Cast iron, ASTM A351.
 - 2. Rotor: AISI 316 stainless steel.
 - 3. Stator:
 - a. Buna-N or nitrile rubber.
 - 4. Base plate: Fabricated steel.
 - 5. Stuffing box gland: Ductile iron.
 - 6. Lantern ring: 316 stainless steel.

2.3 EQUIPMENT

- A. Performance and Configuration Requirements:
 - 1. Polymer Pumps (PMP-510-10, PMP-510-11, PMP-510-12):
 - a. Design condition: 1.5 GPM at 15 PSIG and 32 RPM.
 - b. Secondary condition: 15 GPM at 15 PSIG and 303 RPM.
 - c. Nameplate driver horsepower: 1.5 HP.
 - d. Drive type: Variable frequency.
 - e. Drive configuration: Direct coupled.
 - f. Suction 2.5 IN DIA minimum, discharge 2 IN DIA minimum.
- B. Performance and Configuration Requirements:
 - 1. RST Sludge Hopper Thickened Sludge Pumps (PMP-560-01, PMP-560-02):
 - a. Design condition: 50 GPM at 50 PSIG and 146 RPM
 - b. Secondary condition: 25 GPM at 50 PSIG and 74 RPM
 - c. Nameplate driver horsepower: 7.5 HP.
 - d. Drive type: Variable frequency.
 - e. Drive configuration: Direct coupled.
 - f. Performance consistent with Seepex BTQ26-12/ A1-J0-L8-F0-GA pump model.

2.4 ACCESSORIES

- A. See Section 43 21 00.
- B. Provide protection against run dry or overpressurization by furnishing and installing an adjustable pressure switch at the pump discharge for switching off the pump upon low or overpressurization.

2.5 FABRICATION

- A. Pump Body:
 - 1. Provide body containing two inspection ports 180 DEG apart.
 - 2. Cradle mount pump to permit suction port to be rotated at 90 degree increments perpendicular to pump centerline.
- B. Rotor:
 - 1. Harden to minimum Rockwell C-57.
- C. Stator:
 - 1. Construct by bonding rubber-type material to inside of a steel tube.
 - 2. Minimum 65 durometer hardness (Shore A).
- D. Drive Train:
 - 1. Include crown gear-type universal joints, seals, connecting rod, driveshaft, and shaft bearings.
 - 2. Connect rotor drive shaft by a connecting rod equipped with two crowned gear-type factory grease lubricated and positively sealed universal joints.
 - a. Joint unconditionally guaranteed by manufacturer to meet 10,000 HR operation at the required performance conditions.
 - 3. Use universal joints to transmit thrust and torque while allowing the rotor to move through an eccentric path.

4. Joint shall be positively sealed and encased in a series 300 stainless steel cover to protect it from tramp metal and glass.
 5. Mount drive shaft in two ball or tapered roller bearings.
 6. Bearing ABMA L-10 life: 50,000 HRS at design operating conditions specified.
 7. Provide fittings for grease or oil lubrication of bearings.
 8. Stuffing box:
 - a. Design for either grease lubrication or water seal.
 - b. Permit gland adjustment and repacking without dismantling pump.
- E. Suction and Discharge:
1. Provide ANSI, Class 150 LB rated flanged.
- F. Provide open throat suction flange with bridge breaker above pump's auger feed.
1. Bridge breaker consisting of a series of fingers projecting from two counter-rotating shafts.
 2. Drive bridge breaker by main pump power source.
- G. Base Plate: Provide common base plate for pump, drive and motor.

2.6 SOURCE QUALITY CONTROL

- A. Testing:
1. Perform Level I test for each pump as defined by HI standards to assure conformance to manufacturer's commercial performance criteria.
 2. Perform hydrostatic test for each pump in compliance with HI standards.
 3. Perform required net inlet pressure test as defined by HI standards to verify compliance with specified performance criteria for the specified viscosity and pump speed.
 - a. For variable speed pumps, perform tests for the maximum, minimum, and three intermediate speeds equally spaced between the maximum and minimum.

2.7 MAINTENANCE MATERIALS

- A. Furnish Owner the following extra parts for each pump category:
1. One rotor.
 2. One stator.
 3. One connecting rod with bushings.
 4. One set of connecting rod joint assemblies.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. See Section 43 21 00.
- B. RST Sludge Hopper Thickened Sludge Pumps (PMP-560-01, PMP-560-02) to be furnished as part of Rotary Screen Thickener package. See Section 46 71 33.

3.2 FIELD QUALITY CONTROL

- A. See Section 43 21 00.

END OF SECTION

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SECTION 43 23 62

W-1 Water System

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This Section specifies requirements for fabrication and assembly of the packaged W-1 water system which includes an air gap tank (with vent and funnel), air gap tank level controls, air gap tank supply water control valve, hydropneumatic tank, booster pumps, motors, control panel, pressure switches, pressure gauges, piping, fittings, electrical conduits and wiring between the control panel and system components, and all other appurtenances as specified and required for proper operation of the system.

1.2 QUALITY ASSURANCE

- A. This Section incorporates by reference the latest revision of the following documents. These references are a part of this Section as specified and modified. In case of conflict between the requirements of this Section and those of the listed documents, the requirements of this Section shall prevail:

<u>Reference</u>	<u>Title</u>
ASME BPVC	Boiler and Pressure Vessel Code
ASTM A36	Standard Specification for Carbon Structural Steel
ASTM A48	Standard Specification for Gray Iron Castings
HIS	Hydraulic Institute Standards
IBC	International Building Code
NSF/ANSI 61	National Sanitation Foundation Standard 61

- B. Unity Responsibility: Assign unit responsibility for the W-1 water system to the supplier of the boosted pumps as specified in this Section..

1.3 SUBMITTALS

- A. Procedures: Section 01300.
- B. Certificate of Unit Responsibility Assignment attesting that the Contractor has assigned unit responsibility in accordance with the requirements of this Section. No other submittal material required in this Section will be reviewed until the certificate has been received and found to be in conformance with these requirements
- C. Manufacturer's specifications, data, and drawings of pumps, valves, tanks, instruments, and control panel of the packaged W-1 water system:
1. Pump performance data, type, model, rpm, type of bearing, type of coupling, weight, material of construction, and shop paint information. Provide pumps' net positive suction head (NPSH) requirements, efficiency, brake horse power, and motor information.
 2. Motor Data Submittal as required in Section 016103.
 3. Hydropneumatic tank manufacturer's catalog information including dimensions, capacity, construction materials, piping connections locations and sizes. Provide submittals required by Section VIII, Division 1 or 2 of the ASME Boiler and Pressure Vessel Code. Provide hydropneumatic tank's charged pressure.
 4. Air gap tank fabrication drawings with capacity, dimensions, and construction materials as indicated.

5. Air gap tank supply water control valve data. Catalog information for pressure control switches and level control switches, as required for the automatic operation and control of the W-1 water pressure system.
 6. Control panel drawings, including power, control, monitoring, and a alarm wiring diagram, and control system description.
 7. Seismic tie-down drawings and details.
- D. Final test results of the W-1 water system.
- E. Operation and maintenance information: Section 01 33 04.
- F. Manufacturer's Installation Certification Form.
- G. Motor Data Submittal Form

1.4 LABELING

- A. Electrical materials, devices, appliances, and equipment used shall be indicated as acceptable by the established standards of the Underwriters Laboratories Inc. or other electrical product testing laboratory which is accredited by the State of Washington Department of Labor and Industries. Indication shall be by a valid label affixed to the item.
- B. Panels, which consist of multiple components, shall be listed and labeled as a unit in addition to any other state requirements. Labeling to conform to the requirements of Specification Section 10 14 0.0

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Pumps:
 1. Grundfos.
 2. Goulds.
 3. Asiatic Engineering.
 4. Or approved equal.

2.2 PERFORMANCE AND DESIGN REQUIREMENTS

- A. The W-1 water system shall supply the plant water system for the Wenatchee WWTP. The system receives water in an air gap tank then pressurizes the plant water system to meet the process needs. The pump suction header shall be connected to the air gap tank. Water supply to the air gap tank shall be controlled by a control valve. The system pressure shall be maintained continuously at a set point pressure by pumps and a pre-charged hydropneumatic tank as specified in this Section.
- B. The W-1 system performance shall be stable and free from cavitation and noise throughout the full operating range. The water temperature will be 45 to 85 degrees F. The W-1 water system shall be designed for the following operating conditions and requirements:

SYSTEM COMPONENTS	EQUIPMENT NO.	DESIGN REQUIREMENTS	
Booster Pumps and Motors			
W-1 Water Booster Pump No. 1	P-560-13	Capacity at rated head, gpm	210 at 110 psi
W-1 Water Booster Pump No. 2	P-560-14	Operating Pressure range, psig	90-110
		Shutoff head, FT	330

SYSTEM COMPONENTS	EQUIPMENT NO.	DESIGN REQUIREMENTS	
		Pump suction and discharge size, inches	2
		Motor rated speed, RPM	3600
		Power supply	460v/60Hz/3PH
		Motor nameplate HP	15
Hydropneumatic Tank			
Hydropneumatic Tank	TNK-560-06	Capacity, gallons	34
		Tank diameter, inches	16
		Pre-charge pressure, psig	As required
Air Gap Tank			
Air Gap Tank	TNK-560-05	Capacity, gallons	550
		Tank diameter, inches	64

2.3 PUMPS

- A. The pump shall be closed-coupled, vertical multi-stage centrifugal type fitted with a mechanical seal to prevent leakage. The mechanical seal shall be suitable for water temperatures from 32 degrees F to 212 degrees F. The pump shall be suitable for a maximum operating pressure of 200 psig. The pump motor shall be totally enclosed, fan cooled, energy efficient, severe duty and suitable for 480 volt, 60 Hz, 3 phase power supply as specified in Section 01 61 03. Motor shall high temperature switches shall be employed in the motors and controls for high temperature cutout as required per the NEC.
- B. Materials:

ITEM	MATERIAL
Pump Casing	Cast iron, ASTM A48 Class 40
Impeller	Stainless steel, Type 316
Wear Ring	Stainless steel, Type 316
Motor Shaft	Stainless steel, Type 416
Shaft Sheave	Stainless steel, Type 316
Base plate	ASTM A36 steel or cast iron Class 40

2.4 HYDROPNEUMATIC TANK

- A. The hydro-pneumatic tank shall be designed for a pressure booster system with cyclic pump operation. The tank shall be an ASME rated pressure vessel designed for a working pressure of 200 PSI. The tank shall be of welded steel construction with a field replaceable heavy-duty butyl rubber bladder diaphragm certified to NSF/ANSI standard 61. The tank liner shall be corrosion resistant polypropylene with a copper-lined acceptance fitting. The air chamber shall be pre-pressurized at the factory as required for the system. The tank shall be designed for vertical mounting and connected to the system as indicated in the Drawings. The tank shall be provided

with corrosion-resistant factory finish coating, interior and exterior, in accordance with Section 09 96 00 requirements.

- B. Design and manufacture in compliance with the ASME Boiler and Pressure Vessel Code. Hydropneumatic tank shall meet the requirements of Section VIII, Division 1 of the ASME Boiler and Pressure Vessel Code. Each tank shall bear an ASME inspector's stamp, complete with design working pressure and date and place of manufacture.
- C. Designed for seismic anchorage and bracing shall be per Section 01 81 10. For purposes of this requirement the weight of the tank shall be the weight when completely filled with water.
- D. The tank shall be provided with rubber bladder replacement access cap, a 1-inch NPT top-mounted water supply system connection, lifting lugs, air charge valve, and 1-inch drain as indicated.
- E. Provide 200 psi pressure safety pressure relief valve mounted on discharge pipe.

2.5 AIR GAP TANK

- A. The air gap tank shall be designed by the Contractor. Provide HDPE or polypropylene tank suitable for potable water storage. Material thickness shall be based upon loads for the given capacity and diameter. The size and location of the tank connections shall be as required for proper system operation. The tank shall be self-supporting, impact resistant, and shall be suitable for operating temperatures up to 32 to 140 degrees Fahrenheit. The tank shall be provided with inlet, outlet, 2 IN DIA vent, 12 IN DIA (min) funnel, overflow, and drain connections.
- B. The air gap tank shall be provided with a stilling well for the water supply and level control sensors. The water supply pipe to the air gap tank shall be terminated a distance two pipe diameters above the funnel.
- C. Designed for seismic anchorage and bracing per Section 01 81 10. For purposes of this requirement, the weight of the tank shall be the weight when completely filled with water.

2.6 PRESSURE SWITCHES AND GAUGES, LEVEL CONTROL INSTRUMENTS, AND WATER SUPPLY CONTROL VALVE

- A. Provide pressure switches for the W-1 water supply system automatic operation. The pressure switches shall operate the lead and lag pumps to maintain the set point pressure and to provide high and low water pressure signals to the control panel.
 - 1. Provide pressure switches per the W-1 system P&ID.
 - 2. Provide pressure gauges per the W-1 system P&ID.
- B. Provide level switch assembly per Section 40 72 00. Provide appropriate length probe; verify and confirm probe length. Ensure adequate clearance for convenient removal, replacement, and maintenance.
- C. Provide air gap tank level control by means of an actuated open/close ball valve as specified in section 40 05 51 and 40 05 63. The actuated ball valve shall be control by level controller supplied as part of the W-1 System Control Panel. No float actuated type level control systems shall be allowed.

2.7 PIPING AND VALVES

- A. Piping: Stainless steel.
- B. Ball valves: Per Section 40 05 51.
- C. Ball check valves: Per Section 40 05 66.

2.8 CONTROL PANEL

- A. The packaged W-1 water system shall be provided with skid mounted factory wired NEMA 4X control panel containing operating switches, indicating lights, safety controls, fused control circuit, terminal strips, lead and lag pumps manual selector switch as indicated and as required for proper system operation.
- B. The control panel shall include components and provide functionality as indicated in the Drawings. Power and control system conduits and wiring installation between the control panel, level and pressure switches, and pumps shall be provided by the Manufacturer according to the manufacturer's installation electrical drawings and the requirements of the Drawings and this Section.
- C. Fabricate per Divisions 26 and 40.

2.9 ELECTRICAL

- A. Electrical motor: Per Section 01 61 03.

2.10 SEQUENCE OF OPERATION

- A. Provide functionality indicated.

2.11 SPARE PARTS

- A. The following spare components shall be provided in accordance with Sections 01 61 03 and 43 21 00:
 - 1. One (1) complete set of pump seals.
 - 2. One (1) complete tank bladder.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. The W-1 water system shall be installed as recommended by the manufacturer and the Hydraulic Institute Standards. Provide water hammer arresters on the supply water line to eliminate water hammer on the supply water piping.
- B. The hydropneumatic tank and accessories shall be installed, precharged, filled, and pressurized in strict accordance with the manufacturer's written instructions and Section 01 81 10.
- C. The hydropneumatic tank's precharge shall be performed in the presence of the Project Representative in accordance with the manufacturer's recommendation. Other pressure and level control setting shall be adjusted by the Contractor and tested.

3.2 TESTING

- A. After installation, the equipment specified in this Section shall be completely tested to ensure compliance with operating requirements.
- B. Testing shall verify the instrument settings and control strategies specified.

END OF SECTION

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SECTION 43 24 16
PUMPING EQUIPMENT - SUMP

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Sump pumps - portable
- B. Related Sections include but are not necessarily limited to:
 - 1. Division 00 - Bidding Requirements, Contract Forms, and Conditions of the Contract.
 - 2. Division 01 - General Requirements.
 - 3. Section 43 21 00 - Pumping Equipment - Basic Requirements.

1.2 QUALITY ASSURANCE

- A. Referenced Standards:
 - 1. American Iron and Steel Institute (AISI):
 - a. Steel Products Manual.
 - 2. ASTM International (ASTM):
 - a. A48, Standard Specification for Gray Iron Castings.
 - b. B62, Standard Specification for Composition Bronze or Ounce Metal Castings.

1.3 SUBMITTALS

- A. Shop Drawings:
 - 1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
 - 2. Product technical data including:
 - a. Acknowledgement that products submitted meet requirements of standards referenced.
 - b. Manufacturer's installation instructions.
- B. Operation and Maintenance Manuals:
 - 1. See Specification Section 01 33 00 for requirements for:
 - a. The mechanics and administration of the submittal process.
 - b. The content of Operation and Maintenance Manuals.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
 - 1. Building Sump pumps:
 - a. Godwin
 - b. Flygt.
 - c. KSB.
 - d. ASB.
 - e. Hydromatic.
- B. Submit request for substitution in accordance with Specification Section 01 25 13.

2.2 MATERIALS

- A. Building Sump Pumps:
 - 1. Pump casing:
 - a. Cast iron, ASTM A48, Class 30B.
 - 2. Impeller:
 - a. Cast iron, ASTM A48, Class 35A.
 - 3. Shaft:
 - a. Stainless steel, AISI Type 304.
 - 4. Base elbow: Cast iron.
 - 5. Lifting Cables: Stainless steel.
 - 6. Motor pedestal: Cast iron.

2.3 EQUIPMENT

- A. Performance and Configuration Requirements:
 - 1. Building Sump Pumps:
 - a. Design condition: 25 GPM at 10 FT TDH and minimum 19 PCT efficiency.
 - b. Secondary design condition (high wet well): 35 GPM at 7.4 FT TDH and minimum 18 PCT efficiency.
 - c. Shutoff condition: 25 FT.
 - d. Pump configuration: Submersible.
 - e. Maximum pump speed: 3600 RPM.
 - f. Drive type: Constant speed.
 - g. Minimum motor horsepower: 0.5.
 - h. Motor electrical: 210 V, 1-phase.
 - i. Drive configuration: Direct coupled.
 - j. Minimum solids passage: 1.7 IN.

2.4 ACCESSORIES

- A. Motor shall be immersible type motor such that it can operate in a dry condition without overheating the motor.
- B. See Sections 43 21 00.

2.5 INSTRUMENTATION AND CONTROLS

- A. Controls – Building Sump Pumps:
 - a. The pump is portable and no controls are required. Provide plug and appurtenances needed for operation from a power receptacle.
- B. Temperature Monitor – All Sump Pumps:
 - 1. Furnish each phase of the motor with a temperature monitor embedded in the motor windings.
 - 2. Provide pump supervision relay for temperature and moisture sensor control. Coordinate with MCC manufacturer for integration of pump supervision relay into MCC
 - 3. Set temperature of the pump supervision relay temperature monitors at not higher than 90 PCT of insulation temperature rating.
- C. Moisture Sensor – All Sump Pumps:
 - 1. Provide electrical probe as needed for detecting presence of water in the seal chamber and motor housing.
 - a. If water enters, the probe shall energize electrical circuit through pump supervision relay for external alarm.
 - b. See pump supervision relay requirements under temperature monitor section.

2.6 FABRICATION

A. General:

1. Pump casing uniform and free from blowholes or other defects and designed to withstand 150 PCT of shutoff head.
2. Equipped with bolted-on strainer with opening equal to specified solids passage of pump.

B. Impeller:

1. Key to pump shafts with same material as shaft.
2. Provide positive means of external axial adjustment of shaft and impeller.

2.7 SOURCE QUALITY CONTROL

- ### **A. See Section 43 21 00.**

PART 3 - EXECUTION

3.1 INSTALLATION

- #### **A. Comply with requirements of Section 43 21 00.**

3.2 FIELD QUALITY CONTROL

- #### **A. See Section 43 21 00.**

END OF SECTION

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DIVISION 46

WATER AND WASTEWATER EQUIPMENT



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SECTION 46 71 33
ROTARY SCREEN THICKENERS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. All rotary screen (drum) thickeners.
- B. Related Sections include but are not necessarily limited to:
 - 1. Division 00 - Procurement and Contracting Requirements.
 - 2. Division 01 - General Requirements.
 - 3. Section 01 61 03 - Equipment - General Requirements.
 - 4. Section 05 50 00 - Metal Fabrications.
 - 5. Division 26 - Electrical.
 - 6. Section 40 05 66 - Check Valves.
 - 7. Section 43 23 57 - Pumping Equipment - Progressive Cavity.

1.2 QUALITY ASSURANCE

- A. Referenced Standards:
 - 1. ASTM International (ASTM):
 - a. A48, Standard Specification for Gray Iron Castings.
 - b. B584, Standard Specification for Copper Alloy Sand Castings for General Applications.
 - 2. American Welding Society (AWS).
 - 3. Hydraulic Institute (HI).
 - 4. National Electrical Manufacturers Association (NEMA):
 - a. 250, Enclosures for Electrical Equipment (1000 Volts Maximum).
 - 5. National Fire Protection Association (NFPA):
 - a. 70, National Electrical Code (NEC).
- B. Qualifications:
 - 1. Utilize only AWS certified welders.
 - 2. Manufacturers must have, as a minimum, 10 other projects of similar scope and size currently in operation.
- C. Conform with the requirements of Section 05 50 00 for all metal fabrications.
- D. Single Source Responsibility:
 - 1. All equipment described in this Specification shall be supplied by the thickener manufacturer, including Rotary Screen Thickeners (RST), 540 gallon Flocculation Tanks, Thickened Sludge Pumps, and local controls.
 - 2. The thickener manufacturer shall be fully responsible for the design of the equipment and integration of all system components to meet all design and performance requirements specified herein.
 - 3. Coordinate placement of manually operated equipment and appurtenances to locations easily accessible to operator following installation of all systems and equipment included in this Contract.
 - a. Manually operated equipment and appurtenances include but are not limited to valves, reservoirs, grease fittings and other lubricating devices, handwheels for wash tube assemblies, and electrical control devices.

1.3 SUBMITTALS

- A. Shop Drawings:
 - 1. See Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
 - 2. See Section 01 61 03.
 - 3. Certification of compatibility of all variable speed drives with motors provided.
 - 4. Utility utilization rates and pressures.
 - 5. Provide complete manufacturer's installation instructions, construction details, materials of construction, electrical diagrams, and motor and drive details.
 - 6. Provide complete layout drawings showing locations of ancillary equipment, foundation requirements and supporting calculations, utility connections, location of thickener relative to equipment pad and discharge end enclosure.
 - 7. Certification of bearing life.
 - 8. Screen specifications including type and mesh size or opening size.
 - 9. Documentation necessary to verify that thickening unit complies with specified construction.
 - 10. Performance test protocol.
 - 11. Provide complete layout drawings for discharge end enclosure.
 - 12. Local control panel data sheets.
 - a. Catalog sheet on all components.
 - b. Wiring diagrams.
 - c. Short Circuit Current Rating (SCCR) nameplate marking per NFPA 70. Include any required calculations per Section 01 61 03.
- B. Contract Closeout Information:
 - 1. Operation and Maintenance Data:
 - a. See Section 01 33 04 for requirements for the mechanics, administration, and the content of Operation and Maintenance Manual submittals.
- C. Informational Submittals:
 - 1. See Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
 - 2. Manufacturer's certification of installation and start-up.
 - 3. Performance test report:
 - a. Performance test report shall have at minimum the following:
 - 1) Summary of testing details.
 - 2) Testing results.
 - 3) Comparison of test results to minimum performance requirements.
 - 4) Presentation of data and results in graphical form.
 - 4. Qualifications of welders.
 - 5. List of past projects of similar scope and size.

1.4 PROJECT CONDITIONS

- A. Feed Sludge Characteristics:
 - 1. Sludge description: Waste Activated Sludge (WAS), or blended WAS and Primary Sludge, or 100% Primary Sludge.
 - 2. Solids content: 0.6 PCT or higher.
 - 3. Sludge Feed Rate: 40-200 gpm
- B. Washwater Supply:
 - 1. Source: Plant W2 water.
 - 2. Pressure: 40 PSI, minimum.
 - 3. Quality: 18.8 GPM.
- C. Polymer Solution:
 - 1. Source: Plant polymer system.
 - 2. Type: Liquid.

3. Polymer will be blended and diluted with non-potable water in the existing system.

1.5 PERFORMANCE WARRANTY

- A. The thickener manufacturer shall guarantee the performance of the thickening system supplied based on minimum performance requirements described in this Specification.
- B. If the thickener does not meet the minimum performance requirements described in this Specification, the Owner, at his discretion, shall assess a monetary penalty of 100 PCT of the equipment cost for the thickener systems supplied.
- C. A retainage equal to 20 PCT of the equipment cost will be withheld by the Owner until after the performance testing.
 1. If the thickener meets the minimum performance requirements, the Owner will then pay the amount retained on the general contractor's next partial payment request after successful performance testing.
- D. The manufacturer shall warrant, in writing, that all equipment supplied by them shall be free from defects in material and workmanship, for a period of (36) months from the date of start-up and acceptance of the system.
- E. The manufacturer shall warrant the drum support rollers and the roller coating to be free from manufacturing defects for a period of (36) months from date of start-up and acceptance of the system. Neither the rollers nor coating shall require preventive maintenance during the warranty period. The warranty shall include all parts and labor and shall cover the cost of repairing or replacing any item that fails during the warranty period.
- F. The manufacturer of the Rotary Screen Thickener shall warrant the complete bearing assembly, as specified herein, for a period of five years from the date of start-up and acceptance of the equipment. The warranty shall include all parts and labor for repairing or replacing any bearing assembly part that fails during the warranty period.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
 1. FKC.

2.2 SYSTEM DESCRIPTION

- A. The Contractor shall be responsible for providing two (2) complete, integrated and properly functioning systems, each consisting of new equipment to be furnished and installed as listed below:
 1. Rotary Screen Thickener
 2. Flocculation Tank and Mixer
 3. Thickened Sludge Pump
 4. Local Control Panel
 5. Hopper and Level Control
- B. Each sludge thickening system shall each include one (1) Rotary Screen Thickener and all associated equipment listed in Section 2.2.A. Each Rotary Screen Thickener system shall be a complete prefabricated unit consisting of at minimum a sludge conditioning system, a frame, rotating screens, drive shafts, drive train equipment including motor and gearbox, complete electrical components and controls, and a screen washing system. The Rotary Screen Thickener shall be FKC model RST-S775 x 3600L., or equal. Any substitution of equipment shall be as specified in section 01 25 13.

- C. The system described herein shall be capable of thickening 100% waste activated sludge (WAS), a blend of WAS and primary sludge, or 100% primary sludge. The thickened sludge shall be between 5.0% and 9.0% Total Solids.
- D. Performance Requirements:
 - 1. Thickened primary sludge concentration of 9.0 % solids assuming no greater than 7 lb/dry ton for 100% primary sludge operation assuming 4% primary sludge solids concentration.
 - 2. Thickened waste activated sludge (WAS) concentration of 4.0 % solids assuming no greater than 16 lb/dry ton for 100% WAS feed operation assuming 0.6% feed solids concentration.
- E. The overall dimensions of the single Rotary Screen Thickener system shall be as shown on the Drawings.

2.3 MATERIALS AND EQUIPMENT

- A. All materials used in the construction of the sludge thickening equipment shall be of the best quality and entirely suitable in every respect for the service required. All materials shall conform to the ASTM Specifications where such specifications exist; the use of such materials shall be based on continuous and successful use under similar conditions of service.
- B. Unless otherwise specified herein, all materials in contact with polyelectrolyte or sludge shall be of Type 304 stainless steel.

Bearing Housings	Coated cast iron
Covers	304 stainless steel, 16 - 18 gauge
Shower Header and Nozzles	304 stainless steel
Shower Header	304 stainless Steel
Thickened Sludge Hopper	304 stainless steel, 12 gauge
Flexible Boot	Reinforced molded rubber
Drain Pan	304 stainless steel, 11.-.14 gauge
Frame	304 stainless steel, 11 gauge
Hardware, Fasteners	304 stainless steel
Full Length Polyurethane	Schedule 40 carbon steel pipe fully encased with
Coated Shafts	polyether polyurethane. Stub ends shall be 17-4 SS

- C. Flocculation Tank
 - 1) Each Rotary Screen Thickener shall be provided with a sludge flocculation tank, designed to efficiently mix polymer with the sludge and to adequately condition the sludge for optimum thickener performance.
 - 2) The flocculation tank shall be mounted upstream of the thickener and shall consist of an open top flocculation tank, and a mechanical mixer mounted inside the flocculation tank as shown on the drawings.
 - 3) The flocculation tank shall be constructed of 304 stainless steel throughout. The flocculation tank shall be self-supporting and will be furnished with stainless steel mounting foot pads as shown.
 - 4) The flocculation tank will be designed for a retention time of two minutes or greater under the normal design flow rate. The inlet of the tank will be located at the bottom of the tank and conditioned sludge will overflow from an outlet discharge pipe located near the top of the tank. The outlet pipe shall convey the conditioned sludge to the inlet pipe on the Rotary Screen Thickener.
 - 5) The flocculation tank shall be supplied with a mechanical mixer. The mixer shall be equipped with a TEFC, 230/460 VAC, 3 phase, inverter duty rated motor sized by the manufacturer to provide adequate mixing energy for the intended flow rate. The mixer motor speed shall be adjustable with a VFD mounted in the RST local control panel

- 6) The flocculation tank shall be covered with a hinged lid to allow easy visual inspection of flocculated sludge.

D. RST Structural Main Frame

- 1) The framework shall be of welded and/or bolted construction. All welding shall conform to the American Welding Society Structural Welding Code. The structure shall be designed for installation on a prepared concrete foundation and secured with anchor bolts. Permanent lifting lugs shall be provided as necessary, to allow installation and removal of the unit.
- 2) The construction shall allow easy access and visual contact of all internal components.

E. RST Drum Support Shafts

- 1) The full length drum support shafts shall be supported by a pillow block bearing mounted at each end outside the wetted environment. The shafts shall be fully coated with polyurethane and machined to match the drum support points. The polyurethane shall have a minimum thickness of 1/2 inch on all drum supporting surfaces. The shafts shall have stub ends manufactured from 17-4 stainless steel.
- 2) Drum thickeners designed with caster wheel type supports will not be accepted. Designs must incorporate all bearing located outside of the wetted environment.

F. RST Bearings

- 1) All rollers shall be supported by 3-IN greasable type, high capacity "E" design roller bearings, equipped with a metal cages, in sealed, splash proof, pillow block housings. All Shafts shall be supported by self-aligning spherical roller bearings mounted in fixed pillow block housings.
- 2) All bearings shall have a minimum L10 bearing life of 675,000 hours, calculated by using the latest ANSI/AFBMA, standard. The L10 life shall be based on the summation of all forces applied to the bearings. Certified calculations, based on the AFBMA/ISO capacity formula, showing that all bearings comply with the specified requirements for minimum L10 bearing life, at maximum loadings, shall be submitted to the engineer as set forth in the contract documents.
- 3) Bearing housings shall be class 30 cast iron with two stainless steel mounting bolts and two stainless steel cap bolts.
- 4) The bearing seal in the pillow block housing shall be of nonmetallic construction with a carrier/flinger, which rotates with the roller shaft. A static sealing arrangement between the carrier/flinger and the shaft shall be a triple rubber seal, constructed in a manner that prevents relative rotation between the seal and the shaft. A dynamic sealing arrangement between the carrier/flinger and the bearing housing shall consist of a primary dynamic contact seal of ozone resistant rubber which shall seal by rotational contact with a machined housing surface.
- 5) Bearing lubrication shall be performed through a type 304 stainless steel grease fitting mounted on the bearing housing. All bearings shall be greasable while the unit is in operation. Lubrication shall not be required more often than once every month.

G. RST Screen Wash System

- 1) Each thickener shall be equipped with individual washwater systems. The shower system will be designed for 40 PSIG water pressure and shall not require the use of a booster pump. The spray tube and nozzle assembly shall be readily removable.
- 2) Nozzle spacing and spray pattern shall be such that the sprays from adjacent nozzles overlap one another at the drum surface. Individual nozzles shall be replaceable.
- 3) Each wash spray tube shall be positioned at the top of the drums and shall extend the full length the drum. The washwater system shall be suitable for use with plant effluent water supplied at a minimum pressure of 40 psig.
- 4) The shower header shall be equipped with a manually operated handwheel attached to a flush valve and a series of internal brushes which can clean any debris accumulated on the

inner surface of the nozzle orifice. When the handwheel is rotated counterclockwise, the flush valve is opened so debris dislodged from the nozzle orifices is flushed from the header. When the handwheel is rotated clockwise, the flush valve is closed and the header returned to normal operation.

H. RST Drum Drive

- 1) Input power to the drive roller shaft is supplied through an A.C., high efficiency inverter rated motor via a VFD through a shaft mounted gearbox. The gearbox shall connect directly to the drive shaft. Drive roller rotational speed shall be controlled through variation in motor frequency, which is regulated by the operator input to a variable frequency drive controller. The VFD shall be mounted in the RST local control panel.
- 2) Driving the drums with a chain or sprocket are not acceptable.
- 3) The thickener drum speed range shall be 1.8 to 18 rpm.
- 4) The RST shall be supplied with an integral 3.0 HP, 230/460 VAC, 3 Phase, SEW motor.

Reducer Data

Manufacturer:	SEW Eurodrive
Quantity per machine:	1
Description:	Helical-worm shaft mounted gear reducer

Motor Data

Manufacturer:	Toshiba or equal (High Efficiency)
Horsepower:	3.0 HP
Power requirement:	230/460 volt, three phase, 60 hertz.
Maximum speed:	1800 r.p.m.
NEMA design:	B
Ambient temp.	40 degrees C.
Insulation class:	F
Full load amps:	460 volt at 1.6 amps.
Efficiency:	89.5%
Service factor:	1.15
Time rating:	Continuous.
Enclosure:	TEFC

I. RST Filtrate Pan

- 1) Filtrate pan shall be provided as necessary to contain filtrate from all dewatering areas within the thickener without splashing and to prevent re-wetting of downstream thickened sludge. All filtrate piping shall be furnished, adequately sized for the intended service, and rigidly attached to the thickener frame. Filtrate piping shall terminate at a flanged connection at the bottom of the filtrate pan. Flushing connections or similar provisions shall be provided for easy access during cleaning. Filtrate pan shall be located such that the moving parts do not come into contact with the pan under any conditions.

J. Thickened Sludge Hopper and Thickened Sludge Pump

1. Provide stainless steel thickened sludge hopper on the discharge of the Rotary Screen Thickener. The hopper shall be supported by the RST and include a 3" mounting flange for

- a Headbox Level Transmitter and a 2" FNPT fitting for a high-high level switch conductance probe.
- 2. RST manufacturer to provide a conductivity level switch in each hopper for high-high level alarm. Provide Warrick model 3E2C electrode holder with a single 0.25" diameter x 12" long stainless steel probe and Warrick 16MA1B0 level switch electronics module.
- 3. RST manufacturer to provide a Headbox Level Transmitters in each hopper for level control. Provide Rosemount model 3051L2AA0AAD21AAE5 or equal, 3" Flange Mount transmitter.
- 4. The outlet of the thickened sludge hopper shall be a flanged 300mm x 300mm square to match the inlet of the Thickened Sludge Pump.
- 5. RST manufacturer shall supply custom square rubber expansion joint to fit between the thickened sludge chute outlet and the Thickened Sludge Pump inlet.
- 6. The Thickened Sludge Pump shall be a variable speed Seepex progressive cavity pump – BTQ 26-12 / A1-J0-L8-F0-GA or approved equal. The pump shall include a 300mm x 300mm square inlet opening.
 - a. Pump Equipment Tags: PMP-560-01, PMP-560-02
 - b. See Section 43 23 57 for performance information and materials of construction.
- 7. The pump motor shall be a 7.5HP WEG model W22 premium efficient motor with a 20:1 constant torque variable speed turndown ratio. The motor shall be powered from the manufacturer provided control panel. All control signals to and from the pump shall be through the manufacturer provided control panel and the pump VFD shall be located in the manufacturer provided control panel.

K. Control System

- 1. One local control panel (LCP) shall be furnished and installed for each thickening system. The RST shall be controlled by the combined LCP that will contain all necessary control devices and equipment for complete controls of the RST system, which includes but is not limited to controls for the thickener drum drive, wash system, floc tank mixer, thickened sludge hopper level control, and Thickened Sludge Pump system.
- 2. The RST portion of the Local Control Panel (LCP)
- 3. Each local control panel enclosure shall be free-standing and fabricated of type 304 stainless steel and shall be rated NEMA 4X, as manufactured by Hoffman or approved equal. The equipment, controls, components, and control panels for all thickening equipment and ancillary equipment shall be UL listed. The control panel shall be UL listed and shall be assembled in a UL listed facility. The local control panel and its ancillary control components shall be as specified herein and as specified in Division 40 67 00.
- 4. The control panel shall accept a 460 VAC, 60 hertz, 3-phase power input and be equipped with a door interlocked fused disconnect. When the disconnect is in the open position, all power shall be removed from the control system.
- 5. The local control panel shall be equipped with a control power transformer fused primary and secondary with 120VAC transient voltage surge suppressor (TVSS).
- 6. The local control panel shall be equipped with a programmable logic controller (PLC) by Allen Bradley model 1769-L24ER-QBFC1B CompactLogix PLC with sufficient relays and timers to monitor equipment-mounted electrical devices and to perform necessary control functions. All required I/O modules, Ethernet communication modules, and power supplies, etc. shall be furnished to connect all available I/O into the PLC. The PLC in the LCP shall communicate to the plant control system using Ethernet. Control of the thin sludge feed pump (by others) and polymer system (by others) shall be through Ethernet. See item 10 for coordination details.
- 7. The equipment manufacturer shall provide IEC rated motor starters with short circuit protection for all motors in each RST system. Motor control for the mixer motors, the drum drive motors, and the Thickened Sludge Pump shall be via variable frequency drives (VFDs) mounted inside the LCP. The speed of the floc tank mixer motors and the drum drive motors shall all be adjustable from the RST local control panel. The speed of the Thickened Sludge Pump motor shall be controlled through the RST local control panel to maintain a constant setpoint level in the thickened sludge hopper as determined by the level

transmitter. All VFD's for the RST system shall meet the requirements of Electrical Specification, Section 26 29 23.

8. Located on the front of the control panel shall be a Maple Systems HMI5097DXL Dual-Ethernet HMI or equal for operator control of the system.
9. All nameplates shall be black phenolic nameplates with white lettering.
10. All other alarms, controls, switches, outputs, ladder logic programming, or other programming required to properly operate the RST system shall be provided by the equipment manufacturer at no additional cost to the Owner. The Contractor shall be responsible for coordinating with the Control System Programmer defined in Section 40 61 13 and the equipment manufacturer to provide the controls specified herein and full integration of the RST system into the plant control system if required.
11. All RUN, FAIL, and ALARM status from all equipment shall be integrated and displayed on LCP HMI system. The Contractor shall be responsible for coordinating with the RST equipment manufacturer and the Systems Integrator to provide the control and status of the equipment as specified on the existing plant SCADA system.
12. Provide a front panel mounted HMI for local operator interface when the system is under PLC control. As a minimum, the following control pilot devices shall be located on the front of each RST LCP to provide manual operation:

RST System

EMERGENCY STOP mushroom style push-pull illuminated button

CONTROL POWER ON-OFF selector switch

CONTROL POWER ON status light

L. Control Strategy

1. The equipment manufacturer shall furnish at a minimum, the controls as specified herein. The control strategy for any other items and equipment integral to the RST and required for the proper operation of the RST and its ancillary systems shall be programmed and controlled per the equipment manufacturer at no additional cost to the Owner.
2. For RST control, the LCP shall be equipped with a digital HAND-OFF-REMOTE switch. In HAND mode, the RST shall be manually controlled by the operator using the START/STOP pushbuttons on the HMI. In REMOTE mode, the RST shall be controlled from the Auto sequence command on the HMI. The RST equipment manufacturer shall be responsible for the control logic for the automatic operation of the RST.
3. For floc tank mixer control, the LCP shall be equipped with a digital HAND-OFF-AUTO switch. In HAND mode, the floc tank mixer shall be manually controlled by the operator using the START/STOP pushbuttons on the HMI. In REMOTE mode, the floc tank mixer shall be controlled from the Auto sequence command on the HMI.
4. For Thickened Sludge Pump control, the LCP shall be equipped with a digital HAND-OFF-REMOTE switch. In HAND mode, the Thickened Sludge Pump shall be manually controlled by the operator using the START/STOP pushbuttons on the HMI. In REMOTE mode, the Thickened Sludge Pump shall be controlled from the Auto sequence command on the HMI. The Thickened Sludge Pump equipment manufacturer shall be responsible for the control logic for the automatic operation of the Thickened Sludge Pump.
 - a. The RST LCP shall control the sludge feed using the input from the flow meter (supplied by others) and the operator set-point for desired flow. The PLC shall vary the thin sludge feed pump (supplied by others) speed to maintain a constant flow to the RST.
 - b. The RST LCP shall pace the polymer flow based on ratio control to the sludge feed into the RST Flocculation Tank Only. A signal input for the flocculation tank flow meter will be used.
 - c. The RST LCP will control the Thickened Sludge Pump speed, based on the level hopper. The Thickened Sludge Pump will vary flow to maintain a constant level. The pump speed will be adjustable from a VFD located in the RST LCP. The level input to the PLC will be provided from the thicken sludge hopper level transmitter.

- d. The equipment manufacturer shall be responsible for providing any interlocks required for the proper operation of RST system.

2.4 MAINTENANCE MATERIALS

- A. Furnish Owner the following extra materials:
 - 1. Rotary drum thickener:
 - a. Woven wire mesh screens: One complete set.
 - b. Trunnion wheel assembly: One set of six.
 - c. Drive chain or belt: One.
 - d. Drive sprocket: One.
 - e. Stabilizer wheel (if applicable): Four.
 - f. Base tensioner sprocket (if applicable): One.
 - g. One set of any special tools required for maintenance and operation.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. The Contractor shall unload and store the equipment at the site in a suitable fashion, as recommended by the equipment manufacturer. If required, the Contractor shall erect a suitable weather protected enclosure for equipment storage.
- B. The Contractor shall furnish and install equipment anchor bolts per the recommendations of the Equipment Contractor.
- C. The Contractor shall set the thickeners, control panels, and appurtenant equipment on foundations and grout the units.
- D. The Contractor shall run and land all required electrical and control wires. The rotary drum thickener supplier shall coordinate with the plant system integrator to integrating the controls between the local panel and plant SCADA system.

3.2 SURFACE PROTECTION

- A. All iron and steel surfaces shall be coated per Section 099600.
- B. All factory painted purchased equipment, such as electric motors and gear reducers, shall be coated with the premium paint from the manufacturer.

3.3 TRAINING SUPERVISION

- A. The equipment manufacturer shall furnish a qualified Training Supervisor to train the Owner's employees in the proper operation and maintenance of the sludge thickening equipment.
- B. The Training Supervisor will be required for a 2 working day period. The training period shall not begin until after the completion of the installation and successful debugging and start-up.
- C. The price bid shall include the training services of the Training Supervisor for 2 days in one trip.
- D. The approved operations and maintenance manuals shall be available and used during the instruction of the Owner's employees.

3.4 SPECIAL TOOLS AND ACCESSORIES

- A. Furnished one set of tools, wrenches and accessories required for removing parts, or making adjustments. There shall also be furnished all gauges, indicators, lubricating devices, and other items necessary for proper operation of the rotary drum thickener, whether or not such accessories are specified elsewhere.

3.5 START-UP SERVICES

- A. The manufacturer shall provide the services of a qualified engineer or technician to place the units in operation. The Contractor shall assist the manufacturer by starting up and operating all support systems, such as the water, sludge pumping, polymer mixing and feed, electric power and instrumentation and Thickened Sludge Pumping. The services provided by the manufacturer shall be the start-up services detailed in the O&M Manuals, which shall include at least the following:
1. Check equipment alignment and ensure there are no unusual internal stresses
 2. Calibrate all instrumentation
 3. Verify gear boxes and bearings are properly filled with the correct lubricants
 4. Start the drives and assure that they are operating properly with no binding and with the correct rotation
 5. Adjust spray wash
 6. Adjust all seals
 7. Begin feeding sludge and polymer, and make all adjustments to all systems to ensure proper operation
- B. Start-up services shall be considered complete when the manufacturer and Contractor have demonstrated that all units are operating optimally for two (2) consecutive days, and without mechanical, electrical and control problems. All start-up and trouble-shooting efforts will be provided at no additional cost to the Owner. The Engineer shall be sole judge as to whether the manufacturer and Contractor have completed start-up services. Upon successful equipment check out and start up, manufacturer's qualified representative will train Owner's employees in the proper operation and maintenance of the sludge thickening equipment.

3.6 POST INSTALLATION TESTING

- A. After installation, and start-up and debugging, the thickening unit shall be tested to assure conformance with the performance criteria outlined in this section.
- B. The Rotary Screen Thickeners shall be operated by the equipment manufacturer under the supervision of the engineer or plant staff. The unit shall be fed sludge and shall be operated until the unit reaches steady state optimum performance. The unit shall then begin a 2-day, 6-hour per day run period during which the average performance of the unit must equal or exceed the guaranteed performance parameters. If the unit fails to equal or exceed that required, or cannot operate continuously during the duration of the test, due to equipment failure, the test shall be repeated. The Contractor shall be given 30 calendar days to optimize performance to produce results to equal or exceeding the guaranteed performance criteria.

3.7 TESTING PROGRAM PROCEDURES

- A. A pretest meeting shall be held jointly between representatives of the Contractor, the manufacturer, the Owner and the Engineer to provide the details of the final performance testing program.
- B. The 2 days of the testing program shall comprise the formal testing portion of the installation. During this period, the Owner will collect any and all samples, and perform any and all such analyses as it deems necessary to fully determine the performance of the system.
- C. The RST Manufacture will test the unit for a minimum of 6 hours. This data will be used to determine the average RST output. The output shall be equal to or higher than the outlined performance in Section 1.04.
- D. When the manufacturer makes a change in settings, the Owner shall be notified, who will note the change and its purpose. This shall include sludge feed rate, polymer feed rate, polymer dilution, floc tank mixer speed, drum rotation speed, washwater system flow or pressure, or other equipment changes that could change results.
- E. A run shall be defined as a minimum of 3 hours of continuous running and production of thickened sludge with no major changes in any process parameters. All samples taken during a

run may either be composited for laboratory testing, or tested individually with the results averaged.

- F. A total of two test runs shall be made over a 2-day period. The Owner shall decide if there is sufficient cause to extend the testing to a third run. The Owner shall extend the test period, as required, provided there has been reasonable cause (i.e., loss of sludge, loss of power, loss of water pressure, etc.).
- G. The thickener shall operate without cake spilling from the feed end of the system.
- H. The following sample feed rates, calibrations or setting, shall be taken in specified 1 hour intervals. Samples shall be taken by the Owner and analyzed by a laboratory designated by the Owner and paid for by the Owner.
 - 1. Sludge feed - total solids (sludge only).
 - 2. Filtrate – total suspended solids.
 - 3. Final thickened sludge - total solids.
 - 4. Polymer feed rate - gallons per hour.
 - 5. Sludge feed rate - gallons per minute.
 - 6. Thickened sludge discharge rate - pounds per hour.
 - 7. Polymer feed pump Speed
 - 8. Setting for sludge feed pump.
 - 9. Setting for thickener drum drive speed.
- I. The average results of the two day test will be used to evaluate the equipment performance.
- J. Following successful completion of the testing program and compilation of the data collected by the Owner, the Owner will provide a copy of the test results and the Owner's determination of the performance levels to be used in the evaluation of equipment. The Owner reserves the right to evaluate any and all data from the testing program, and to formulate the final conclusions regarding performance on the basis of the demonstrate system performance.
- K. The thickener supplier shall make any and all modifications to the system as required to provide satisfactory operation at no additional cost to the Owner.

END OF SECTION

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SECTION 46 73 00
ANAEROBIC DIGESTER EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Basic requirements for floating digester cover(s), gas equipment, mixing equipment, and boiler and heat exchanger equipment.
- B. Related Specification Sections include but are not necessarily limited to:
 - 1. Division 00 - Procurement and Contracting Requirements.
 - 2. Division 01 - General Requirements.
 - 3. Section 09 96 00 - High Performance Industrial Coatings.
 - 4. Section 01 61 03 - Equipment - Basic Requirements.
 - 5. Section 46 73 35 - Digester Gas Equipment.
 - 6. Section 46 73 30 - Digester Mixing System – Linear Motion Type

1.2 QUALITY ASSURANCE

- A. See Specification Section 01 61 03.
- B. Reference Standards:
 - 1. American Welding Society (AWS):
 - a. D1.1/D1.1M, Structural Welding Code - Steel.
 - 2. National Fire Protection Association (NFPA):
 - a. 54, National Fuel Gas Code.

1.3 SUBMITTALS

- A. Shop Drawings:
 - 1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
 - 2. See Specification Section 01 61 03.
 - 3. Product technical data including:
 - a. Acknowledgement that products submitted meet requirements of standards referenced.
 - b. Manufacturer's installation instructions.
 - c. Equipment weights.
 - d. Electrical and control diagrams.
- B. Contract Closeout Information:
 - 1. Operation and Maintenance Data:
 - a. See Specification Section 01 33 04 for requirements for the mechanics, administration, and the content of Operation and Maintenance Manual submittals.
- C. Informational Submittals:
 - 1. Certifications:
 - a. Manufacturers installation check letter.

PART 2 - PRODUCTS

2.1 DESIGN REQUIREMENTS

- A. Electric Motor Operated Equipment:
 - 1. Class 1, Division 1 rated.
- B. Materials suitable for exposure to and operation with digester gas having the following approximate volumetric composition:
 - 1. Methane (CH₄): 59 PCT, ±5 PCT.
 - 2. Carbon Dioxide (CO₂): 36 PCT, ±2 PCT.
 - 3. Hydrogen Sulfide (H₂S): 2 PCT, ±0.5 PCT.
 - 4. Moisture: Saturated.

2.2 FABRICATION

- A. Employ welding procedures and practices which comply with AWS D1.1.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. See Specification Section 01 61 03 and Specification Section 40 05 00 for purging requirements:
 - 1. Purge all digester gas piping, digester gas safety equipment, digester gas handling equipment, digester gas combustion equipment, digester gas storage equipment and the headspace beneath floating and fixed digester covers.
 - a. Use nitrogen or carbon dioxide gas.
 - b. Conform to NFPA 54, Part 4, Section 4.3.
 - 2. Provide all materials, inert gas, and labor for purging.
 - 3. Place into operation or valve off to prevent entrance of air to the system after completion of purging.
- B. Employ welding procedures and practices which comply with AWS D1.1.

3.2 FIELD QUALITY CONTROL

- A. Employ and pay for services of authorized manufacturer's field service representative to:
 - 1. Inspect equipment to be installed by these Specifications.
 - 2. Supervise adjustments, perform modifications as necessary.
 - 3. Conduct start-up of equipment and perform operational checks.
 - 4. Provide Owner with a written statement that manufacturer's equipment has been installed properly, started up, and is ready for operation by Owner's personnel.
 - 5. Instruct Owner's personnel for the specified minimum period on jobsite on operation and maintenance of following equipment:
 - a. Section 46 73 35 - Digester - Gas Equipment: 4 HRS.

END OF SECTION

SECTION 46 73 30

DIGESTER MIXING SYSTEM: LINEAR MOTION TYPE

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Digester mixing system, linear motion type.
 - a. Primary Digester 4 Mixer: LMM-550-01 (Guaranteed Price Bid Alternate).
 - 2. Furnishing all labor, materials, equipment, supervision and incidentals necessary for fabrication and complete installation, training, programming, and testing of the items specified in this Section.
- B. Related Sections include but are not necessarily limited to:
 - 1. Division 01 - General Requirements.
 - 2. Section 01 61 03 - Equipment: Basic Requirements.

1.2 QUALITY ASSURANCE

- A. Referenced Standards:
 - 1. American Bearing Manufacturers Association (ABMA).
 - 2. American Iron and Steel Institute (AIS):
 - a. Steel Products Manual.
 - 3. ASTM International (ASTM):
 - a. A36, Standard Specification for Carbon Structural Steel.
 - b. A48, Standard Specification for Gray Iron Castings.
 - 4. American Welding Society (AWS).
 - 5. National Electrical Manufacturers Association (NEMA):
 - a. 250, Enclosures for Electrical Equipment (1000 Volts Maximum).
- B. Manufacturer shall be solely and fully responsible for warranty and mechanical design adequacy of all mixer components in the scope of supply defined in this specification. This warranty will become effective upon Final Acceptance and remain in effect for a period of five (5) years.

1.3 SYSTEM DESCRIPTION

- A. Linear motion mixer installation shall be coordinated with digester cover manufacturer.
- B. Single Source Responsibility:
 - 1. All equipment described in this Specification shall be supplied by the mixer manufacturer.
 - 2. The mixer manufacturer shall be fully responsible for the design of the equipment and integration of all system components to meet all design and performance requirements specified herein.
 - 3. Coordinate placement of manually operated equipment and appurtenances to locations easily accessible to operator following installation of all systems and equipment included in this Contract.
 - a. Manually operated equipment and appurtenances include but are not limited to grease fittings and other lubricating devices and electrical control devices.

1.4 SUBMITTALS

- A. Shop Drawings:
 - 1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
 - 2. Fabrication and/or layout drawings:
 - a. Scaled (1/4 IN = 1 FT minimum) drawings illustrating proper orientation of mixing system components when cover is at high, low and intermediate positions.
 - 1) Identify elevations of key components including hydro-disk, seal tube, and mixer flange.
 - 2) Provide all mixer supporting framework, erection drawings, and cover attachment details.
 - 3. Product technical data including:
 - a. Acknowledgement that products submitted meet requirements of standards referenced.
 - b. Manufacturer's installation instructions.
 - c. Detailed summary of dead and operating weights for all components mounted on cover.
 - 1) All dynamic and dead loads imposed by the mixer to the cover.
 - 2) Evidence that a copy has been forwarded to the cover manufacturer for coordination and counterbalancing. This will be completed after a General Contractor is selected.
 - d. Detailed wiring schematics and instrumentation logic diagram for all electrical components.
 - 4. A three-dimensional (3D) model computational fluid dynamics (CFD) mixing analysis for the specific configuration of the tanks where the mixing system will be installed. Any interference for the occurrence of the nodal mixing patterns such as columns, or any other significant structures, shall be included in the 3D model of the tank being analyzed. The mixing analysis shall simulate the flow generated by the disk and shall show the velocity vectors in an output format.
 - 5. Warranty letter stating materials and workmanship are defect free for a minimum of five (5) years.
 - 6. Provide the completed form "Equipment Warranty and Certification Form" in the equipment submittal. Submittal will not be reviewed until form is provided to Engineer. Form is included.
- B. Operation and Maintenance Manuals:
 - 1. See Specification Section 001 33 04 for requirements for:
 - a. The mechanics and administration of the submittal process.
 - b. The content of Operation and Maintenance Manuals.
- C. Contract Closeout Information:
 - 1. Operation and Maintenance Data:
 - a. See Specification Section 01 33 04 for requirements for the mechanics, administration, and the content of Operation and Maintenance Manual submittals.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
 - 1. Ovivo Linear Motion Mixer Model LM12/7.5/72.
- B. No like, equivalent, "or-equal" items, or substitutions are permitted.

2.2 PERFORMANCE AND DESIGN REQUIREMENTS

- A. Mixing equipment suitable to completely mix entire contents of digester.
 - 1. Complete mixing is defined as maintaining sludge concentration within +10 percent of average at all locations in digester and temperature variation no greater than +5 DegF.
 - 2. Approximate digester dimensions:
 - a. Primary Digester No. 4
 - 1) Diameter, inside: 45 FT.
 - 2) Side water depth: 25 FT.
 - 3) Conical section depth: 1.9 FT- See Drawings.
 - 4) Sludge volume: 39,800 cubic feet
 - 5) Solids Concentration in Digester shall be 2% to 4% solids concentration.
 - 3. Mixing system:
 - a. Complete mixing through range of cover and liquid travel and solids variations.

2.3 MATERIALS

- A. Linear Motion Mixer
 - 1. Hydro-disk: 304L Stainless Steel
 - a. Outer diameter: 84 inches
 - b. Inner diameter: 56 inches
 - c. Shape: round
 - 2. Mixer shaft: 304L Stainless Steel
 - 3. Mounting base: Steel
 - 4. Flange bolts: 304 Stainless Steel

2.4 EQUIPMENT

- A. Performance and Configuration Requirements:
 - 1. Stroke length: 12 inches
 - 2. Cycle time: Approximately 30 cycles per minute (cpm) with option to adjust with variable speed drive.
 - 3. Nameplate driver horsepower: 7.5 hp
 - 4. Mixer assembly shall be removable as a unit without varying the normal sludge level or gas pressure within the digesters.
- B. Drive System:
 - 1. Drive mechanism (scotch yoke design), enclosure, and stand
 - 2. Driving shaft with seals
 - 3. Gearbox and motor
- C. Motor:
 - 1. Explosion-proof, single-speed motor, and a helical bevel gear box driving a cam-scotch-yoke mechanism that vertically moves the hydro-disk shaft.
 - 2. Mechanism housing shall include a hinged door complete with a 6mm thick Plexiglas cover to allow access to yoke mechanism.
 - 3. Designed, manufactured, and tested in accordance with the latest edition of NEMA MG 1.
 - 4. Type: Variable-speed, explosion-proof, (Class I, Division 1, Group D).
 - 5. Horsepower: 7.5 hp
 - 6. Motor speed: 1800 RPM.
 - 7. Electrical: 230/460 volts, 3 phase, 60 hertz.
 - 8. Minimum motor efficiency at high speed: 90%.
 - 9. Service Factor: 1.15 @ 40 degrees C.
 - 10. Include high winding temperature switch.
 - 11. NEC code: T2A OR T3C
- D. Electrical Controls:
 - 1. NEMA 7 local control station with an on/off/auto switch.

2.5 FABRICATION

- A. Hydro-disk
 - 1. Hollow (donut) round, non-elliptical type design.
 - 2. The design shall create a vertical “up and down” motion of the hydro-disk producing a turbulent “liquid-core” that extends through its range of motion and the tank contents.
- B. Seal Tube System
 - 1. The linear motion mixer seal tube shall extend a minimum of 12-inches below the minimum liquid level in the digester. This minimum seal tube depth shall be maintained throughout the linear motion mixer’s oscillating motion.
- C. Mounting Plate
 - 1. The mixer manufacturer shall supply a structural fabricated steel mixer mounting plate designed to be attached to the structural opening or mounting ring. The mounting plate shall be provided with the necessary flange bolts and gaskets. The plate shall be designed to support the entire weight of the linear motion mixer and transfer all dynamic and dead loads imposed by the mixer to the digester cover.
- D. Finishes:
 - 1. All fabricated surfaces requiring painting shall be cleaned by near white sand blast (SSPC-SP10) by mixer manufacturer. All fabricated surfaces requiring painting as required in specification section 0996 00. Shop prime and finish painted by mixer manufacturer. Shop prime paint shall consist of one coat, 4-6 mil DFT, Tnemec Series N69, or equal. Shop finish paint shall consist of one coat, 4-6 mil DFT Tnemec Series N69, or equal

2.6 MAINTENANCE MATERIALS

- A. Spare Parts:
 - 1. Furnish one set of extra materials matching products installed for each set as described below:
 - a. Two Mixer Rails (LM12)
 - b. Four Mixer Sliding Blocks (LM12)
 - c. One CAM Follower Assembly (LM12)
 - d. Four Auto Greasers
 - 2. Spare parts shall be suitably packaged and labeled with the name and number of the equipment to which they belong.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Anchorage as required.

3.2 FIELD QUALITY CONTROL

- A. Provide services of equipment manufacturer's field service representative(s) to:
 - 1. Inspect equipment covered by these Specifications.
 - 2. Supervise pre-start adjustments and installation checks.
 - 3. Conduct initial startup of equipment and perform operational checks.
 - 4. Provide a written statement that manufacturer's equipment has been installed properly, started up and is ready for operation by Owner's personnel.
 - 5. Instruct Owner's personnel in field and classroom on operation and maintenance.
 - 6. For manufacturer’s field services, provide a minimum of two separate trips, each lasting two 8-hour days.

END OF SECTION

SECTION 46 73 35
DIGESTER GAS EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

- A. Work included consists of but not necessarily limited to:
 - 1. Foam separator.
 - 2. Manometer.
 - 3. Combination pressure/vacuum relief valves with flame arresters.
 - 4. Waste gas burner and control panel.
 - 5. Automatic Drip Traps.
 - 6. Safety selector valve.
 - 7. Emergency relief manhole cover.
 - 8. Quick opening manways.
 - 9. Insulating jackets.

- B. Related Sections include but are not necessarily limited to:
 - 1. Division 00 - Procurement and Contracting Requirements.
 - 2. Division 01 - General Requirements.
 - 3. Section 09 96 00 - High Performance Industrial Coatings.
 - 4. Section 10 14 00 - Identification Devices.
 - 5. Section 40 42 00 - Pipe, Duct and Equipment Insulation.
 - 6. Section 40 61 13 - Process Control Systems General Requirements.
 - 7. Section 46 73 00 – Anaerobic Digester Equipment

1.2 QUALITY ASSURANCE

- A. Referenced Standards:
 - 1. American Society of Mechanical Engineers (ASME):
 - a. B 16.1, Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250.
 - 2. ASTM International (ASTM):
 - a. A 182, Standard Specification for Forged or Rolled Alloy and Stainless Steel Pipe Flanges, Forged Fittings, and Valves and Parts for High-Temperature Service.
 - b. A 351, Standard Specification for Castings, Austenitic, for Pressure-Containing Parts.
 - 3. National Electrical Manufacturers Association (NEMA):
 - a. 250, Enclosures for Electrical Equipment (1000 Volts Maximum).

1.3 SUBMITTALS

- A. Shop Drawings:
 - 1. See Specification Section 01 33 00 for requirements for the mechanics and administration of the submittal process.
 - 2. Fabrication and/or layout drawings:
 - a. Schematic drawing of gas system showing major components and corresponding initial pressure settings.
 - b. Schematic to include tag numbers assigned to each component by Contract Documents.
 - 3. Product technical data:
 - a. Acknowledgement that products submitted meet requirements of standards referenced.
 - b. Manufacturer's installation instructions.
 - c. Calibration constants and pressure settings for devices requiring settings.
 - 1) Calibrate settings using certified manometer.

- B. Contract Closeout Information:
 - 1. Operation and Maintenance Data:

- a. See Specification Section 01 33 04 for requirements for the mechanics, administration, and the content of Operation and Maintenance Manual submittals.

1.4 SYSTEM DESCRIPTION

- A. The components described in this Section shall be supplied by one manufacturer and when interconnected with piping constitute a complete digester gas control system.
 - 1. Each component is to be provided to integrate with other components for a complete operating system.
 - 2. Match the digester gas control system to all external devices using digester gas.
- B. Digester operating pressure: 8IN WC to 12 IN WC

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Subject to compliance with the Contract Documents, the following manufacturers are acceptable:
 - 1. Varec.
 - 2. Or approved equal.

2.2 PERFORMANCE AND DESIGN REQUIREMENTS

- A. Waste gas burners:

Equipment Number	Inlet Size	Gas Flow	Pressure Loss	Pilot Supply
WGB-560-01	4 IN	9,300 scfh	0.5 IN w.c.	Natural Gas

- B. Automatic Drip Traps:

Equipment Number	Capacity	Working Pressure
DT-560-01	6 QT	5 psig
DT-560-02	6 QT	5 psig

- C. Foam separator:

Equipment No.	Diameter	Inlet/Outlet Size	Gas Flow
FS-550-01	24 IN	6 IN	4,650 SCFH

- D. Combination pressure/vacuum relief valves with flame arresters:

Pressure and Vacuum Relief Valves				
Equipment No.	Size	Gas Flow	Pressure Setting	Vacuum Setting
PRV-550-01	3 IN	4,650 SCFH	12 IN WC	2 IN WC
		@10% overpressure and 50% underpressure		
PRV-550-02	3 IN	4,650 SCFH	12 IN WC	2 IN WC
		@10% overpressure and 50% underpressure		
Flame Arresters				
Equipment No.	Size	Gas Flow		

FA-550-01	3 IN	4,650 SCFH
FA-550-02	3 IN	4,650 SCFH

2.3 FABRICATION AND MANUFACTURE

- A. Foam separator:
1. The foam separator shall operate by means of a continuous spray wash of water. The biogas must rise vertically past an internal baffle located in the center of the unit.
 2. The foam separator shall be a cylindrical tank 24-in (or 36-in) feet in diameter with 6-in inlet and outlet connections. The tank shall be constructed with 1/4" thick, welded, 316L stainless steel. Each separator shall be provided with ANSI 150 FF flanged connections.
 3. Each tank shall remain gas tight to maximum operating pressure of 18-in WC. Each tank shall be provided with a multiple spray system. The nozzles shall be 3/8" in 316 SS construction and rated for 40 psi pressure with 2 gpm water flow at 2 psi supply pressure. Nozzles shall be spaced on the pipe sections so as to completely cover the base area of the tank. Internal pipe sections shall be constructed of stainless steel.
 4. Each tank shall be provided with float-operated high and low level switches with termination wiring in an explosion proof junction box.
 5. 6-IN inlet and outlet piping.
 6. Materials of construction:
 - a. Tank: 316 Stainless Steel
 - b. Welded components shall be 316 SST L Grade, min.
 - c. Spray system: 316 Stainless Steel.
 - d. Valves: 316SS.
 7. Varec 231 Series, or approved equal.
- B. Manometer:
1. Provide at the location shown on Drawings and specified.
 2. Well type.
 3. Calibrated to read in inches and tenths of inches of water column.
 4. Red unity oil indicating fluid.
 - a. Specific gravity 1.0.
 - b. Temperature range 30F to 100 F.
 5. Design for easy removal of tube without disturbing piping.
 6. 0-30 IN WC range.
 7. Varec 217 Series, or approved equal.
- C. Combination pressure/vacuum relief valves with flame arrestors:
1. Pressure/vacuum relief valves:
 - a. All aluminum construction.
 - b. All-weather with all-weather coated aluminum pallet/seat
 - c. Replaceable Teflon® pressure and vacuum seat rings.
 - d. Flanged end connections: 150 lb. FF ANSI.
 - e. Statically balanced pallet, loosely guided both center and side that will not bind:
 - 1) Provide pallets with knife-edge drip ring to prevent collection of condensate at seats.
 - 2) Seat constructed of Teflon®
 - 3) Tight seating.
 - f. Removable top plate for inspection of internal parts.
 - g. Each unit with a complete set of removable pallet lead weights which may be utilized to set the relief pressure at 1 IN increments of pressure.
 2. Flame arrestors:
 - a. Same size as pipe and pressure/vacuum relief valves.
 - b. Vertical configuration, as indicated on Drawings.
 - c. Flanged end connections: 150 lb. ANSI.
 - d. Working pressure: 10 psig

- e. Construct housing from aluminum.
 - f. Construct bank assembly from a aluminum material and arrange for easy removal from housing.
 - g. Net free area through bank assembly: Not less than 4 times connection size.
 - h. Provide grids of bank constructed as individual corrugate stamped and rectangular shaped sheets.
3. Varec 5811B Series, or approved equal.
- D. Safety selector valve (SSV-550-01):
- 1. Switch-over device to permit routine or emergency servicing of redundant pressure relief devices without process interruption.
 - 2. Provide Cv values that result in less than 3% pressure drop to the active PRV inlet. Cv shall be a minimum of 612.
 - 3. Connection size: 3-IN
 - 4. Foolproof dual padlocking in either pressure relief valve position, in accordance with ASME Section VIII.
 - 5. Packing design tested per ASTM E427, Method A halogen leak test.
 - 6. Temperature range -40 F 250 F.
 - 7. Flanged end connections: 150 lb. ANSI.
 - 8. Aluminum body material.
 - 9. 316 stainless steel rotor, indicator, and seat material.
 - 10. 17-4 stainless steel isolation disk and retraction bushing.
 - 11. All hardware shall be stainless steel.
 - 12. Teflon® soft goods.
 - 13. Meet all mandatory requirements of ASME Section VIII, Division 1, UG-135 (b).
 - 14. Varec SVR 24 Series Safety Selector Valve, or approved equal.
- E. Emergency Relief Manway Cover:
- 1. 24-IN diameter.
 - 2. Self-draining.
 - 3. Maximum leakage of less than 1 SCFH at 90% of set pressure.
 - 4. Hinged pivot design for a automatic re-seating.
 - 5. Flanged connection: 150 lb. ANSI. FF
 - 6. Pressure settings: 15 IN WC
 - 7. Vacuum settings: 3 IN WC
 - 8. Base and cover shall be a luminum.
 - 9. Hinge arm, seat, weatherhood, spring a ssembly, and all hardware shall be stainless steel.
 - 10. Varec 400W series, or approved equal.
- F. Access Hatch:
- 1. 30-IN diameter.
 - 2. Gas-tight seal, non-sparking.
 - 3. Aluminum base and cover.
 - 4. Wing nut shall be brass.
 - 5. Insert shall be Tallow treated flax.
 - 6. Varec 220 Series, or approved equal.
- G. Insulating jackets:
- 1. Cold weather protection for the foam separator, combination pressure/vacuum relief valves with flame arrestors, and safety selector valve.
 - 2. Silicone impregnated woven glass cloth lining with fiber glass insulating material.
 - 3. Closures shall consist of Velcro and cinch belts.
 - 4. Varec, or approved equal.
- H. Waste Gas Burner and Control Panel:
- 1. Materials of construction:
 - a. Upper 24 IN of burner, continuous flame nozzle, flame retentive nozzle: 304 and 316 SS.

- b. Stand pipe and other piping: Carbon steel.
- c. Thermowell and thermocouple: 316 SS.
- 2. Burner:
 - a. Self-supporting.
 - b. Mounted vertically on ANSI 150 lb. flange stack.
- 3. Automatic ignition system:
 - a. Continuous flame nozzle shall be mixed and ignited to the burner and designed to burn combustible air/gas mixture with long profile flame.
 - b. Flame retention nozzle designed to flow natural gas when required during the ignition cycle.
 - c. Pilot gas and air shall be mixed and ignited at ground level, remote from the burner stack a minimum of 15 feet to a maximum of 100 feet away from the burner tip.
 - d. Thermocouple in a thermowell mounted in the continuous flame nozzle.
 - e. Adjustable Thermocouple set point.
 - f. Ignition control panel:
 - 1) NEMA 4X weatherproof enclosure.
 - 2) Pilot flame monitoring.
 - 3) Selector switch:
 - a) Auto manual.
 - b) Standby.
 - 4) High voltage transformer.
 - 5) Dry contacts for remote indication:
 - a) Standby, Auto, manual.
 - b) Flame failure alarm.
 - c) Pilot on/off.
 - 6) Status indicator for:
 - a) Pilot On/Off,
 - b) Retention valve open
 - c) System alarm
 - 7) Field adjustable set points for:
 - a) Pilot purge time
 - b) Spark time
 - c) Thermocouple hot
 - d) Reignition attempts
 - e) Remote start time delay
 - 8) Manual ignition button
 - 9) Heater and thermostat
 - g. Venturi:
 - 1) 2-NTP.
 - 2) Supplies combustible air/gas mixture to continuous flame nozzle.
 - 3) Combustion chamber.
 - 4) Spark plug.
 - 5) Back-flash preventer.
 - 6) Mounted at remote NEMA 4 spark generator panel.
 - 7) High tension lead.
 - h. Valve and regulator package:
 - 1) Provides pressure reduction.
 - 2) Isolation valves.
 - 3) Pressure regulators.
 - 4) Pressure gauges.
 - 5) Explosion proof solenoid valves.
 - 6) All interconnecting fittings and piping.
 - 7) Copper free components.
 - 8) Package affixed to SS panel.
 - 9) 2" NPT inspiring venturi include:

- a) Combustion chamber
 - b) Spark plug
 - c) Back flash
 - i. The flare system will be in standby until it receives the remote start permissive signal
 - j. Designed for a high pressure natural gas system with a minimum pressure of 10 psig.
4. Varec model 244 WS series.

I. Automatic Drip Trap:

- 1. 1 inch size NPT inlet and outlet connections and 6-QT capacity.
- 2. Rotating disc type
- 3. An air inlet port shall be provided to permit free flow of condensate from reservoir when
- 4. Low copper cast aluminum body, cover plate, disc, and handle. Internal working parts and fasteners shall be stainless steel. "O" rings shall be neoprene.
- 5. Electric-actuator to open and close the drip trap shall be rated for Class 1, Divs 1 and 2. And include a manual override and not be operable electrically while the manual override is engaged.
- 6. A timer shall be provided in a NEMA 7 enclosure to open the actuator at a specified interval shall be mounted with the electric actuated drip trap assembly. Provide a stainless steel bracket and hardware to secure actuator to the drip trap.
- 7. LOCAL CONTROL PANEL (optional):
 - a) A local control panel shall be provided and will remotely monitor and operate 2 electric-actuated drip traps.
 - b) The control panel shall be NEMA 4X, (316 Stainless Steel enclosure or NEMA 7, aluminum construction) where specified on the drawing.
 - c) Control Panel to include:
 - 1. Timer to open and close the drip trap automatically and at specified set intervals for 4 hour fill cycle and 4 min. drain cycle.
 - 2. Selector switches to initiate automatic or hand mode.
 - 3. Indicator for FILL and DRAIN status while in automatic or hand modes.
 - 4. Fault Alarm for each drip trap monitored by the control panel and will come on when the trap does not close at the specified timer setting.
 - 5. Remote contacts for "Fill" or "Drain" status and fault alarms.
- 8. Varec Model 246 series

2.4 AUTOMATICALLY OPERATED DRIP TRAPS

A. Design Criteria:

TAG #	CAPACITY	LOCATION
DT-901	2-1/2 QT	Gas safety room
DT-902	6 QT	Gas safety room

B. Fabrication:

- 1. Automatically operated drip traps 1 IN NPT inlet and outlet connection and a 6 QT storage capacity.
- 2. Rotating disc type drip traps with an air inlet port to permit free flow of condensate from bowl when draining.
- 3. Gas cannot exit while draining or revolving operating handle.
- 4. Cast aluminum unit with stainless steel shaft and springs.
- 5. Working pressure: 5 PSIG.
- 6. Pipe discharge from trap to nearest equipment or floor drain.
- 7. Actuator: Class 1, Div 1; Aluminum.
- 8. Electrical: Timer.
- 9. Varec Model 246AT Drip Trap, or equal.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Pipe insulation.
- B. Insulate sludge and gas piping which is exposed to ambient conditions below 40 DEGF.
 - 1. Use minimum 2 IN thick insulation with aluminum jacket in compliance with Specification Section 40 42 00.

END OF SECTION

APPENDICES



City of Wenatchee

Wastewater Treatment Plant Digester 4 Project

Project No. 1810

Appendix A Standard Details

Wenatchee, WA

October 4, 2021



City of Wenatchee	
WWTP Digester 4 Project	
PROJECT NO. 1810	
DRAWING TITLE	DETAIL NUMBER
Division 01 - General Requirements	
Anchor Bolt Blockout	01 61 03-08
Equipment Drain Bell	01 61 03-09
Sawcut Detail	01 73 29-01
Sawcut and Patch Detail	01 73 29-02
Division 03 - Concrete	
Repair Detail at Concrete Spall and at Exposed and Rusted Reinf.	03 01 37-01
Sealant System at Existing Wall CTJ	03 01 37-02
Adhesive Anchor Details & Schedule	03 15 19-01
Reinforcing at Openings	03 21 00-01
Reinforcing Splice Stagger	03 21 00-02
Typical Stirrups & Ties	03 21 00-03
Column Splices & Ties	03 21 00-06
Typical Beam Reinforcing	03 21 00-07
Notes for Extra Reinforcing Around Openings	03 21 00-07A
Reinforcement at Corners and Intersections	03 21 00-11
Hinged Top Slab to Wall	03 21 00-12
Concrete Curb	03 21 00-15
Concrete Pad at Electrical Panel	03 21 00-16
Circular Tank Horiz. Reinforcing	03 21 00-19
Typical Equipment Support Pad	03 21 00-20
Typical Equipment Support Pad	03 21 00-20A
Staggered Reinforcing at Construction Joint	03 21 00-21
Type Approach Slab	03 21 00-22
Concrete Vertical Curb	03 21 00-23
Mowing Strip Detail	03 31 00-24
Shop Fabricated Waterstop	03 31 31-01
Horizontal Wall Joints with Waterstops	03 31 31-02
Construction Joints (CJ)	03 31 31-03
Sealant Detail	03 31 31-04
Additional Slab Reinforcing	03 31 31-05
Typical Isolation Joint (IJ)	03 31 31-07
Concrete Joint (CTJ)	03 31 31-08
Slab-On-Grade Joint	03 31 31-09
Concrete Splash Block	03 31 31-11
Concrete Plug	03 31 31-13
Concrete Walkway	03 31 31-15
Retaining Structure	03 31 31-16
Blockout for Conc Fill	03 31 31-17
Concrete Fill Key Detail at Wall	03 31 31-18
Concrete Fill Key Detail at Slab	03 31 31-19
Division 05 - Metals	
Single Plate Beam Connection	05 12 00-01
Typical Beam Connection Detail	05 12 00-03
Beam Moment Splice	05 12 00-04
Single Plate Beam to Column	05 12 00-05
Column to Beam Connection	05 12 00-06
Column Base Plate	05 12 00-07
Moment Connection Beam to Column Flange	05 12 00-09

City of Wenatchee	
WWTP Digester 4 Project	
PROJECT NO. 1810	
DRAWING TITLE	DETAIL NUMBER
Moment Connection Beam to Column Web	05 12 00-10
Anchor Bolt Detail	05 12 00-11
Steel Beam to Concrete Connection Detail	05 12 00-13
Steel Beam to Concrete Connection Detail	05 12 00-14
Aluminum Beam to Concrete Connection Detail	05 14 00-01
Typical Aluminum Beam Connection	05 14 00-02
Aluminum Beam to Concrete Connection Detail	05 14 00-03
Aluminum Beam to Concrete Stiffener Beam Detail	05 14 00-04
Grating and Support Detail	05 50 00-01
Checkered Plate Support	05 50 00-02
Checkered Plate Access Hatch	05 50 00-03
Railing Mounted Hose Rack	05 50 00-04
Floor Mounted Hose Rack	05 50 00-05
Wall Mounted Hose Rack	05 50 00-06
Stair Detail	05 50 00-07
Stair Bottom Connection	05 50 00-08
Stair Top Connection at Concrete	05 50 00-09
Stair Top Connection at Concrete	05 50 00-10
Stair Bottom Connection At Beam	05 50 00-11
Bollard	05 50 00-14
Interior Bollard Structured Floor Slab	05 50 00-14A
Removable Bollard Detail	05 50 00-14B
Concrete Rod Support	05 50 00-15
Through Bolt	05 50 00-17
Lifting Eye	05 50 00-25
Pipe Support Bracket	05 50 00-26
Typical Wall Supported Ladder	05 50 00-30
Typical Wall Supported Ladder at Roof Hatch	05 50 00-34
Wall Supported Ladder	05 50 00-35
Valve Cover in Grating	05 50 00-38
Valve Cover in Concrete	05 50 00-45
Light Pole Support Bracket	05 50 00-47
Light Pole at Conc Wall	05 50 00-48
Chemical Tote Rack	05 50 00-49
Moment Conn. At Col. Flange	05 50 00-49A
Moment Conn. At Col. Web	05 50 00-49B
Column Base at Conc Pedestal	05 50 00-49C
Guardrail At Digester	05 52 00-06A
Removable Guardrail	05 52 02-01
Guardrail (Type 1)	05 52 02-02
Guardrail (Type 2)	05 52 02-03
Guardrail Gate	05 52 02-04
Aluminum Vertical Post Base	05 52 02-05
Guardrail (Type 3)	05 52 02-09
Aluminum Guardrail Post	05 52 02-10
Wall Mounted Handrail Detail	05 52 02-16
Handrail Detail	05 52 02-17
Stair Rail Detail	05 52 02-18
Stair Rail Detail	05 52 02-19
Division 06 - Wood, Plastics, and Composites	

City of Wenatchee	
WWTP Digester 4 Project	
PROJECT NO. 1810	
DRAWING TITLE	DETAIL NUMBER
FRP Curb Angle	06 82 00-04
FRP Ladder Mount	06 82 00-07
FRP Ladder	06 82 00-08
Division 07 - Thermal and Moisture Protection	
EIFS & PVC Roofing At Digester	07 24 13-01
Coping Detail	07 62 00-01
Scupper & Conductor Box	07 62 00-02
Scupper Detail	07 62 00-03
Boiler Stack	07 62 00-04
Roof Curb For Roof Equipment	07 62 00-05
Vent Thru Roof	07 62 00-06
Roof Hatch at Ladder without Cage	07 72 33-01
Roof Hatch at Ladder with Cage	07 72 33-02
Floor Joint Cover	07 95 13-01
Division 08 - Openings	
Door Head	08 11 00-01
Door Jamb	08 11 00-02
Door Head	08 11 00-05
EXT Door Jamb	08 11 00-06
Threshold Detail	08 11 00-07
Hatch Detail	08 31 00-01
OH Rolling Door Head	08 33 22-01
OH Rolling Door Jamb	08 33 22-02
Storefront Elevation	08 41 10-01
Storefront with Louver	08 41 10-02
Aluminum Window Head	08 51 13-01
Aluminum Window Jamb	08 51 13-02
Aluminum Window Sill	08 51 13-03
Louver Head	08 90 00-01
Louver Jamb	08 90 00-02
Louver Sill	08 90 00-03
Access Manway Detail	08 90 00-04
Access Hatch Detail	08 90 00-05
Gas Bonnet Detail	08 90 00-06
Louver at Existing Storefront	08 90 00-07
Division 09 - Finishes	
FRP Wall Panel Detail	09 77 61-01
Division 10 - Specialties	
Sign Detail	10 14 23-01
Sign Detail	10 14 23-02
Sign Detail	10 14 23-03
Handicap Signage	10 14 23-04
Warning Sign for Non-Potable Water	10 14 23-05
Typical Sign Mounting	10 14 23-06
Canopy Plan	10 73 16-01
Canopy Section	10 73 16-02
Division 11 - Equipment	
Safety Tie-Back	11 24 26-01
Division 22 - Plumbing	

City of Wenatchee	
WWTP Digester 4 Project	
PROJECT NO. 1810	
DRAWING TITLE	DETAIL NUMBER
Trapped Equipment Drain	22 20 00-01
Roof Drain	22 20 00-03
Floor Drain	22 20 00-04
Yard Hydrant YH-1	22 20 00-06
Yard Hydrant (YH-2)	22 20 00-09
Hose Bibb HB-1	22 20 00-11
Service Sink	22 20 00-12
Pressure Cleanout at Grade	22 20 00-13
Pressurized System Cleanout Above Grade	22 20 00-14
Gravity Cleanout	22 20 00-15
Outdoor Trench Drain	22 20 00-17
Division 23 - Heating, Ventilating, and Air-Conditioning (HVAC)	
Cast-In-Place Sleeve	23 31 00-01
Duct Transition	23 31 00-02
Combination Louver Damper/Filter	23 31 00-04
Splitter Damper	23 31 00-05
Square Throat 90° Elbow When Duct Sizes Unequal	23 31 00-07
Square Throat 90° Elbow When Duct Size Equal	23 31 00-08
Flexible Duct Connection	23 31 00-09
Filtered Air Intake	23 31 00-10
Gas Appliance Vent	23 80 00-01
Mechanical Equipment Roof Penetration	23 80 00-02
Division 26 - Electrical	
Modular Device Pedestal	26 05 00-01
Modular Equipment Rack	26 05 00-02
Modular Support Rack	26 05 00-03
Guardrail Mounted Device	26 05 00-06
Conduit Entrance Detail	26 05 00-07
Wall or Column Mounted Device	26 05 00-08
Type 'A' Handhole	26 05 00-10
Type 'B' Handhole	26 05 00-11
Handhole Plan	26 05 00-12
Conduit Handhole/Manhole Entrance	26 05 00-13
Termination of Shielded Control Cable	26 05 00-14
Gate and Fence Grounding	26 05 26-01
Column Ground Connection	26 05 26-02
Ground Electrode	26 05 26-03
Conduit Curb	26 05 33-01
Conduit Floor Sleeve	26 05 33-02
Motor Activated Valve Feed from Above	26 05 33-03
Typical Struct Installation	26 05 36-01
Strut Exploded View	26 05 36-02
Strut Mounting Detail	26 05 36-03
Conduit to Cable Tray	26 05 36-04
Concrete Encased Ductbank	26 05 43-02
Reinforced Concrete Encased Ductbank	26 05 43-03
Conduit Transition to Above Grade (Exterior)	26 05 43-04
Conduit Transition to Above Grade (Exterior to Interior)	26 05 43-05
Reinforced Concrete for Outdoor Electrical Equipment	26 05 43-06

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DRAWING TITLE	DETAIL NUMBER
Conduit Entry Thru Wall & Floor	26 06 00-01
Conduit Underground Entrance	26 06 00-02
Watertight Conduit Seal	26 06 00-03
Flush Conduit Stub	26 06 00-04
Hazardous Location Conduit Stub	26 06 00-05
Typical Heat Trace Connection Detail	26 06 00-06
Audio/Visual Alarm Detail	26 06 00-07
Division 31 - Earthwork	
Class B Trench Backfill	31 23 33-01
Class C Trench Backfill	31 23 33-02
Typical Pipe Embedment Dimensions	31 23 33-03
Typical Ductile Iron Pipe Embedment	31 23 33-04
Construction Entrance	31 23 33-05
Flexible Pipe Trench Section	31 23 33-06
Tree Protection Fence	31 25 00-03
Division 32 - Exterior Improvements	
Asphalt Pavement Detail	32 12 16-01
AC Pavement Overlay Transition	32 12 16-02
Pervious Paver Section	32 12 16-03
Lowered Curb	32 16 13-02
Maintenance Strip	32 16 13-05
Chain Link Fence	32 31 13-01
Division 33 - Utilities	
Precast Eccentric Manhole	33 05 16-01
Type III 72" Doghouse Manhole	33 05 16-01A
Access Cover	33 05 16-02
Manhole Tee Base Detail	33 05 16-04
Substructure Drain Cleanout	33 46 13-01
Substructure Drain	33 46 13-02
Roof Drain Cleanout	33 46 13-03
Division 40 - Process Interconnections	
Underslab Pipe Encasement Type 1	40 05 00-01
Underslab Pipe Encasement Type 2	40 05 00-02
Location of Flexible Connections	40 05 00-03
Gas Appliance Connection	40 05 00-04
Unit Heater	40 05 00-05
Thrust Block Detail	40 05 00-06
Harnessed Mechanical Coupling	40 05 00-07
Air Release Valves	40 05 00-08
Cooling Coil Drain Trap	40 05 00-09
Flushing Connection FC-1	40 05 00-10
Flushing Connection FC-2	40 05 00-11
Hose Flushing Connection	40 05 00-12
Typical Pipe Joint Locations at Pipeline Crossings	40 05 00-13
Thrust Tie for Flexible Coupling	40 05 00-14
Line Drain Valve Installation	40 05 00-15
FRP Drain	40 05 00-16
Ductile Iron Wall Pipe	40 05 00-17
Wall Pipe	40 05 00-18

City of Wenatchee
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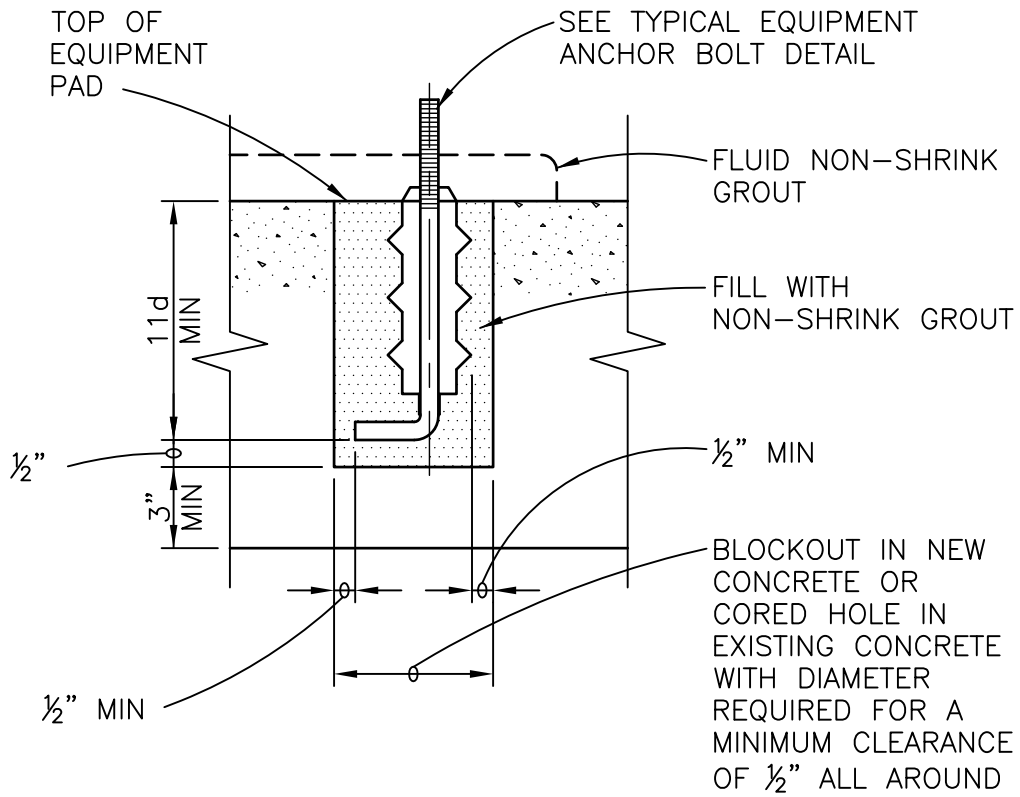
DRAWING TITLE	DETAIL NUMBER
Ductile Iron or Steel Wall Pipe in Existing Wall	40 05 00-19
Ductile Iron Wall Pipe in Existing Concrete Ceiling	40 05 00-20
Steel Wall Pipe	40 05 00-21
Wall Penetration Seal	40 05 00-22
Type 'A' Wall Penetration Seal	40 05 00-23
Type 'B' Pipe Sleeve	40 05 00-24
Modular Mechanical Seal	40 05 00-26
Modular Mechanical Seal	40 05 00-27
Floor Sleeve	40 05 00-28
Floor Sleeve	40 05 00-29
Floor Pipe Detail	40 05 00-30
Floor Sleeve	40 05 00-31
Wall Pipe - Small Diameter PVC Pipe	40 05 00-32
Wall Pipe - Large Diameter PVC Pipe	40 05 00-33
Wall Pipe - Large Diameter Ductile Iron or Steel Pipe	40 05 00-34
Flange Lug	40 05 00-35
Typical Thrust Tie Details for Steel Pipe - Single & Dual Couplings	40 05 00-43A
Restrained Flanged Coupling Adapter (FCA)	40 05 00-43B
PCCP/Steel Wall Thimble Connection	40 05 00-51
Buried Dip Wall Connection	40 05 00-52
Restrained Mechanical Joint to Flanged Joint	40 05 00-53
Vent Pipe Thru Wall	40 05 00-55
Concrete Pedestal Support	40 05 07-01
Concrete Pedestal Heavy Support	40 05 07-01A
Base Elbow Pedestal	40 05 07-02
Fabricated Steel Base Elbow	40 05 07-02A
Steel Elbow Support	40 05 07-02B
Medium Pipe Support	40 05 07-05
Heavy Duty Pipe Support	40 05 07-07
Surface Mount Modular Strut	40 05 07-08
CIP Modular Frame	40 05 07-09
One Hole Clamp	40 05 07-10
Flanged Pipe Support	40 05 07-11
Flanged Pipe Support	40 05 07-11A
Riser Pipe Support	40 05 07-12
Pipe Support Detail	40 05 07-13
Pipe Support Detail	40 05 07-14
Offset Pipe Support	40 05 07-15
Plastic Pipe Support	40 05 07-16
Plastic Pipe Support Channel Connection	40 05 07-16A
Modular Trapeze Hanger	40 05 07-17
Floor Pipe Support	40 05 07-18
Pipe Hanger Detail	40 05 07-20
Pipe Hanger Detail	40 05 07-21
Pipe Hanger Detail	40 05 07-22
Pipe Hanger Detail	40 05 07-23
Beam Clamp	40 05 07-24
Type 'A' Sway Brace Assembly	40 05 07-25
Type 'B' Pipe Sway Brace	40 05 07-26
Type 'C' Pipe Sway Brace	40 05 07-27

City of Wenatchee

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DRAWING TITLE	DETAIL NUMBER
Concrete Pipe Support	40 05 07-28
6" Air Duct Support	40 05 07-30
Pipe Support Type B Concrete Pier	40 05 07-30A
Pressure Reducing Station (PRS)	40 05 51-02
Buried Valve Box	40 05 51-04
Buried Valve Box with Tracer Wire	40 05 51-05
2-1/2" or Smaller Valve Box	40 05 51-06
Sample Valve	40 05 51-07
Air Relief Valve Installation	40 05 52-04
Valve Stem Extension	40 05 59-08
Wall Mounted Instrument Installation	40 91 10-01
Floor Mounted Pipe Stand for One Instrument	40 91 10-02
Floor Mounted Pipe Stand for Multiple Instruments	40 91 10-03
Stanchion Support for Case Mounted Instruments	40 91 10-04
TYP Handrail Mounting for Case Mounted Instruments	40 91 10-05
Equipment Support	40 91 10-06
Rain Hood Installation	40 91 10-07
Pressure Gauge/Pressure Switch Applications	40 91 10-16
Inline Primary Element Installation	40 91 10-17
Transmitter/Junction Box Mounting Detail	40 91 10-20
Wire Connection for Vertical & Horizontal Surfaces	40 91 10-23
Wire Color Code	40 91 10-25
Flexible Coupling with Corrosion Protection	40 91 10-27
Galvanic Anode Installation at Buried Metallic Fittings	40 91 10-28
Sludge/Scum Pressure Gage/Switch	40 91 10-31
Magnetic Flow Meter Grounding Ring Bonding	40 91 10-33
Shielded Control Cable Termination Dressing	40 91 10-34
Single Phase Control Station	40 91 10-35
Suspended Float Switch	40 91 10-37
Thermal Mass Flow Sensor	40 91 10-47
Diaphragm Seal	40 91 10-54

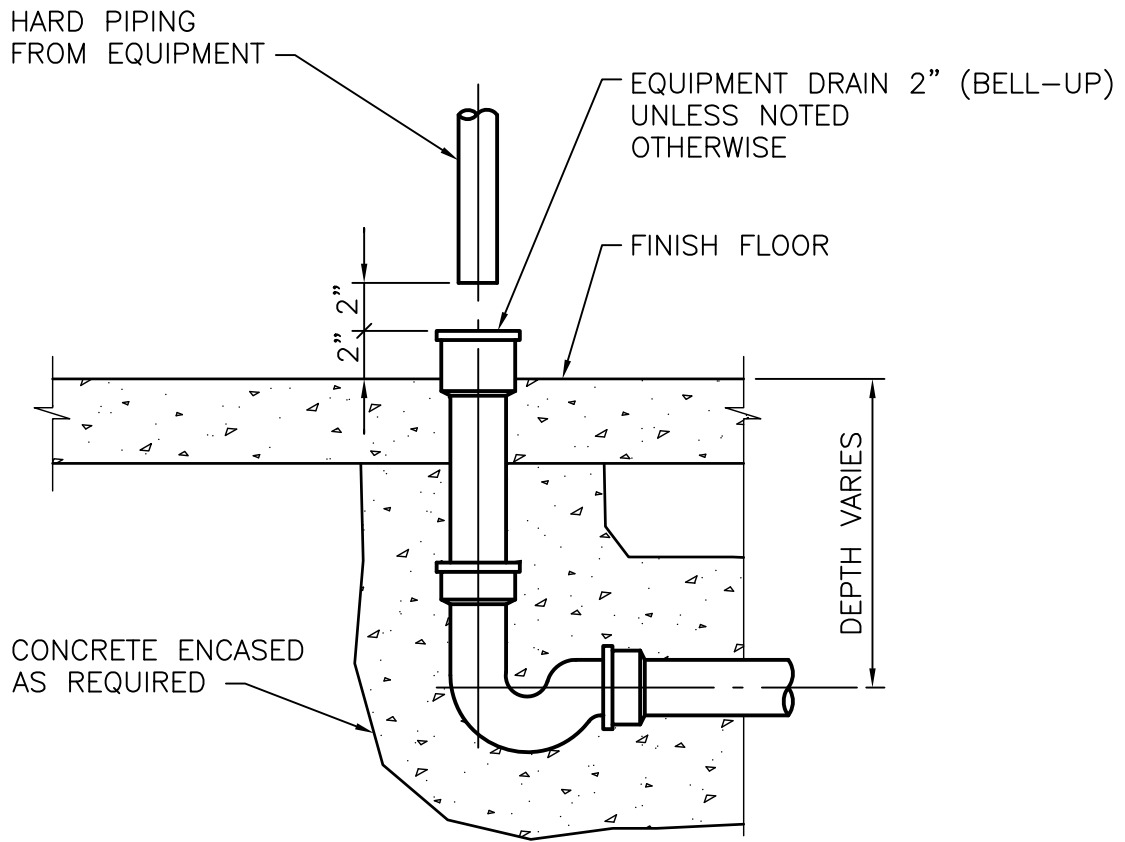


ANCHOR BOLT BLOCKOUT

NTS

01 61 03-08



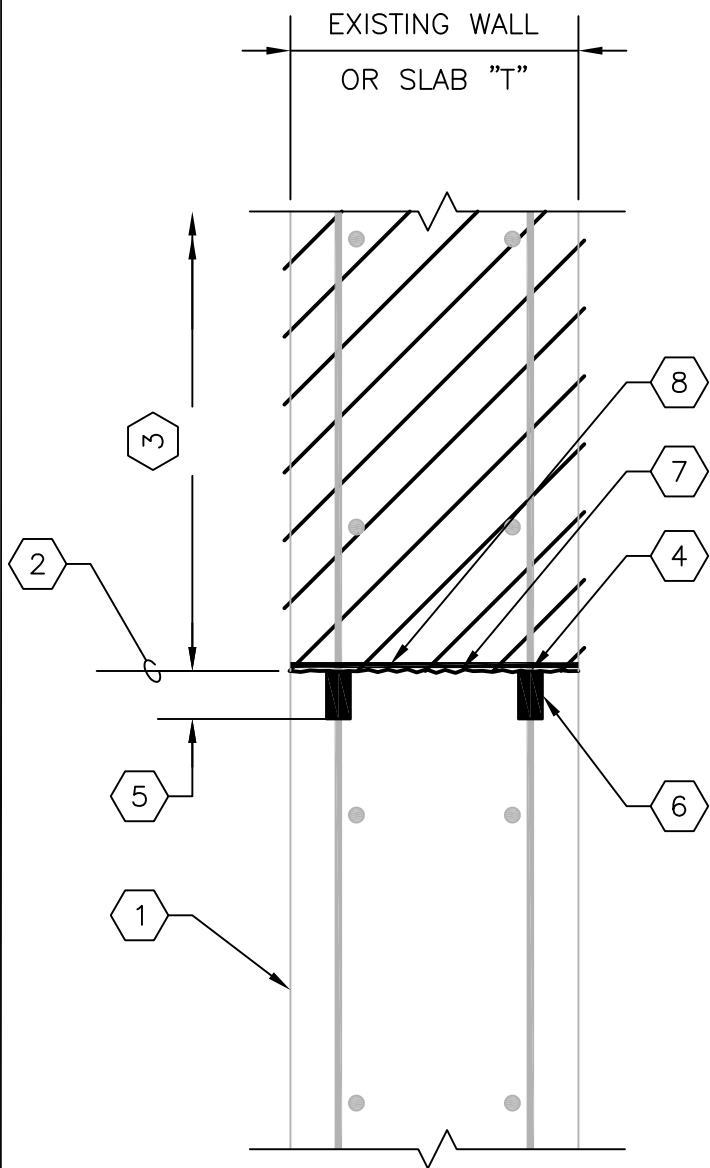


EQUIPMENT DRAIN BELL

NTS

01 61 03-09





KEY NOTES:

- 1 EXISTING CONCRETE WALL OR SLAB TO BE DEMOLISHED. SEE DEMO PLAN AND SECTIONS.
- 2 LINE OF SAWCUT. SEE DEMO PLAN AND/OR SECTIONS.
- 3 PORTION OF EXISTING WALL OR SLAB TO BE DEMOLISHED.
- 4 CUT ALL EXISTING REBAR FLUSH TO LINE OF SAWCUT.
- 5 DRILL EXPOSED ENDS OF EXISTING REBAR TO A DEPTH OF 2" MINIMUM BELOW THE LINE OF SAWCUT.
- 6 PATCH HOLES AT DRILLED ENDS OF EXISTING REBAR USING ANTI-CORROSION BONDING AGENT AND NON-SHRINK GROUT PER SPECIFICATIONS.
- 7 AFTER ALLOWING PATCHED HOLES TO COMPLETELY CURE PER THE MANUFACTURER'S RECOMMENDATIONS, ROUGHEN FACE OF SAWCUT AND APPLY ANTI-CORROSION BONDING AGENT TO ROUGHENED SURFACE. SEE SPECIFICATIONS.
- 8 COAT SURFACE WITH CEMENTITIOUS PROTECTIVE SLURRY MORTAR PER SPECIFICATIONS.

SAWCUT DETAIL

1 1/2" = 1'-0"

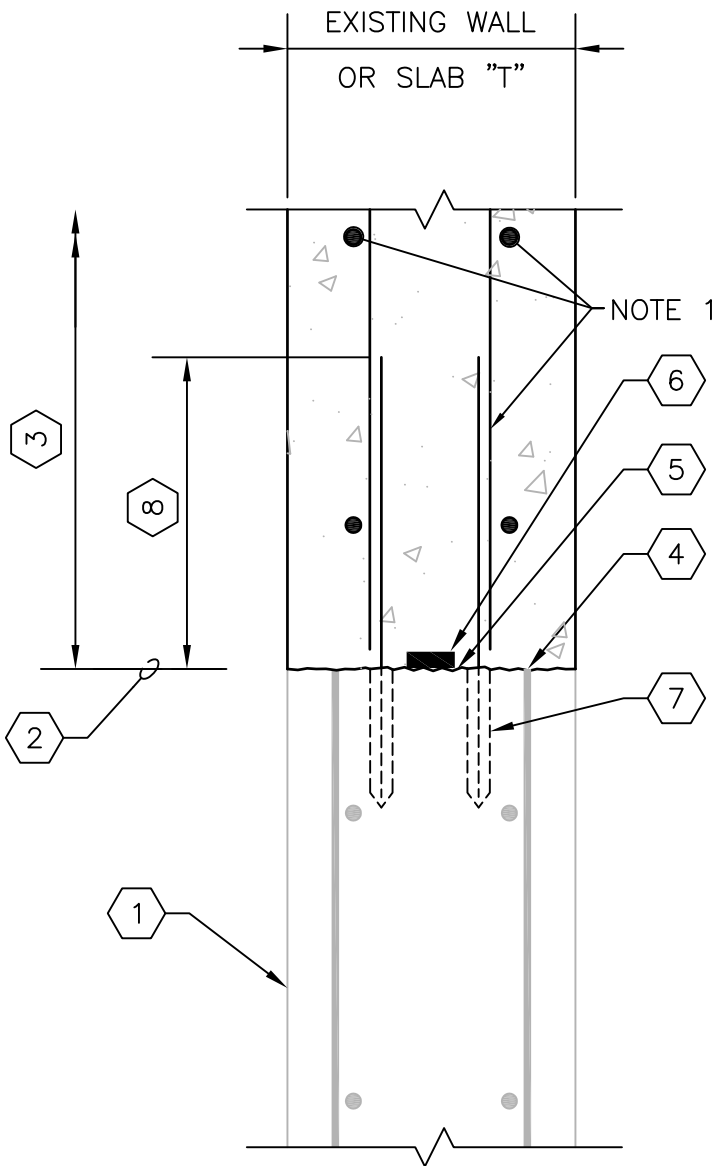
01 73 29-01

GENERAL NOTES:

1. SEE DRAWING FOR REINFORCING SIZE AND LOCATION.
2. SEE SPECIFICATION SECTION 31 23 00 FOR SUBGRADE PREPARATION AT SLABS ON GRADE TO BE DEMOLISHED AND PATCHED, UNLESS OTHERWISE NOTED ON DRAWING.

KEY NOTES:

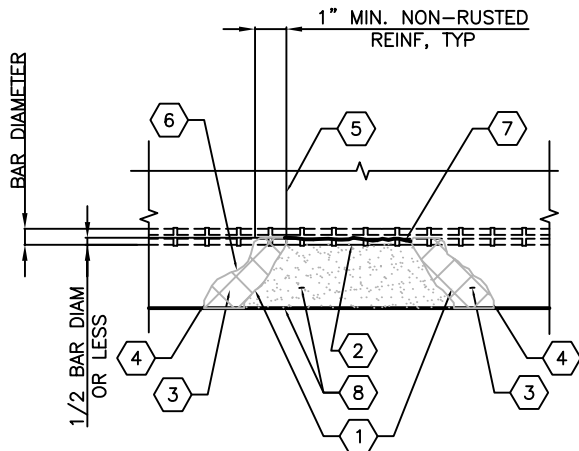
- 1 EXISTING CONCRETE WALL OR SLAB TO BE DEMOLISHED. SEE DEMO PLAN AND SECTIONS.
- 2 LINE OF SAWCUT. SEE DEMO PLAN AND/OR SECTIONS.
- 3 PORTION OF EXISTING WALL OR SLAB TO BE PATCHED.
- 4 CUT ALL EXISTING REINFORCING FLUSH TO LINE OF SAWCUT.
- 5 ROUGHEN FACE OF SAWCUT AND APPLY ANTI-CORROSION BONDING AGENT TO ENTIRE SURFACE. SEE SPECIFICATIONS.
- 6 PROVIDE PREFORMED STRIP TYPE WATER STOP ALL AROUND UNLESS OTHERWISE NOTED ON DRAWING. SEE SPECIFICATION SECTION 03 31 31.
- 7 ADHESIVE ANCHOR DOWELS PER 03 15 19-01. SEE GENERAL NOTE 1 FOR ADDITIONAL INFORMATION.
- 8 LAP LENGTH PER 03 21 00-01.



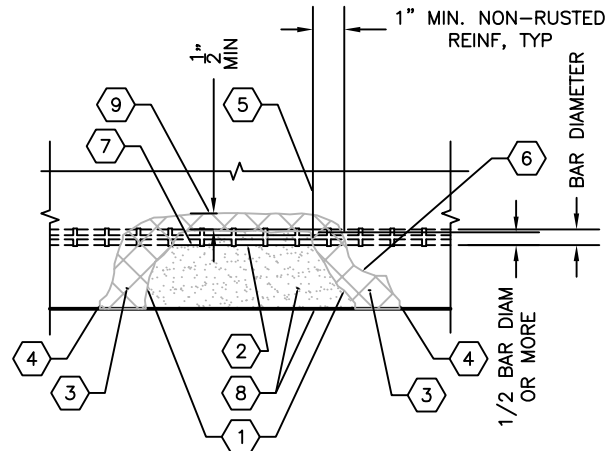
SAWCUT AND PATCH DETAIL

NTS

01 73 29-02



**NO EXPOSED REINFORCEMENT OR
EXPOSED REINFORCEMENT < 1/2 BAR DIAM**



EXPOSED REINFORCEMENT > 1/2 BAR DIAM



KEY NOTES:

- ① LINE OF SPALL IN EXISTING STRUCTURAL MEMBER.
- ② EXISTING EXPOSED AND RUSTED REINFORCEMENT.
- ③ CONCRETE REMOVED DURING SANDBLASTING.
- ④ 1/2" DEEP PERIMETER CUT TO ELIMINATE FEATHERED EDGES.
- ⑤ EDGE OF NON-RUSTED REINFORCEMENT.
- ⑥ LINE OF CONCRETE AFTER SANDBLASTING.
- ⑦ COAT EXPOSED REINFORCEMENT WITH ANTI-CORROSION BONDING AGENT. IF NO REINFORCEMENT IS EXPOSED APPLY BONDING AGENT PER NOTE C16 ON SHEET 000S01.
- ⑧ PATCH VOID WITH CEMENTITIOUS POLYMER MODIFIED PATCH TO SMOOTH SURFACE.
- ⑨ GOUGE CONCRETE TO A DEPTH > 1/2" DEEPER THAN DEPTH TO BACK OF REINFORCEMENT.

REPAIR NOTES:

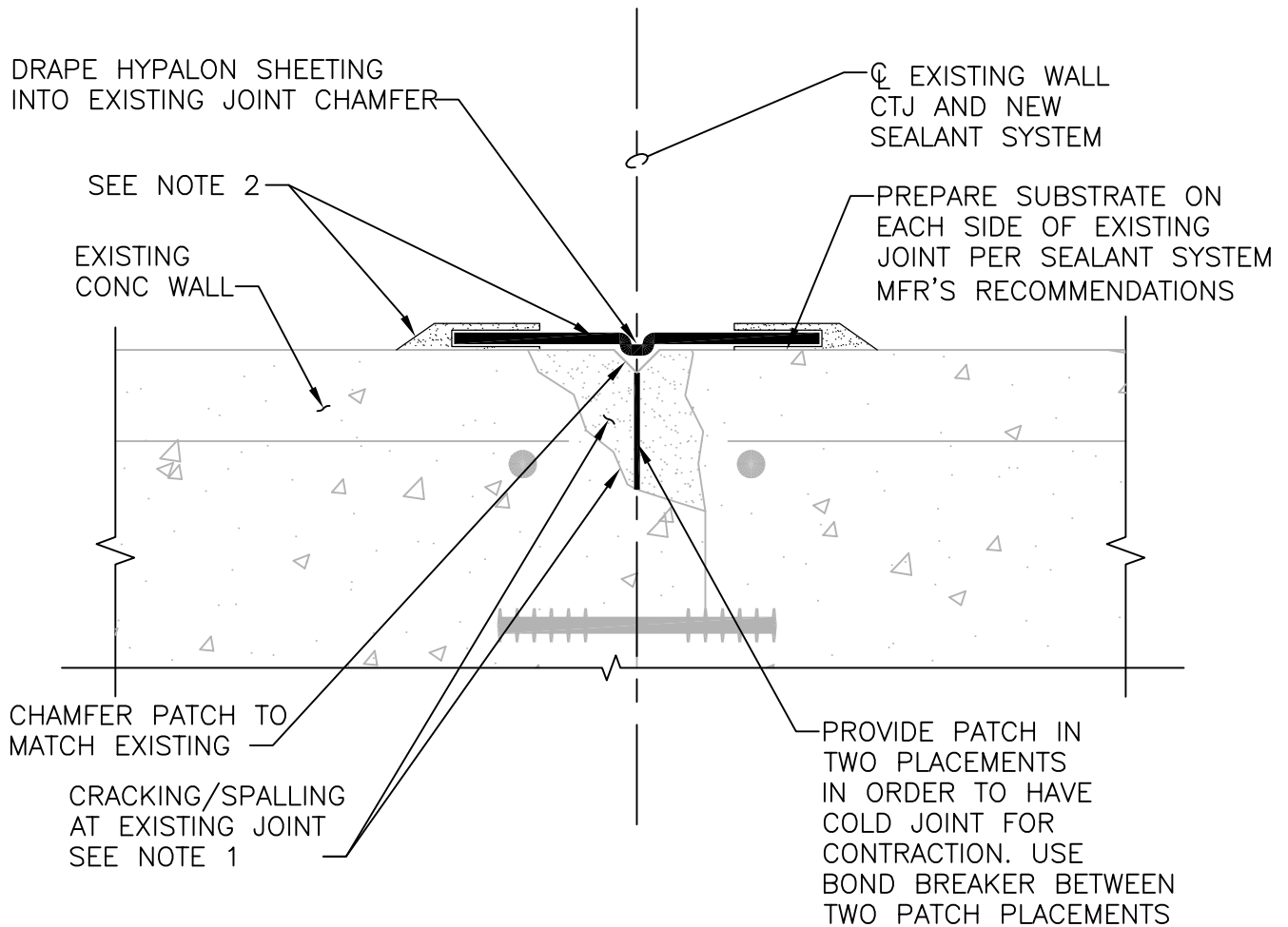
1. IF THERE IS NO EXPOSED REINFORCEMENT IN THE SPALLED AREA, THEN SANDBLAST THE SURFACE OF SPALLED AREA TO REMOVE LOOSE MATERIAL AND EXPOSE A CLEAN SURFACE FOR THE PATCH MATERIAL.
 - A. IF NO REINFORCEMENT IS EXPOSED AFTER SANDBLASTING, THEN USE THE REPAIR SHOWN IN SECTION 1A DISREGARDING KEY NOTES 2 AND 5.
 - B. IF REINFORCEMENT IS EXPOSED AFTER SANDBLASTING, THEN USE THE REPAIR DESCRIBED IN NOTE 2 BELOW.
2. IF THERE IS EXPOSED REINFORCEMENT IN THE SPALLED AREA, SANDBLAST AND GOUGE CONCRETE TO REVEAL NON-RUSTED REINFORCEMENT A MINIMUM OF 1 INCH BEYOND ORIGINAL EXTENT OF CORROSION.
 - A. IF THE DEPTH OF CONCRETE REMOVED DURING SANDBLASTING RESULTS IN LESS THAN 1/2 BAR DIAMETER BEING EXPOSED, THEN SEE SECTION 1A.
 - B. IF THE DEPTH OF CONCRETE REMOVED DURING SANDBLASTING RESULTS IN MORE THAN 1/2 BAR DIAMETER BEING EXPOSED, THEN SEE SECTION 1B.

REPAIR DETAIL AT CONCRETE SPALL AND AT EXPOSED AND RUSTED REINF.

NOT TO SCALE

03 01 37-01





NOTES:

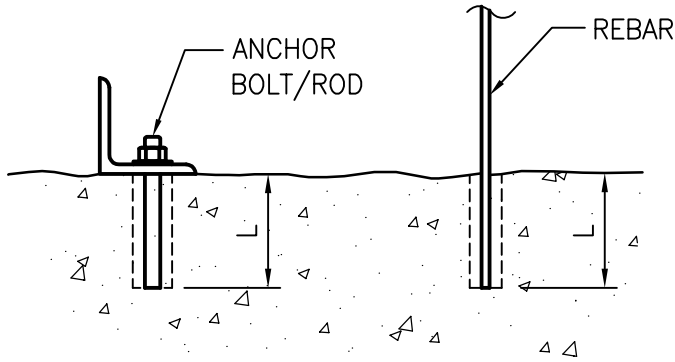
1. IF THERE IS SPALLING CONCRETE ADJACENT TO THE EXISTING JOINT, REMOVE ANY LOOSE OR FRIABLE MATERIAL AND REPAIR CONCRETE SPALL IN ACCORDANCE WITH SPECIFICATION SECTION 03 01 37. IF CRACKS ARE PRESENT ADJACENT TO THE EXISTING JOINT, THEN THE SEALANT SYSTEM SHALL COVER EXISTING JOINT WIDTH AND EXTEND BEYOND THE LIMITS OF CRACKS THAT MAY EXIST ADJACENT TO THE EXISTING JOINT. CRACKS SHOWN IN THIS DETAIL ARE REPRESENTATIVE OF A POSSIBLE CRACK PATTERN AND ARE SHOWN TO DEPICT INTENT ONLY, WHICH IS TO PLACE THE SEALANT SYSTEM ACROSS ALL CRACKS WHICH HAVE SHORT-CIRCUITED TO THE SURFACE FROM WITHIN THE WALL AT THE JOINT. CONTACT ENGINEER IF 8" WIDE HYPALON SHEETING IS NOT SUFFICIENT FOR FULL COVERAGE.
2. EPOXY RESIN ADHESIVE FLEXIBLE SEALANT SYSTEM SHALL BE SIKADUR COMBIFLEX SYSTEM WITH 8" WIDE BY 40 MIL THICK HYPALON SHEETING OR APPROVED EQUAL. INSTALL SEALANT SYSTEM OVER EXISTING JOINT IN ACCORDANCE WITH THE REQUIREMENTS OF THIS DETAIL, SPECIFICATION SECTION 03 01 37, AND THE MANUFACTURER'S RECOMMENDATIONS.
3. THE FLEXIBLE SEALANT SYSTEM SHALL TERMINATE 12" FROM THE TOP OF THE EXISTING WALL AND SHALL EXTEND A MINIMUM OF 12" ONTO THE EXISTING BOTTOM SLAB.
4. TAKE CARE NOT TO ALLOW THE TWO SIDES OF THE CONTRACTION JOINT TO BOND TOGETHER.

SEALANT SYSTEM AT EXIST WALL CTJ

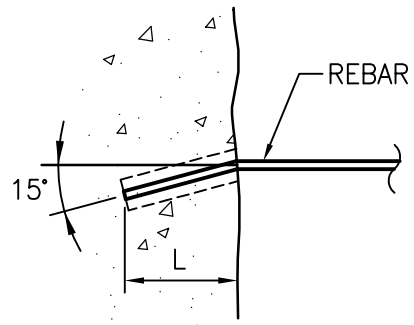
03 01 37-02

NTS

HDR



**VERTICAL
APPLICATION**



**HORIZONTAL
APPLICATION**

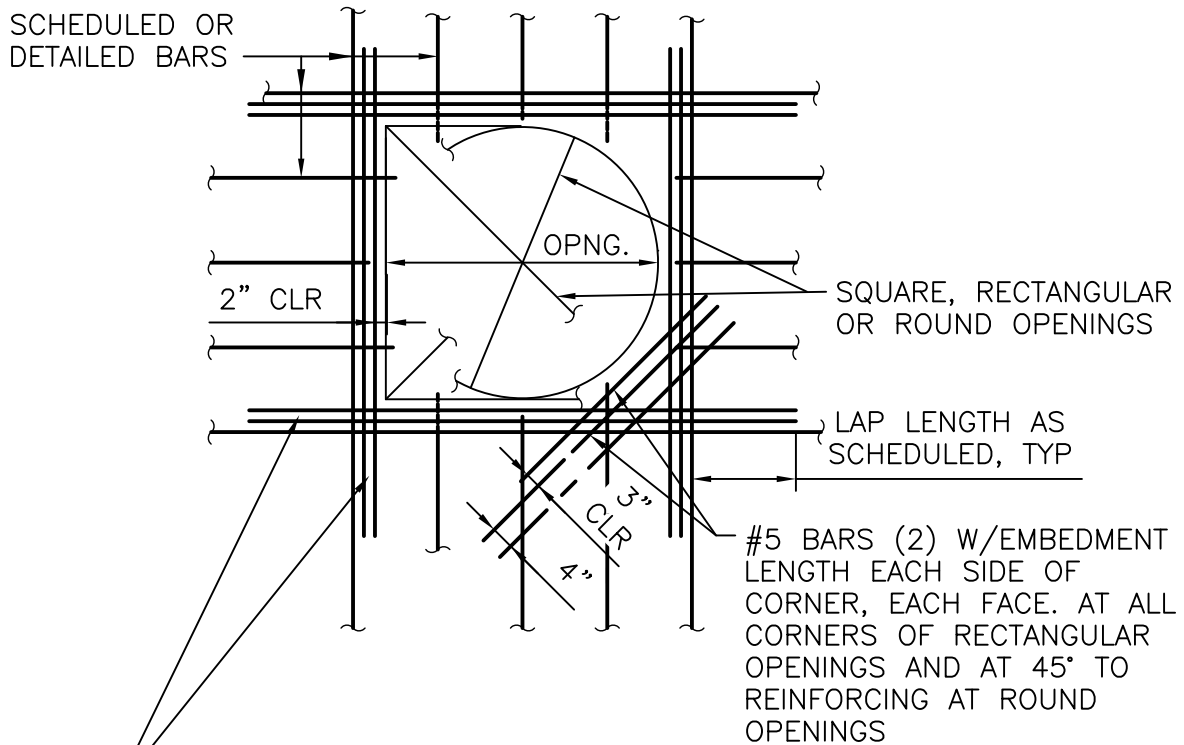
ADHESIVE ANCHOR SCHEDULE			
REINFORCING BARS		ANCHOR BOLTS/RODS	
BAR SIZE	EMBED LENGTH (L)	DIA (IN)	EMBED LENGTH (L)
#3	4"	3/8"	5"
#4	5"	1/2"	6"
#5	6"	5/8"	7"
#6	7"	3/4"	8"
#7	8"	7/8"	9"
#8	9"	1"	10"
#9	10"		
#10	12"		

- NOTES:
1. ADHESIVE TYPE IS SUBJECT TO APPROVAL OF THE ENGINEER OF RECORD.
 2. EMBEDMENT LENGTHS SHOWN ARE MINIMUM. PROVIDE MANUFACTURER'S RECOMMENDATIONS FOR INSTALLATION.
 3. FOR ADDITIONAL REQUIREMENTS, SEE SPECIFICATION SECTION 03 15 19.

**ADHESIVE ANCHOR
DETAILS & SCHEDULE**

NOT TO SCALE

03 15 19-01



EXTRA BARS EACH FACE AT 4 SIDES OF OPENING EQUAL TO NUMBER AND SIZE OF BARS DISCONTINUED AT OPENING. WHERE ODD NUMBER OF BARS ARE DISCONTINUED PROVIDE $(\text{ODD NUMBER} + 1)/2$ BARS ON EACH SIDE OF OPENING

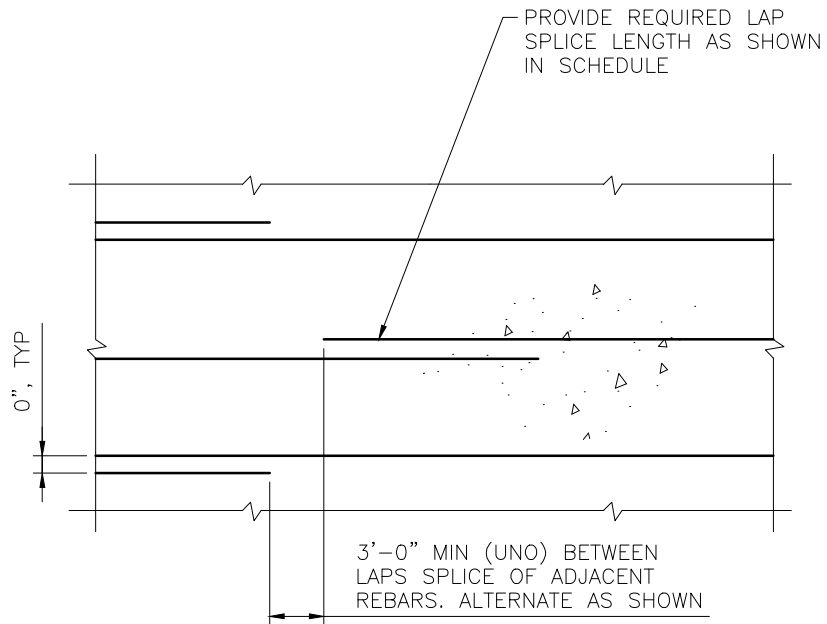
NOTES:

1. UNLESS SHOWN OTHERWISE ON DRAWINGS, PROVIDE EXTRA BARS AROUND OPENINGS IN WALLS, FLOORS, AND ROOFS AS SHOWN.
2. EVERY BAR DISCONTINUED AT AN OPENING SHALL BE REPLACED IN KIND BY ONE EXTRA BAR PLACED AT ONE SIDE OF THE OPENING AS SHOWN ABOVE.
3. FOR OPENINGS 8" OR LESS IN SLABS AND WALLS, NO EXTRA BARS ARE REQUIRED UNLESS OTHERWISE NOTED. SCHEDULED REBARS SHALL BE RESPACED (NOT CUT) TO ALLOW FOR UNIMPAIRED OPENINGS.

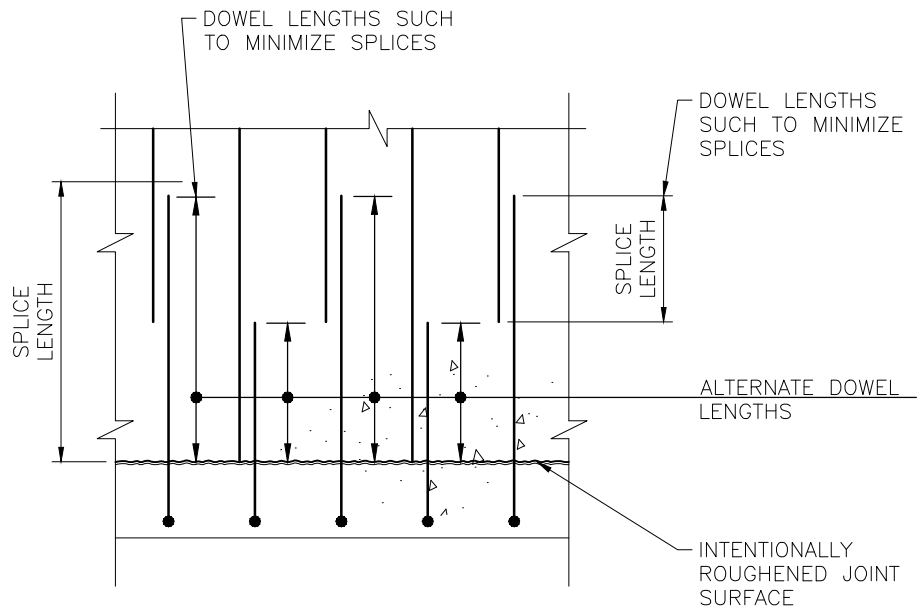
REINFORCING AT OPENINGS

NTS

03 21 00-01



SLABS & WALLS



WALL DOWELS

NOTE:

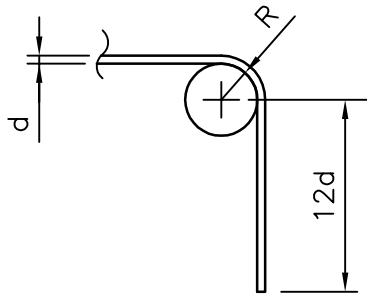
1. APPLIES TO SLABS, WALLS (BOTH HORIZONTAL AND VERTICAL)

REINFORCING SPLICE STAGGER

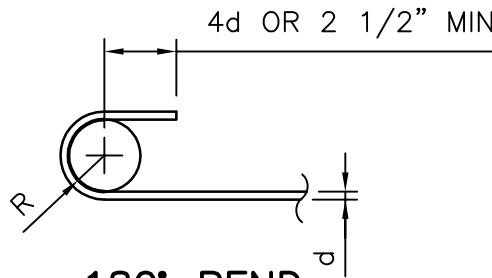
NTS

03 21 00-02

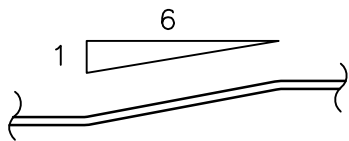




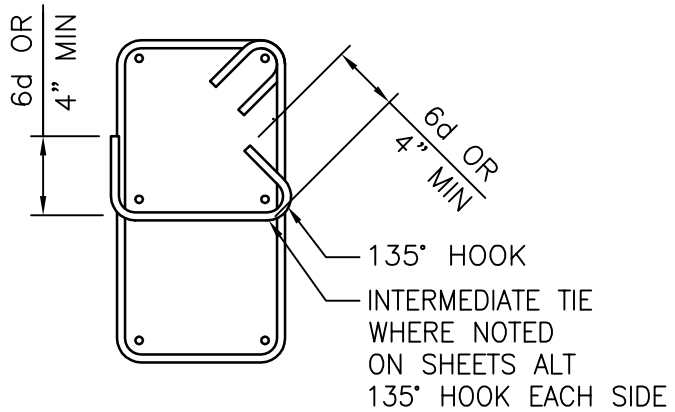
90° BEND



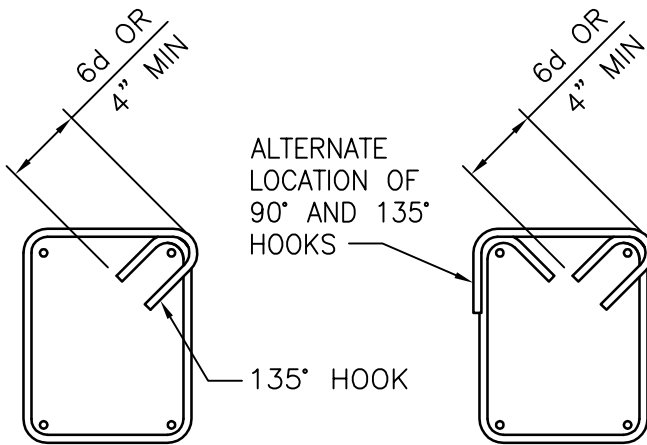
180° BEND



MAX OFFSET BEND



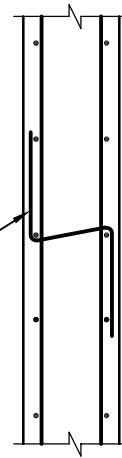
TYP. COLUMN TIE OR CLOSED STIRRUP



TYP HOOP

TYP STIRRUP

Z-BAR SPACERS @ 8'-0" OC EACH DIRECTION. MINIMUM ONE ROW. FABRICATE FROM #2 OR HEAVIER BARS. TIE TO OUTSIDE LAYER OF REINFORCING



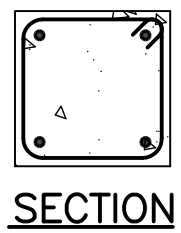
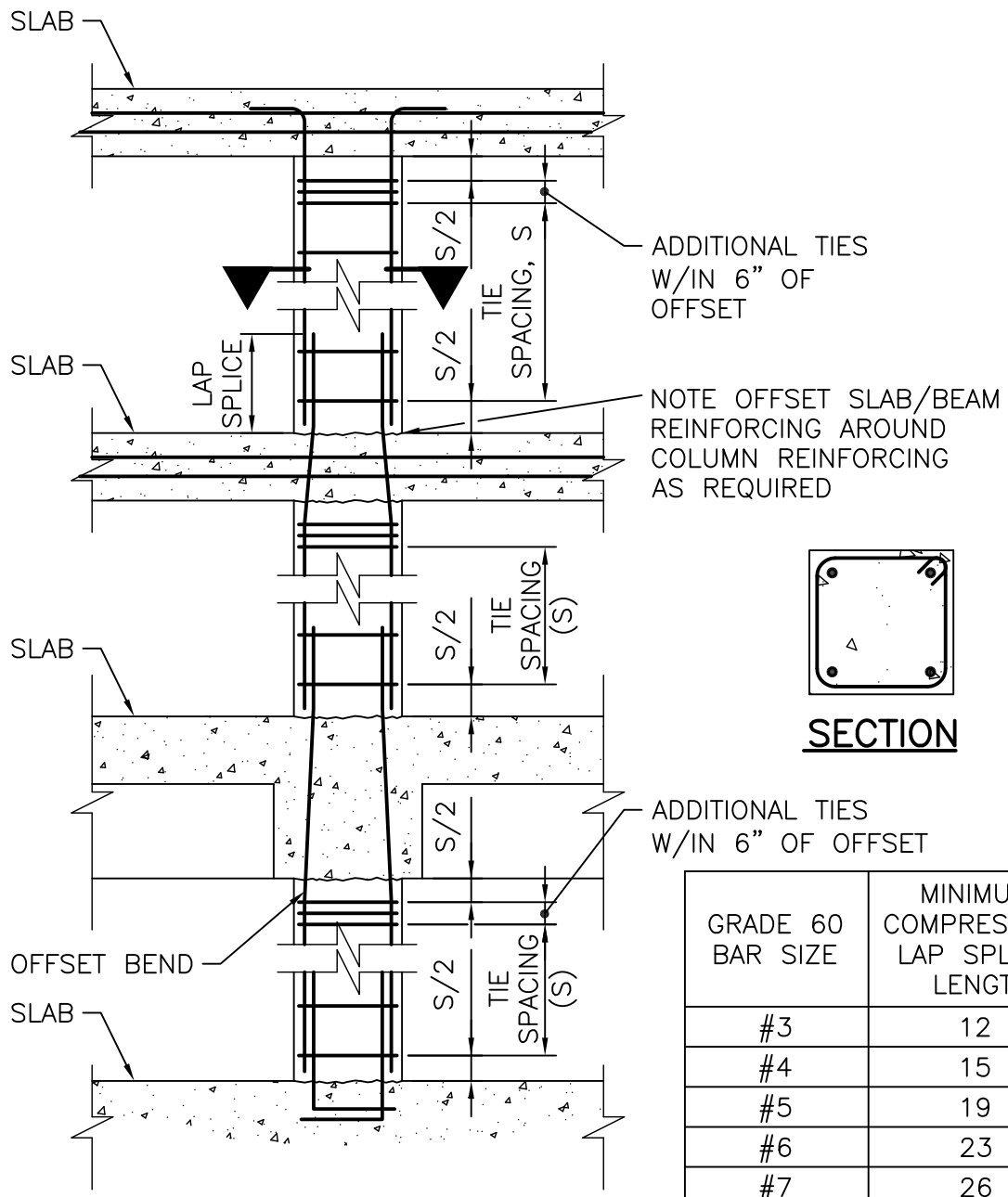
SPACER FOR WALL REINFORCEMENT

BAR SIZE	R
#3-#8	3d
#9-#11	4d
#14-#18	5d

TYPICAL STIRRUPS & TIES

NOT TO SCALE

03 21 00-03



ADDITIONAL TIES
W/IN 6" OF OFFSET

GRADE 60 BAR SIZE	MINIMUM * COMPRESSION LAP SPLICE LENGTH
#3	12
#4	15
#5	19
#6	23
#7	26
#8	30
#9	34
#10	38
#11	42

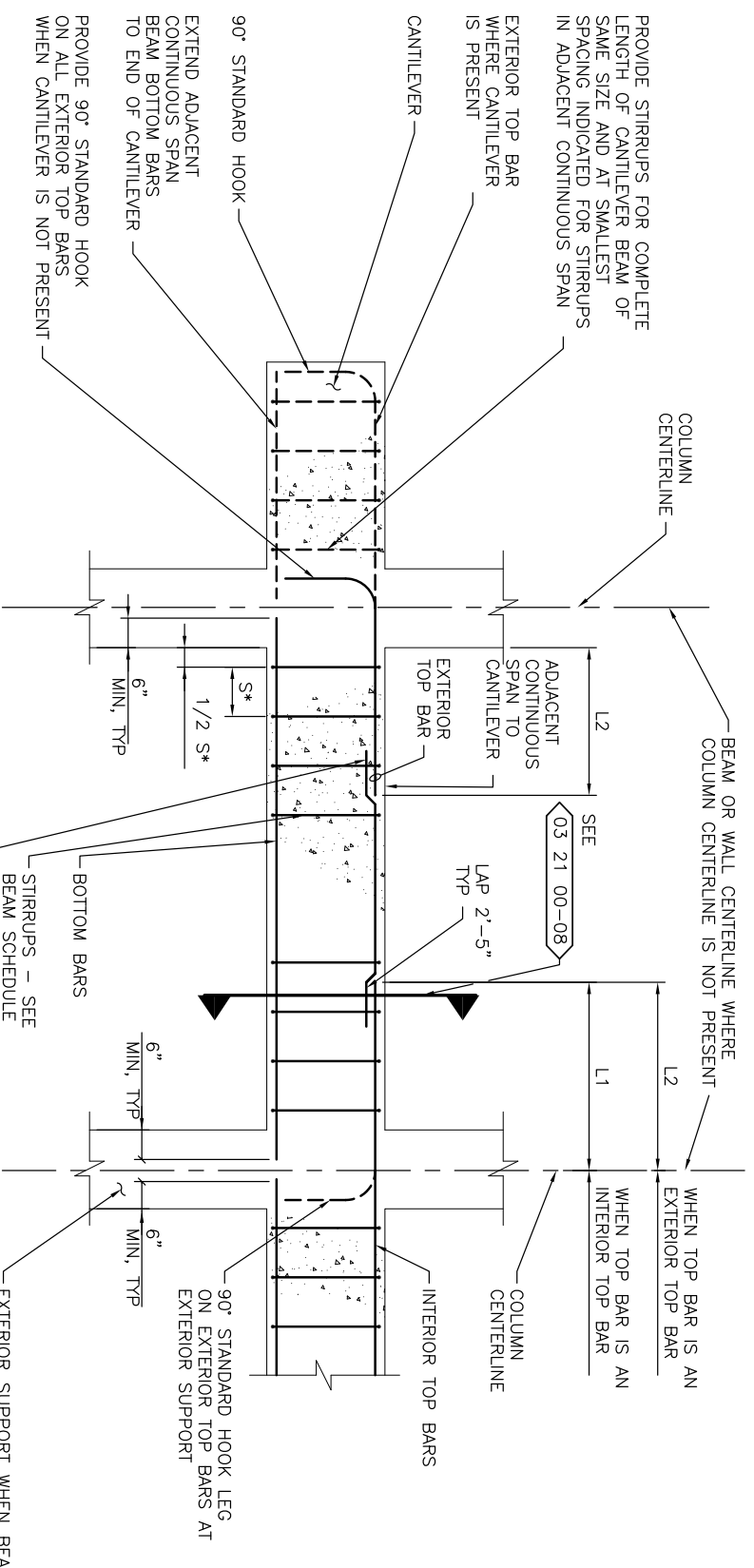
* BASED ON $f'_c=4000$; MAY BE REDUCED PER ACI 318

COLUMN SPLICES & TIES

NTS

03 21 00-06





PROVIDE STIRRUPS FOR COMPLETE LENGTH OF CANTILEVER BEAM OF SAME SIZE AND AT SMALLEST SPACING INDICATED FOR STIRRUPS IN ADJACENT CONTINUOUS SPAN

EXTERIOR TOP BAR WHERE CANTILEVER IS PRESENT

CANTILEVER

90° STANDARD HOOK

EXTEND ADJACENT CONTINUOUS SPAN BEAM BOTTOM BARS TO END OF CANTILEVER

PROVIDE 90° STANDARD HOOK ON ALL EXTERIOR TOP BARS WHEN CANTILEVER IS NOT PRESENT

COLUMN CENTERLINE

BEAM OR WALL CENTERLINE WHERE COLUMN CENTERLINE IS NOT PRESENT

L2
ADJACENT CONTINUOUS SPAN TO CANTILEVER
EXTERIOR TOP BAR

SEE
03 21 00-08

LAP 2'-5" TYP

L2

L1

WHEN TOP BAR IS AN EXTERIOR TOP BAR

COLUMN CENTERLINE

INTERIOR TOP BARS

90° STANDARD HOOK LEG ON EXTERIOR TOP BARS AT EXTERIOR SUPPORT

6" MIN, TYP

6" MIN, TYP

BOTTOM BARS
STIRRUPS — SEE BEAM SCHEDULE

PROVIDE 2 #4 STIRRUPS SUPPORT BARS WHEN TOP BARS ARE DISCONTINUOUS

EXTERIOR SUPPORT WHEN BEAM IS DISCONTINUOUS AT RIGHT SUPPORT (AS VIEWED FROM BOTTOM OR RIGHT HAND SIDE OF SHEET). AT EXTERIOR SUPPORT, TOP BARS ARE LISTED IN SCHEDULES AS EXTERIOR TOP BARS WITH 90° STANDARD HOOK LEG

* S = FIRST STIRRUP SPACING INDICATED IN BEAM SCHEDULE.

* PROVIDE ONE ADDITIONAL STIRRUP IN ALL BEAMS LOCATED AT 1/2 S FROM FACE OF SUPPORT. ADDITIONAL STIRRUP TO BE OF SAME SIZE AS SCHEDULED STIRRUPS.

* — APPLIES FOR ALL BEAMS.

TYPICAL BEAM REINFORCING

NTS

EDITOR NOTE:

1. THIS DETAIL IS TO BE USED WITH

03 21 00-08

03 21 00-07



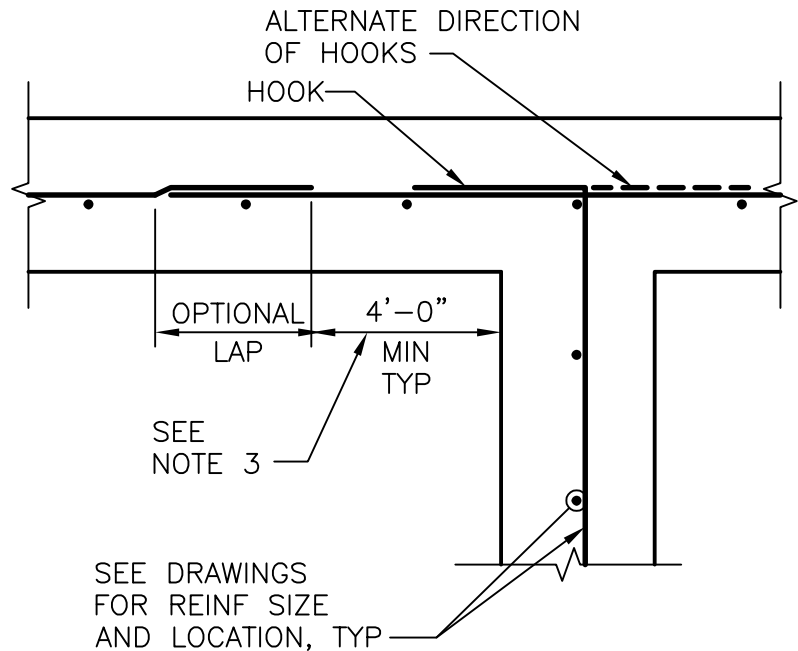
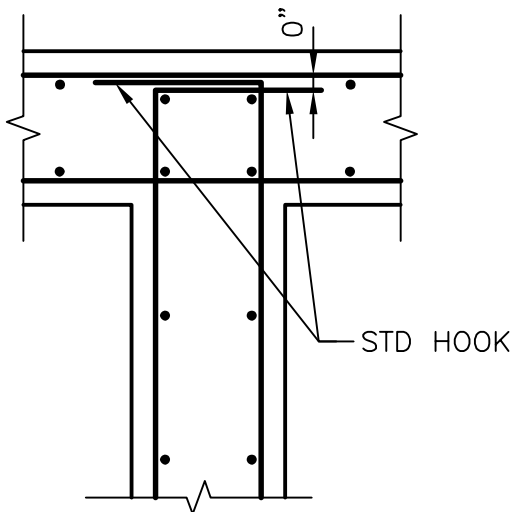
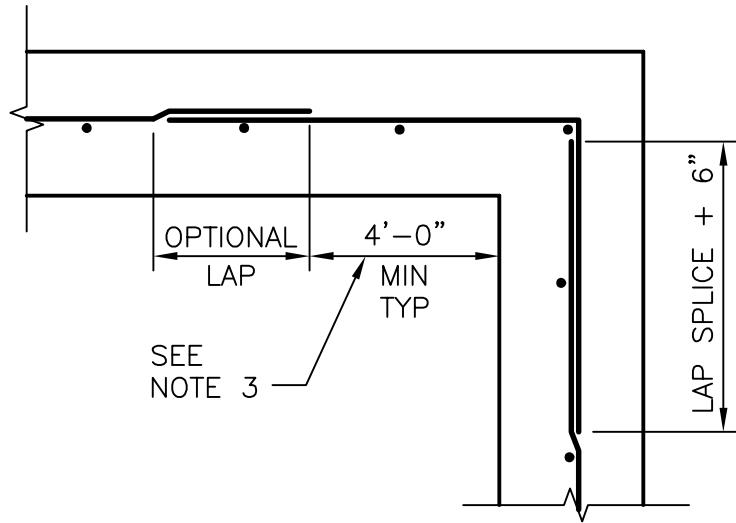
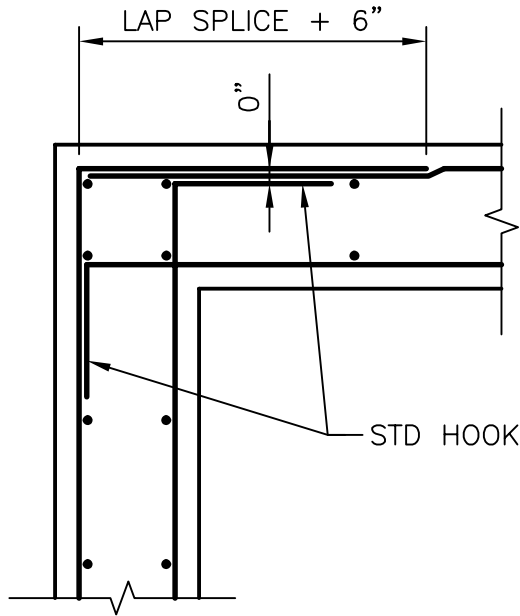
NOTES:

1. THESE NOTES APPLY TO STANDARD DETAIL 03 21 00-07 ON PREVIOUS PAGE.
2. PROVIDE ADDITIONAL REINFORCING THE SAME SIZE AS DISCONTINUOUS REINFORCEMENT AT OPENING. QUANTITY OF REINFORCING IN EACH DIRECTION SHALL BE EQUAL TO OR ONE GREATER THAN THE NUMBER OF DISCONTINUOUS BARS. PLACE 1/2 OF ADDITIONAL REINFORCING BARS EACH SIDE OF OPENING, PLACE ADDITIONAL REINFORCEMENT AT 3" OC (TYPICAL BOTH DIRECTIONS AND ALL LAYERS OF REINFORCEMENT). START FIRST BAR 2" CLEAR TO OPENING. PLACE ADDITIONAL REINFORCING IN SAME PLANES AS INTERRUPTED TYPICAL REINFORCING.
3. EXTEND ADDITIONAL REINFORCING BEYOND EDGE OF OPENING AS SHOWN ABOVE. ADDITIONAL BARS MAY TERMINATE AT THE END OF THE WALL WITH A STANDARD HOOK WHERE THE LENGTH OF THE WALL WILL NOT PERMIT BARS TO EXTEND AS SHOWN ABOVE.
4. TYPICAL WALL OR SLAB REINFORCING NOT SHOWN FOR CLARITY. TERMINATE TYPICAL REINFORCING 2" CLEAR TO OPENING.
5. DETAIL 03 21 00-07 SHALL BE USED WHENEVER THE OPENING IS LARGER THAN THE REINFORCING SPACING.
6. UNLESS SHOWN OTHERWISE ON DRAWINGS, PROVIDE EXTRA REINFORCING AROUND OPENINGS AS SHOWN AND INDICATED ABOVE.
7. PROVIDE ADDITIONAL DOWELS PER NOTE 2 ABOVE FOR ALL OPENINGS NEAR THE FLOOR SLAB, BASE SLAB, OR CORNERS.

**NOTES FOR EXTRA REINFORCING
AROUND OPENINGS**

NOT TO SCALE

03 21 00-07A



NOTES:

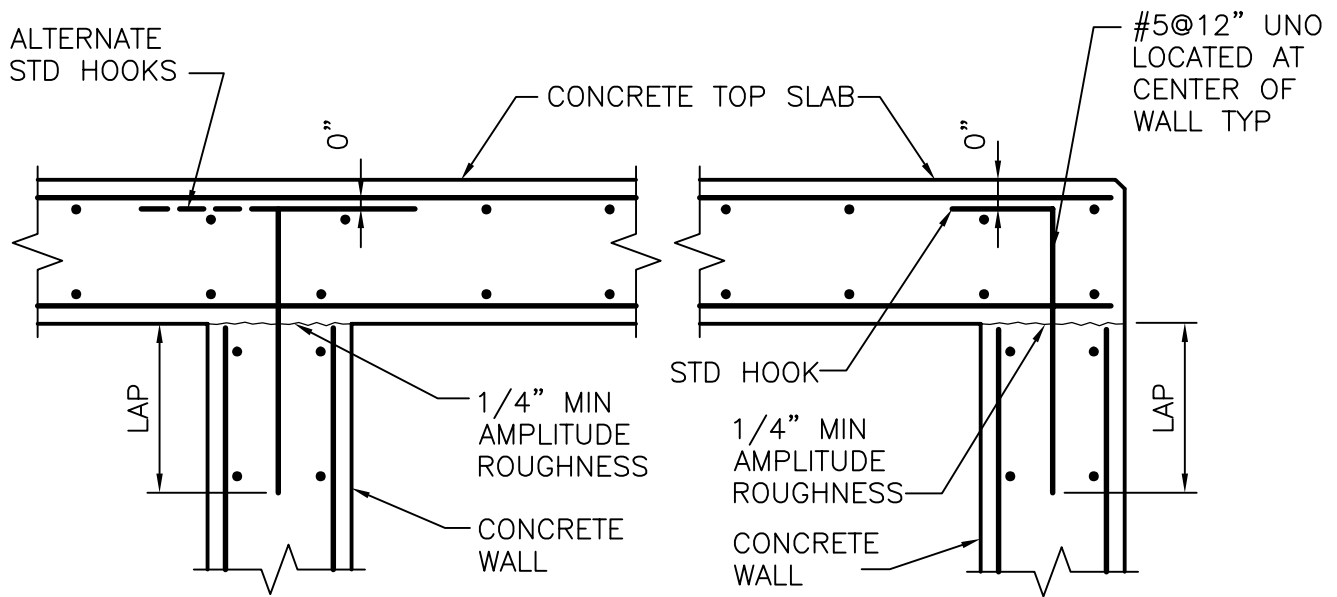
1. ALL HOOKS SHALL BE STD 90 DEGREE HOOKS.
2. SEE DRAWINGS FOR ADDITIONAL HORIZONTAL BARS. STAGGER BETWEEN TYPICAL REINF SPACING, EXTEND TO 1/5 OF DISTANCE TO NEAREST ADJACENT WALL IN EACH DIRECTION, UNO.
3. OPTIONAL LAP LOCATION. APPLIES TO BOTH DOUBLE AND SINGLE LAYER CONDITIONS TYP. OPTIONAL LAPS SHOWN ARE FOR HORIZ REINF ONLY.
4. SEE DRAWINGS FOR POSITION OF VERTICAL REINF VERSUS HORIZONTAL REINFORCING. THE CASE SHOWN IS MOST COMMONLY USED FOR WALL TO SLAB CONNECTIONS SHOWN IN SECTION VIEW. SPECIFIC DWGS CONTROL.

REINFORCEMENT AT CORNERS AND INTERSECTIONS

NOT TO SCALE

03 21 00-11





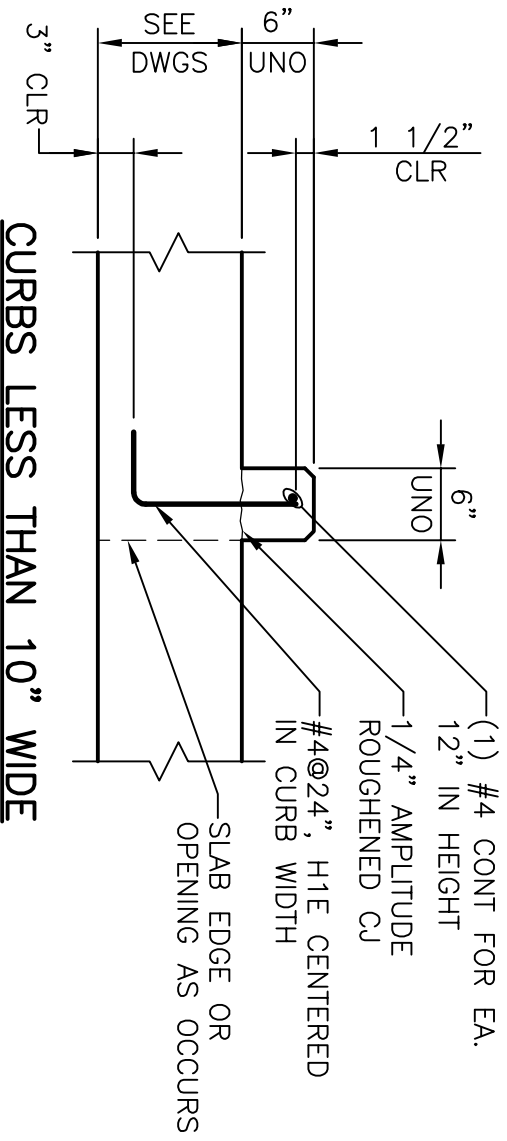
NOTE:

1. ALL HOOKS SHALL BE STD 90 DEGREE HOOKS.

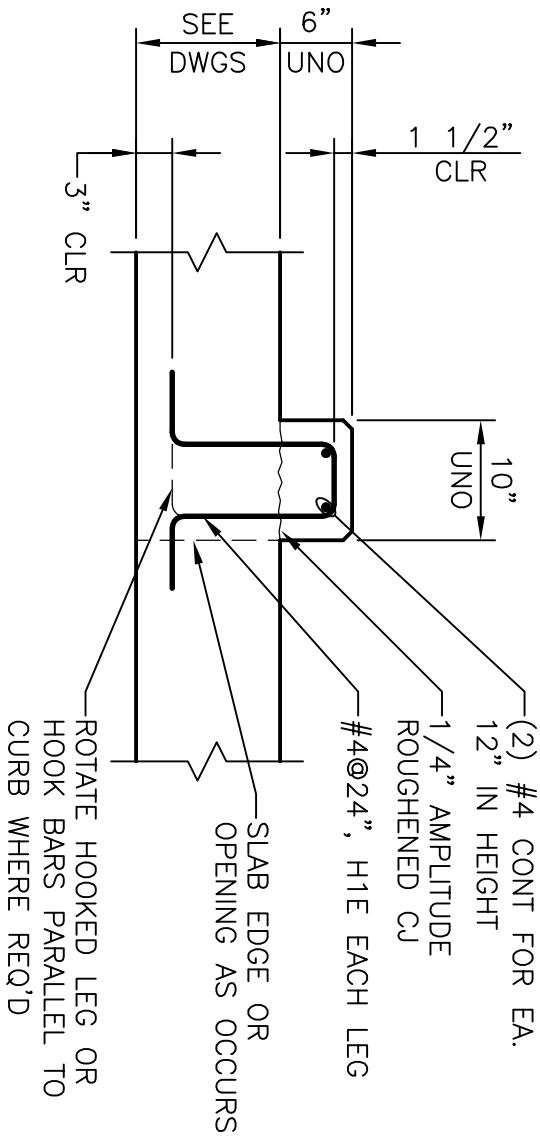
HINGED TOP SLAB TO WALL

NOT TO SCALE

03 21 00-12



CURBS LESS THAN 10" WIDE

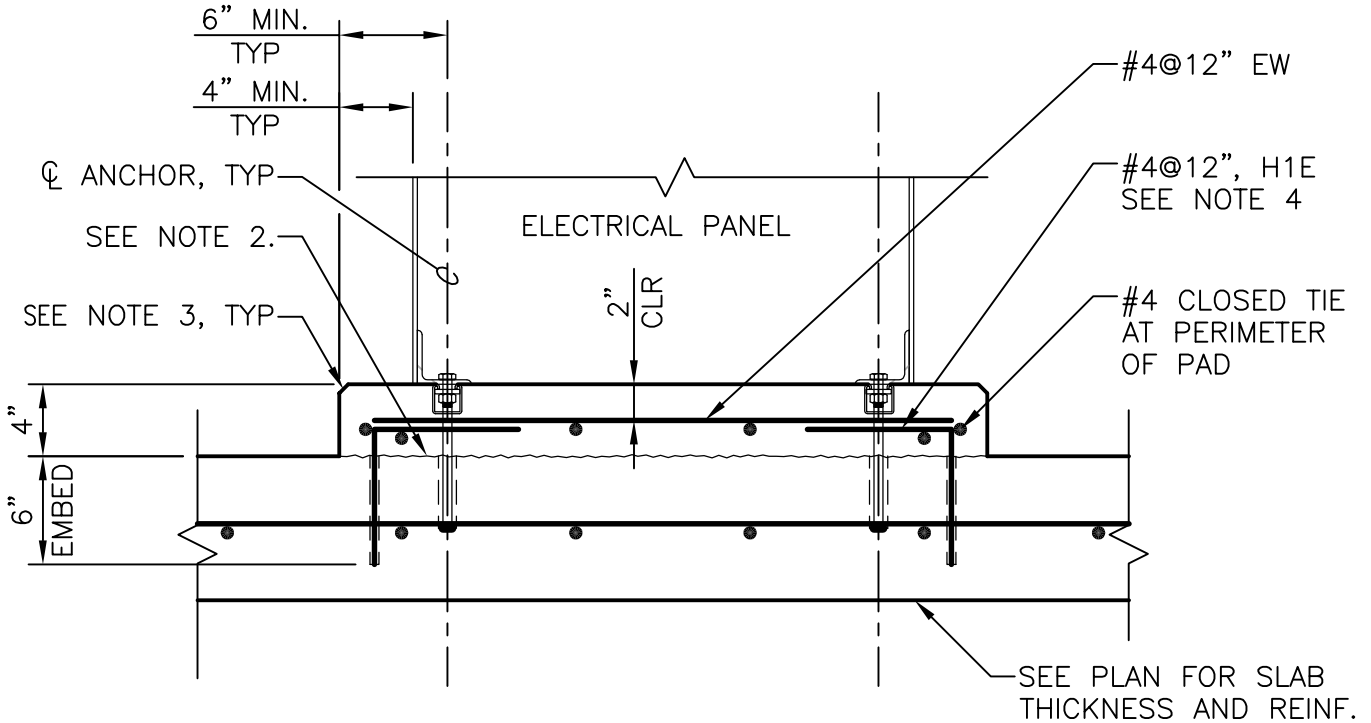


CURBS 10" WIDE & WIDER

CONCRETE CURB

NOT TO SCALE

03 21 00-15



NOTES:

1. FOR ADDITIONAL INFORMATION, SEE ELECTRICAL DETAILS.
2. CONCRETE SURFACE SHALL BE CLEAN, FREE OF LAITANCE, ROUGHENED TO 1/4" AMPLITUDE, AND COATED WITH A BONDING AGENT PRIOR TO CASTING CONCRETE PAD.
3. PROVIDE A 3/4" CHAMFER ON EDGE OF PAD, TYPICAL 4 SIDES.
4. DRILL AND ADHESIVE ANCHOR DOWELS INTO CONCRETE SLAB PER 03 15 19-01 SPECIAL INSPECTION IS REQUIRED DURING INSTALLATION OF DOWELS. SEE SPECIFICATION SECTION 03 15 19 FOR ADDITIONAL REQUIREMENTS.
5. COORDINATE SIZE OF PAD AND NUMBER, SIZE, AND SPACING OF ANCHORS WITH EQUIPMENT MANUFACTURER PRIOR TO CONSTRUCTION.

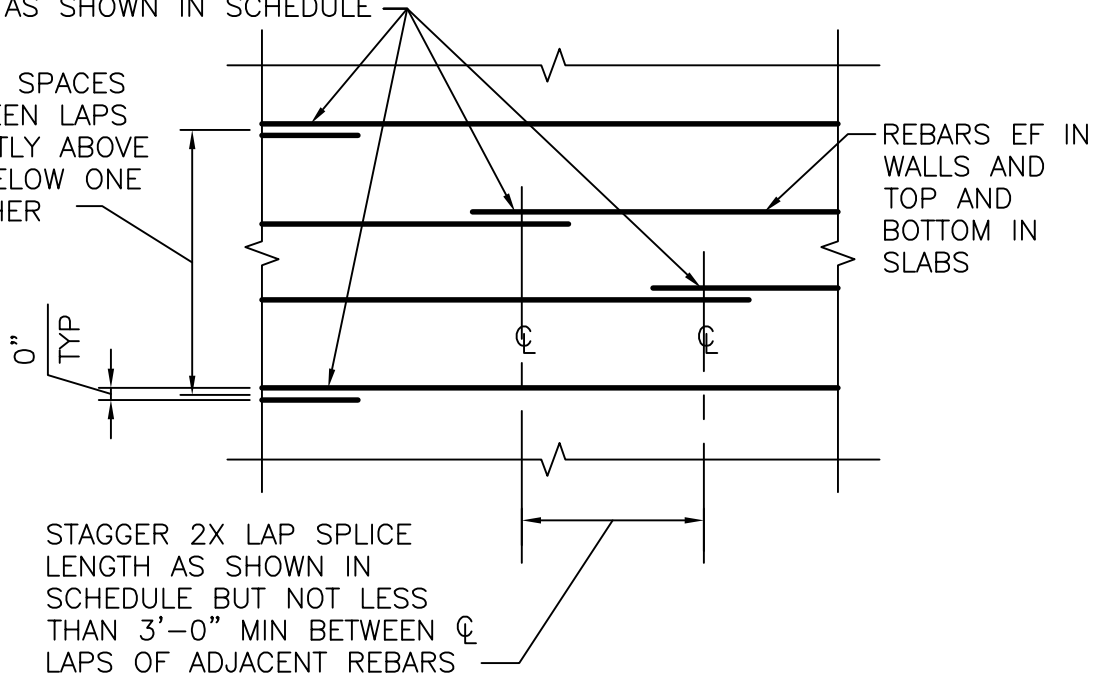
CONCRETE PAD AT ELECTRICAL PANEL

03 21 00-16

NOT TO SCALE

PROVIDE REQUIRED LAP SPACE
LENGTH AS SHOWN IN SCHEDULE

MIN 3 SPACES
BETWEEN LAPS
DIRECTLY ABOVE
OR BELOW ONE
ANOTHER



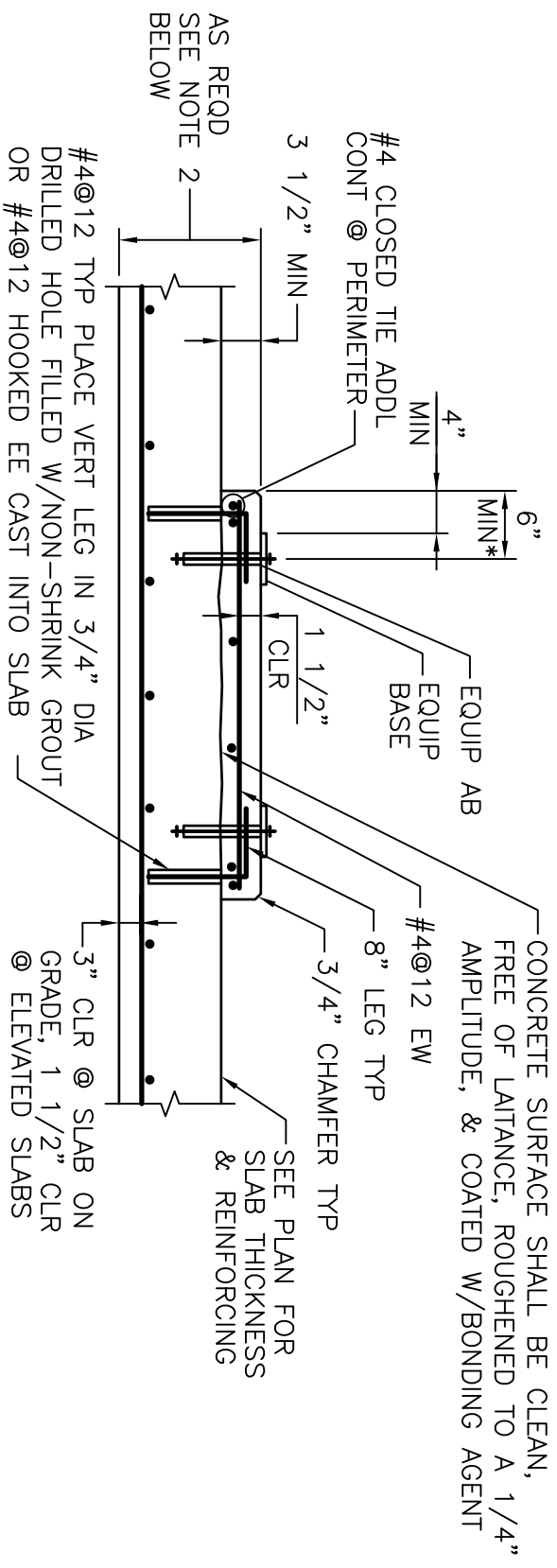
NOTES:

1. LAP AND STAGGER ALL HORIZONTAL CIRCULAR WALL REINFORCING PER THIS DETAIL, INCLUDING ONE LAP STAGGER BETWEEN INSIDE FACE LAPS AND OUTSIDE FACE LAPS.
2. LAP ALL CIRCUMFERENTIAL BARS IN THE BASE SLAB WITHIN 6 WALL THICKNESSES OF EACH FACE OF TANK WALL PER THIS DETAIL.

CIRCULAR TANK HORIZ. REINFORCING

03 21 00-19

NOT TO SCALE



- NOTES:
1. PROVIDE ABOVE PAD UNDER ALL ELECTRICAL AND MECHANICAL EQUIPMENT SUPPORTED ON STRUCTURAL SLABS. ALSO PROVIDE FOR EQUIPMENT WEIGHING LESS THAN 5000 POUNDS WHICH ARE SUPPORTED ON GRADE OR WHERE SPECIFICALLY NOTED ON PLANS.

2. PAD THICKNESS SHALL BE THE LARGER OF SLAB THICKNESS PLUS 3 1/2" OR MINIMUM PAD THICKNESS FROM TABLE. PROVIDE AN ADDITIONAL LAYER OF #4@12 EACH WAY WITH 1 1/2" CLEAR TOP AND BOTTOM FOR EACH 8" ADDITIONAL PAD THICKNESS EXCEEDING THE 3 1/2" MINIMUM THICKNESS. ALTERNATIVELY, THICKEN SLAB ON GRADE BELOW EQUIPMENT PAD AS REQD TO MAINTAIN MIN 3" COVER ON ANCHOR BOLTS.

TYPICAL EQUIPMENT SUPPORT PAD

NOT TO SCALE

03 21 00-20

MINIMUM PAD THICKNESS TABLE	
AB DIA	MIN PAD THK
1/4" DIA	5"
3/8" DIA	6 1/2"
1/2" DIA	8"
5/8" DIA	9 1/2"
3/4" DIA	11"
7/8" DIA	12 1/2"
1" DIA	14"

PAD NOTES:

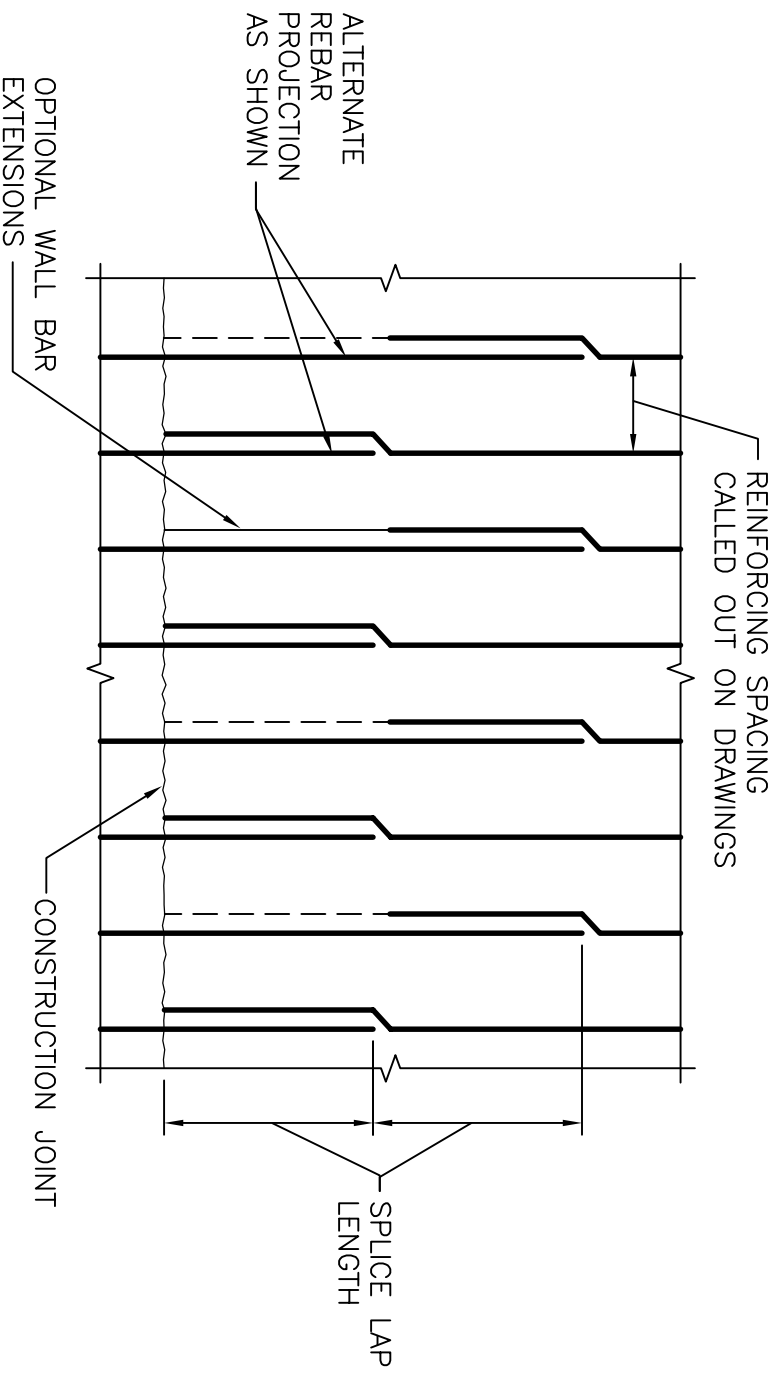
1. ABOVE PAD DETAILS APPLY FOR SUPPORT OF ALL EQUIPMENT UNLESS INDICATED OTHERWISE ON THE DRAWINGS.
2. BEFORE EQUIPMENT SUPPORT PADS ARE CAST, THE PAD SIZES AND REINFORCING SHALL BE APPROVED BY THE ENGINEER AS BEING CAPABLE OF SUPPORTING EQUIPMENT TO BE PLACED THEREON. EQUIPMENT BASE DIMENSIONS SHALL BE THE LARGER OF AS DETERMINED BY THE EQUIPMENT MANUFACTURER OR AS INDICATED ON THE DRAWINGS. SUBMIT ALL EQUIPMENT DIMENSIONS AND LOADS TO ENGINEER. THE SIZE, NUMBER, TYPE, LOCATION AND THREAD PROJECTION OF THE ANCHOR BOLTS (AB) SHALL BE AS DETERMINED BY THE EQUIPMENT MANUFACTURER AND SHALL BE AS APPROVED BY THE ENGINEER. AB SHALL BE HELD IN POSITION WITH A TEMPLATE WHILE EQUIPMENT PAD IS CAST.

*3. 6" MINIMUM PAD EDGE DIMENSION TO EQUIPMENT AB APPLIES FOR ALL EQUIPMENT SUPPORT PADS.

TYPICAL EQUIPMENT SUPPORT PAD

NOT TO SCALE

03 21 00-20A

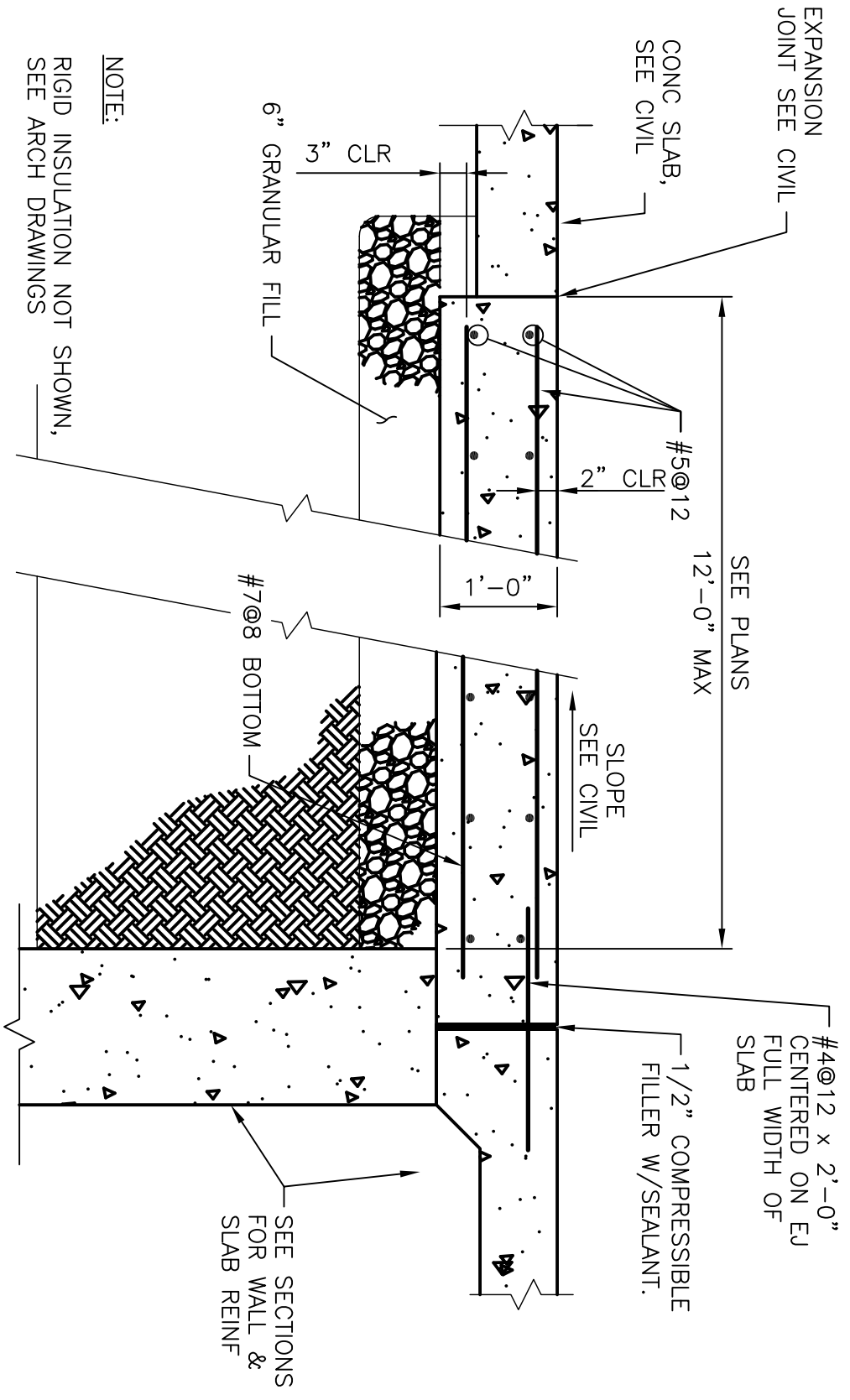


NOTES:
 1. THIS DETAIL ONLY APPLIES WHERE SPECIFICALLY INDICATED ON DRAWINGS.

STAGGERED REINFORCING AT CONSTRUCTION JOINT

NOT TO SCALE

03 21 00-21

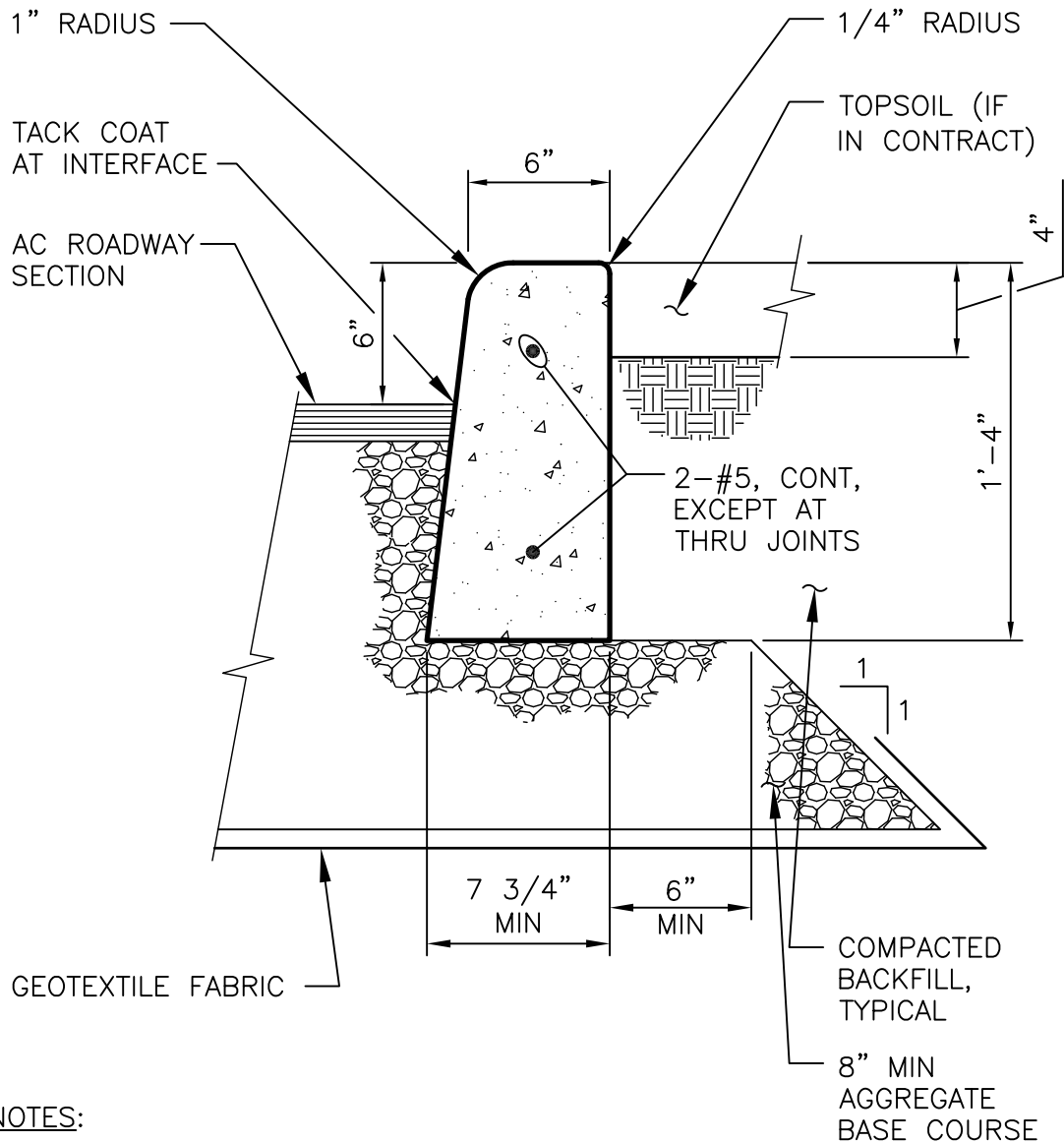


NOTE:
RIGID INSULATION NOT SHOWN,
SEE ARCH DRAWINGS

TYP APPROACH SLAB

NTS

03 21 00-22



NOTES:

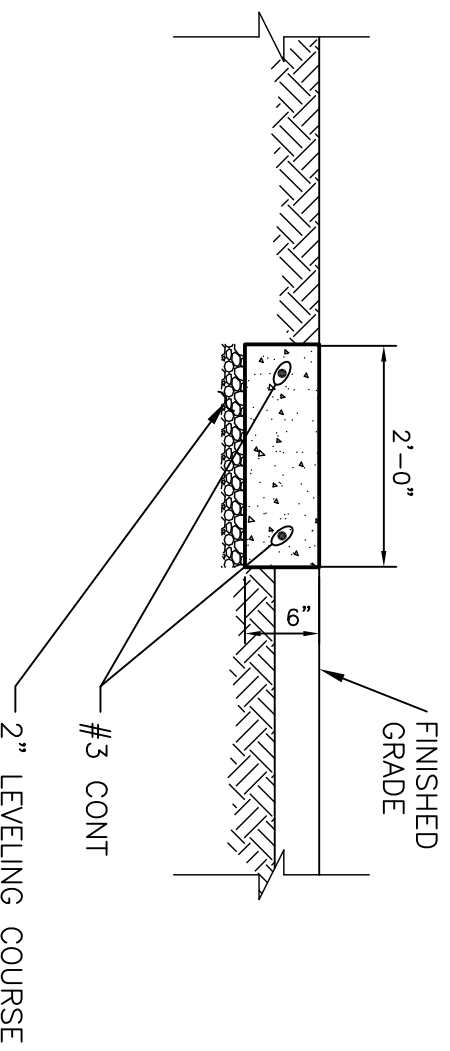
1. PROVIDE TOOLED JOINTS NOT TO EXCEED 15' ON CENTER AND NOT LESS THAN 10' ON CENTER.
2. PLACE FULL DEPTH THRU JOINTS W/ 1/2"x6" PREMOLDED JOINT FILLER AT POINTS OF TANGENCY AND AT 25' INTERVALS, MINIMUM.
3. WHERE VERTICAL CURB DIVIDES GRASS AND LANDSCAPING ROCK, LEAVE CURB STICKING UP 1.5 INCHES ABOVE GRASS.

VERTICAL CURB

NTS

03 21 00-23





NOTES:

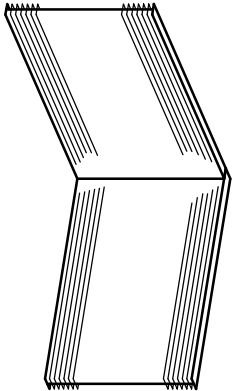
1. PROVIDE CONTROL JOINTS AT 20' ON CENTER MAXIMUM.

MOWING STRIP DETAIL

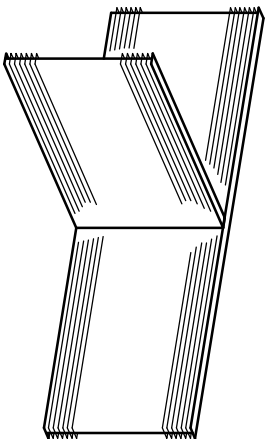
NTS

03 31 00-24

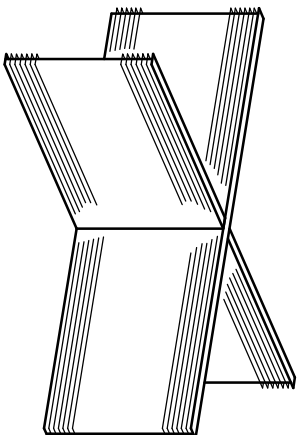
HR



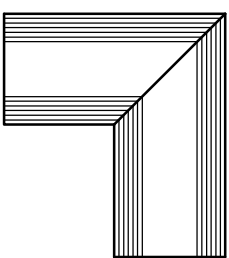
VERTICAL ELL



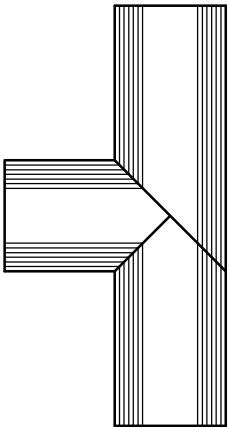
VERTICAL TEE



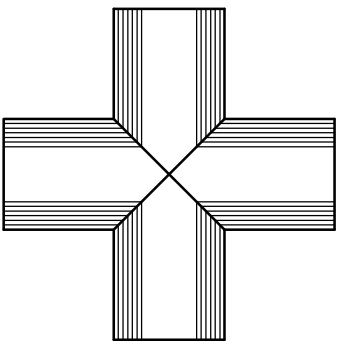
VERTICAL CROSS



FLAT ELL



FLAT TEE



FLAT CROSS

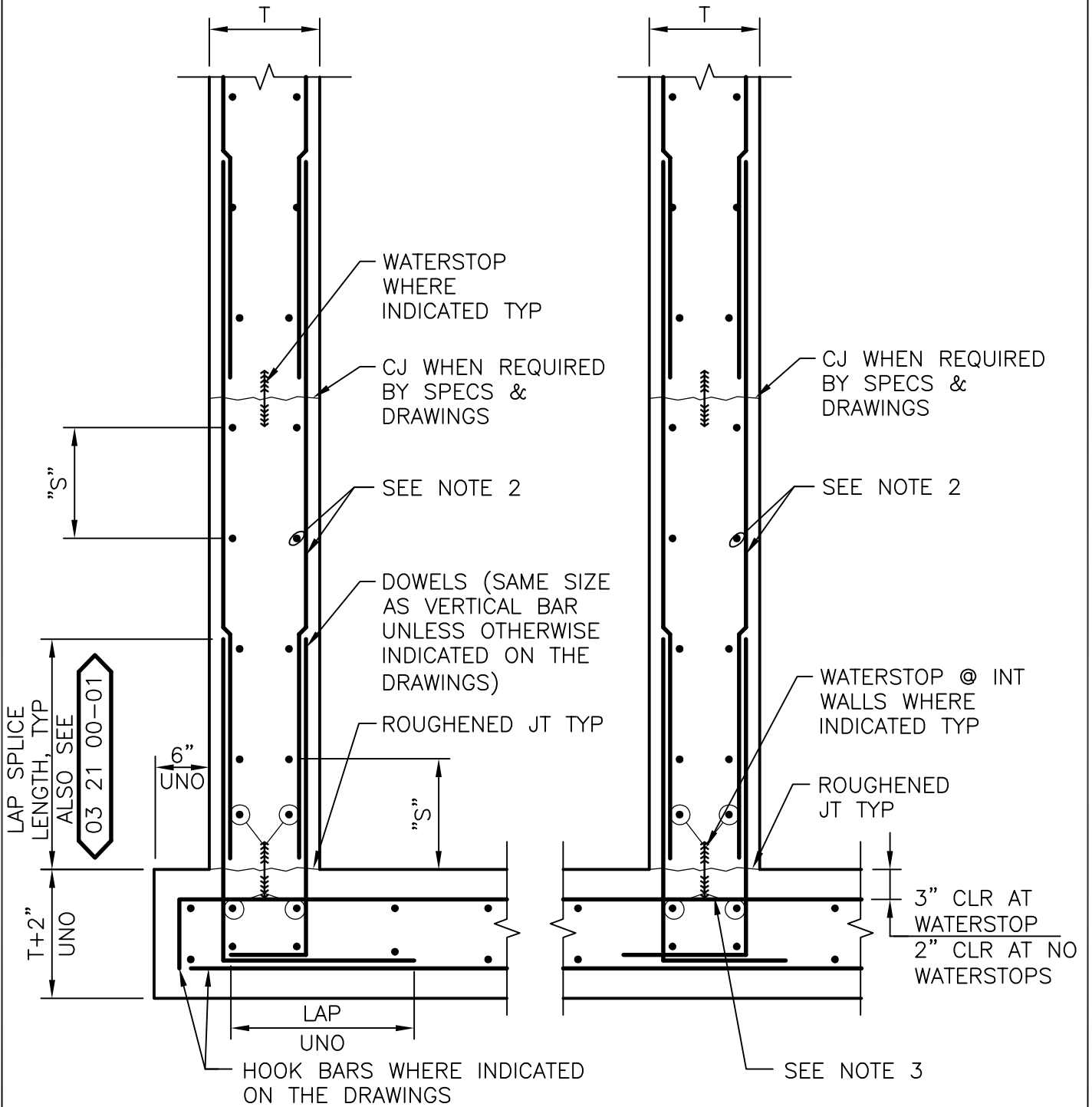
NOTES:

1. BULB TYPE WATERSTOPS SHALL BE HANDLED SIMILAR TO AS SHOWN WITH BULB JOINTS MITERED FOR FULL CONTINUITY OF HOLLOW BULB.
2. ONLY STRAIGHT BUTT JOINT WELDS ARE ALLOWED IN THE FIELD.

**SHOP FABRICATED
WATERSTOP**

NOT TO SCALE

03 31 31-01



NOTES:

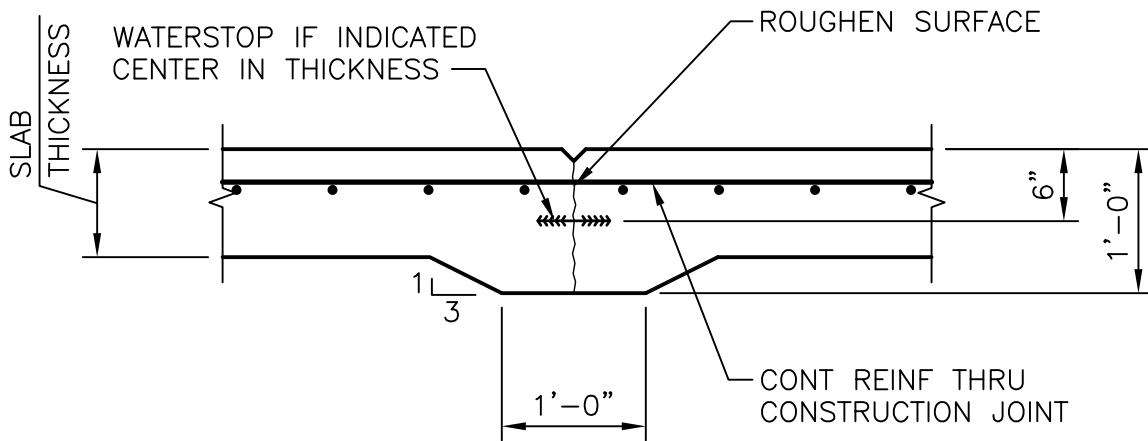
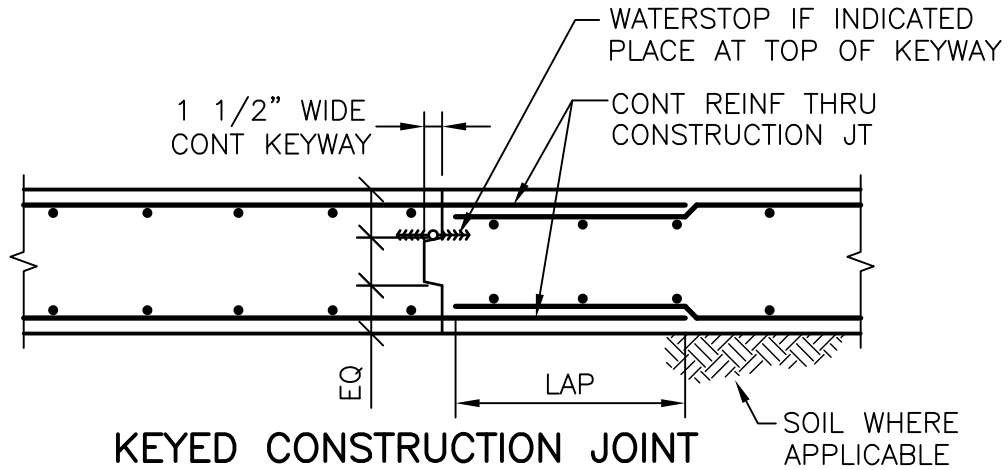
1. "S" = BAR SPACING INDICATED ON THE DRAWINGS
2. FOR HORIZONTAL REINF BAR LOCATION RELATIVE TO VERTICAL REINF BAR LOCATION (INSIDE OR OUTSIDE SEE DRAWING (INSIDE SHOWN)).
3. TIE WATERSTOP SECURELY IN PLACE PER SPECIFICATION SECTION 03 31 31.

HORIZONTAL WALL JOINTS WITH WATERSTOPS

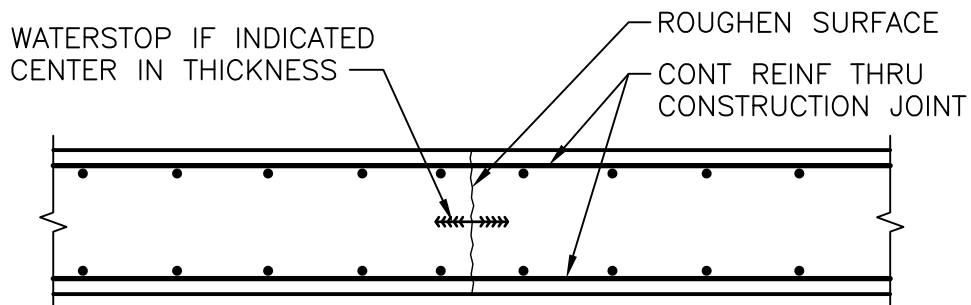
NOT TO SCALE

03 31 31-02





ROUGHENED CONSTRUCTION JOINT AT SLAB < 10" THICK



ROUGHENED CONSTRUCTION JOINT

NOTE:

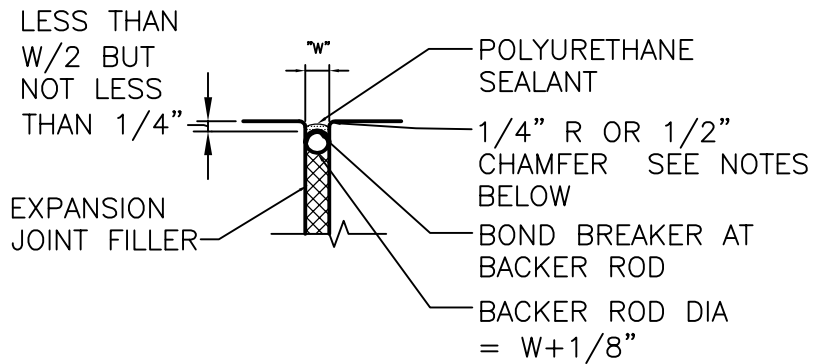
1. SEE SPECIFICATION FOR REQUIREMENT TO TIE WATERSTOPS IN PLACE TO PREVENT MOVEMENT OR FOLDING OVER.

CONSTRUCTION JOINTS (CJ)

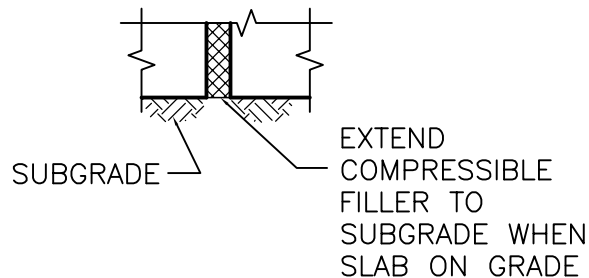
NOT TO SCALE

03 31 31-03





DETAIL "A" EXPOSED FACE



DETAIL "B" SOIL SIDE

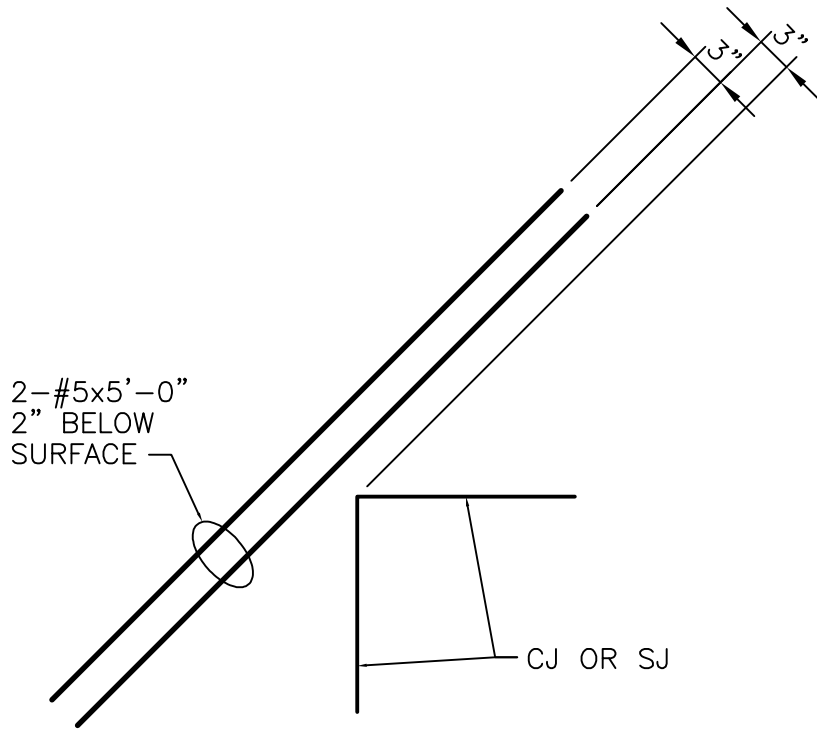
NOTES:

1. FOR WALLS, FORM ALL JOINT EDGES AT 1/2" CHAMFER.
2. FOR UNDER SIDE OF EXPOSED SLABS, FORM JOINT EDGES AT 1/2" CHAMFER.
3. FOR SLABS, PROVIDE 1/4" RADIUS TOOLED EDGES AT TOP SURFACE
4. USE DETAIL "B" AT UNDERSIDE OF SLABS ON GRADE ONLY. USE DETAIL "A" AT ALL OTHER LOCATIONS.
5. "W" = 1" WIDE UNLESS OTHERWISE INDICATED ON THE DRAWINGS.

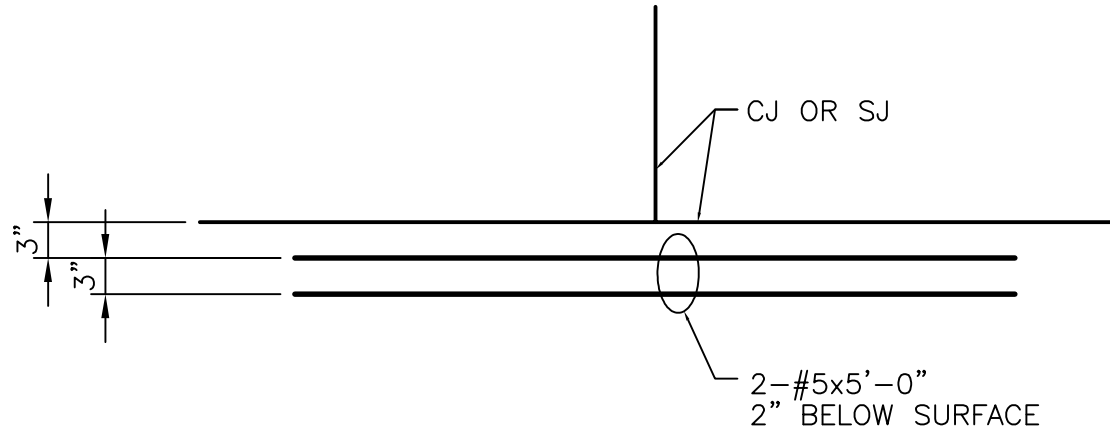
SEALANT DETAIL

3/4"=1'-0"

03 31 31-04



RE-ENTRANT CORNER



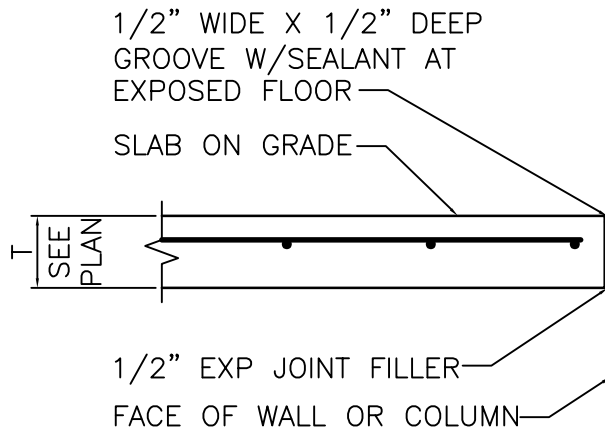
DISCONTINUOUS JOINT INTERSECTION

ADDITIONAL SLAB REINFORCING

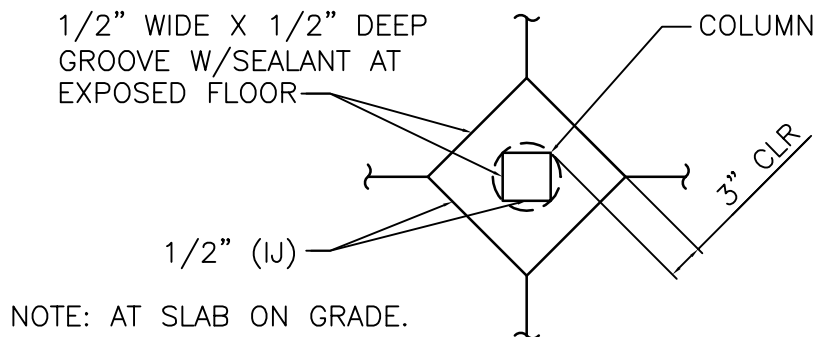
NOT TO SCALE

03 31 31-05





ISOLATION JOINT AT SLAB ON GRADE

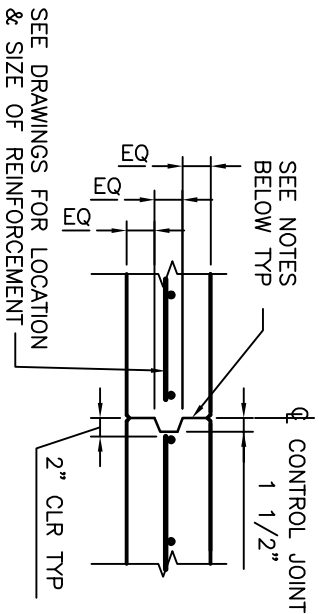


ISOLATION JOINT AT COLUMN

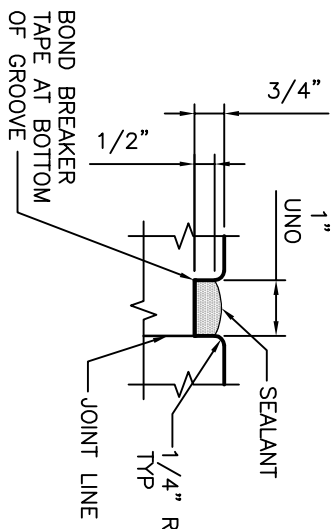
TYPICAL ISOLATION JOINTS (IJ)

3/4" = 1'-0"

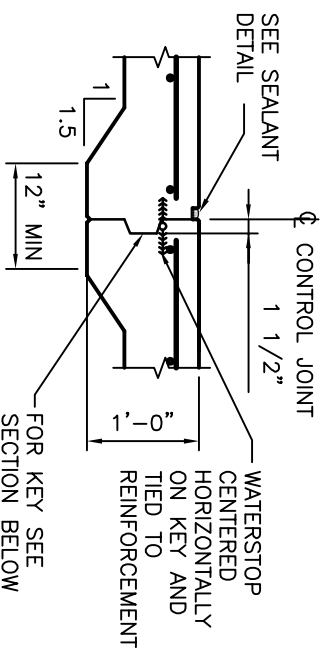
03 31 31-07



NON-WATER BEARING WALL OR SLAB LESS THAN 10" THICK



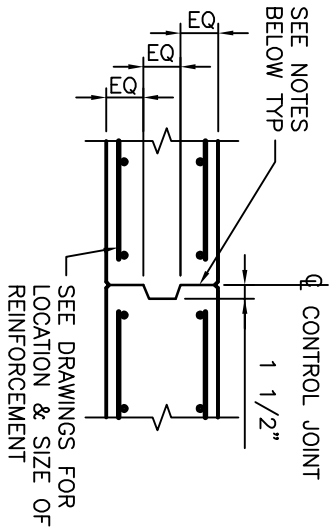
SEALANT DETAIL



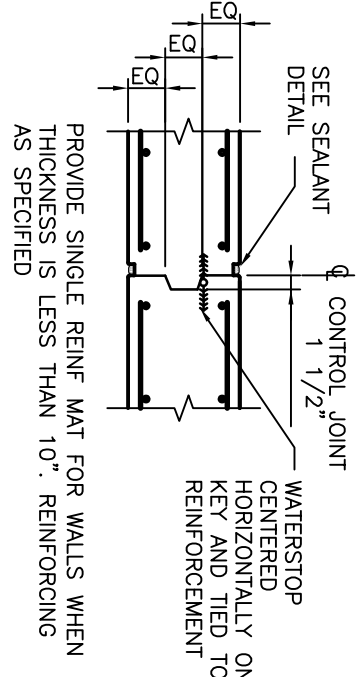
WATER BEARING SLAB LESS THAN 12" THICK

NOTES:

1. COAT CONCRETE JOINT SURFACES WITH BOND BREAKER COMPOUND.
2. FOR WALLS, FORM ALL JOINT EDGES AT 1/2" CHAMFER.
3. FOR SLABS, EDGE TOP OF EXPOSED SLAB JOINT AT 1/4" RADIUS.
4. FOR UNDERSIDE OF EXPOSED SLABS, FORM JOINT EDGES AT 1/2" CHAMFER.



NON-WATER BEARING SLAB OR WALL 10" THICK OR GREATER

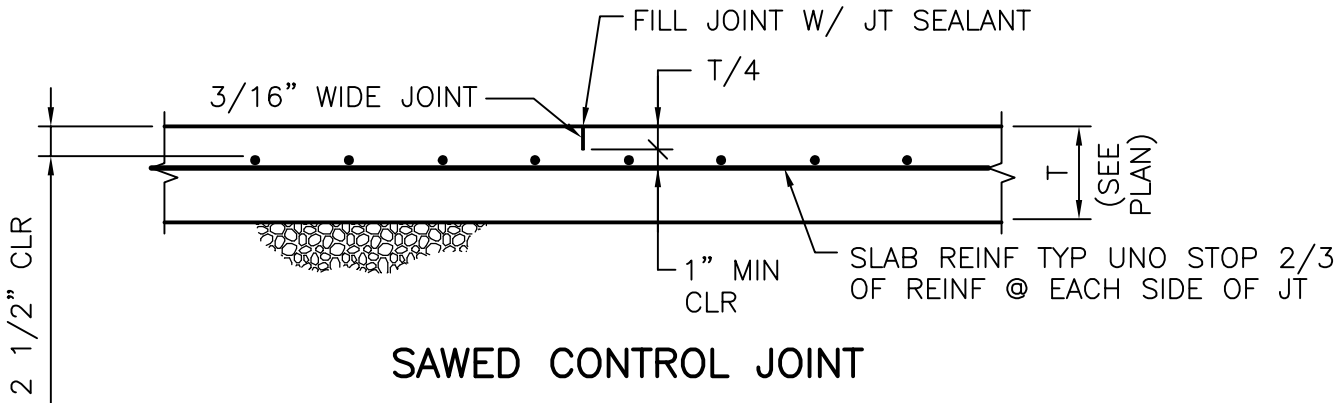


WATER BEARING SLAB OR WALL

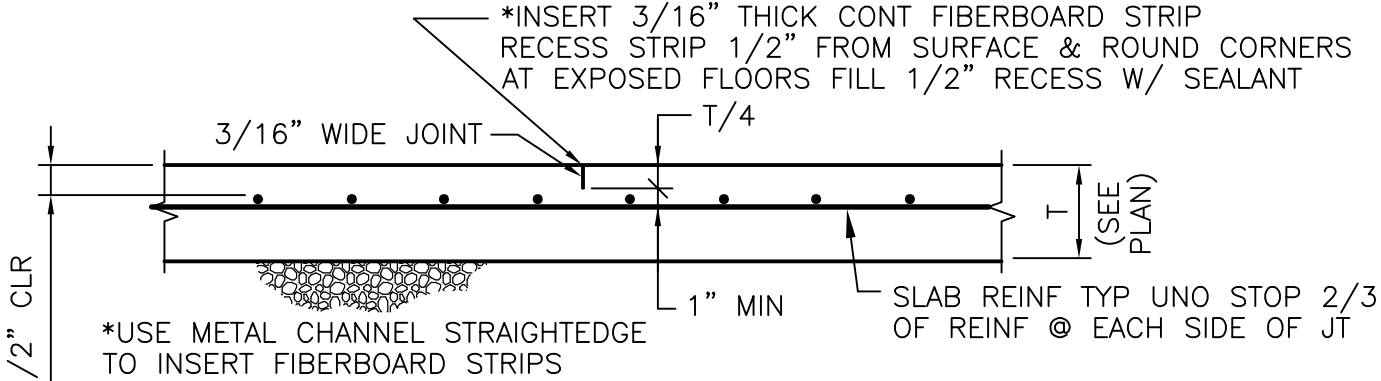
CONCRETE JOINT (CTJ)

NOT TO SCALE

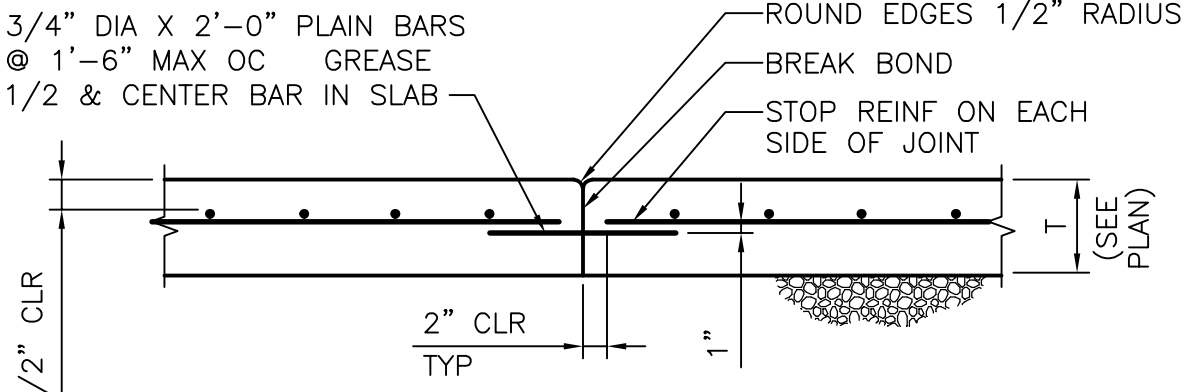
03 31 31-08



SAWED CONTROL JOINT



FORMED CONTROL JOINT



DOWELLED CONSTRUCTION JOINT (DSJ)

NOTE:

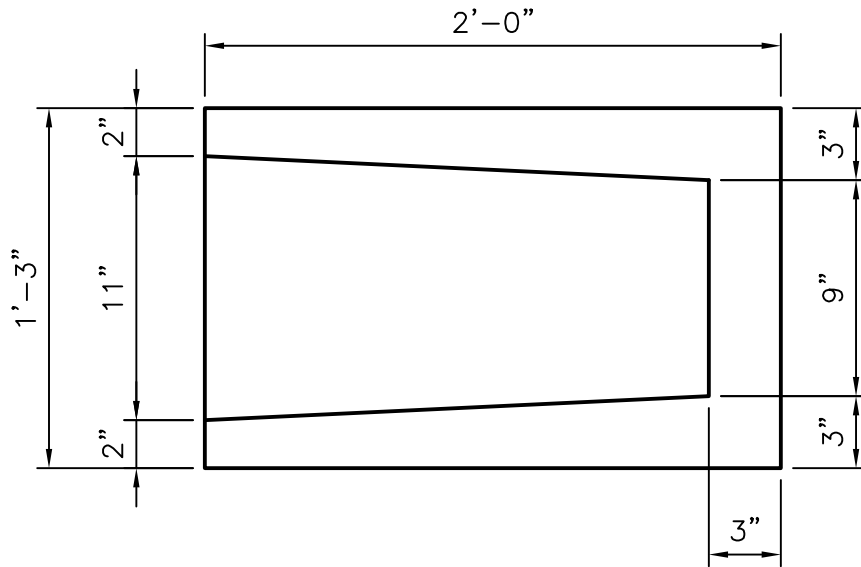
1. ANY ONE OF THE DETAILS ABOVE MAY BE USED AT LOCATIONS INDICATED ON DRAWINGS AS "SJ," AT CONTRACTOR'S OPTION.
2. WHERE "DSJ" IS INDICATED ON PLAN, THE "DSJ" SHALL BE USED.

SLAB-ON-GRADE JOINT

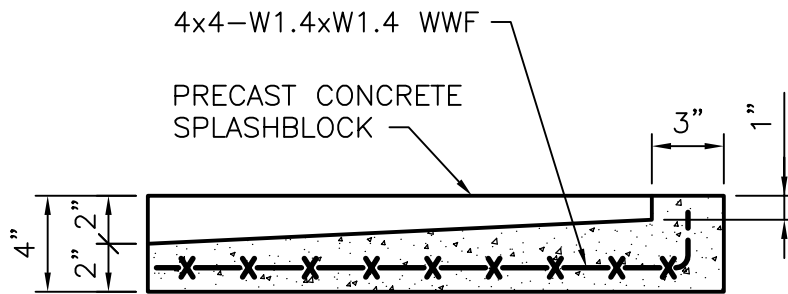
3/4"=1'-0"

03 31 31-09





PLAN

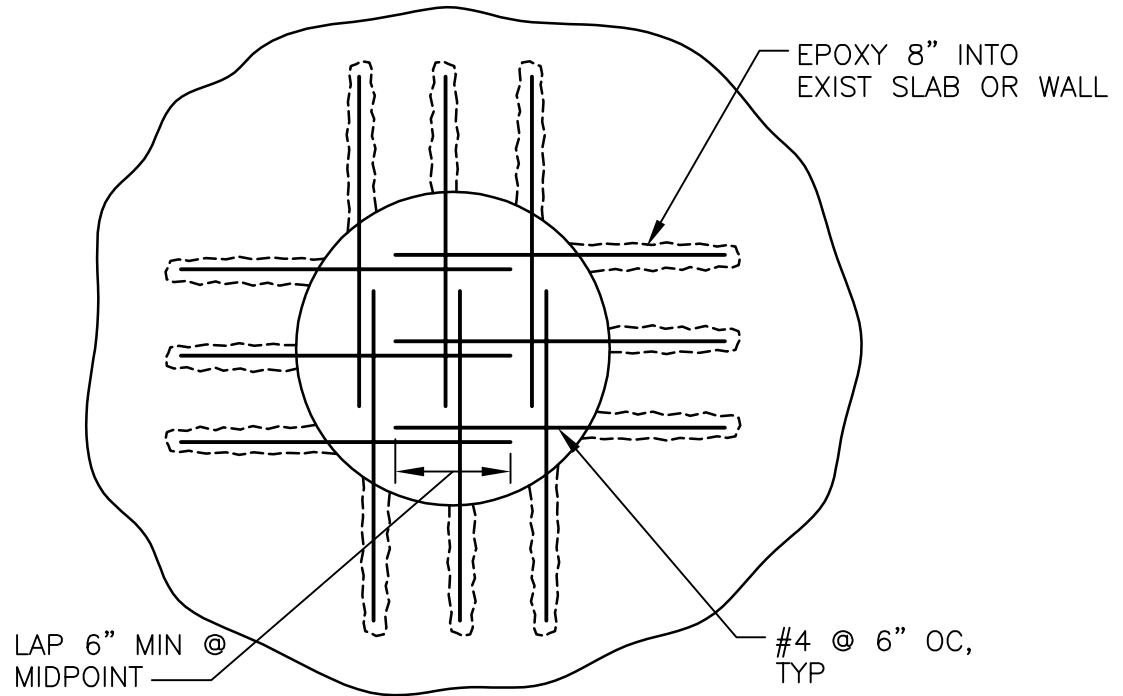


SECTION

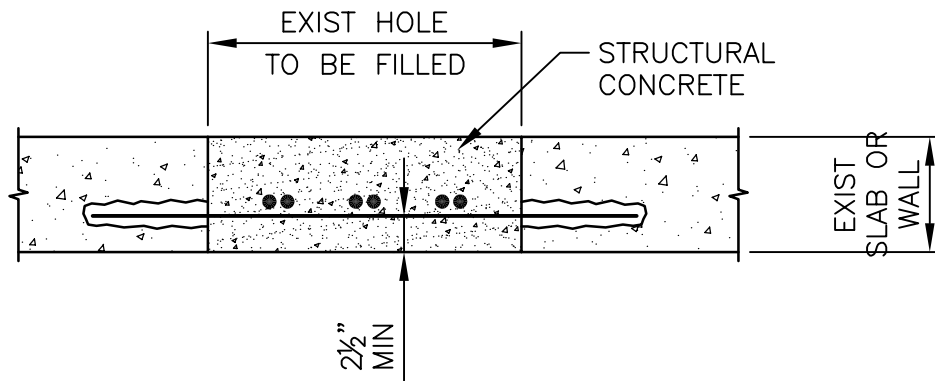
CONCRETE SPLASH BLOCK

NOT TO SCALE

03 31 31-11



PLAN



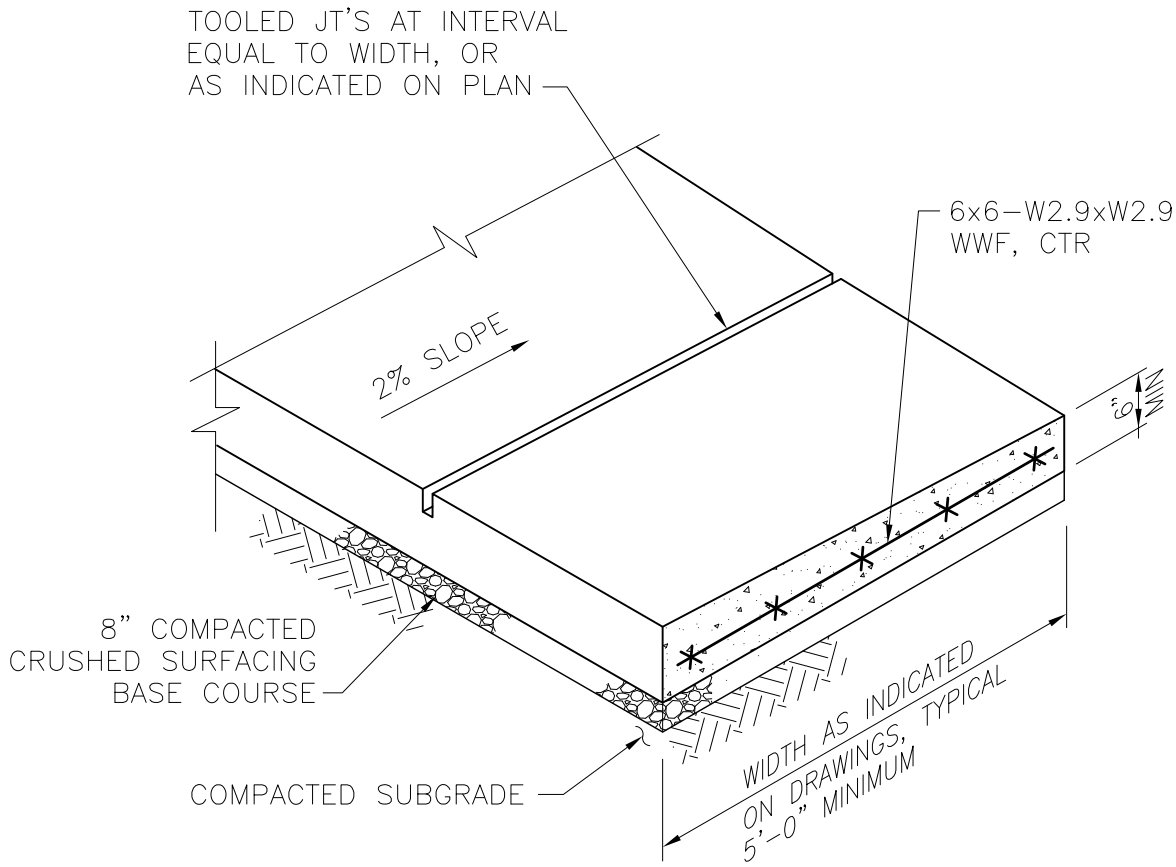
ELEVATION

CONCRETE PLUG

NTS

03 31 31-13





NOTES:

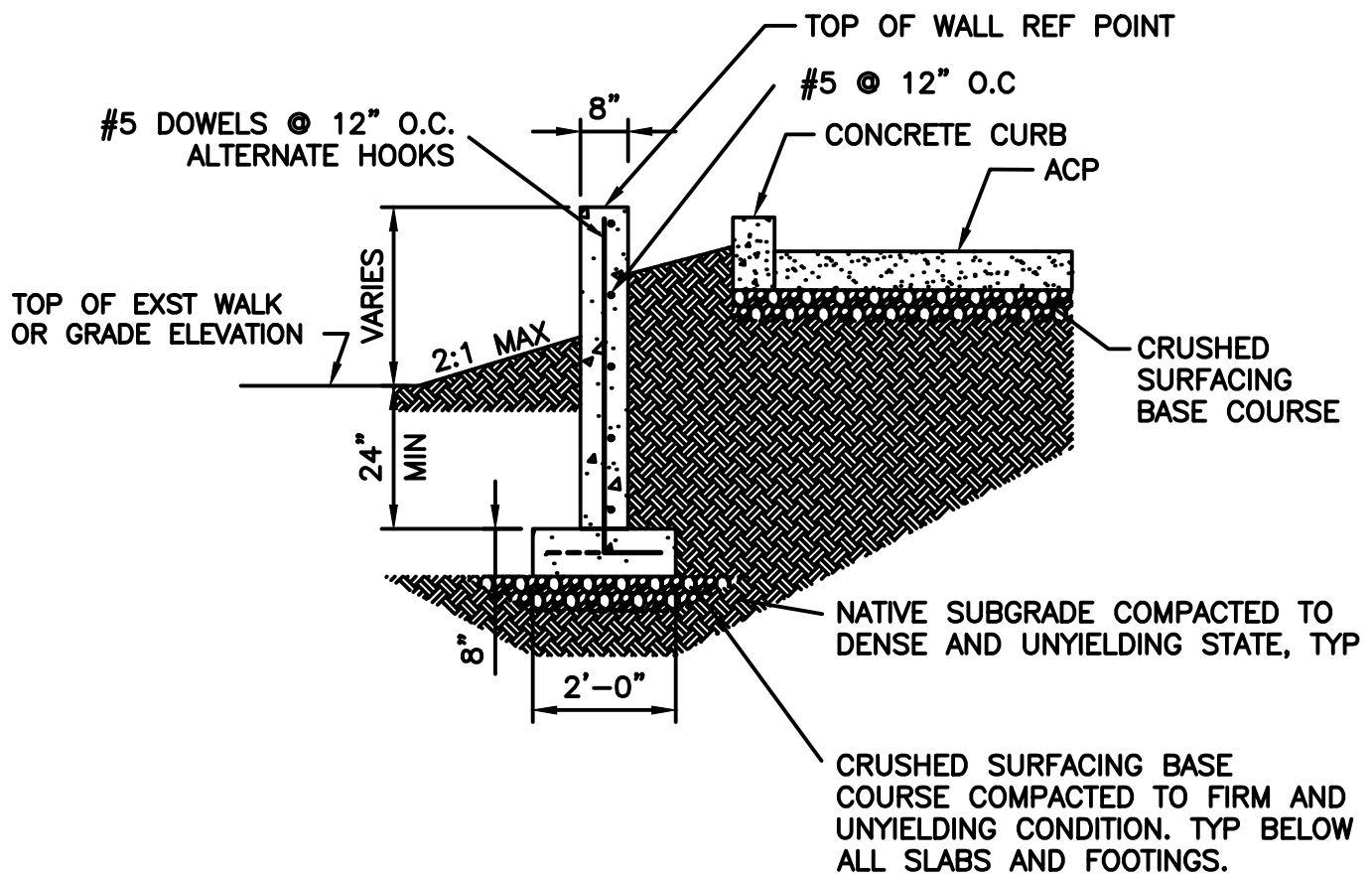
1. PROVIDE FULL DEPTH 3/8" PREMOLDED EXPANSION JOINT FILLER ALL AROUND AT ALL UTILITY POLES, METER BOXES, ETC.
2. PLACE FULL DEPTH THRU JOINTS W/1/2"x6" PREMOLDED EJF AT POINT OF TANGENCY AND AT MIN 25' INTERVALS.
3. PROVIDE FULL DEPTH 3/8" PREMOLDED EXPANSION JOINT FILLER BETWEEN WALKWAYS AND ADJACENT CONCRETE STRUCTURES OR SLABS.

CONCRETE WALKWAY

NTS

03 31 31-15



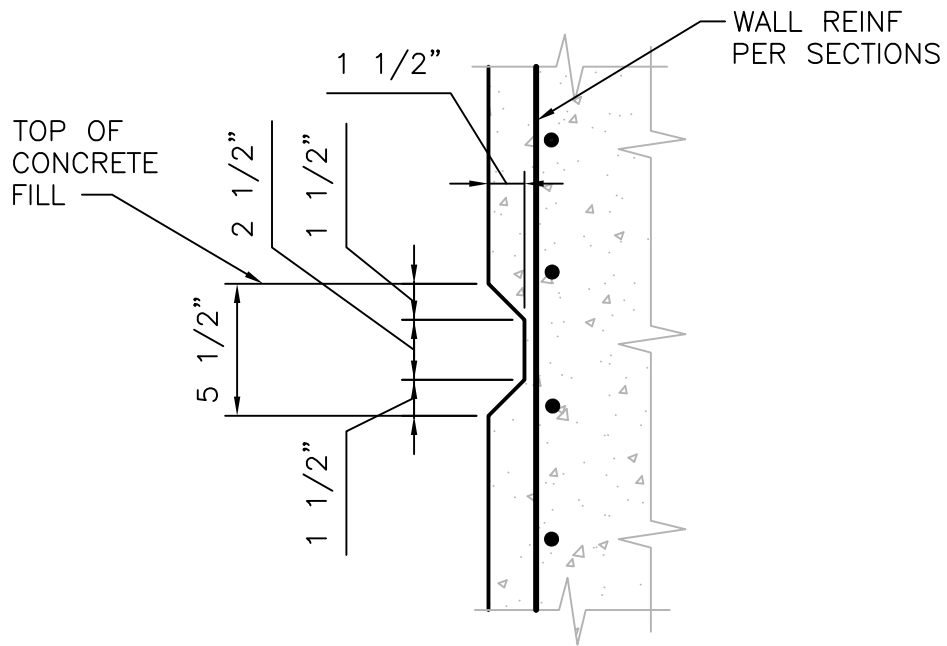


RETAINING STRUCTURE DETAIL

NTS

03 31 31-16





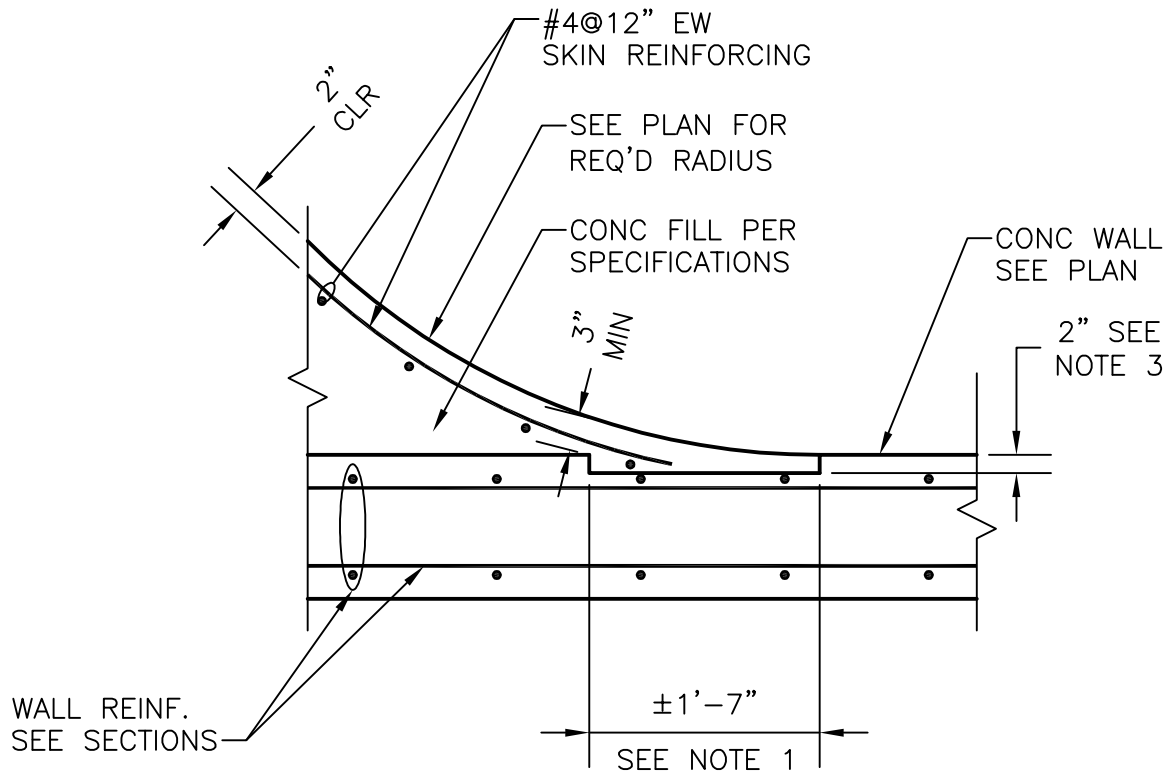
NOTES:

1. SEE DRAWINGS FOR TOP OF CONCRETE ELEVATION FOR CONCRETE FILL.

BLOCKOUT FOR CONC FILL

NTS

03 31 31-17



NOTES:

1. LENGTH OF BLOCKOUT SHALL BE AS REQUIRED TO MAINTAIN 2" MINIMUM THICKNESS OF CONCRETE FILL ABOVE FACE OF CONCRETE WALL.
2. SKIN REINFORCING TO CROSS WEAKENED PLANE AT EDGE OF BLOCKOUT.
3. 2" DEEP BLOCKOUT FOR CONCRETE FILL AT NEW CONCRETE WALL. FOR NEW CONCRETE FILL AT EXISTING WALL, SAW CUT 1 1/2" DEEP BLOCKOUT IN EXISTING WALL TO THE EXTENTS SHOWN. DO NOT DAMAGE REINFORCING IN EXISTING WALL.

CONCRETE FILL KEY DETAIL AT WALL

NO SCALE

03 31 31-18

SLOPE TOP OF
CONC FILL TO
MATCH ELEVATIONS
SHOWN ON PLAN

#4@12" EW
SKIN REINFORCING

CONC FILL PER
SPECIFICATIONS

3"
MIN

3"

TOC EL
SEE PLAN

SLAB REINF.
SEE SECTIONS

±1'-0"

SEE NOTE 1

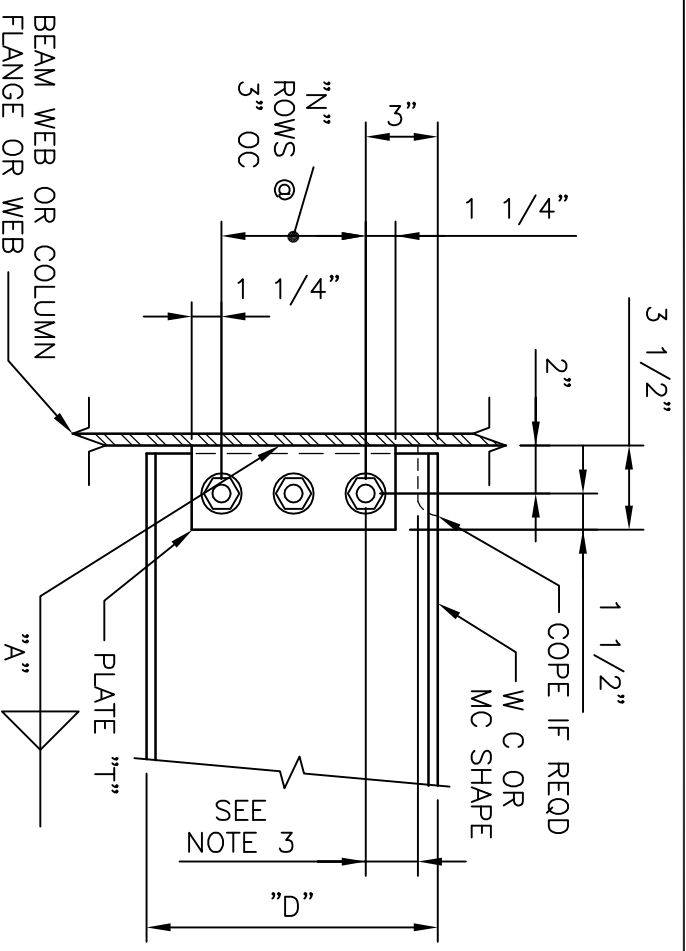
NOTES:

1. LENGTH OF BLOCKOUT SHALL BE AS REQUIRED TO MAINTAIN 3" MINIMUM THICKNESS OF CONCRETE FILL ABOVE TOP OF CONCRETE SLAB.
2. SKIN REINFORCING TO CROSS WEAKENED PLANE AT EDGE OF BLOCKOUT.
3. 2" DEEP BLOCKOUT FOR CONCRETE FILL AT NEW CONCRETE SLAB. FOR NEW CONCRETE FILL AT EXISTING SLAB, SAW CUT 1 1/2" DEEP BLOCKOUT IN EXISTING SLAB TO THE EXTENTS SHOWN. DO NOT DAMAGE REINFORCING IN EXISTING SLAB.

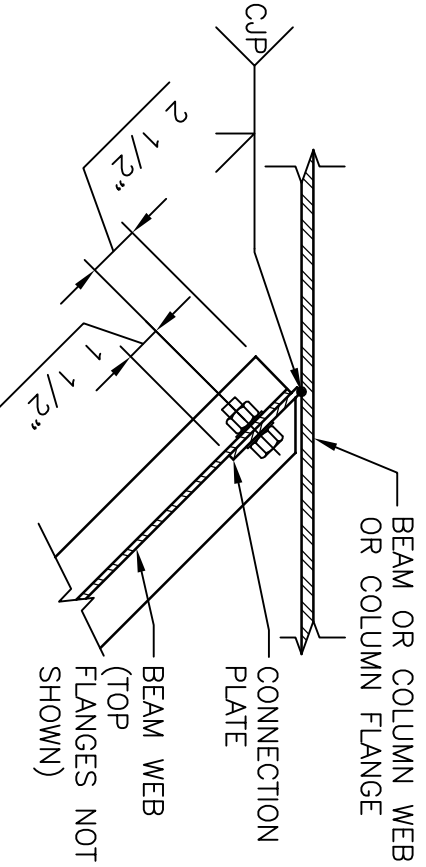
CONCRETE FILL KEY DETAIL AT SLAB

03 31 31-19

NO SCALE



PERPENDICULAR CONNECTION



**SKewed CONNECTION
(IF APPLICABLE)**

SINGLE PLATE BEAM CONNECTION

NOT TO SCALE

SINGLE PLATE BEAM CONNECTION SCHEDULE
3/4" DIA BOLTS

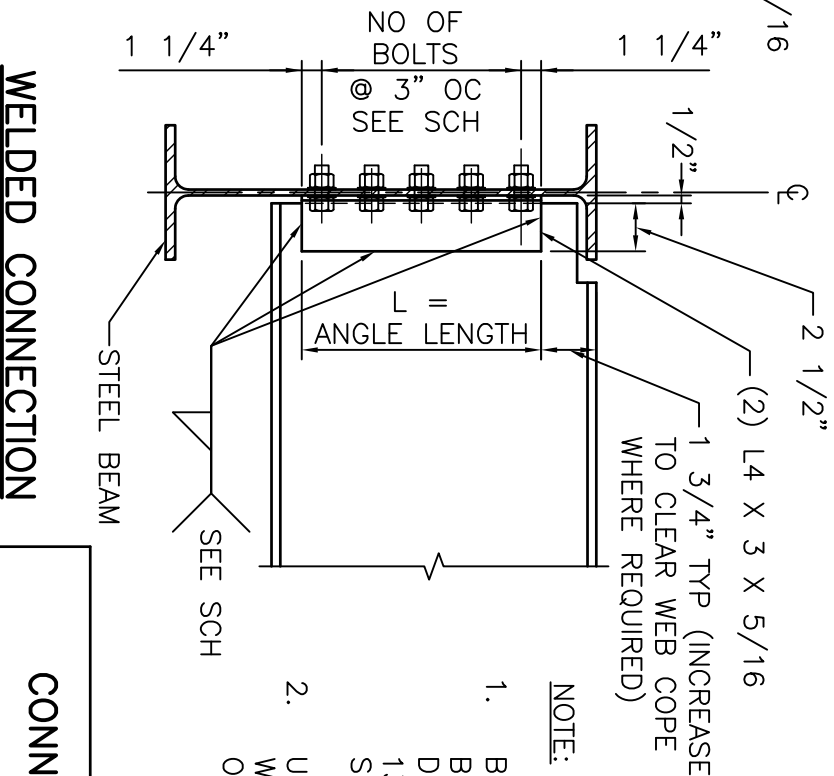
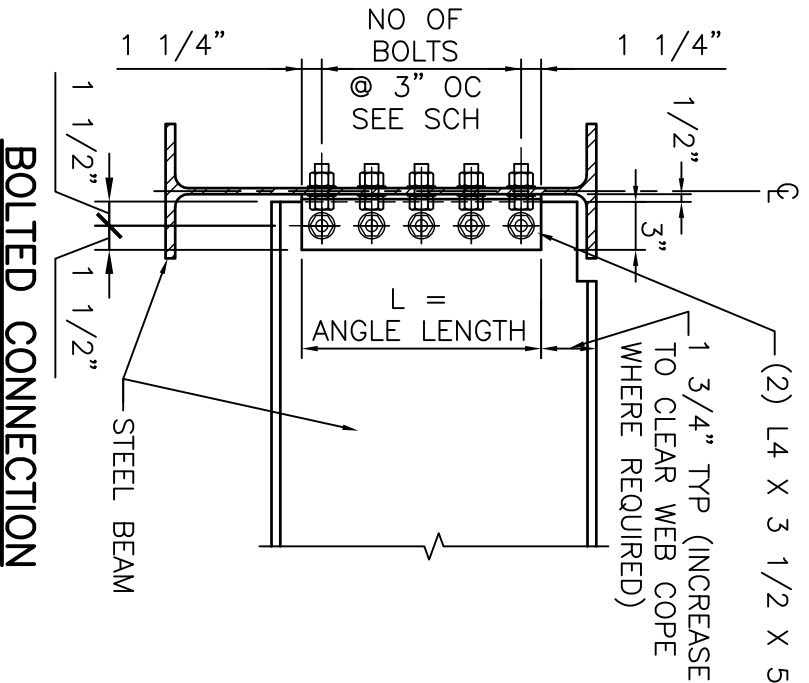
NOMINAL BEAM DEPTH "D"	NUMBER OF BOLT ROWS "N"	PLATE THICKNESS "T"	WELD SIZE "A"
W8	2	5/16"	1/4"
W10	2	5/16"	1/4"
W12	3	5/16"	1/4"
W14	3	5/16"	1/4"
W16	4	5/16"	1/4"
W18	5	5/16"	1/4"
W21	6	5/16"	1/4"
W24	7	3/8"	5/16"
W27	7	3/8"	5/16"
W30	8	7/16"	3/8"
W33	9	7/16"	3/8"
W36	10	7/16"	3/8"

NOTES:

1. ALL BOLTS SHALL BE 3/4" DIA A325-N UNLESS NOTED OTHERWISE.
2. PROVIDE MINIMUM NUMBER OF BOLT ROWS "N" SHOWN AS THE TYPICAL CONN. INCREASE NUMBER OF ROWS AND / OR BOLT DIA IF INDICATED ON PLANS.
3. MIN DISTANCE FROM ϕ OF TOP BOLT TO A COPE SHALL BE 1 1/2". WHERE DEEP COPES ARE REQD, INCREASE DISTANCE FROM TOP OF BEAM TO ϕ OF TOP BOLT.

05 12 00-01





- NOTE:**
1. BOLTS ARE 3/4" DIA A325N BOLTS. HOLES ARE 13/16" DIA IN SUPPORT MEMBER AND 13/16" X 1" HORIZONTAL SHORT SLOTS IN ANGLES.
 2. USE SIMILAR CONNECTION @ WIDE FLANGE COLUMN FLANGE OR WEB.

WELDED CONNECTION
(AT CONTRACTORS OPTION)

BOLTED CONNECTION

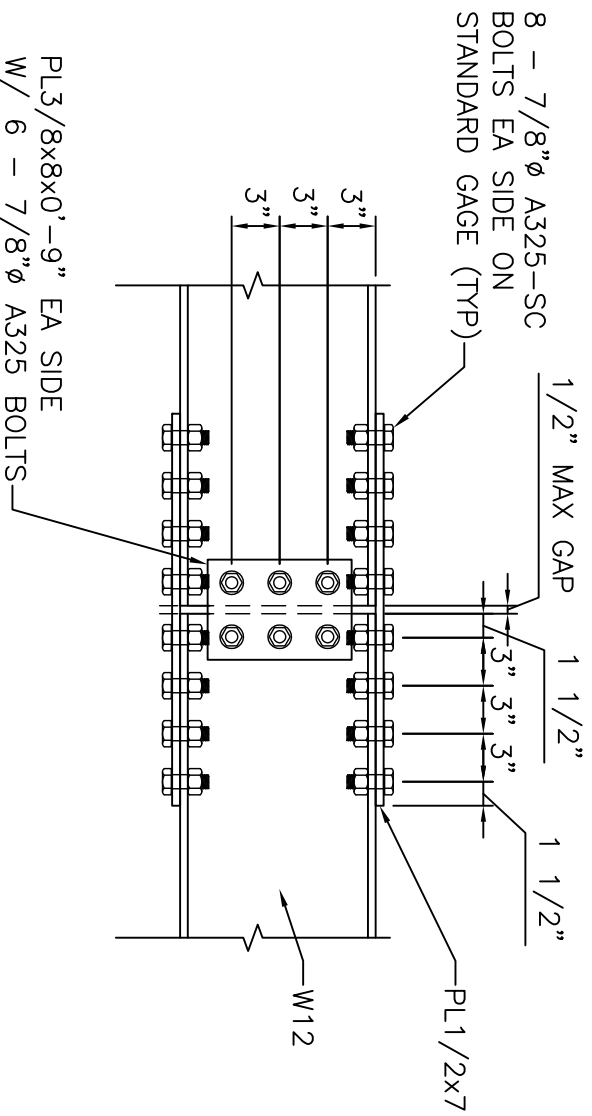
CONNECTION SCHEDULE				
BEAM SIZE	MIN # OF BOLTS	MIN ANGLE LENGTH (L)	WELD SIZE	
W8, W10	2	5 1/2	3/16	
W12, W14	3	8 1/2	3/16	
W16, W18	4	11 1/2	3/16	
W21	5	14 1/2	3/16	
W24	6	17 1/2	1/4	
W27	7	20 1/2	1/4	
W30, W33	8	23 1/2	5/16	
W36	9	26 1/2	5/16	

TYPICAL BEAM CONNECTION DETAIL

1" = 1'-0"

05 12 00-03

H22

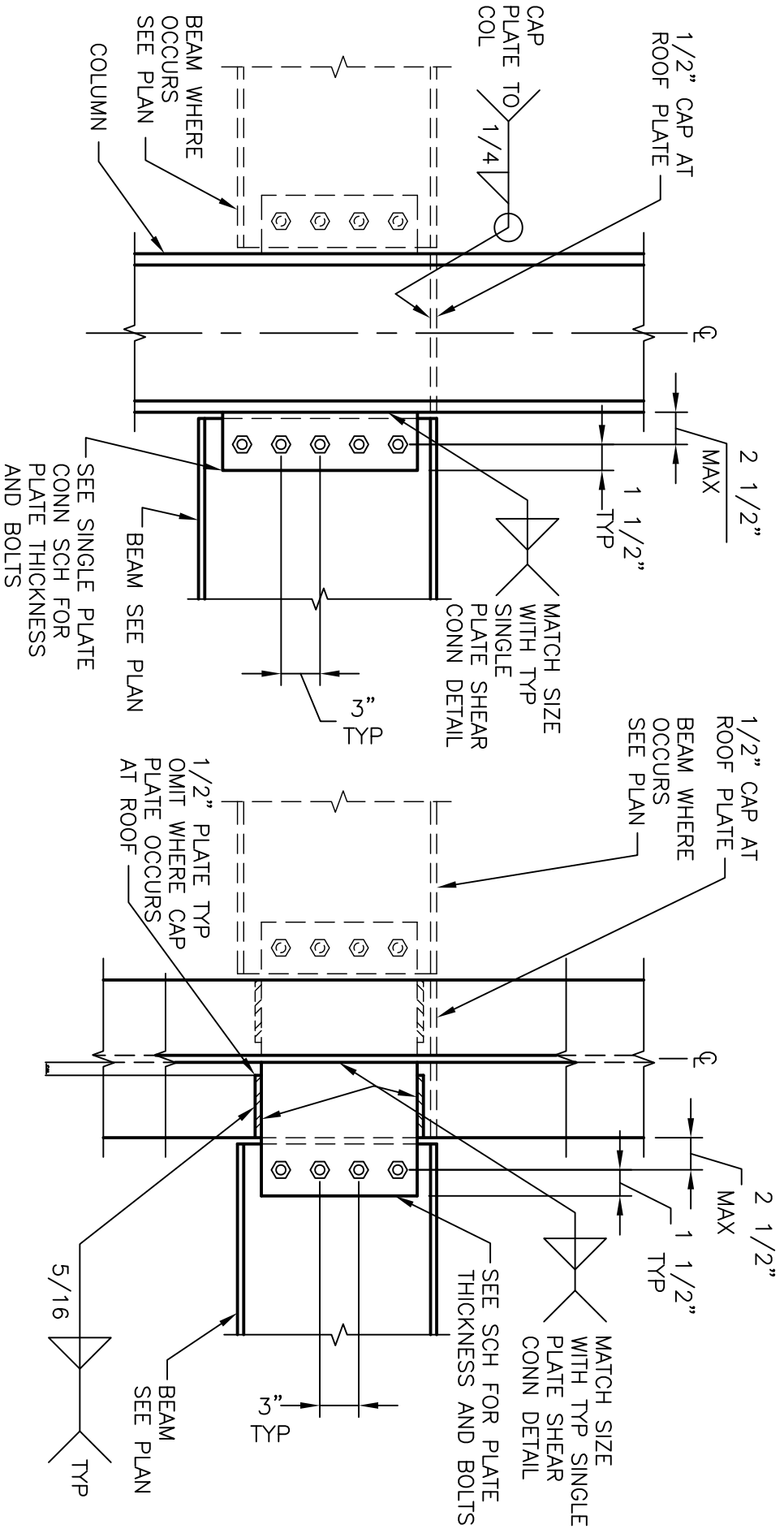


- NOTE:
1. CONNECTION SHOWN THUS ON PLAN: 
 2. DECKING NOT SHOWN FOR CLARITY. 

BEAM MOMENT SPLICE

1" = 1'-0"

05 12 00-04



AT COLUMN FLANGE

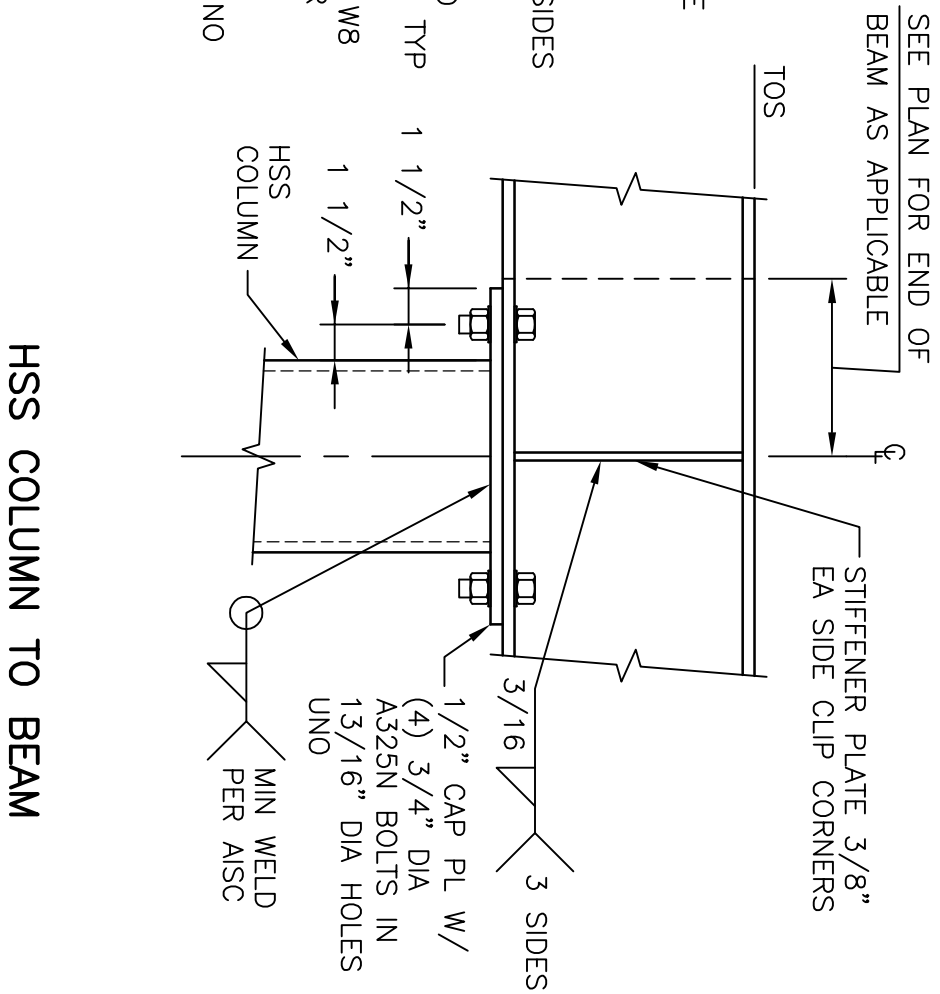
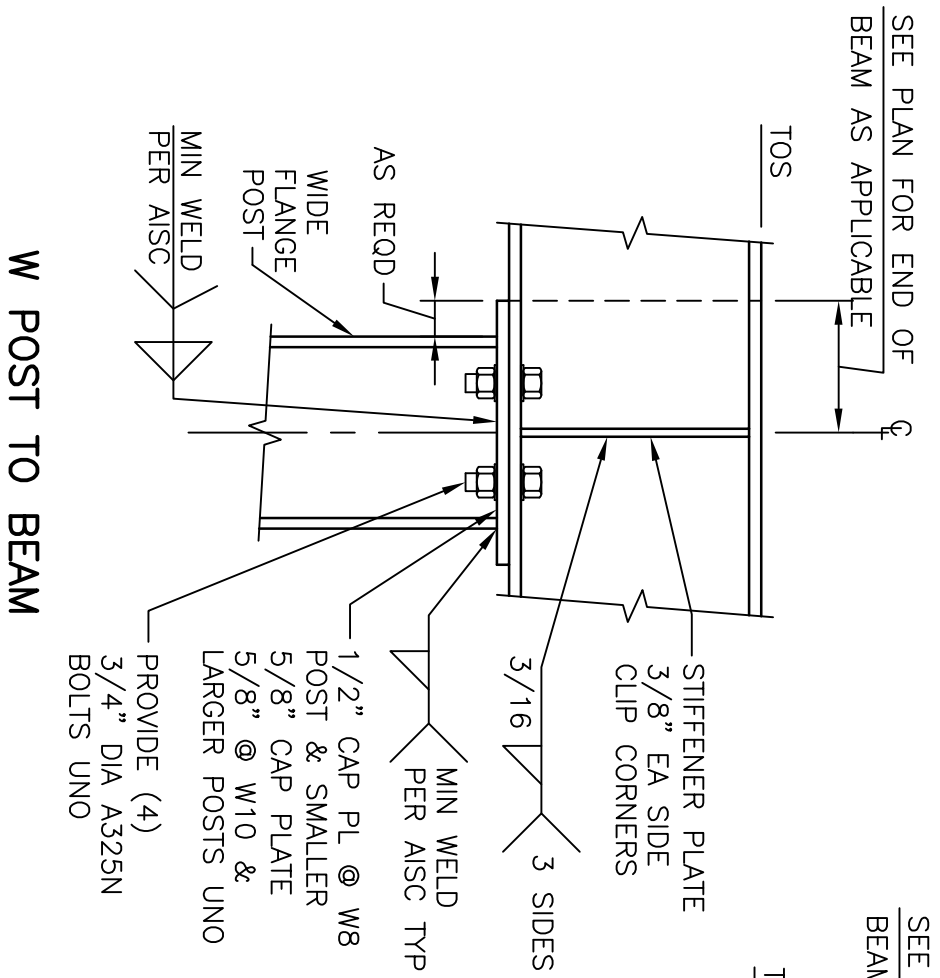
AT COLUMN WEB

SINGLE PLATE BEAM TO COLUMN

1"=1'-0"

05 12 00-05

H2R



NOTE:

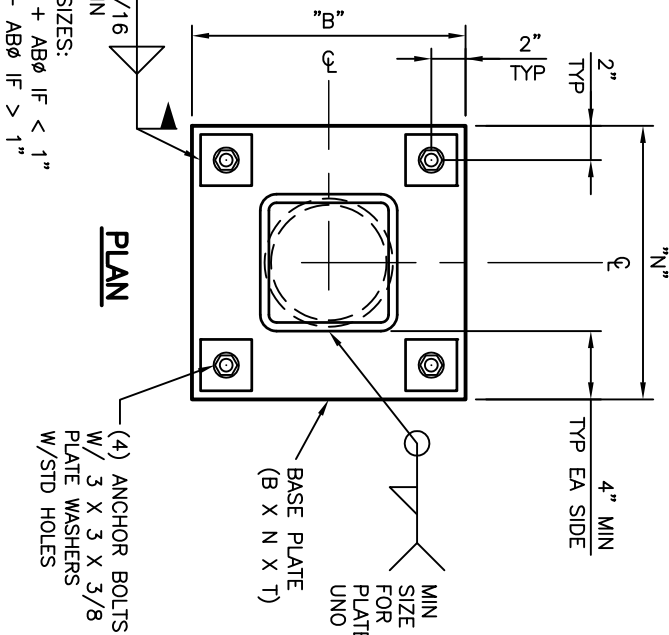
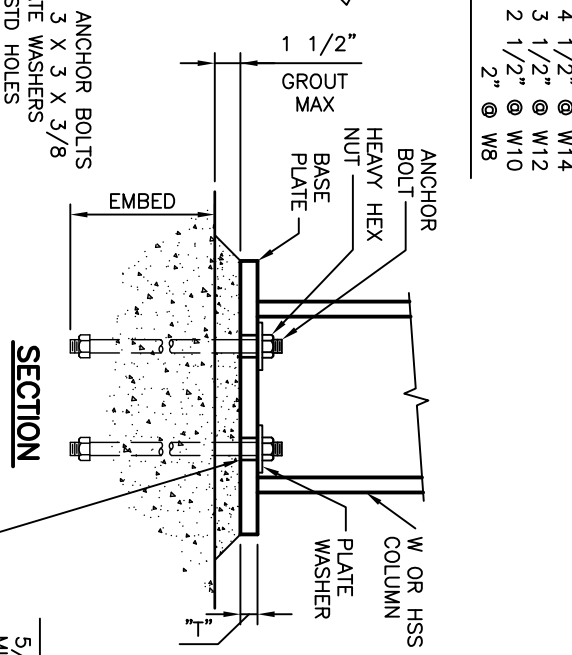
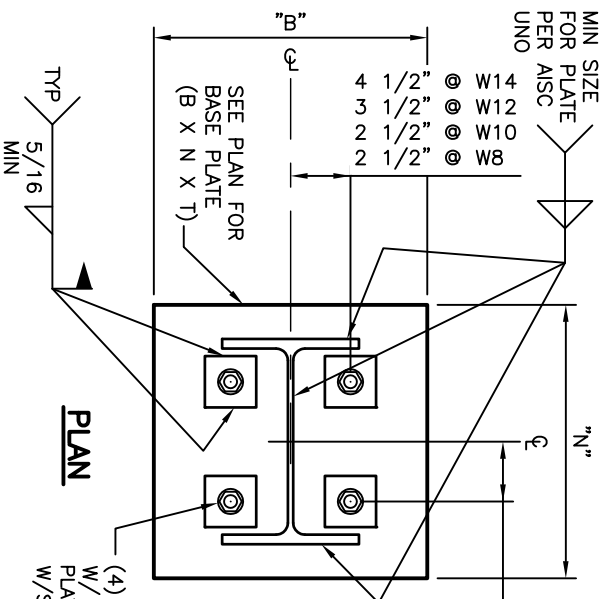
1. DETAIL TYPICAL AT HSS OR PIPE COLUMN.

COLUMN TO BEAM CONNECTION

1 1/2"=1'-0"

05 12 00-06

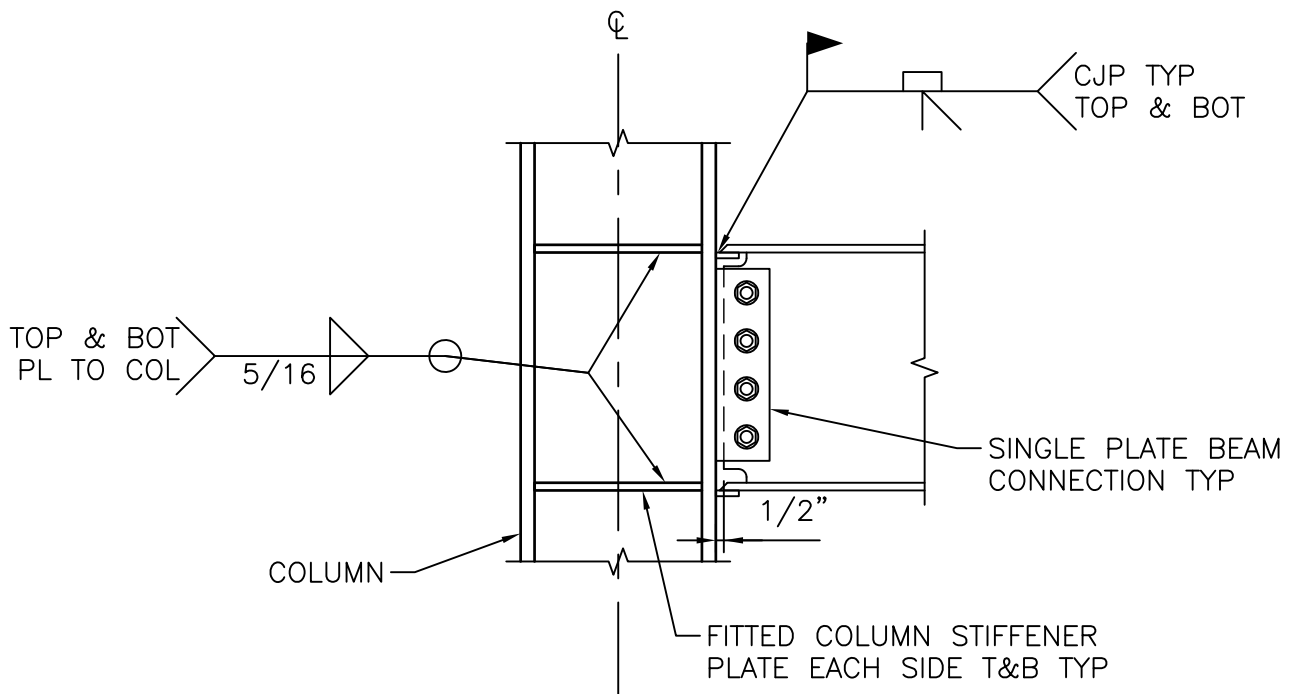
HR




NOTE:
1. SEE PLAN FOR AB Ø AND EMBED.

COLUMN BASE PLATE
NO SCALE

05 12 00-07



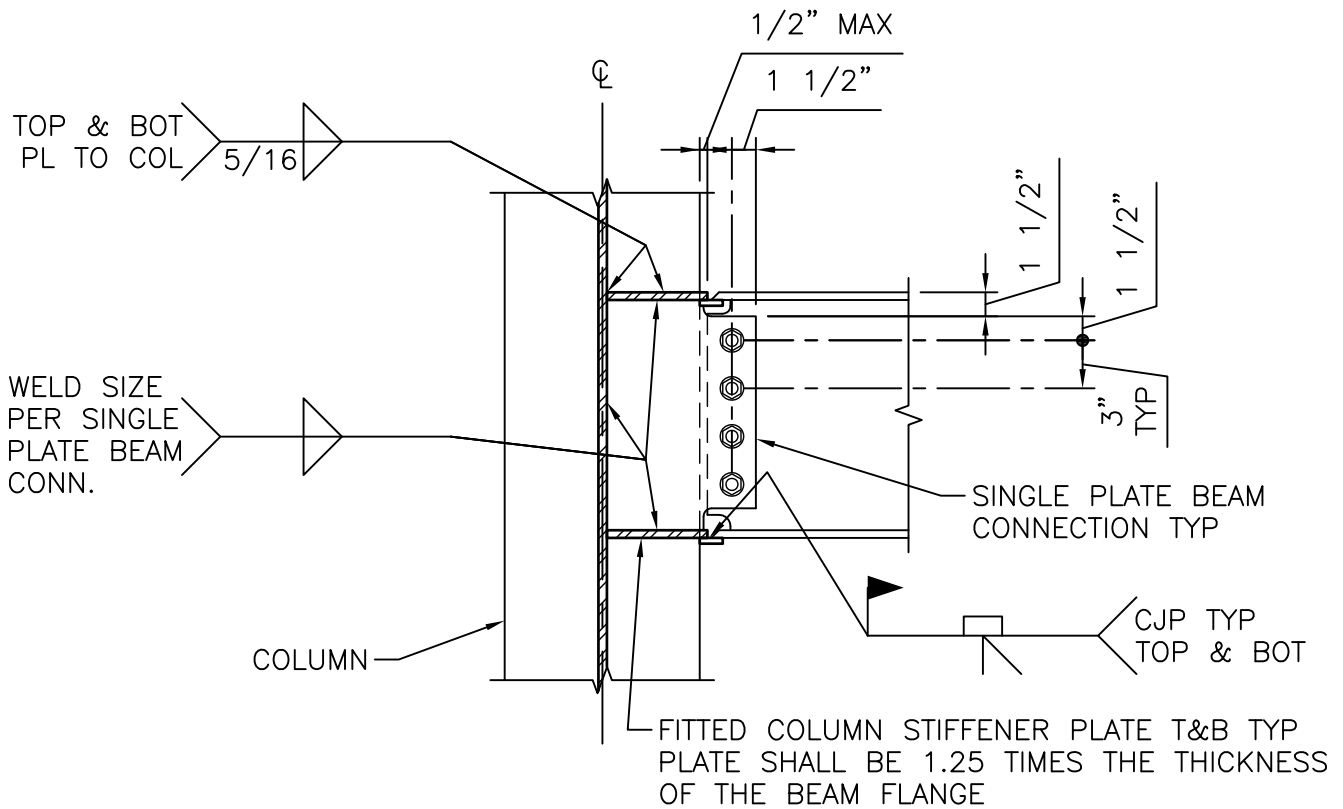
NOTE:

1. CONNECTION SHOWN THUS ON PLAN: 
2. FITTED COLUMN STIFFENER PLATE. MINIMUM THICKNESS WIDTH AND MATERIAL TO MATCH WELDED MEMBER FLANGE THICKNESS, TOTAL WIDTH AND MATERIAL.
3. PROVIDE SIM. CONN. FOR OTHER FRAMING MEMBERS NOT SHOWN FOR CLARITY.


MOMENT CONNECTION BEAM TO COLUMN FLANGE

NO SCALE

05 12 00-09



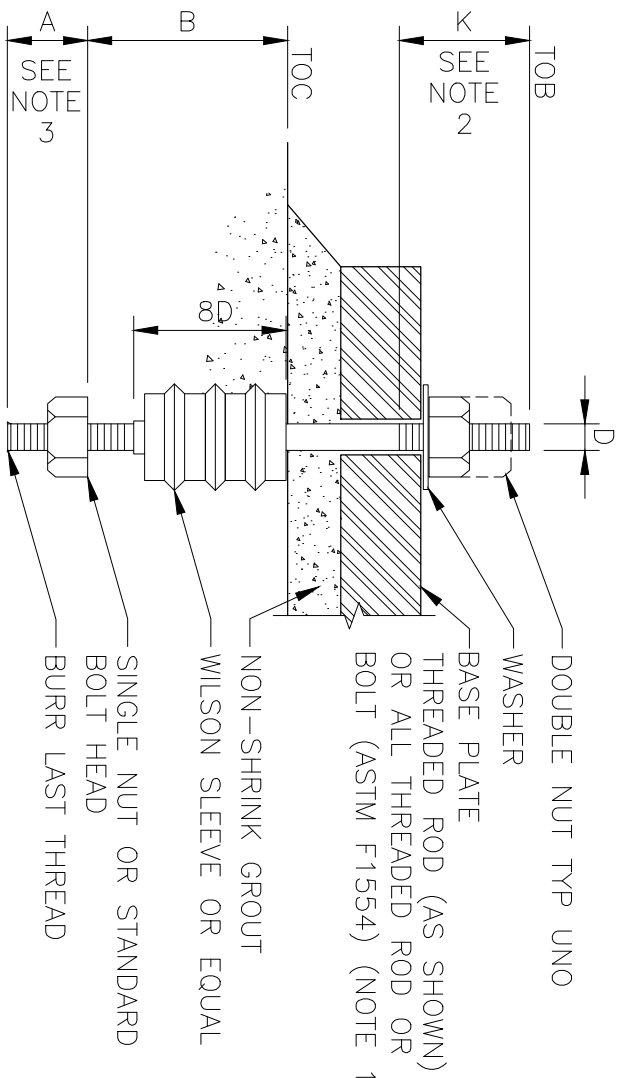
NOTE:

1. CONNECTION SHOWN THUS ON PLAN: 
2. FITTED COLUMN STIFFENER PLATE. MINIMUM WIDTH AND MATERIAL TO MATCH WELDED MEMBER FLANGE TOTAL WIDTH AND MATERIAL.
3. PROVIDE SIM. CONN. FOR OTHER FRAMING MEMBERS NOT SHOWN FOR CLARITY.

MOMENT CONNECTION BEAM TO COLUMN WEB

NO SCALE

05 12 00-10



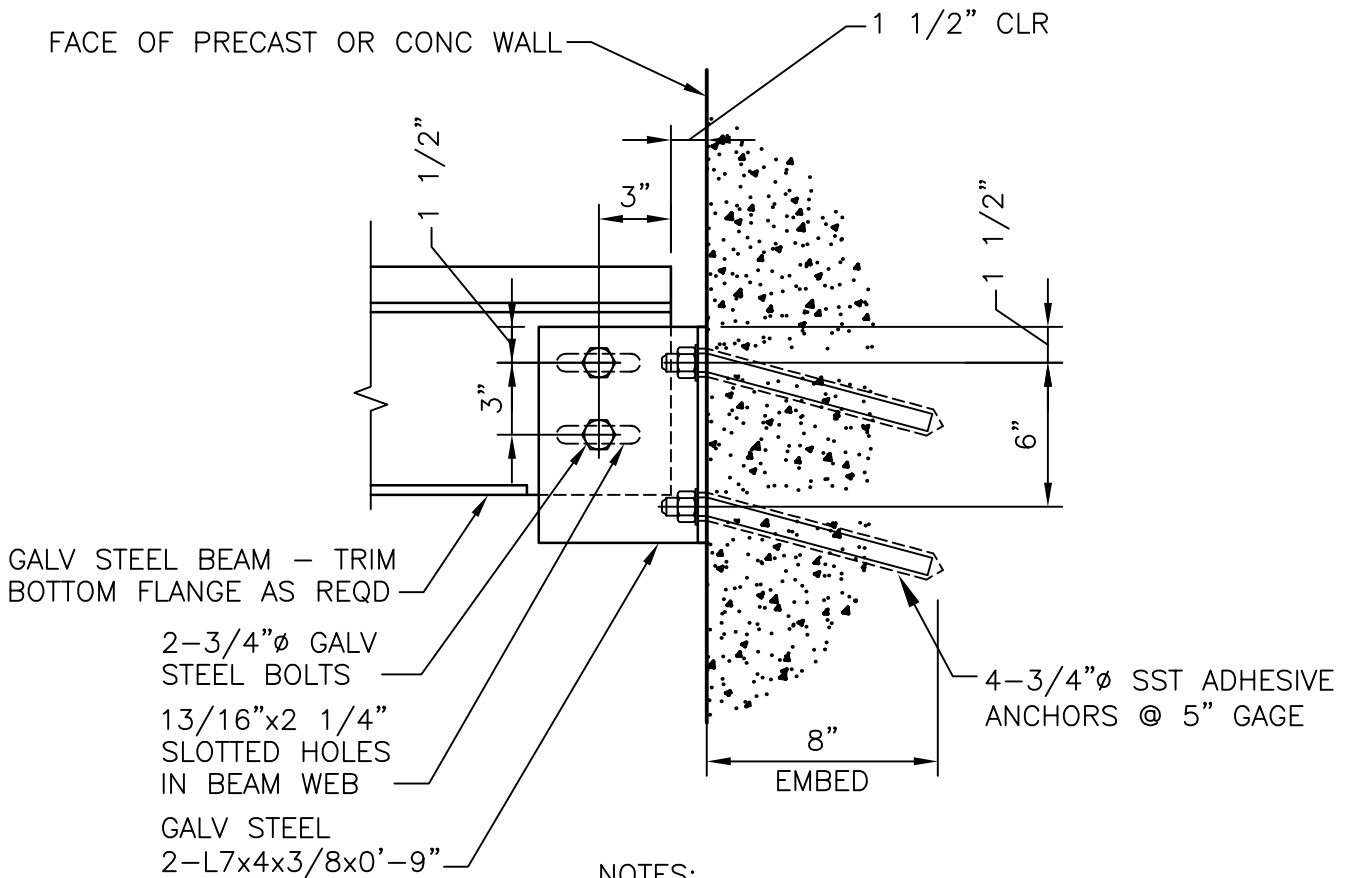
- NOTE:**
1. PROVIDE SST ANCHOR BOLTS WHERE INDICATED IN SECTIONS AND DETAILS.
 2. STANDARD BOLT THREAD LENGTH MAY BE USED WHERE APPLICABLE.
 3. DIMENSION IN SCHEDULE OR STANDARD BOLT HEAD.

SCHEDULE-ANCHOR BOLT TYPE A					REMARKS
D	A	B	K		
3/8"	1"	6"	2 3/4"		
1/2"	1 1/4"	8"	3"		
5/8"	1 1/2"	10"	3 1/4"		
3/4"	1 3/4"	12"	3 1/2"		
7/8"	2"	14"	3 3/4"		
1"	2 1/4"	16"	4"		
1 1/8"	2 1/2"	18"	4 1/4"		
1 1/4"	2 3/4"	20"	4 1/2"		
1 3/8"	3"	22"	4 3/4"		
1 1/2"	3 1/4"	24"	5"		
1 3/4"	3 3/4"	28"	5 1/2"		
2"	4 1/4"	32"	6"		
2 1/2"	5 1/2"	48"	7"		
3"	6 1/4"	66"	8"		

ANCHOR BOLT DETAIL

NOT TO SCALE

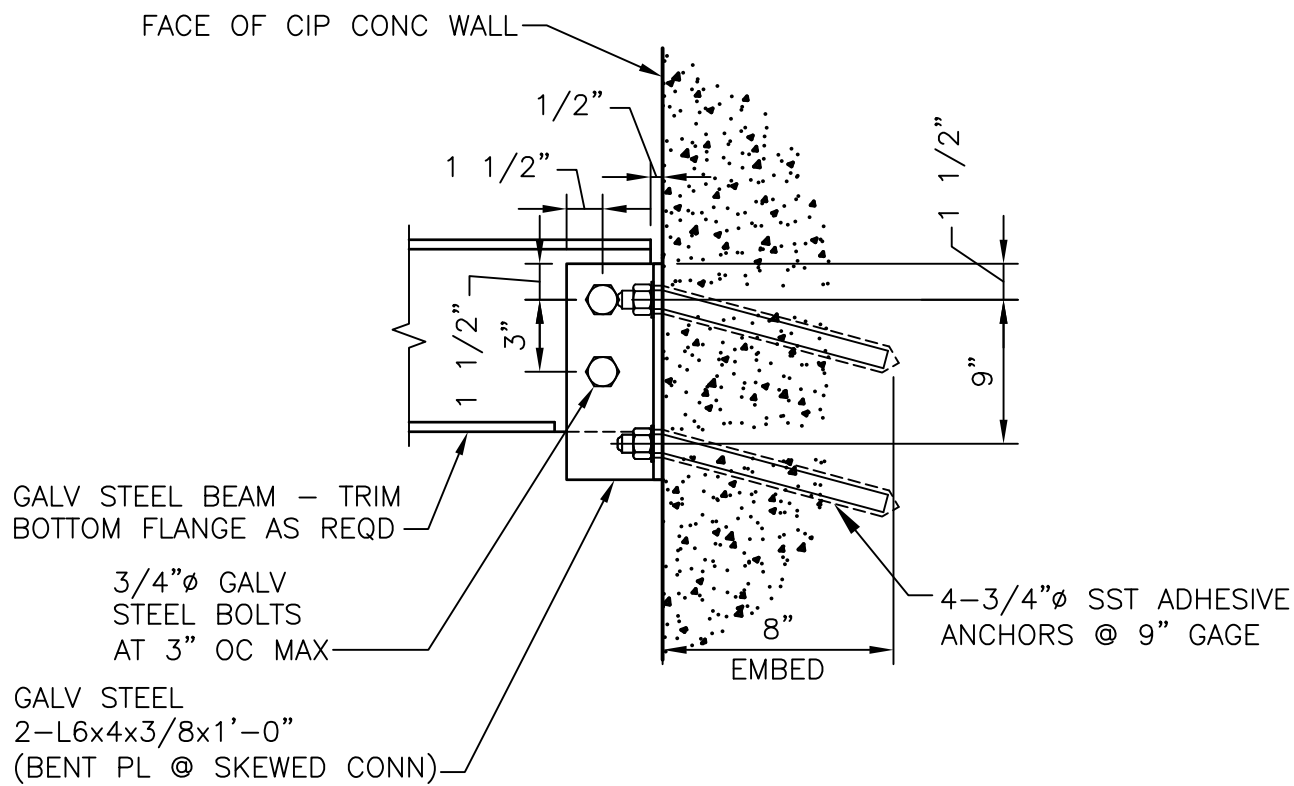
05 12 00-11



STEEL BEAM TO CONCRETE CONNECTION DETAIL

1 1/2"=1'-0"

05 12 00-13



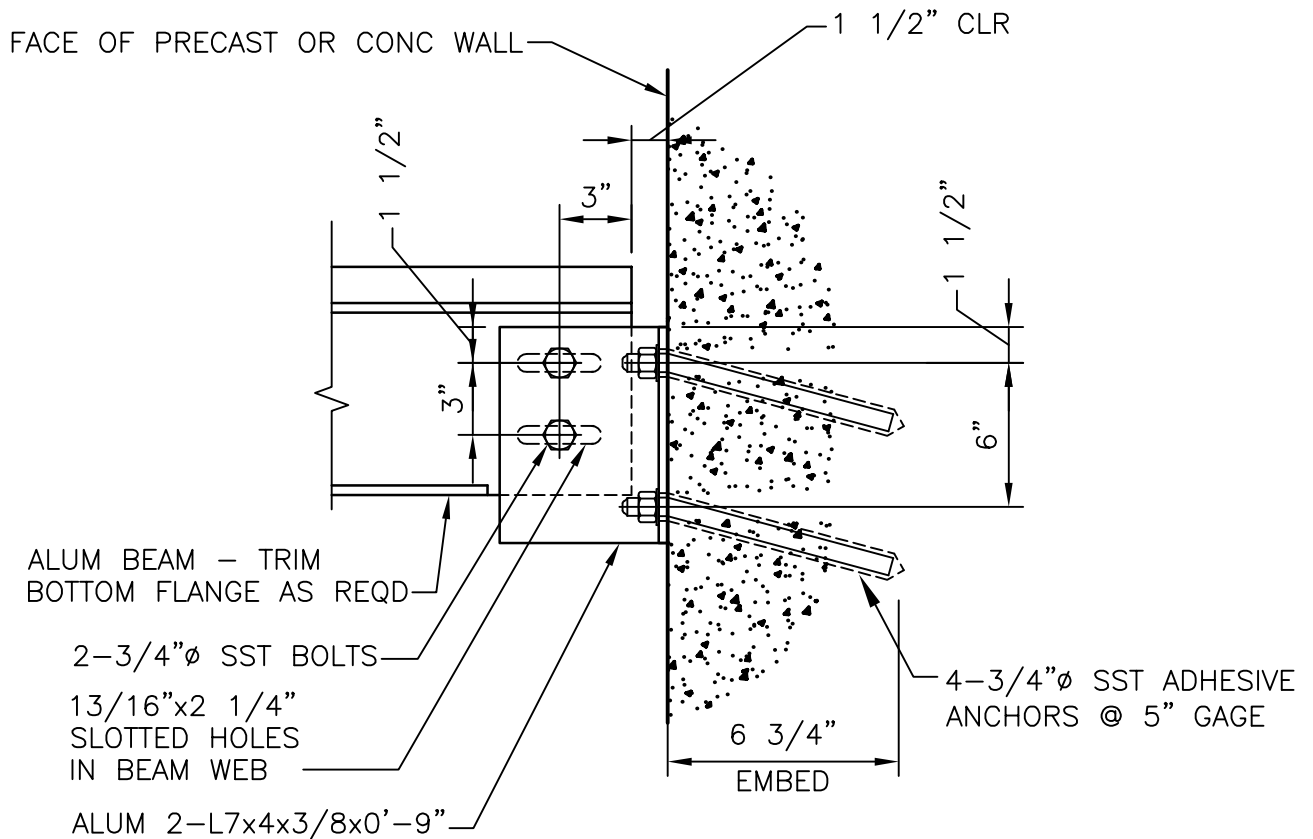
NOTES:

1. FIELD LOCATE VERTICAL REINF PRIOR TO INSTALLING ANCHORS. FIELD ADJUST ANGLES TO AVOID REINF. DO NOT DAMAGE EXISTING REINF.

STEEL BEAM TO CONCRETE CONNECTION DETAIL

1 1/2"=1'-0"

05 12 00-14



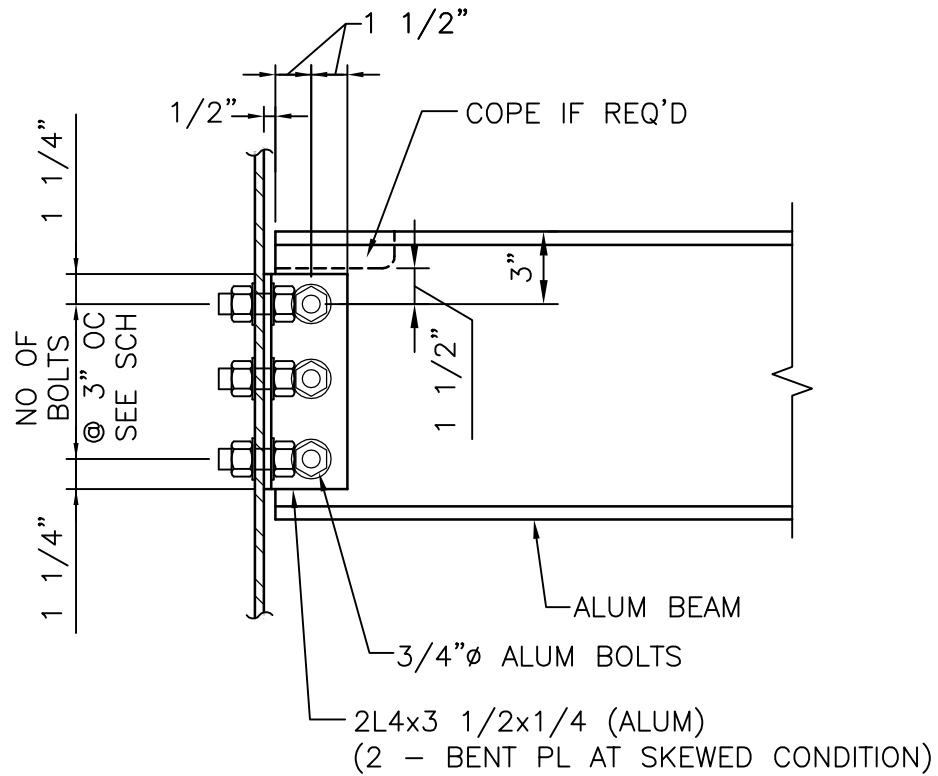
NOTES:

1. FIELD LOCATE VERTICAL REINF PRIOR TO INSTALLING ANCHORS. FIELD ADJUST ANGLES TO AVOID REINF. DO NOT DAMAGE EXISTING REINF.

ALUMINUM BEAM TO CONCRETE CONNECTION DETAIL

1 1/2" = 1'-0"

05 14 00-01



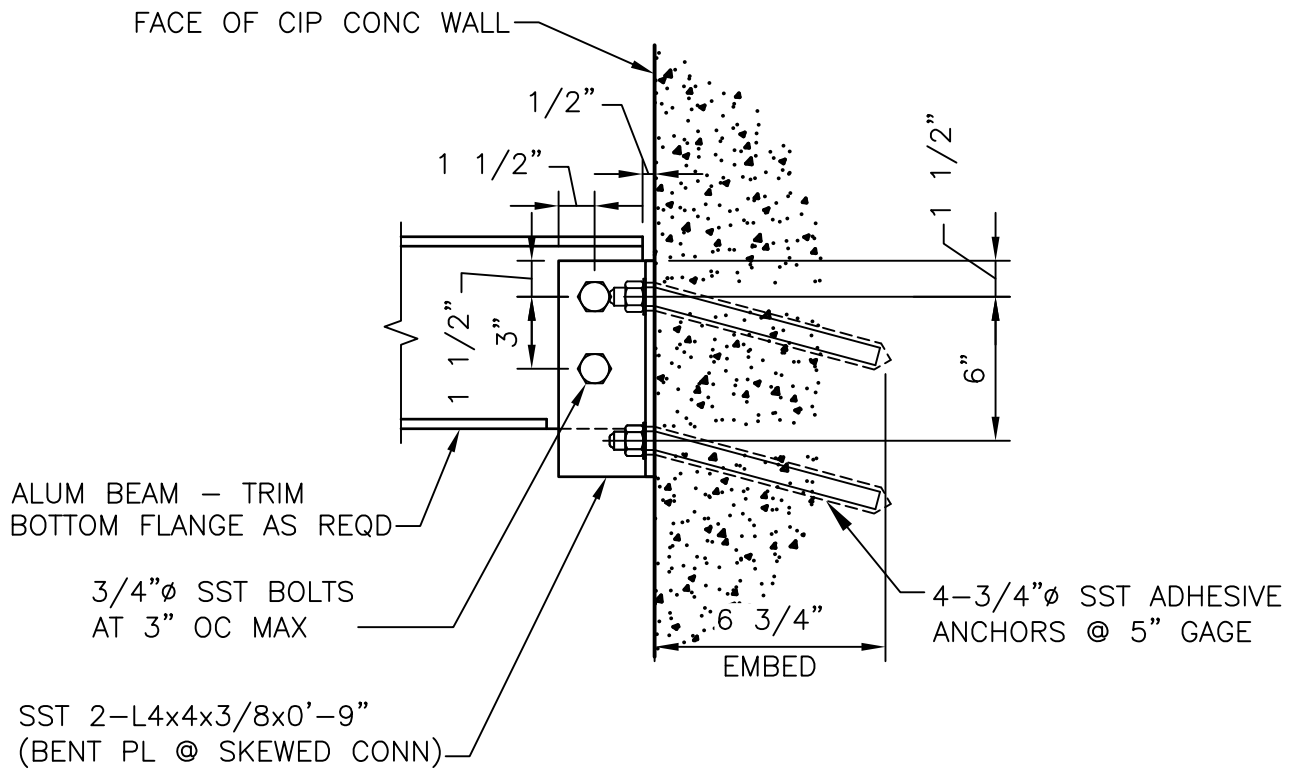
BOLTED CONNECTION SCHEDULE

BEAM SIZE	NUMBER OF BOLTS
I10	2
I12	3

TYPICAL ALUMINUM BEAM CONNECTION

1 1/2"=1'-0"

05 14 00-02



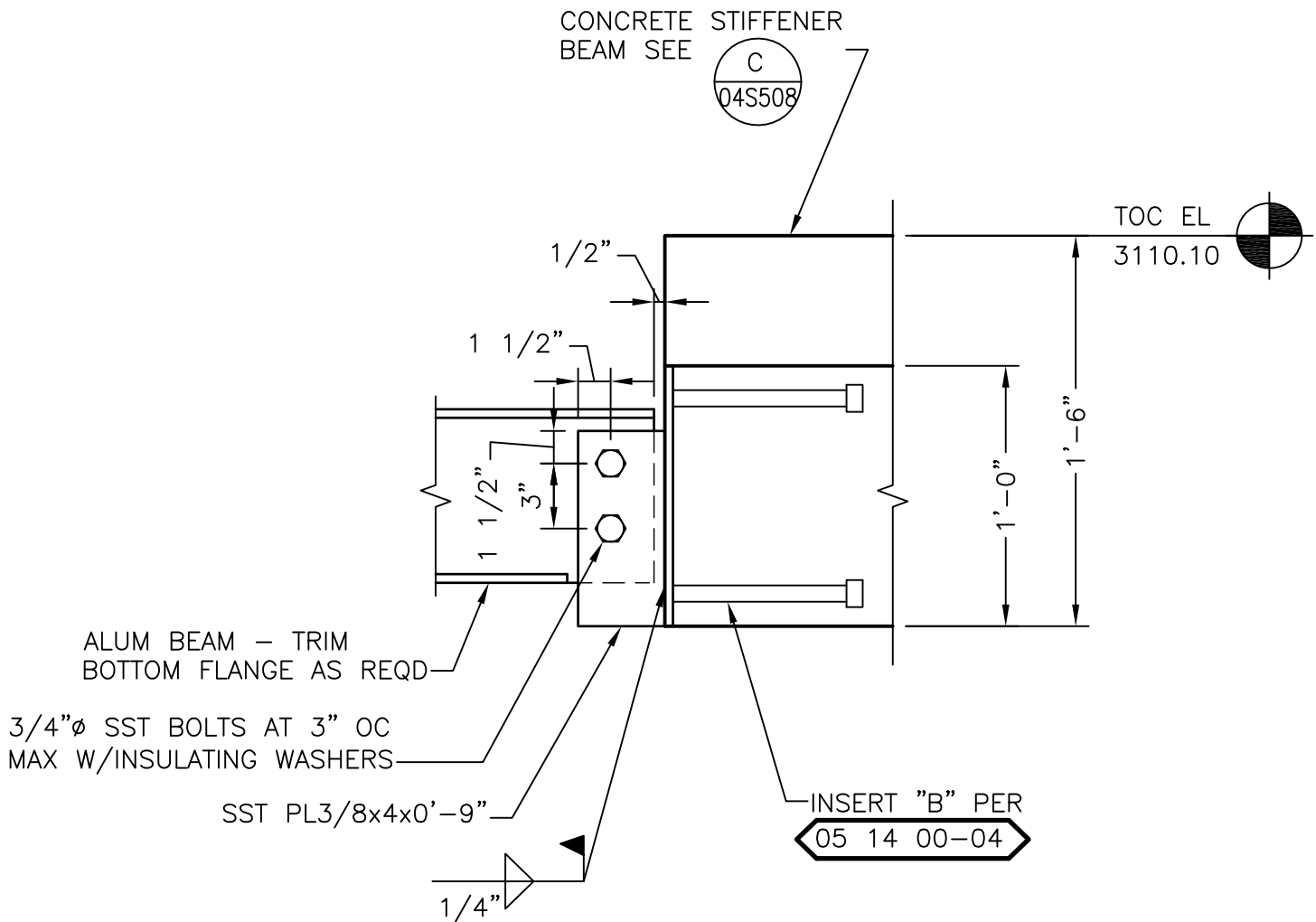
NOTES:

1. FIELD LOCATE VERTICAL REINF PRIOR TO INSTALLING ANCHORS. FIELD ADJUST ANGLES TO AVOID REINF. DO NOT DAMAGE EXISTING REINF.

ALUMINUM BEAM TO CONCRETE CONNECTION DETAIL

1 1/2"=1'-0"

05 14 00-03



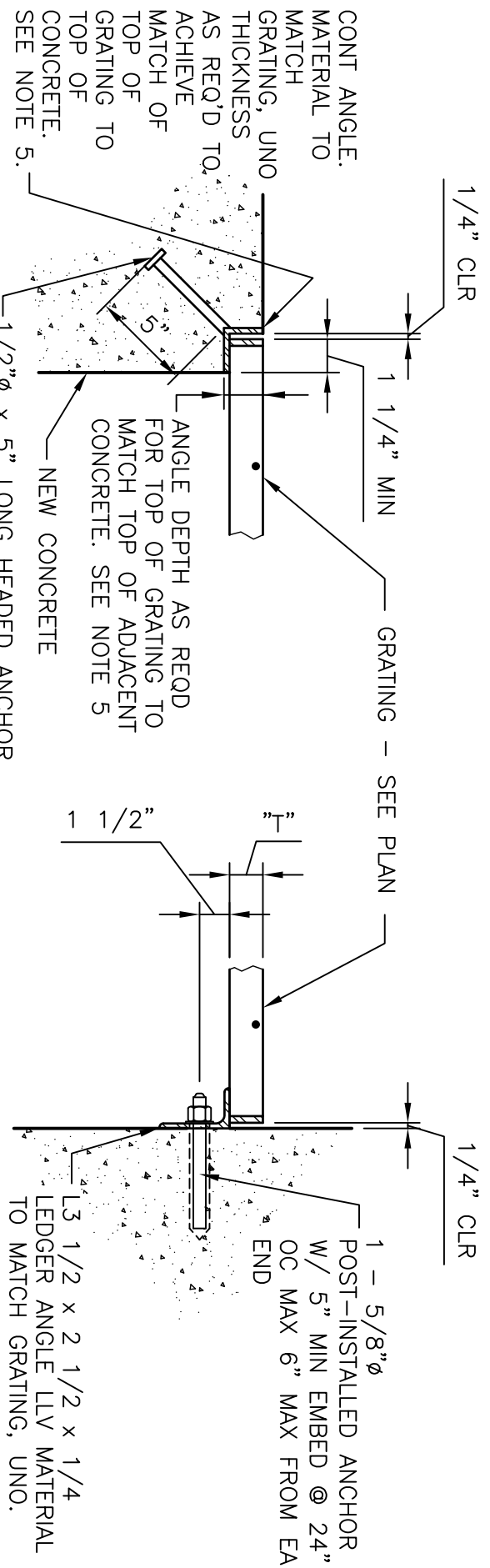
NOTES:

1. POSITION EMBED PLATE TO AVOID BEAM LONGITUDINAL REINFORCING.
2. PROVIDE DISSIMILAR METALS PROTECTION BETWEEN ALUM BEAM AND SST PLATE PER SPEC SECTION 09 96 00.

ALUMINUM BEAM TO CONCRETE STIFFENER BEAM DETAIL

1 1/2"=1'-0"

05 14 00-04



NOTES:

1. GRATING SIZE AND MATERIAL PER CONTRACT DOCUMENTS. ANCHORS SHALL BE TYPE 316 SST.
2. ALL ENDS AND OPENINGS SHALL BE BANDED, SEE SPECIFICATION.
3. ATTACH GRATING TO ALL SUPPORT ANGLES WITH BOLTED CLIPS, SPACED AT 2'-0" MAX CENTERS.
4. CONT ANGLE WITH ADD'L CONT PL SIMILAR TO CHECKER PL SUPPORT DETAIL 05 50 00-02 MAY BE USED TO ACHIEVE MATCH OF TOP OF GRATING TO TOP OF CONCRETE IN LIEU OF USING THICKNESS OF CONT ANGLE TO ACHIEVE MATCH OF TOP OF GRATING TO TOP OF CONCRETE SHOWN.
5. ALL EMBEDDED ITEMS AND SUPPORT ANGLES SHALL BE SST AT ALUMINIUM GRATING.
6. AT COVERED GRATING LOCATIONS, THE TOP OF COVERED GRATING SHALL BE FLUSH WITH THE TOP OF THE CONCRETE.

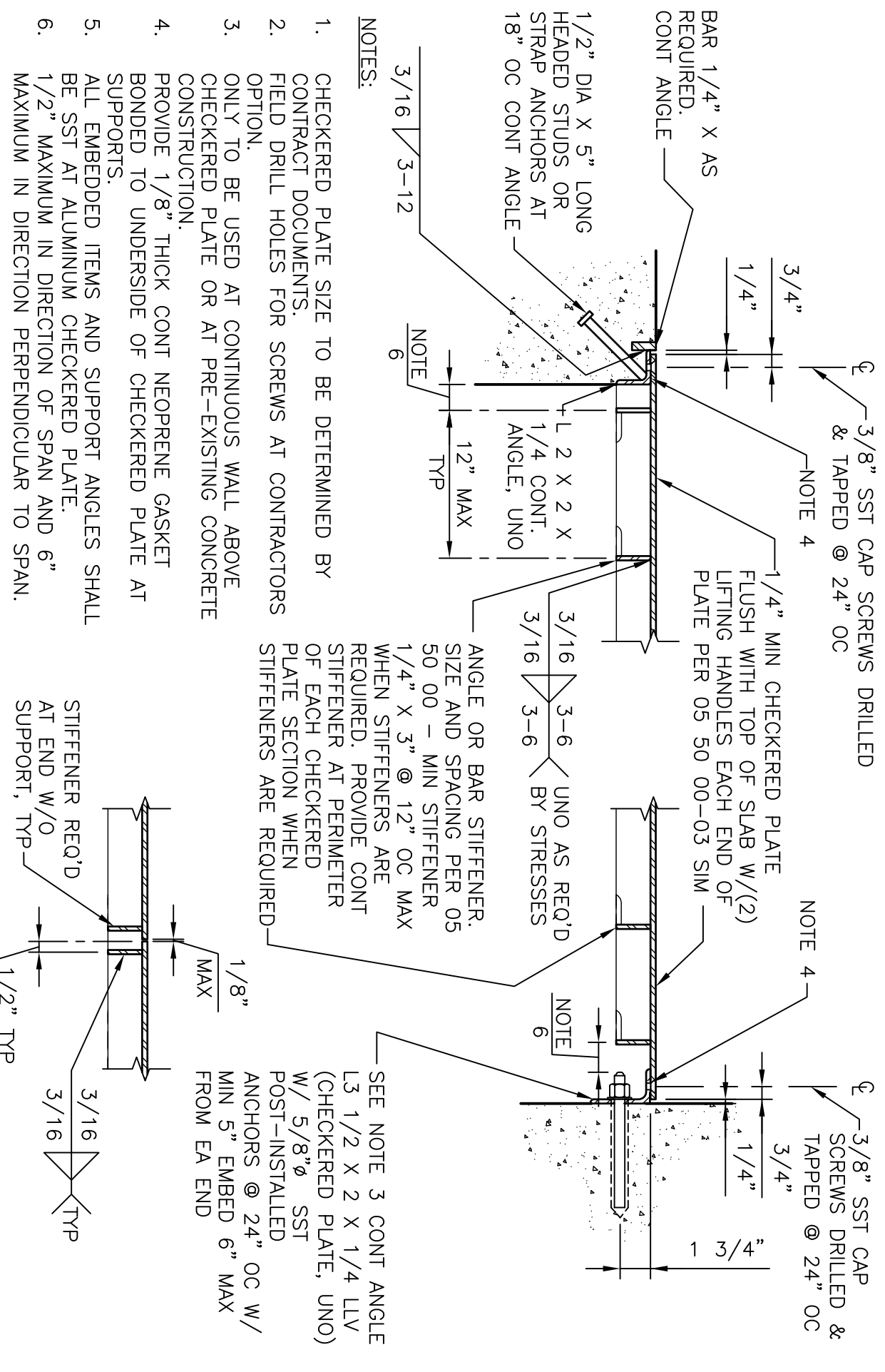
ONLY TO BE USED AT CONT WALL ABOVE GRATING OR AT PRE-EXISTING CONCRETE CONSTRUCTION

GRATING AND SUPPORT DETAIL

NOT TO SCALE

05 50 00-01





- CHECKERED PLATE SIZE TO BE DETERMINED BY CONTRACT DOCUMENTS.
- FIELD DRILL HOLES FOR SCREWS AT CONTRACTORS OPTION.
- ONLY TO BE USED AT CONTINUOUS WALL ABOVE CHECKERED PLATE OR AT PRE-EXISTING CONCRETE CONSTRUCTION.
- PROVIDE 1/8" THICK CONT NEOPRENE GASKET BONDED TO UNDERSIDE OF CHECKERED PLATE AT SUPPORTS.
- ALL EMBEDDED ITEMS AND SUPPORT ANGLES SHALL BE SST AT ALUMINUM CHECKERED PLATE.
- 1/2" MAXIMUM IN DIRECTION OF SPAN AND 6" MAXIMUM IN DIRECTION PERPENDICULAR TO SPAN.

CHECKERED PLATE SUPPORT

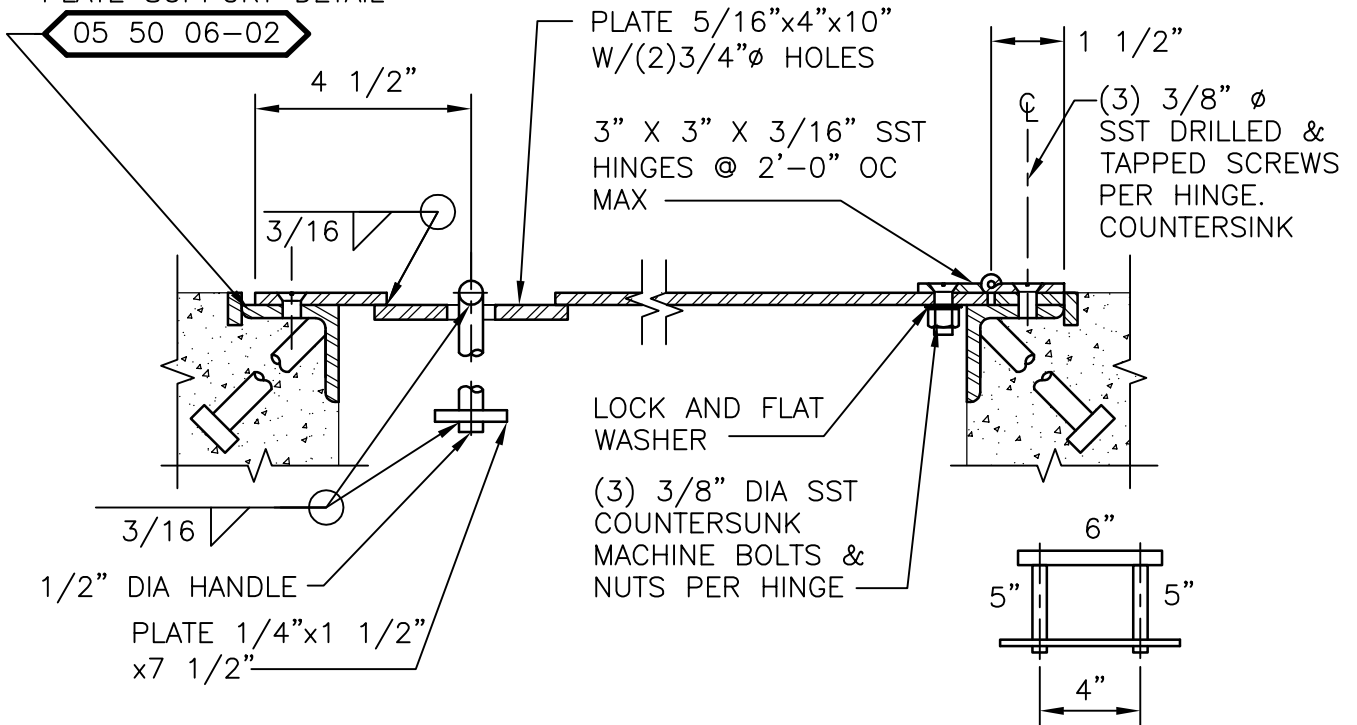
NOT TO SCALE

05 50 00-02



REFERENCE CHECKERED
PLATE SUPPORT DETAIL

05 50 06-02



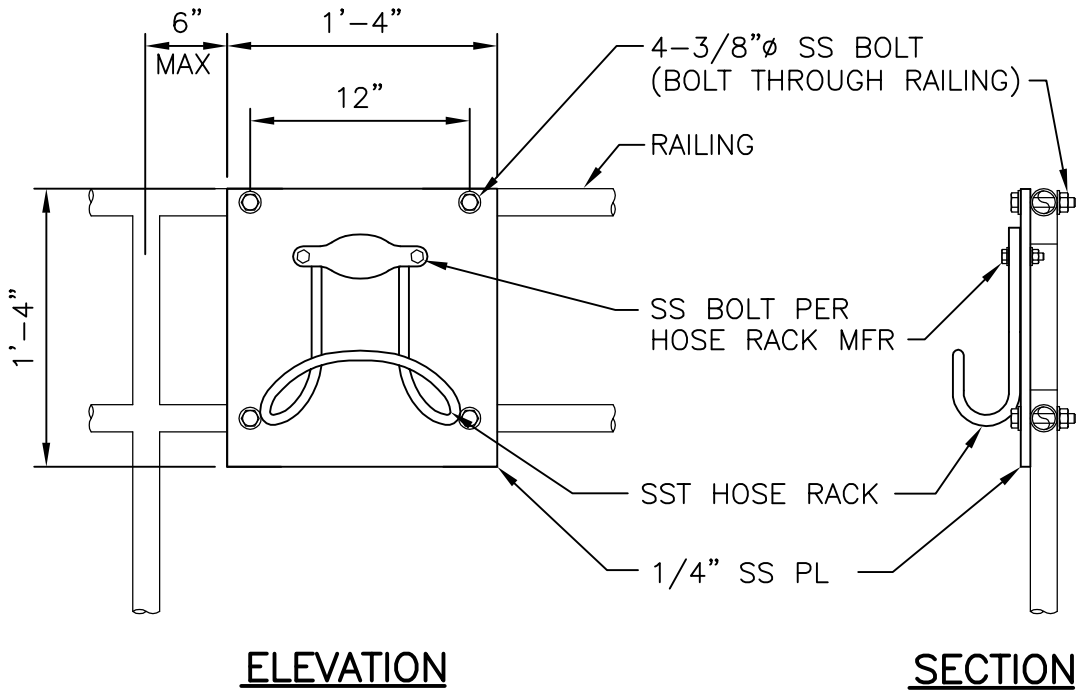
HANDLE DETAIL

(USE WHERE
SHOWN ON
DRAWINGS)

CHECKERED PLATE
ACCESS HATCH

NOT TO SCALE

05 50 00-03



ELEVATION

SECTION

NOTE:

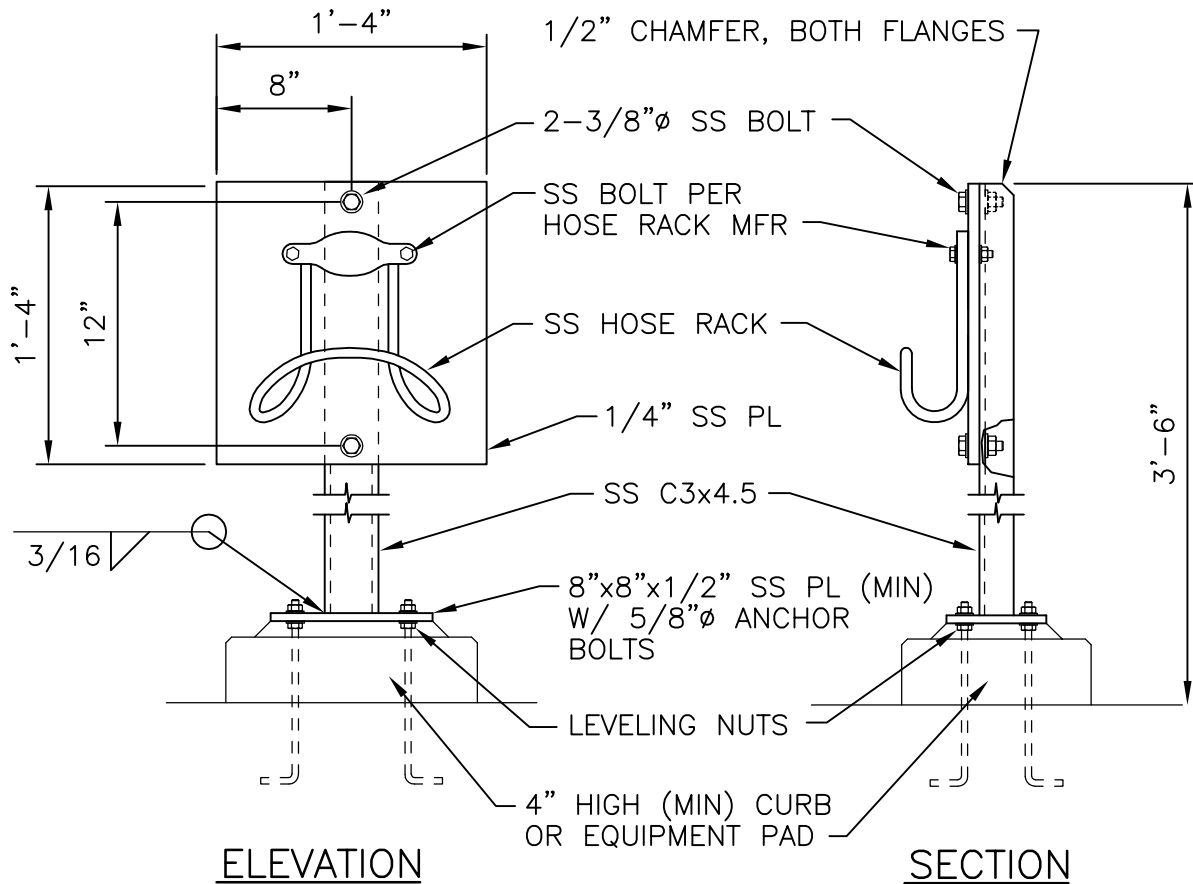
REMOVE ALL BURRS AND SHARP EDGES.

**RAILING MOUNTED HOSE
RACK**

NOT TO SCALE

05 50 00-04





NOTE:

REMOVE ALL BURRS AND SHARP EDGES.

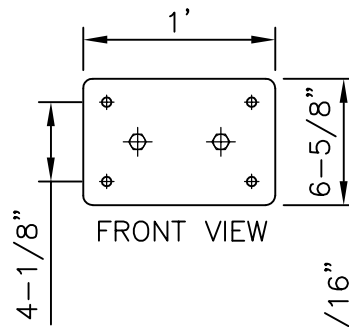
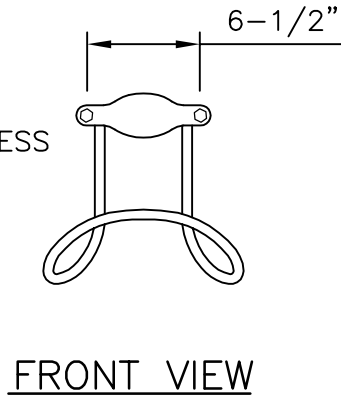
FLOOR MOUNTED HOSE RACK

NOT TO SCALE

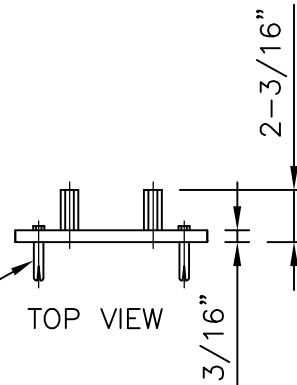
05 50 00-05



NOTE:
ALL STAINLESS
STEEL



4-SLEEVE
ANCHORS
PROVIDED BY
MANUFACTURER



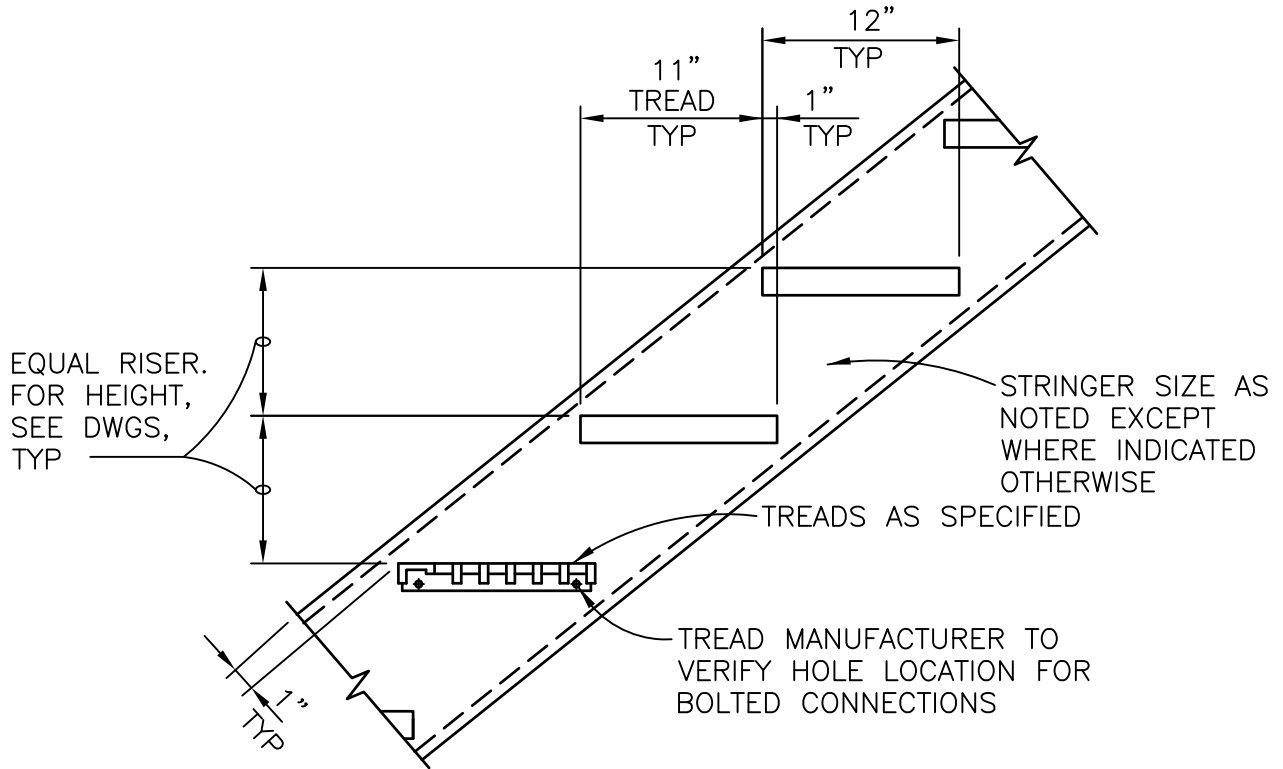
MOUNTING PLATE

WALL MOUNTED HOSE RACK

NOT TO SCALE

05 50 00-06





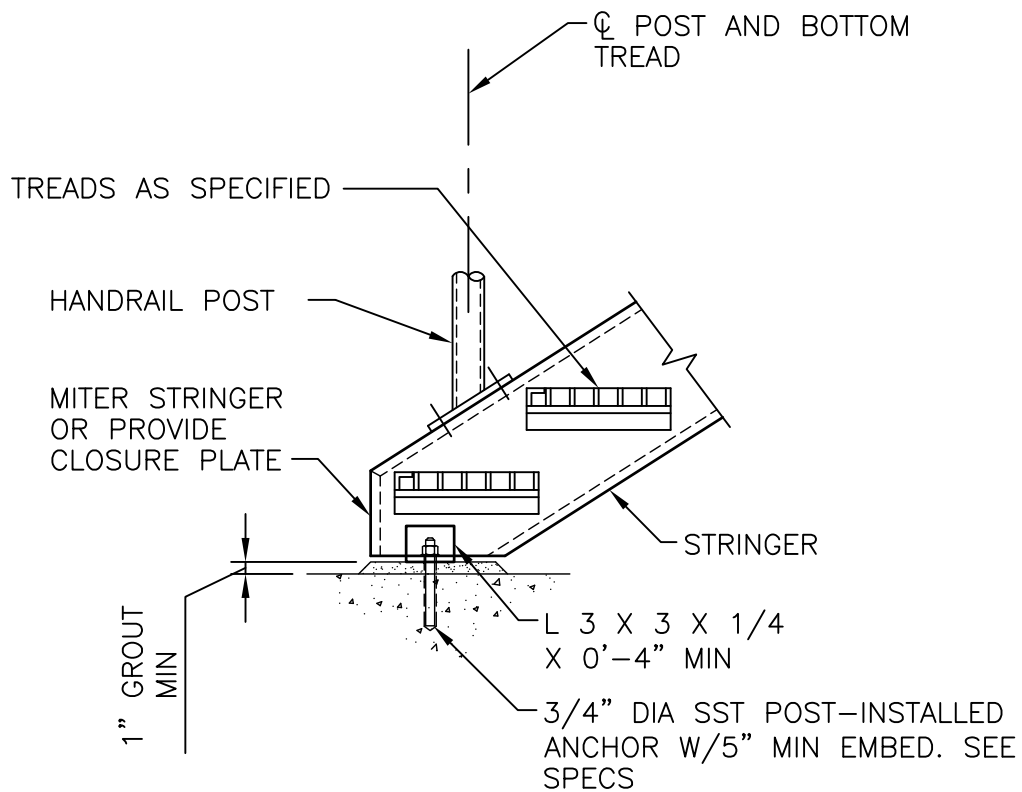
NOTES:

1. FOR MATERIALS USED FOR STAIRWAY, SEE PLANS AND OR SPECS. USE C12x20.7 FOR STEEL STRINGERS AND C12x7.41 FOR ALUMINUM STRINGERS.
2. STAIR HANDRAIL NOT SHOWN.

STAIR DETAIL

NOT TO SCALE

05 50 00-07



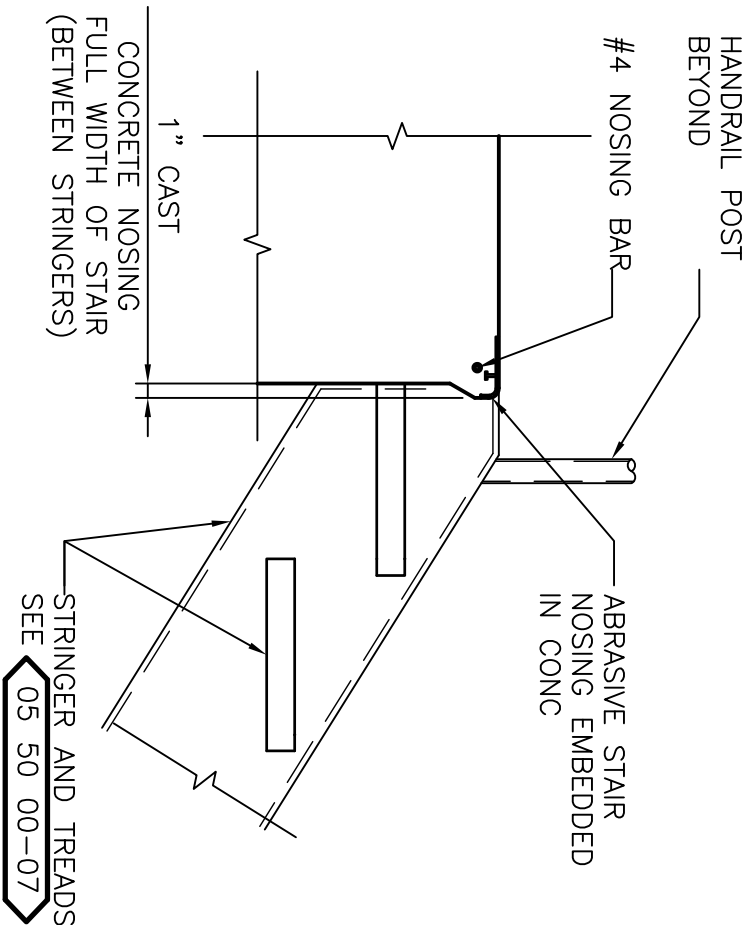
NOTES:

1. ALL STAIRS AND APPURTENANT ITEMS SHOWN ON DRAWINGS SHALL BE ALUMINUM UNLESS SHOWN AS OTHERWISE ON DRAWINGS. ALL FASTENERS SHALL BE STAINLESS STEEL TYPE 316.
2. SEE ARCH STAIR SCHEDULE AND DETAILS, AS APPLICABLE.

STAIR BOTTOM CONNECTION

NOT TO SCALE

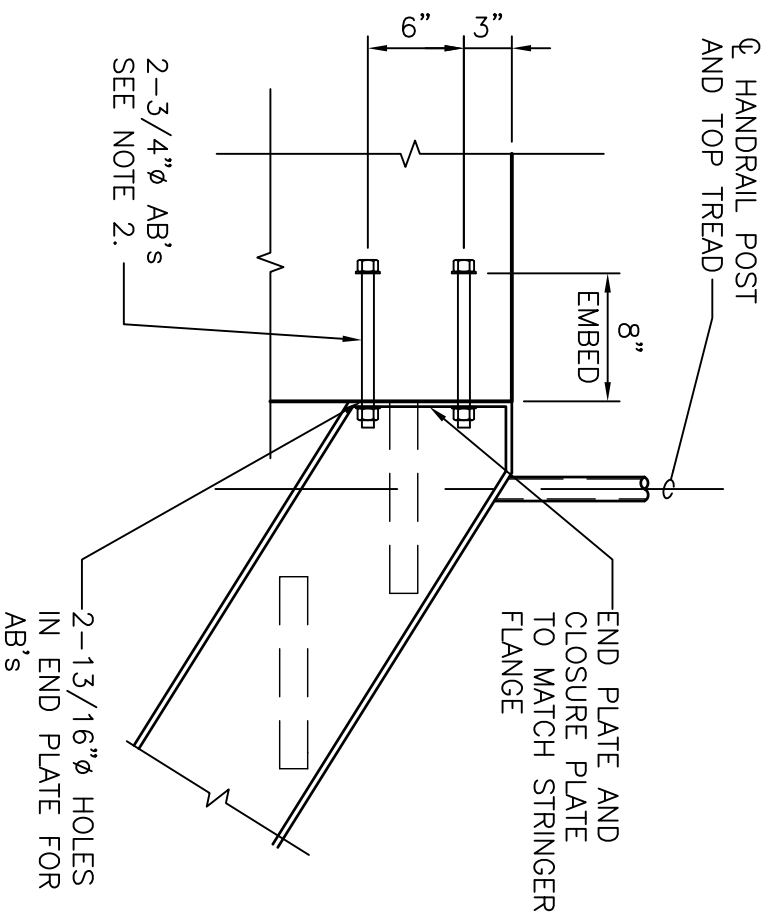
05 50 00-08



SECTION BETWEEN STRINGERS

NOTES:

1. SEE SPECIFICATIONS AND DRAWINGS FOR STAIR MATERIAL TYPE.
2. ANCHOR BOLT MATERIAL SHALL MATCH STAIR MATERIAL TYPE EXCEPT THAT ALUMINUM STAIRS SHALL USE SST TYPE 316 ANCHOR BOLTS. USE SST TYPE 316 ADHESIVE ANCHORS AT EXISTING CONCRETE ONLY.

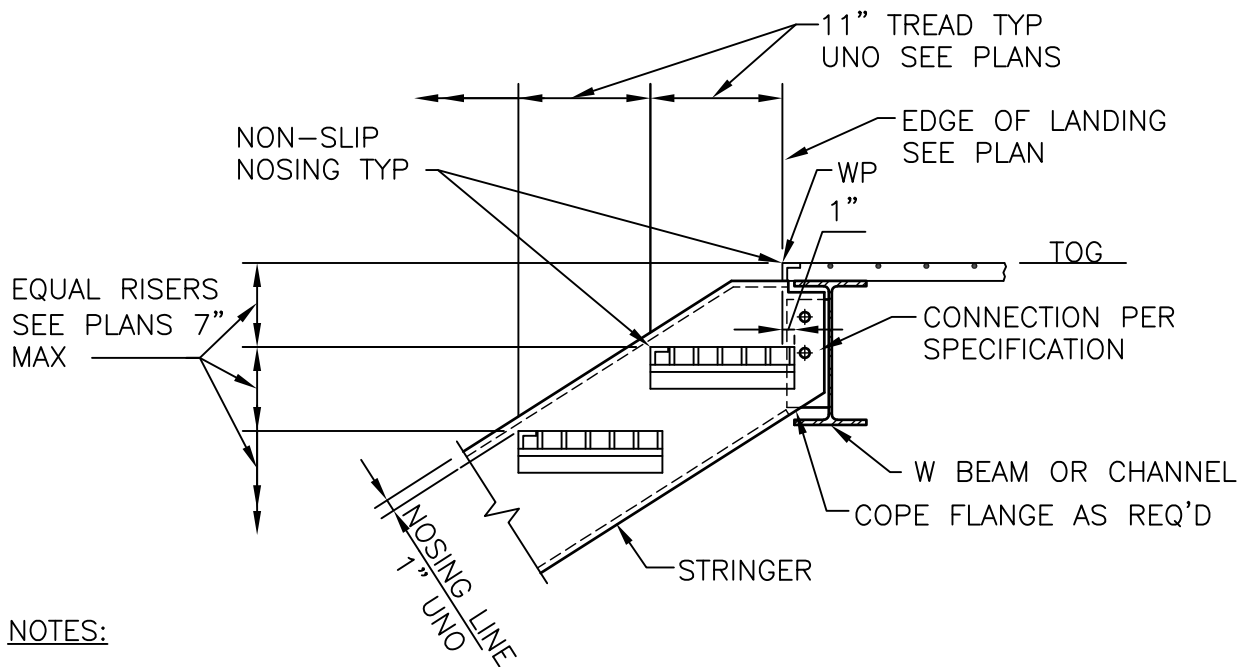


DETAIL AT STRINGERS

STAIR TOP CONNECTION AT CONCRETE

NOT TO SCALE

05 50 00-09



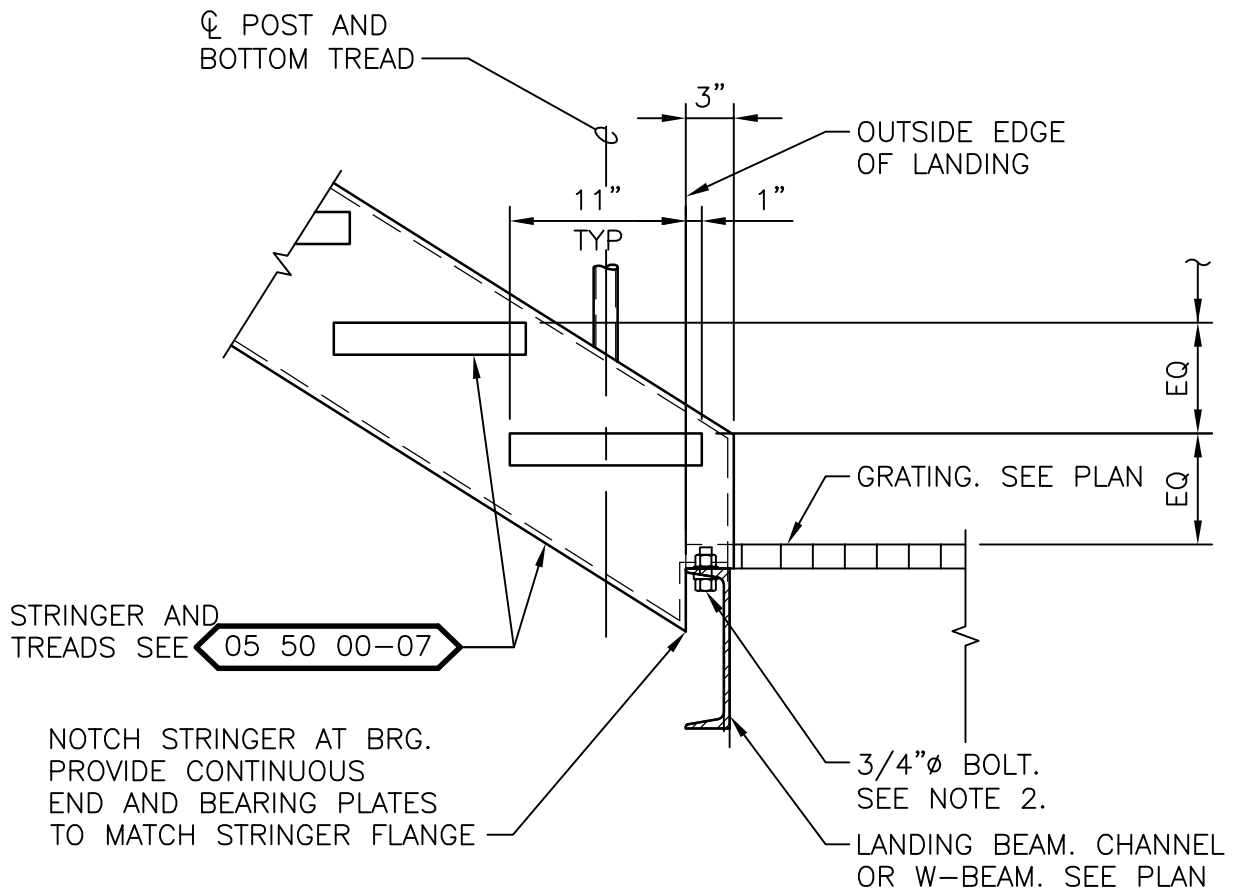
NOTES:

1. SEE SPECS AND DRAWINGS FOR MATERIAL TYPE.
2. FASTENER MATERIAL SHALL MATCH STAIR MATERIAL TYPE EXCEPT THAT ALUMINUM STAIRS SHALL USE SST TYPE 316 FASTENERS.
3. SEE ARCH STAIR SCHEDULE AS APPLICABLE.
4. SEE SPECIFICATIONS FOR DESIGN REQUIREMENTS.

STAIR TOP CONNECTION AT BEAM

NOT TO SCALE

05 50 00-10



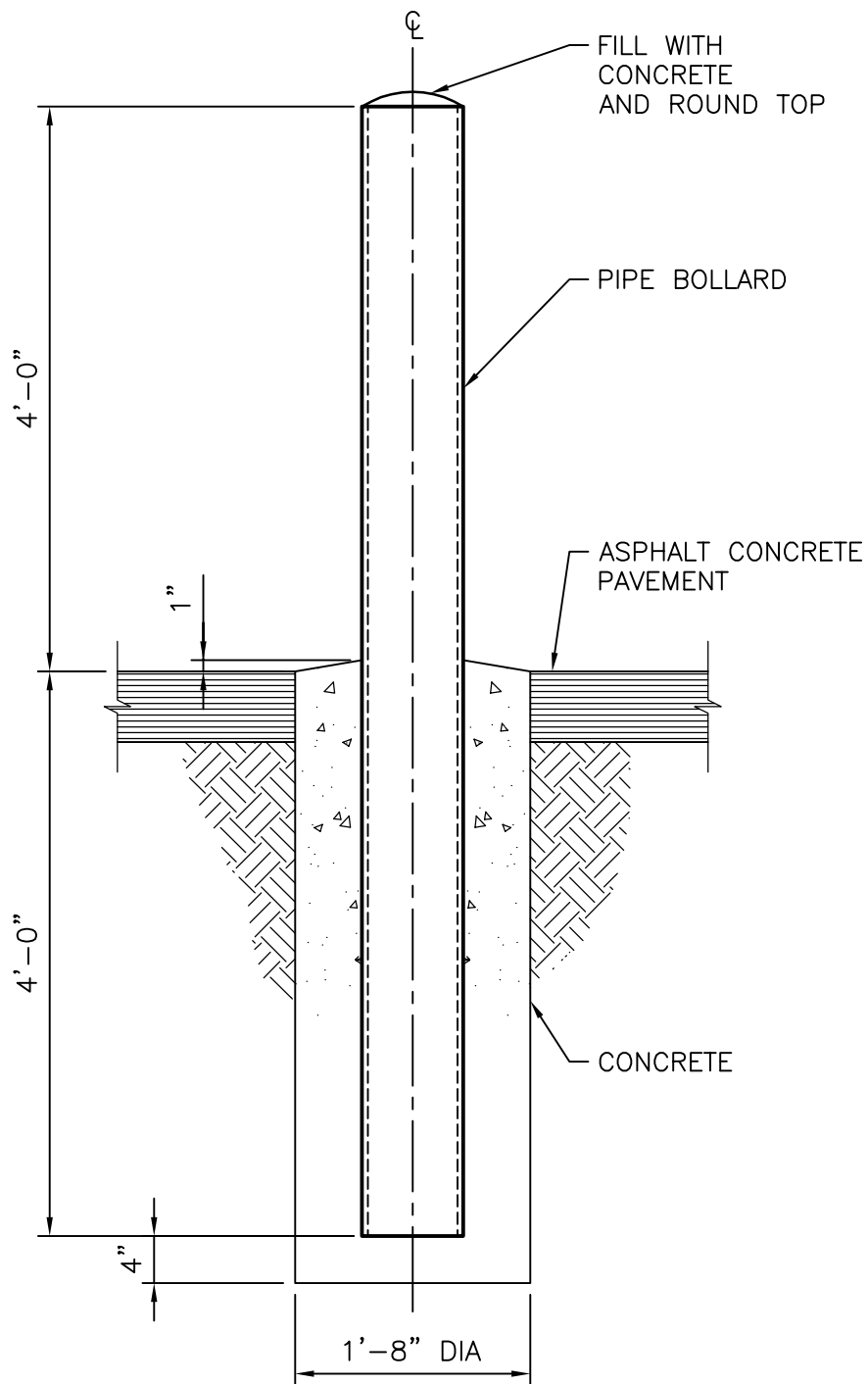
NOTES:

1. SEE SPECIFICATIONS AND DRAWINGS FOR STAIR MATERIAL TYPE.
2. BOLT MATERIAL SHALL MATCH STAIR MATERIAL TYPE EXCEPT THAT ALUMINUM STAIRS SHALL USE SST TYPE 316 ANCHOR BOLTS.

STAIR BOTTOM CONNECTION AT BEAM

NOT TO SCALE

05 50 00-11



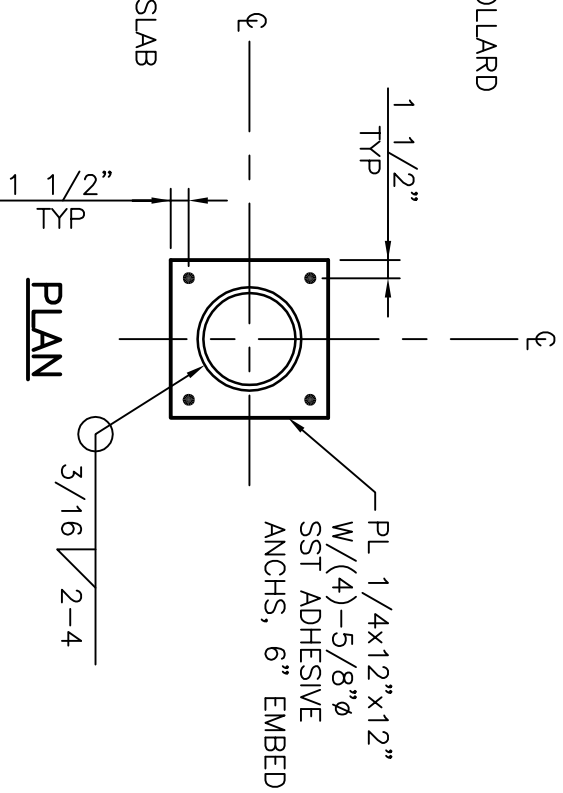
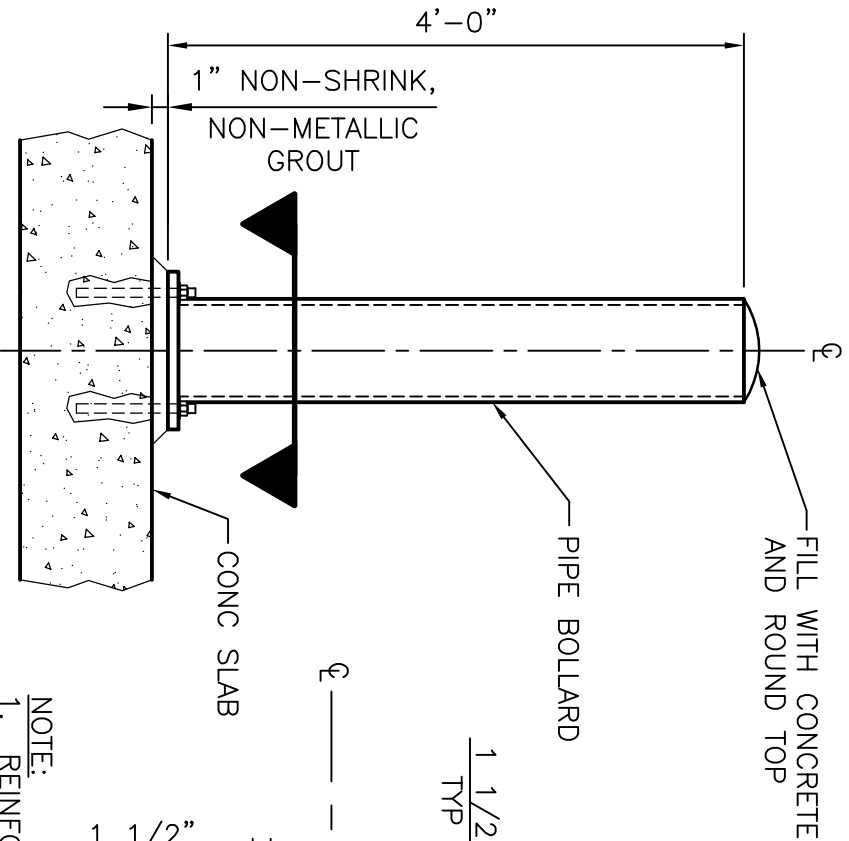
NOTE:

1. FOR BOLLARD AT CONCRETE SLAB, SEE 05 50 00-14A

BOLLARD

NOT TO SCALE

05 50 00-14



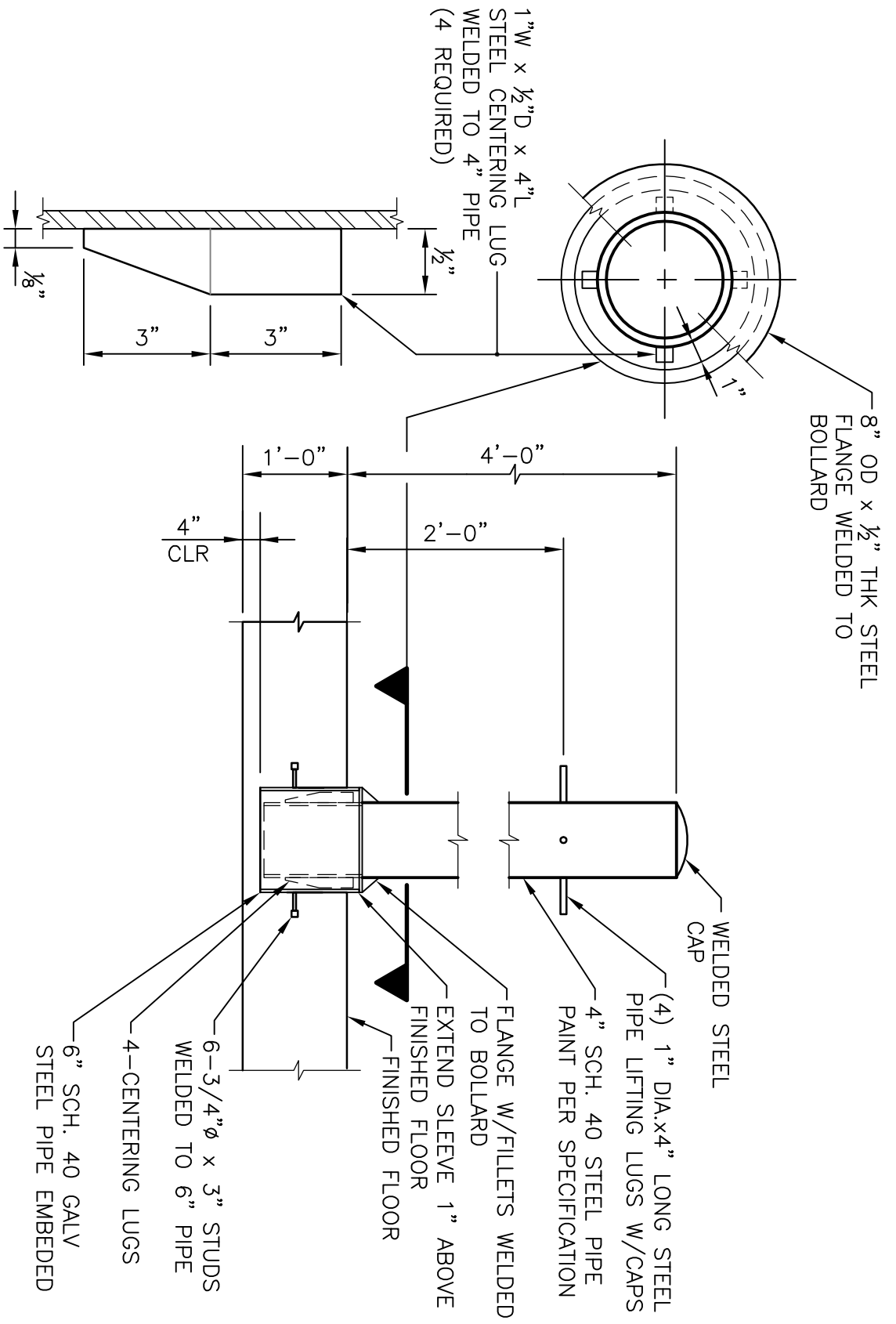
NOTE:
 1. REINFORCING FOR CONCRETE SLAB NOT SHOWN.

SECTION

**INTERIOR BOLLARD
 STRUCTURED FLOOR SLAB**

3/4"=1'-0"

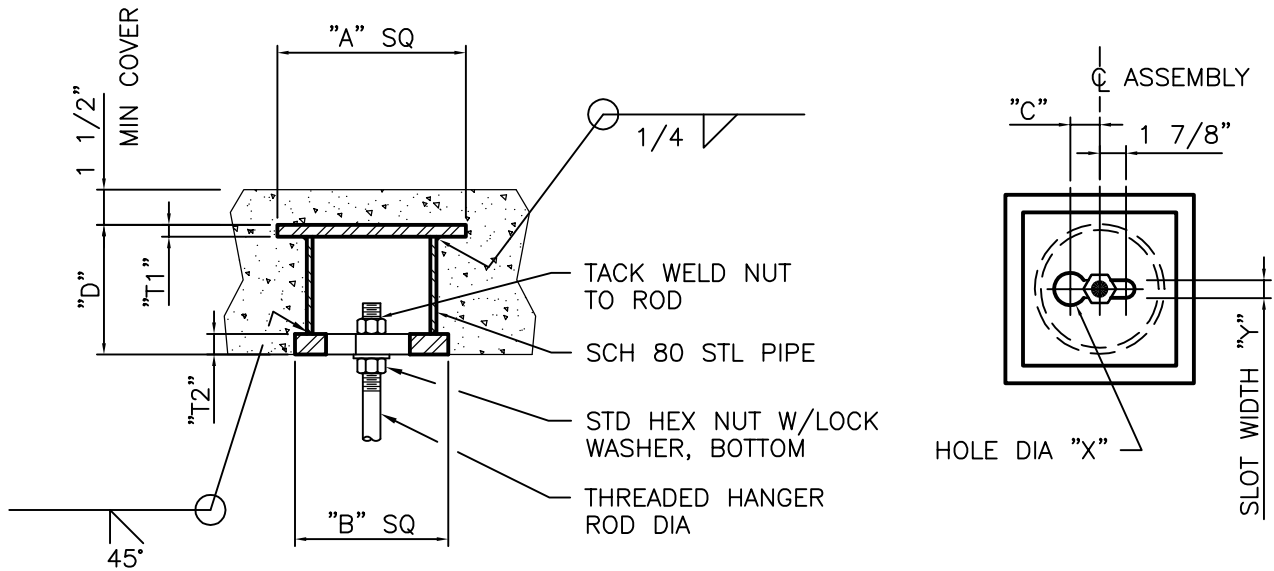
05 50 00-14A



REMOVABLE BOLLARD DETAIL

NOT TO SCALE

05 50 00-14B



SIDE SECTION

SECTION FROM BOTTOM

HANGER ROD DIAMETER (IN)	"A" (IN)	"B" (IN)	"C" (IN)	"D" (IN)	"X" (IN)	"Y" (IN)	PIPE DIA (IN)	"T1" (IN)	"T2" (IN)	MAX. HANGER LOAD (KIPS)
3/8	7	5 1/2	1 1/4	5 1/2	1	1/2	4	1/2	1/2	2
1/2	7	5 1/2	1 1/4	5 1/2	1	5/8	4	1/2	5/8	4
3/4	8	6 1/2	1 1/4	5 1/2	1 3/8	7/8	5	1/2	7/8	8
7/8	8	6 1/2	1 1/2	7 1/2	1 9/16	1	5	1/2	1	11
1	9	8	1 1/2	8	1 13/16	1 1/8	6	5/8	1 1/8	15
1 1/4	9	8	1 1/2	8	2 1/4	1 3/8	6	5/8	1 3/8	23

NOTES:

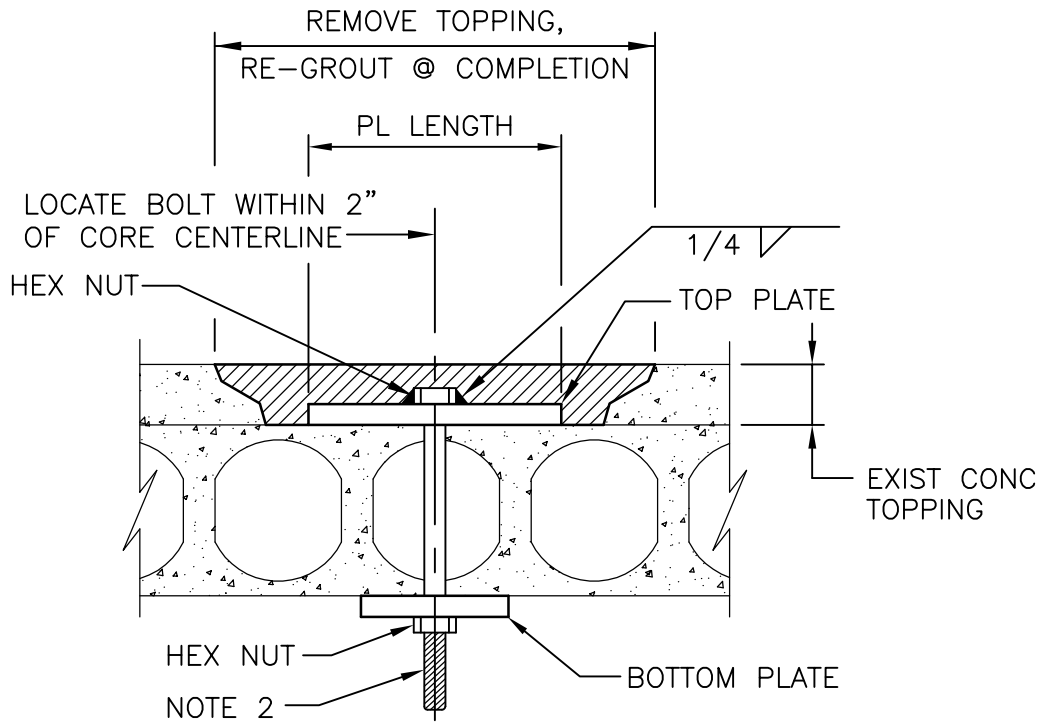
1. ALL DIMENSIONS ARE IN INCHES.
2. THIS DETAIL ASSUMES EMBED IS NOT LOCATED NEAR FREE EDGE OF CONCRETE WHICH WOULD REDUCE PULL-OUT CAPACITY.
3. PIPE OD = "B" - 1" NOMINAL.

CONCRETE ROD SUPPORT

NOT TO SCALE

05 50 00-15





THROUGH BOLT SCHEDULE		
HANGER ROD SIZE	TOP PLATE SIZE	BOTTOM PLATE SIZE
3/8"-3/4"	12"x6"x1/2"	6"x4"x3/8"
1"-1 1/2"	18"x9"x3/4"	9"x4 1/2"x1/2"

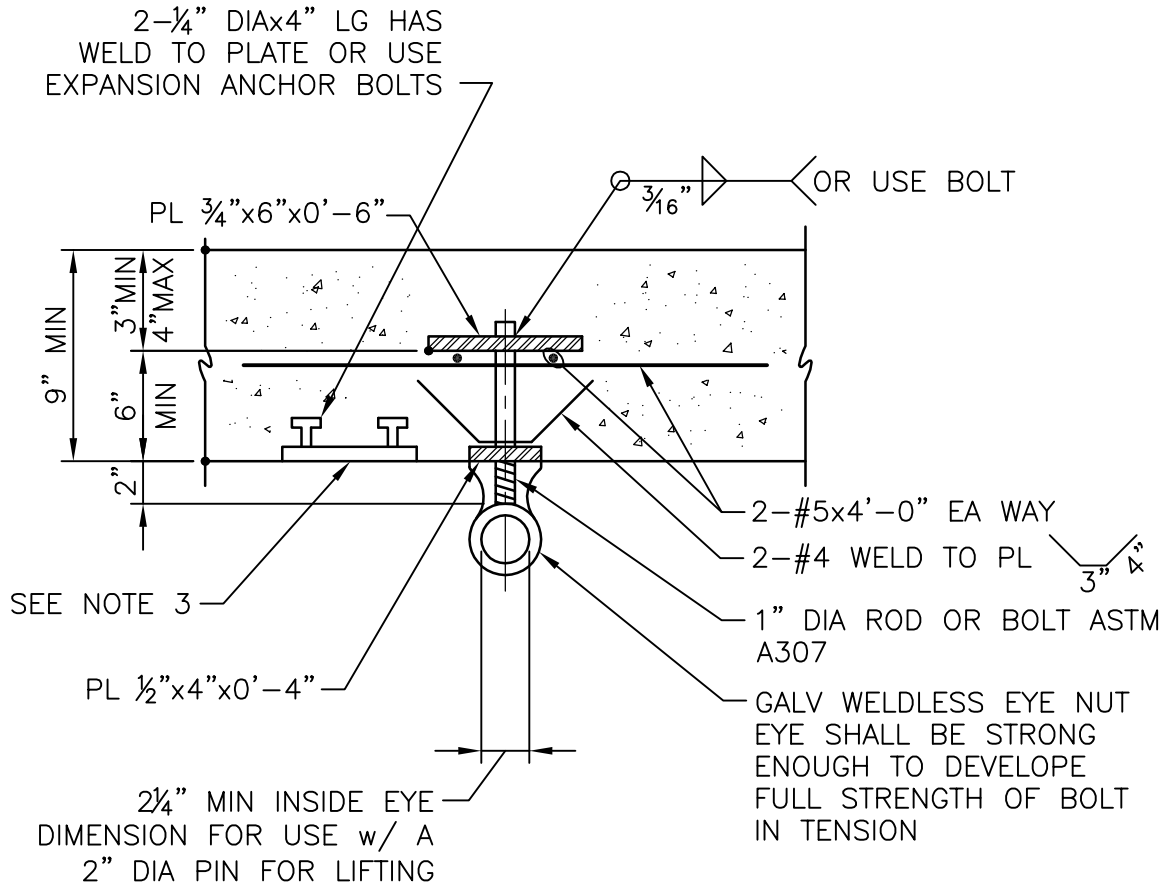
NOTES:

1. PLATE SHOULD SPAN CORE.
2. USE IN CONJUNCTION WITH PIPE HANGER DETAILS SPECIFIED.
3. DO NOT INSTALL IN SAME HC PANEL THAT HAS SIMILAR TYPE PS ALREADY INSTALLED.
4. ROD AND NUTS TO BE STAINLESS STEEL.
5. PLATES TO BE HD GALVANIZED OR SST.

THROUGH BOLT

NTS

05 50 00-17



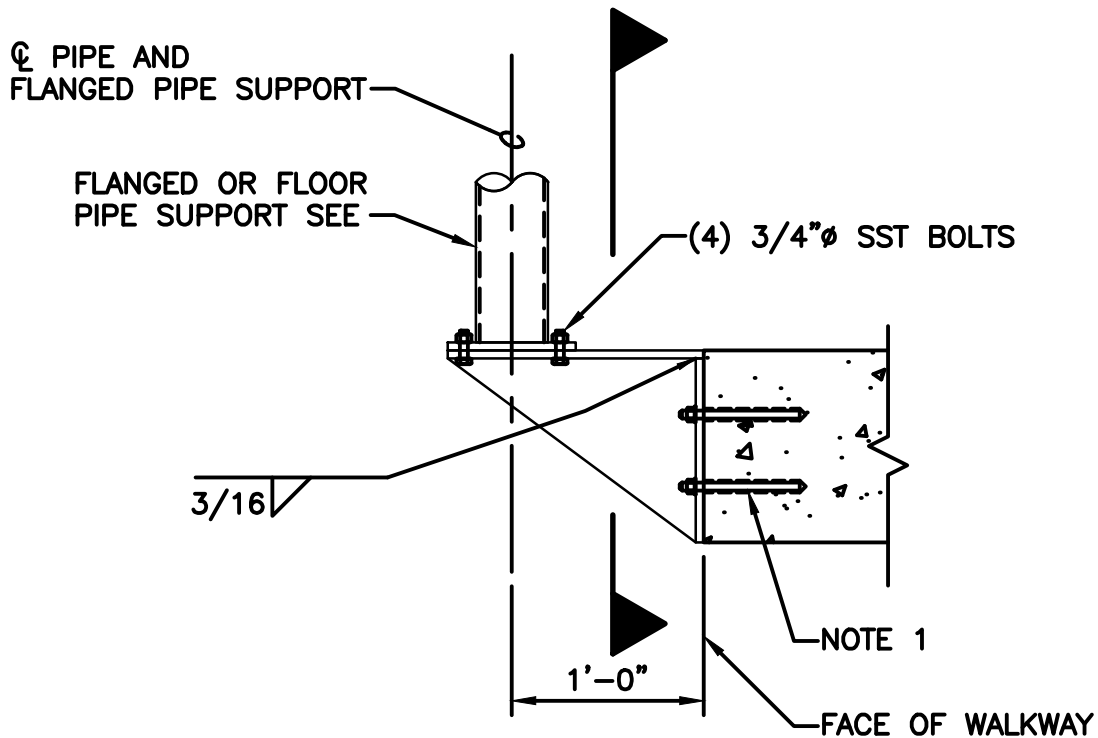
NOTES:

1. MAX. LOAD RATING FOR LIFTING EYE IS 4000 LBS
2. SUBMIT DATA ON EYE BOLT WITH SHOP DWGS.
3. PROVIDE $\frac{1}{8}$ " THICK GALVANIZED STEEL SIGN STATING MAX ALLOWABLE LOAD CAPACITY OF LIFTING EYE. SIGN LETTER HEIGHT SHALL BE 6" MIN.

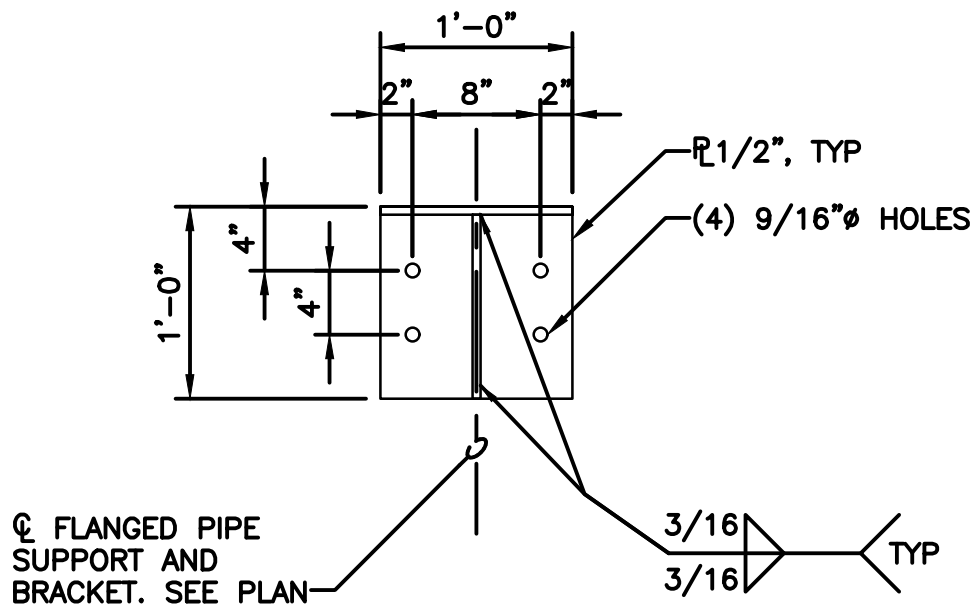
LIFTING EYE

NOT TO SCALE

05 50 00-25



BRACKET ELEVATION



BRACKET SECTION

NOTES:

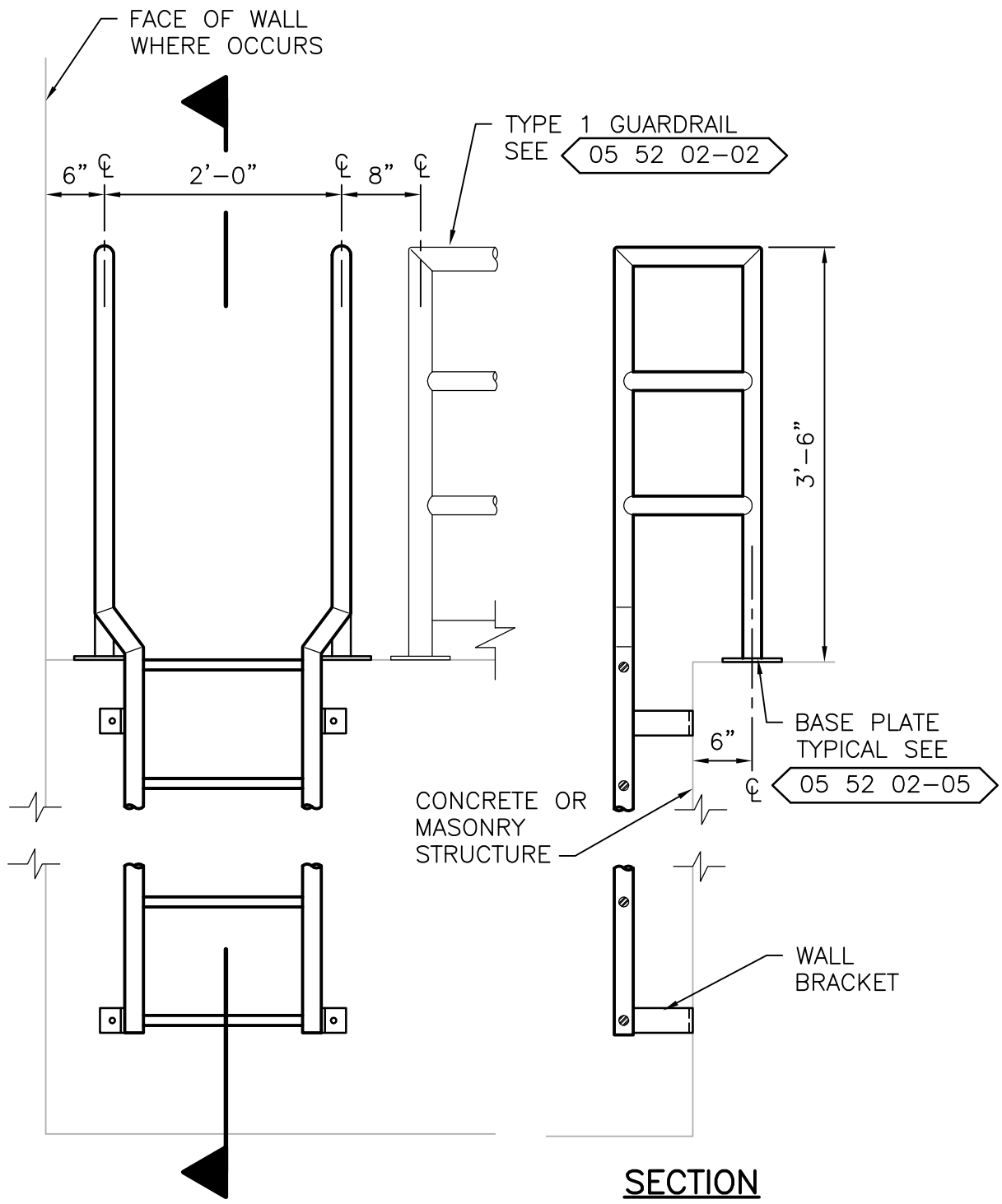
1. DRILL AND EPOXY (4) 1/2" ADHESIVE ANCHORS WITH MINIMUM 6-INCH EMBEDMENT.
2. MATERIAL FOR ALL COMPONENTS SHALL BE HOT DIPPED GALVANIZED AFTER FABRICATION UNLESS NOTED OTHERWISE, REFERENCE SPECIFICATION SECTION 40 05 07.

PIPE SUPPORT BRACKET

NTS

05 50 00-26

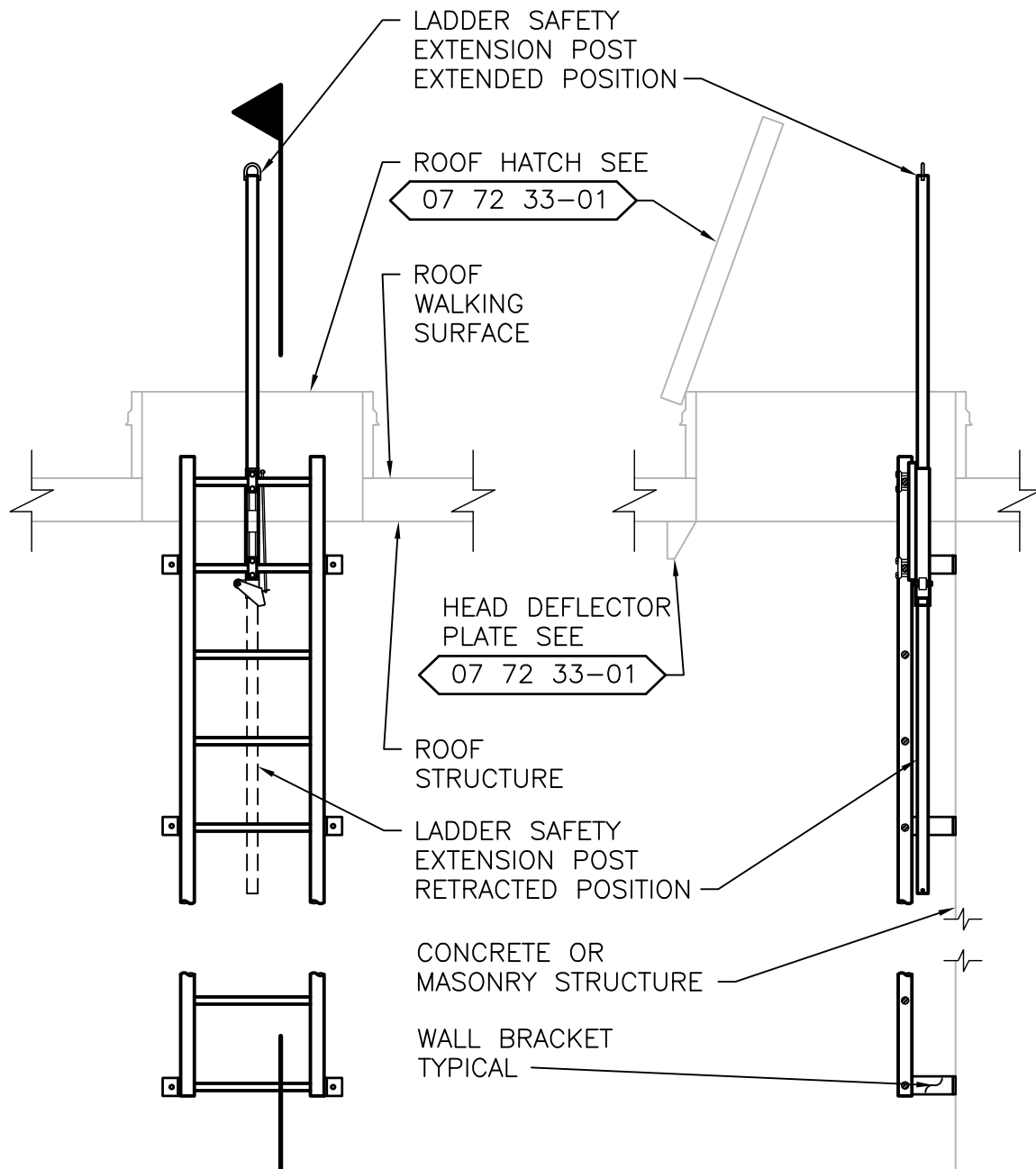




**TYPICAL
WALL SUPPORTED LADDER**

NTS

05 50 00-30



NOTE:

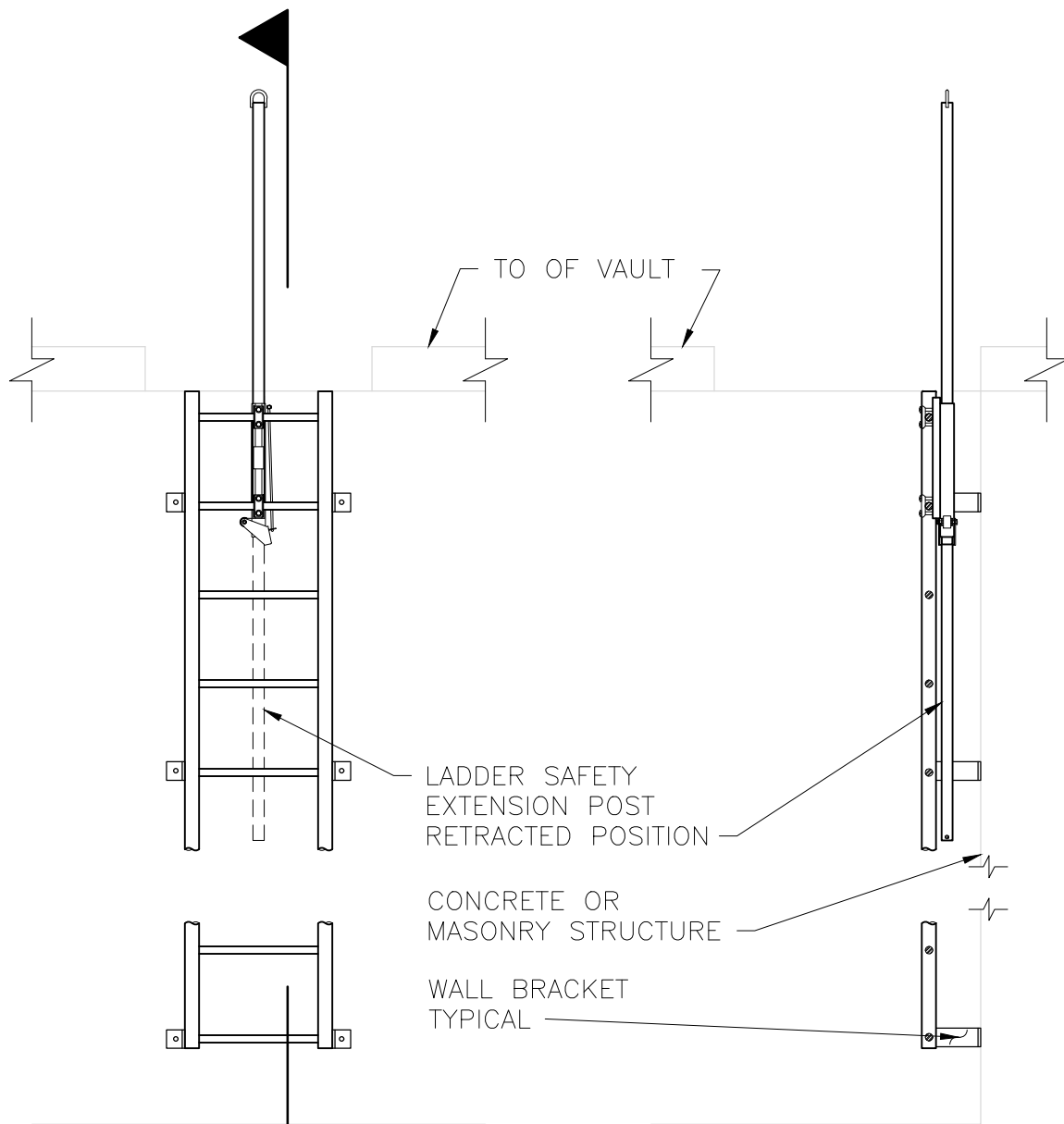
1. TOP RUNG OF LADDER TO BE FLUSH WITH BOTTOM FLANGE OF ROOF HATCH.
2. MAINTAIN 7" CLEAR FROM CL OF RUNG TO ANY OBSTRUCTION OPPOSITE THE CLIMBING SIDE OF THE LADDER.

SECTION

**TYPICAL WALL SUPPORTED
LADDER AT ROOF HATCH**

NTS

05 50 00-34



NOTE:

1. TOP RUNG OF LADDER TO BE FLUSH WITH BOTTOM FLANGE OF ROOF HATCH.
2. MAINTAIN 7" CLEAR FROM CL OF RUNG TO ANY OBSTRUCTION OPPOSITE THE CLIMBING SIDE OF THE LADDER.

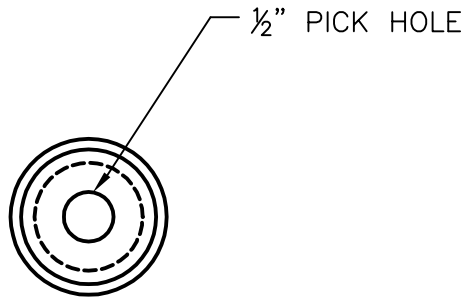
SECTION

WALL SUPPORTED LADDER

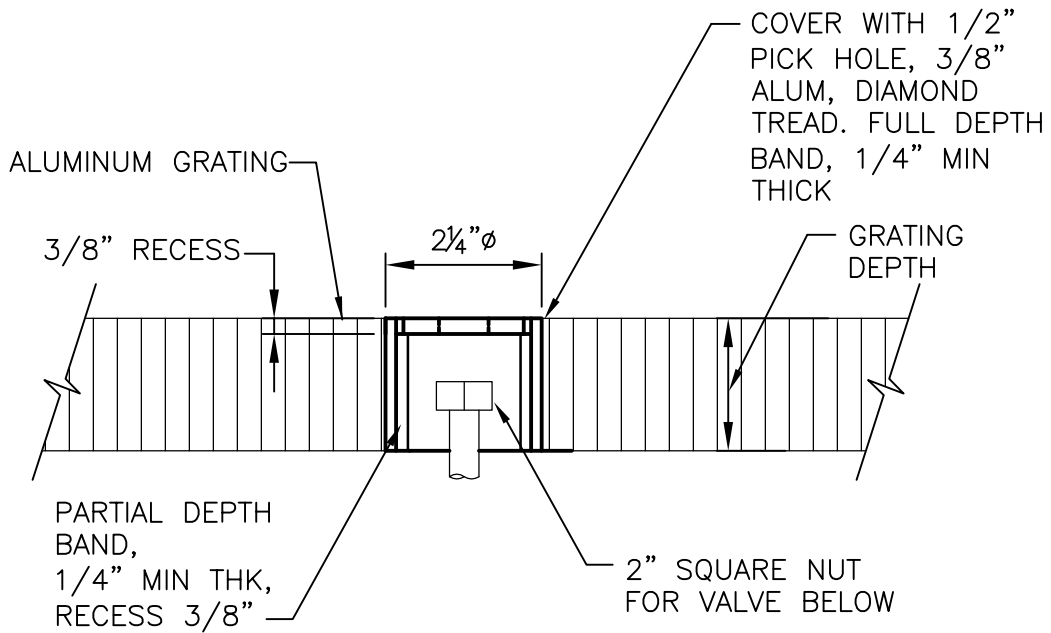
NTS

05 50 00-35





PLAN



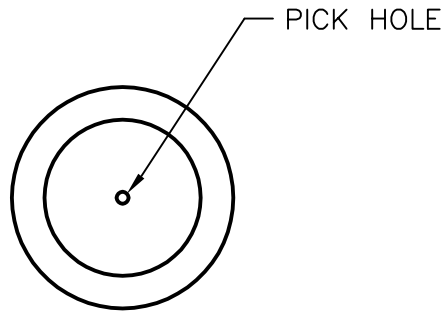
SECTION

NOTE:
COVER WITH 1/2" PICK HOLE, 3/8" ALUM DIAMOND TREAD. FULL DEPTH BAND, 1/4" MIN THICK.

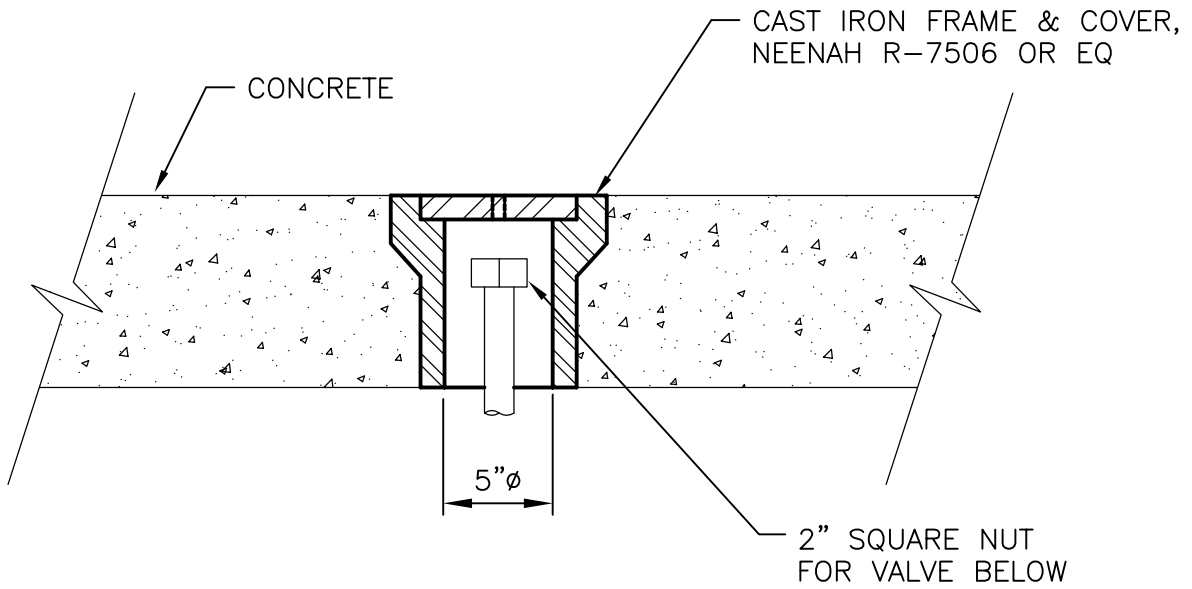
VALVE COVER IN GRATING

NTS

05 50 00-38



PLAN

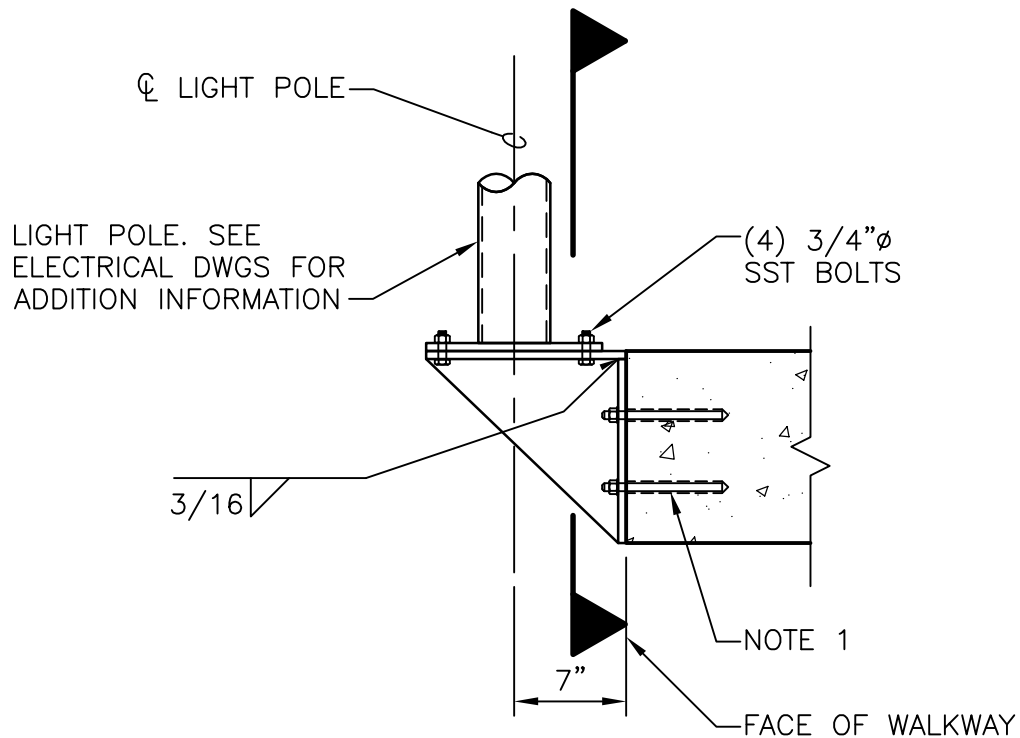


SECTION

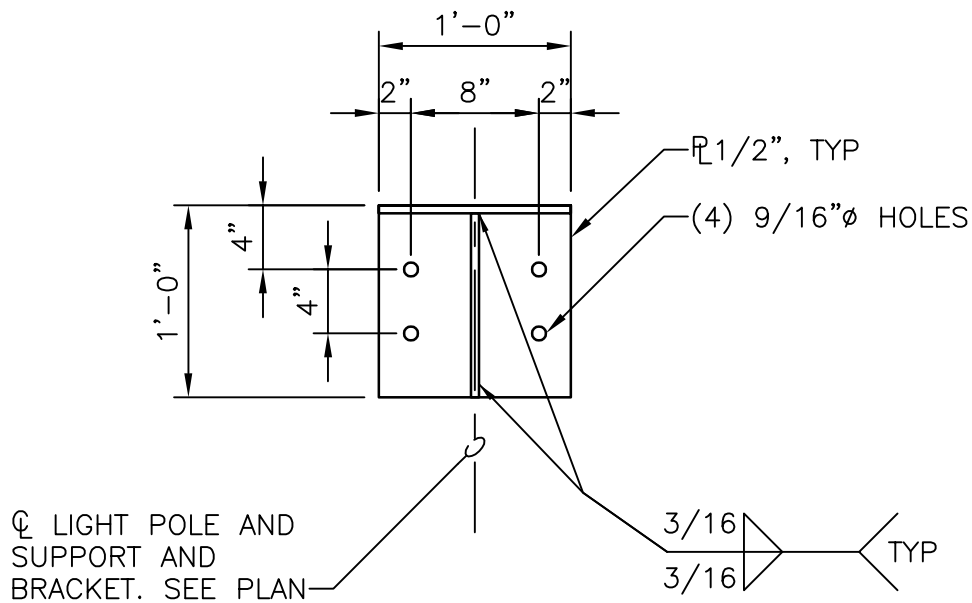
VALVE COVER IN CONCRETE

NTS

05 50 00-45



BRACKET ELEVATION



BRACKET SECTION

NOTES:

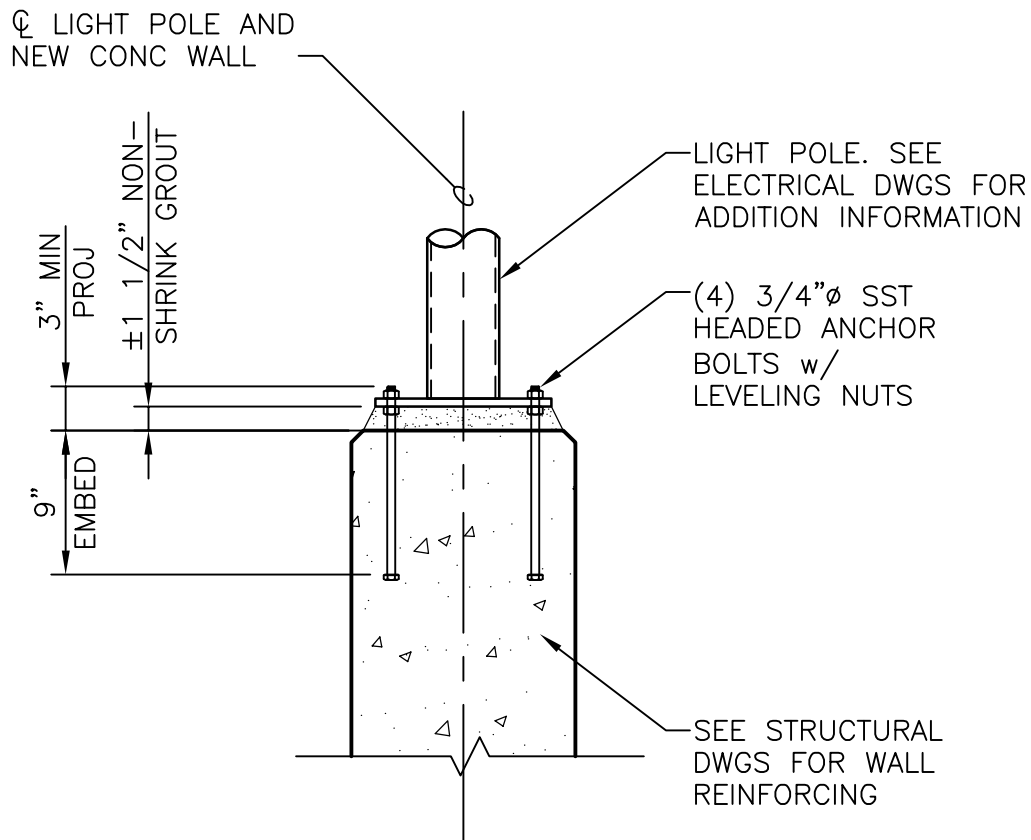
1. (4) $1/2"$ \varnothing ADHESIVE ANCHORS WITH MINIMUM 6-INCH EMBEDMENT. SEE SPECIFICATION SECTION 03 15 19.
2. MATERIAL FOR ALL COMPONENTS SHALL BE HOT DIPPED GALVANIZED AFTER FABRICATION UNLESS NOTED OTHERWISE, REFERENCE SPECIFICATION SECTION 40 05 07.

LIGHT POLE SUPPORT BRACKET

NTS

05 50 00-47





NOTES:

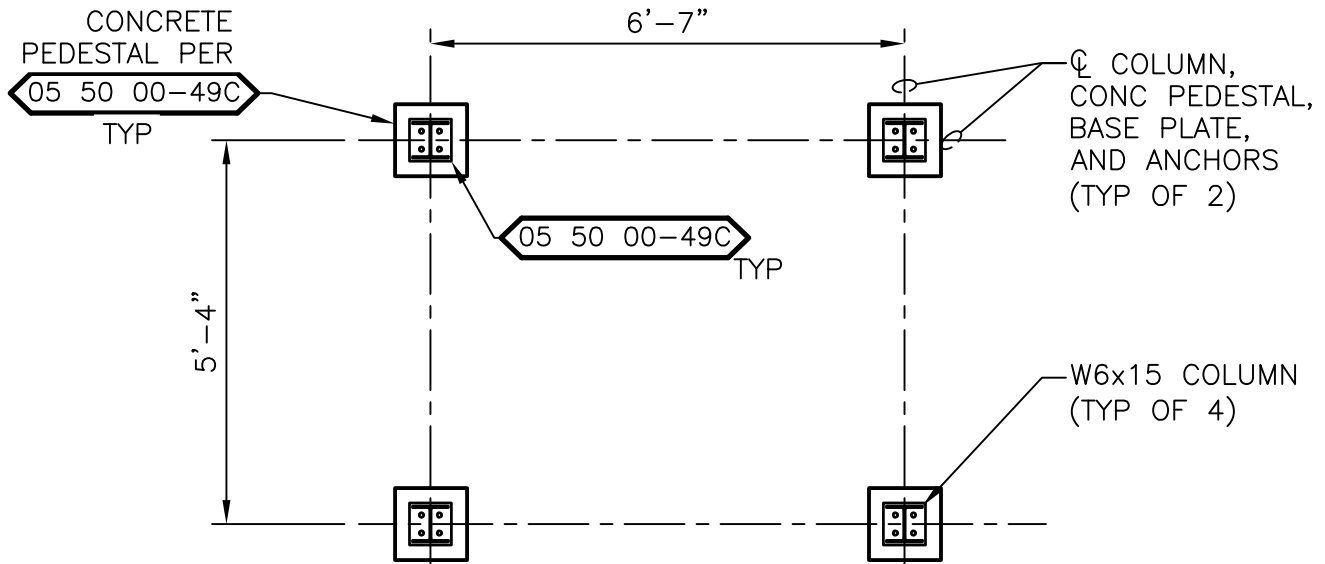
1. CONDITION SHOWN IS AT TOP OF NEW CONCRETE WALL. CONDITIONS AT NEW CONCRETE SLABS OR WALKWAYS SHALL BE SIMILAR. AT EXISTING CONCRETE SLABS OR WALKWAYS, USE (4) 3/4" ϕ SST ADHESIVE ANCHORS PER SPECIFICATION SECTION 03 15 19 IN LIEU OF THE HEADED CAST-IN-PLACE ANCHORS SHOWN.

LIGHT POLE AT CONC WALL

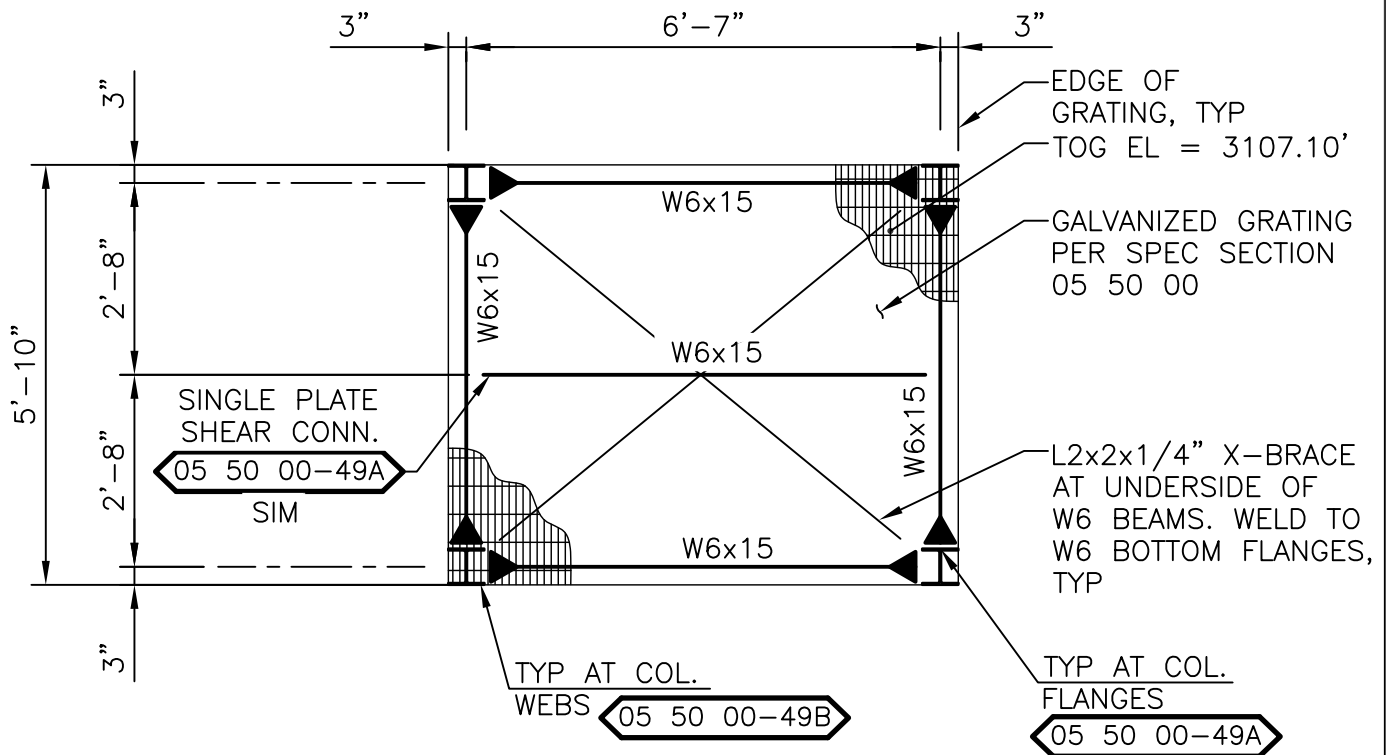
NTS

05 50 00-48

HR



TOTE RACK BASE PLATES



TOTE RACK FRAMING PLAN

NOTES:

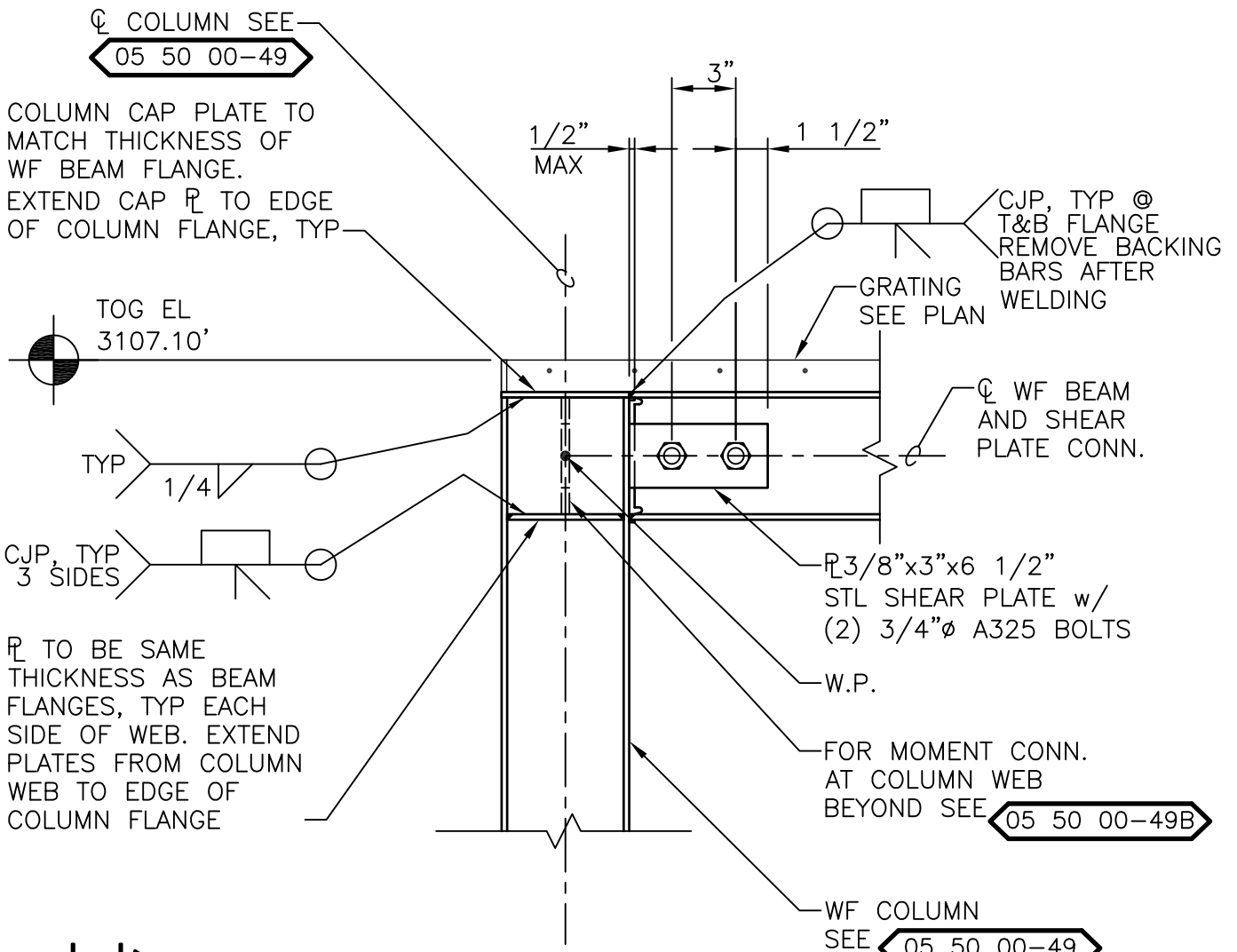
1. ALL GRATING SUPPORTS, PLATES, BEAMS, COLUMNS, AND CONNECTIONS SHOWN SHALL BE HOT DIP GALVANIZED AFTER FABRICATION.

CHEMICAL TOTE RACK

NTS

05 50 00-49





KEY PLAN

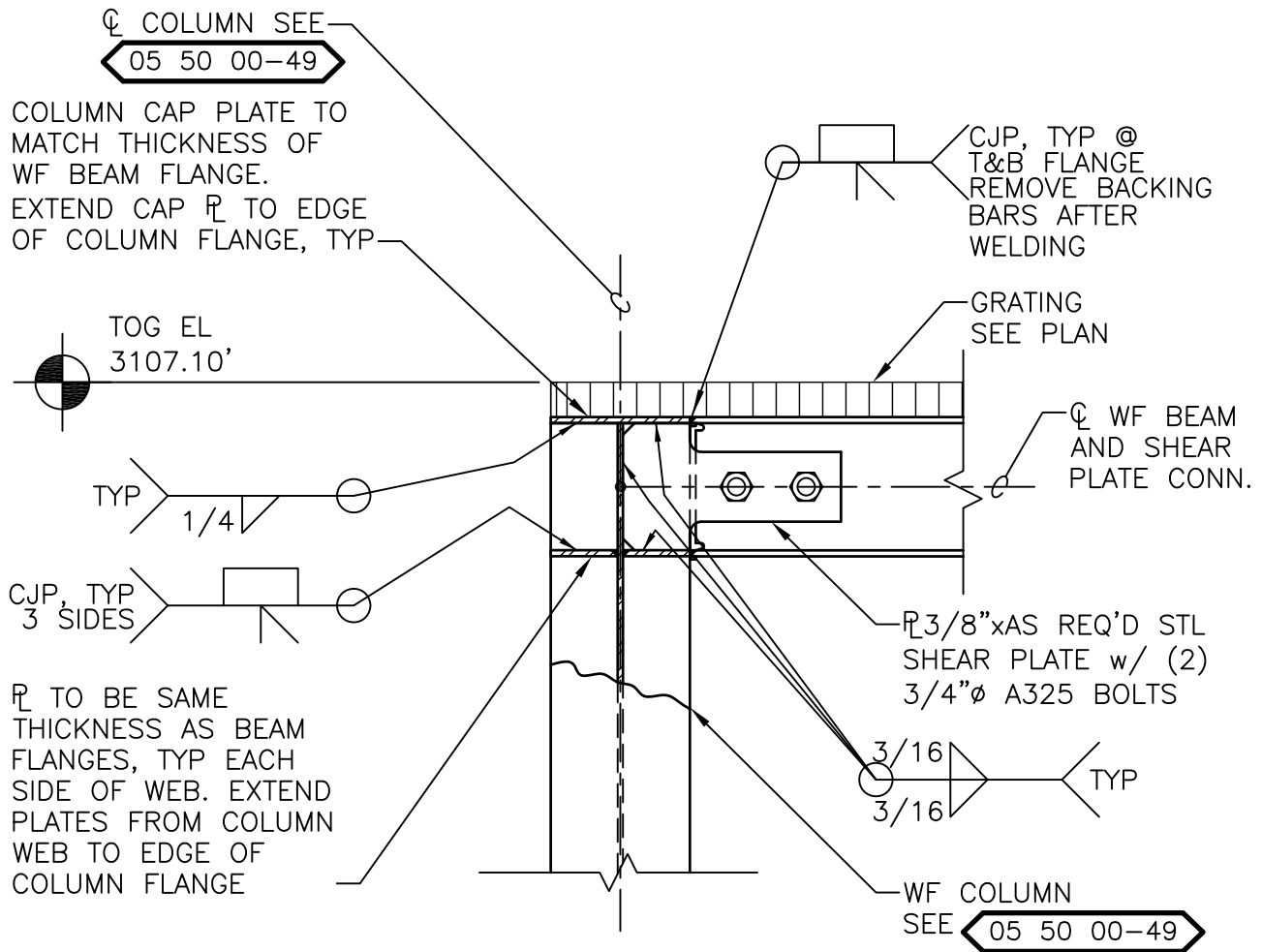
05 50 00-49

MOMENT CONN. AT COL. FLANGE

05 50 00-49A

NTS





KEY PLAN

05 50 00-49

NOTE: FOR ADDITIONAL INFORMATION, SEE **05 50 00-49A**

MOMENT CONN. AT COL. WEB

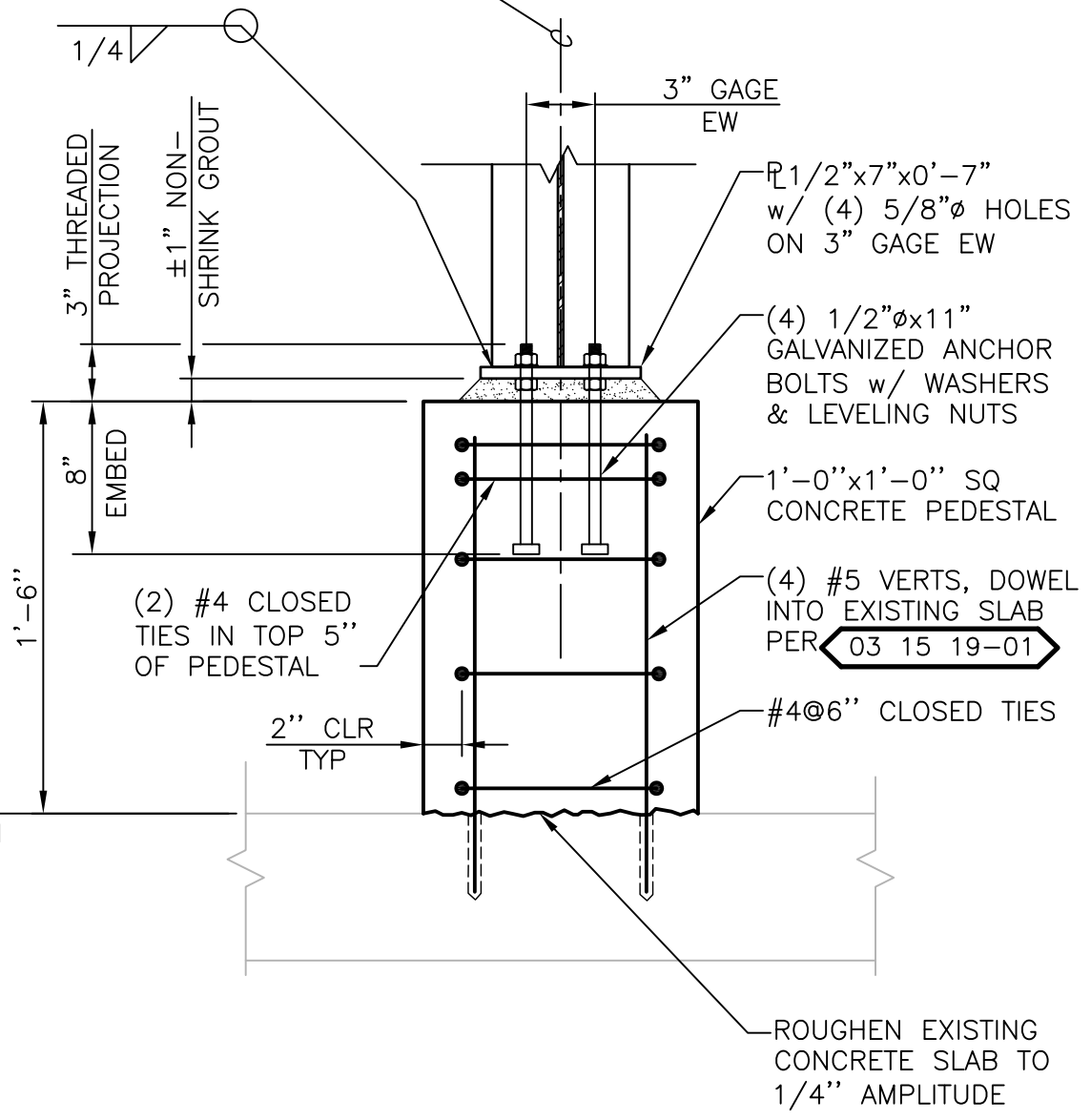
NTS

05 50 00-49B



☉ COLUMN, CONC
PEDESTAL, BASE
PLATE, ANCHOR
BOLTS. SEE

05 50 00-49

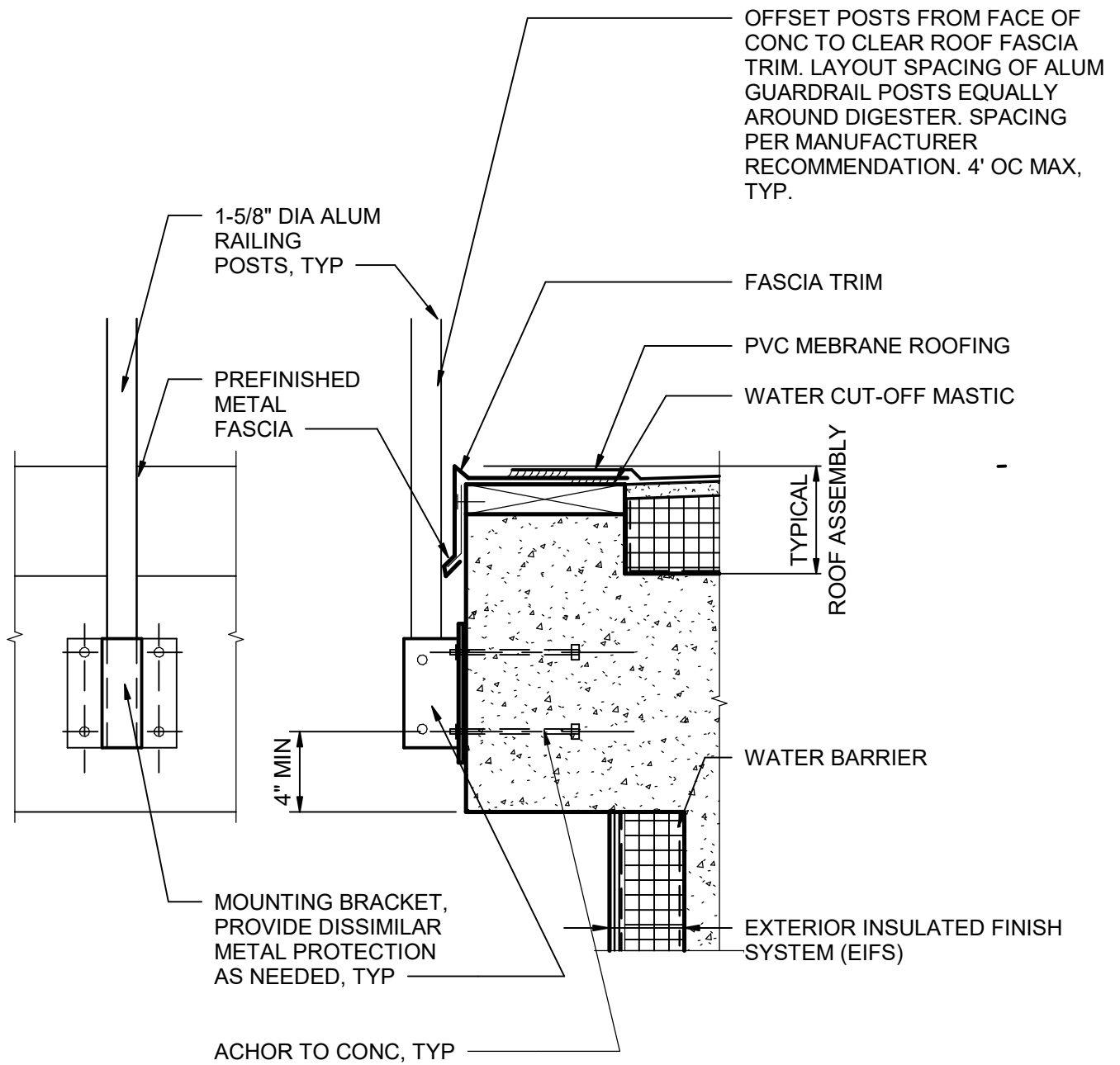


COLUMN BASE AT CONC PEDESTAL

05 50 00-49C

NTS



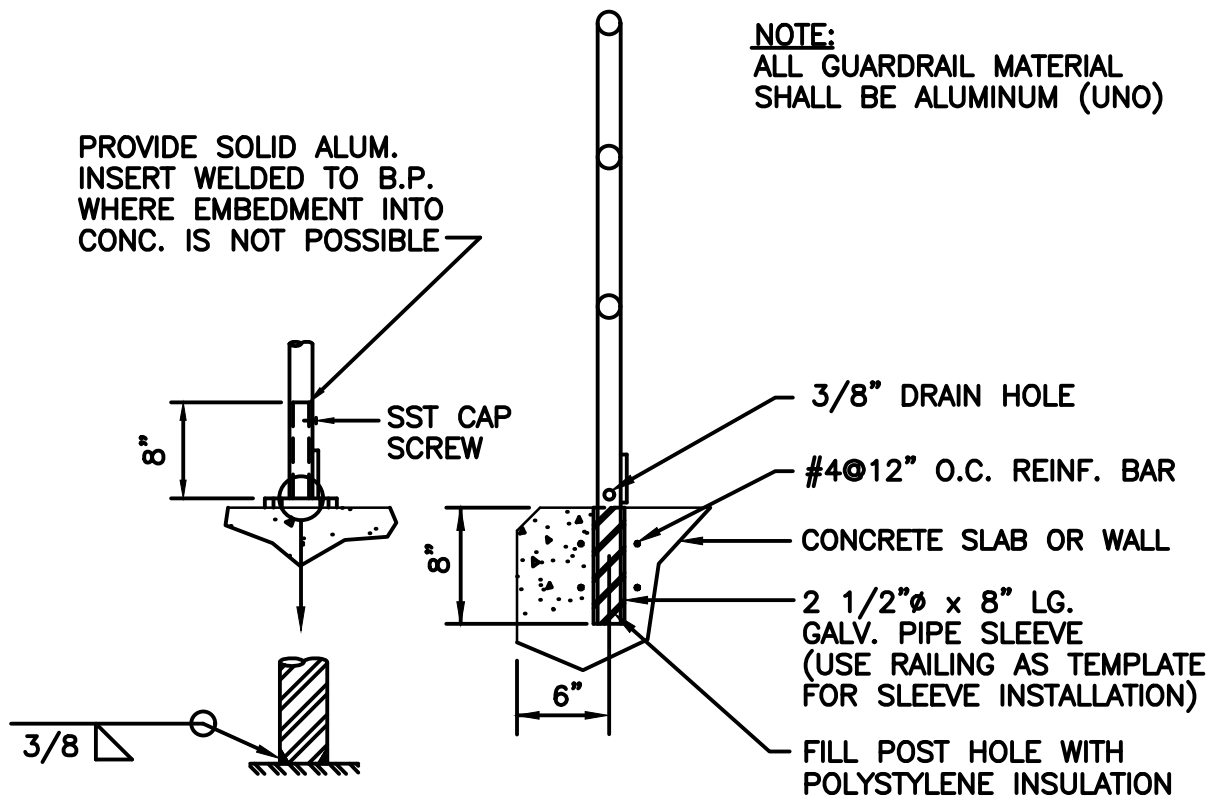


GUARDRAIL AT DIGESTER

1 1/2" = 1'-0"

05 52 00-06A



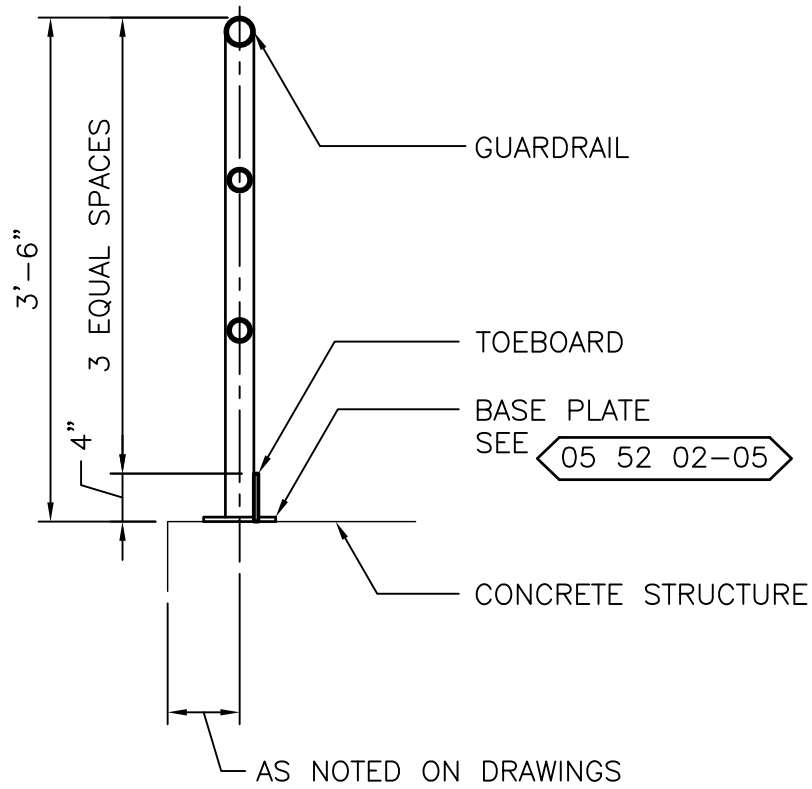


REMOVABLE GUARDRAIL

NTS

05 52 02-01



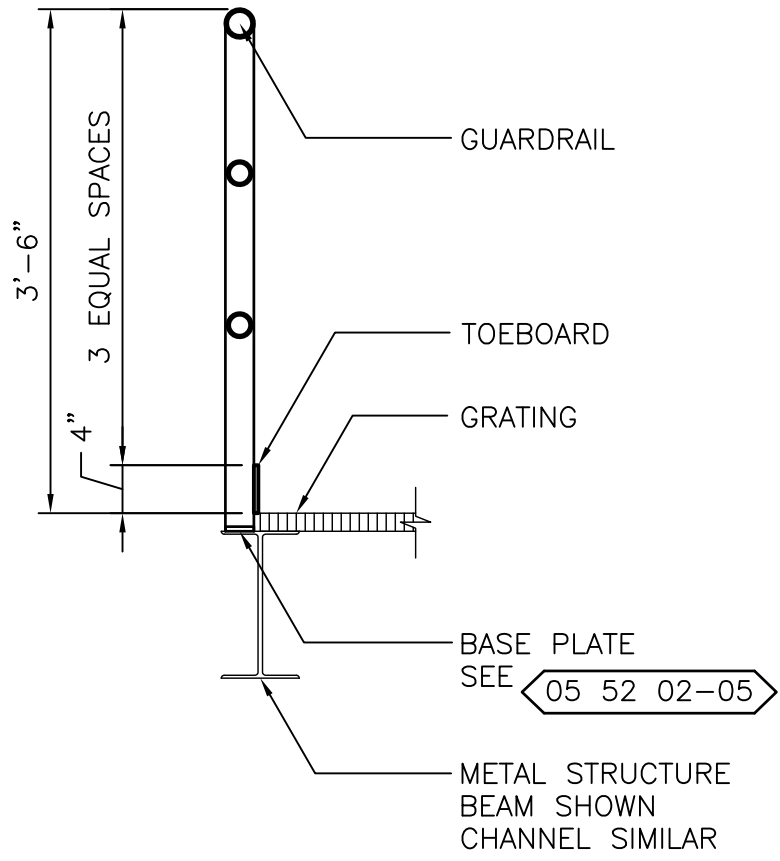


GUARDRAIL (TYPE 1)

NTS

05 52 02-02

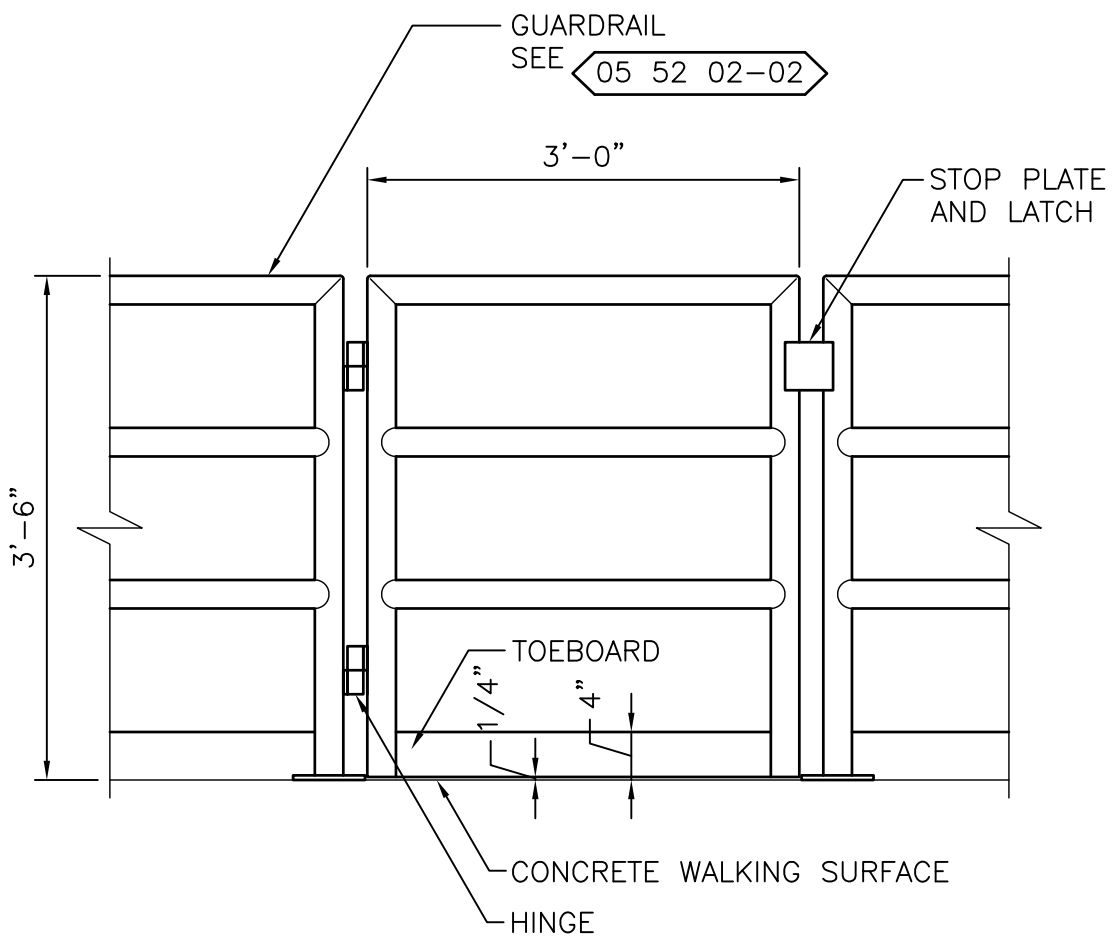




GUARDRAIL (TYPE 2)

NTS

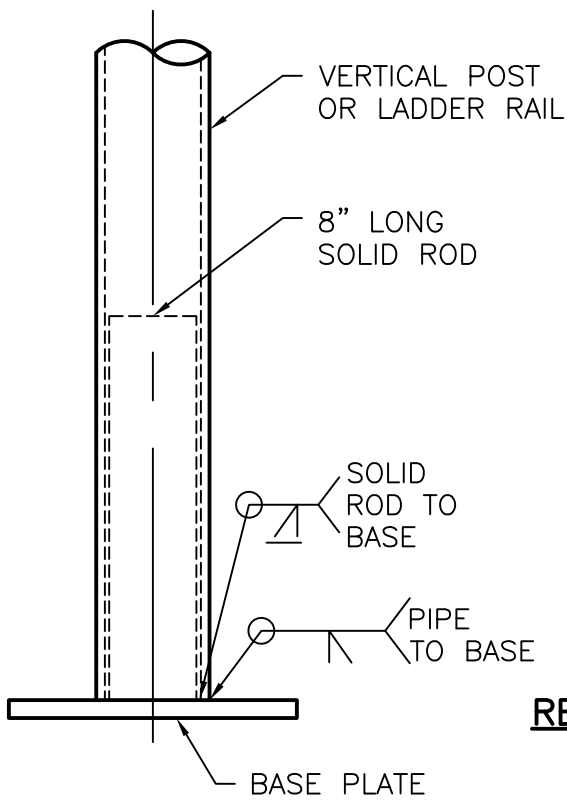
05 52 02-03



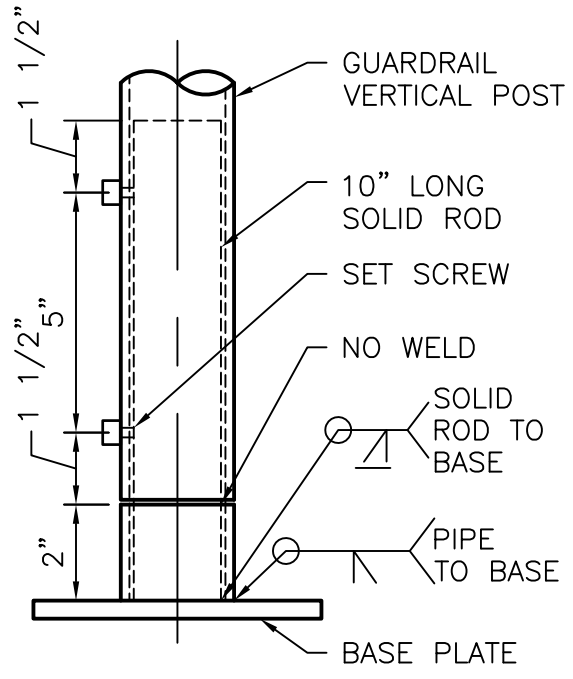
GUARDRAIL GATE

NTS

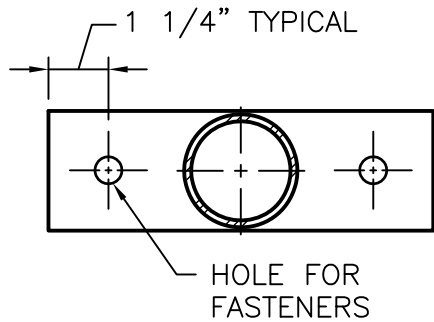
05 52 02-04



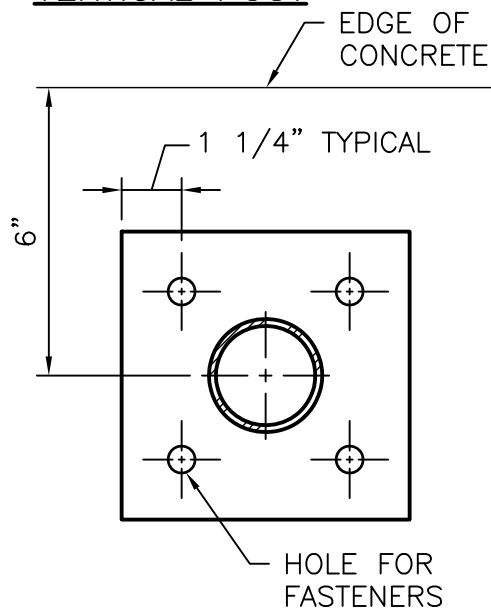
TYPICAL VERTICAL POST



REMOVABLE GUARDRAIL VERTICAL POST



BASE PLATE FOR MOUNTING TO METAL STRUCTURE



BASE PLATE FOR MOUNTING TO CONCRETE

NOTE:

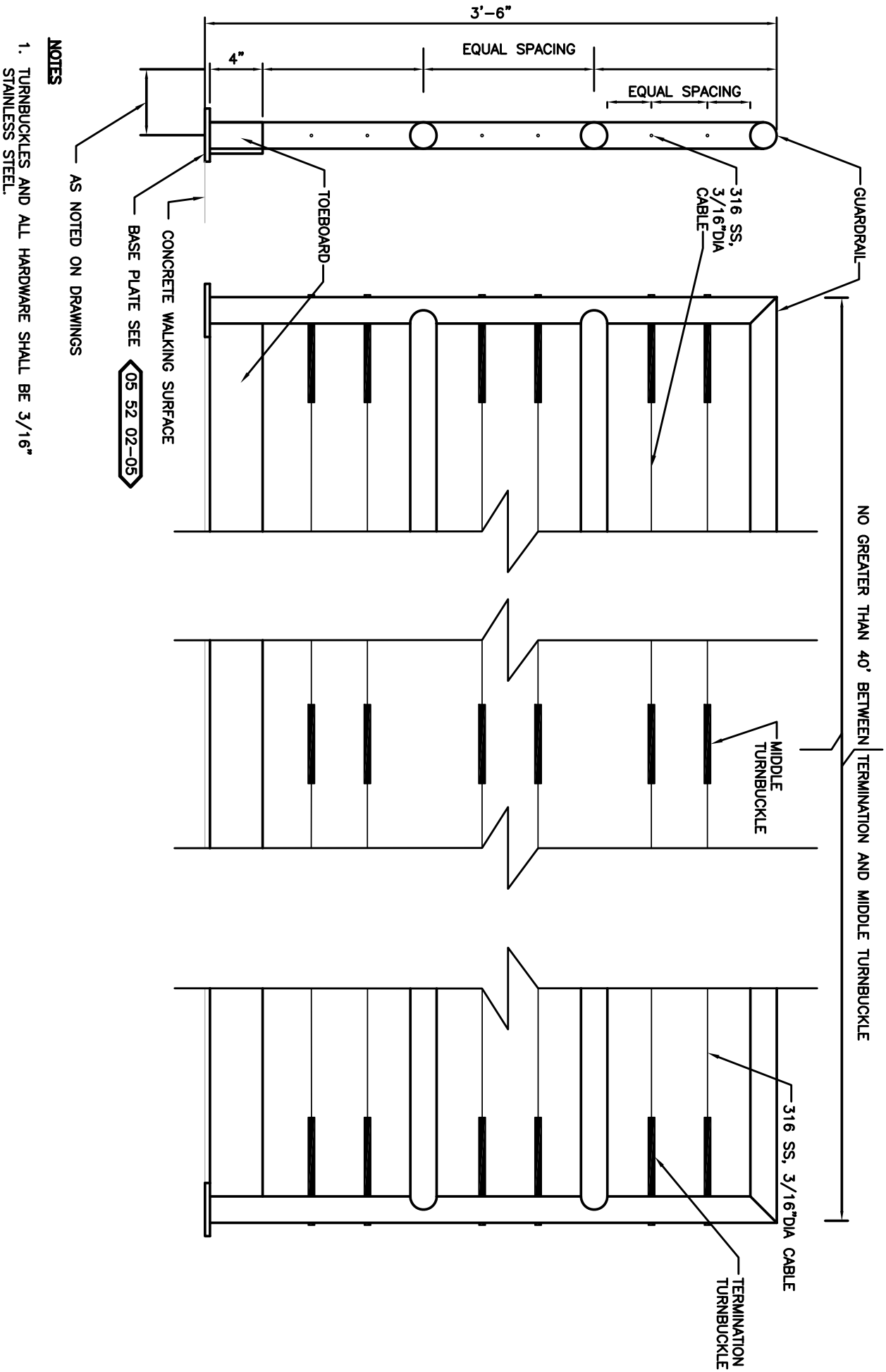
1. TOEBOARD NOT SHOWN.

ALUMINUM VERTICAL POST BASE

NTS

05 52 02-05





NOTES

1. TURNBUCKLES AND ALL HARDWARE SHALL BE 3/16" STAINLESS STEEL.

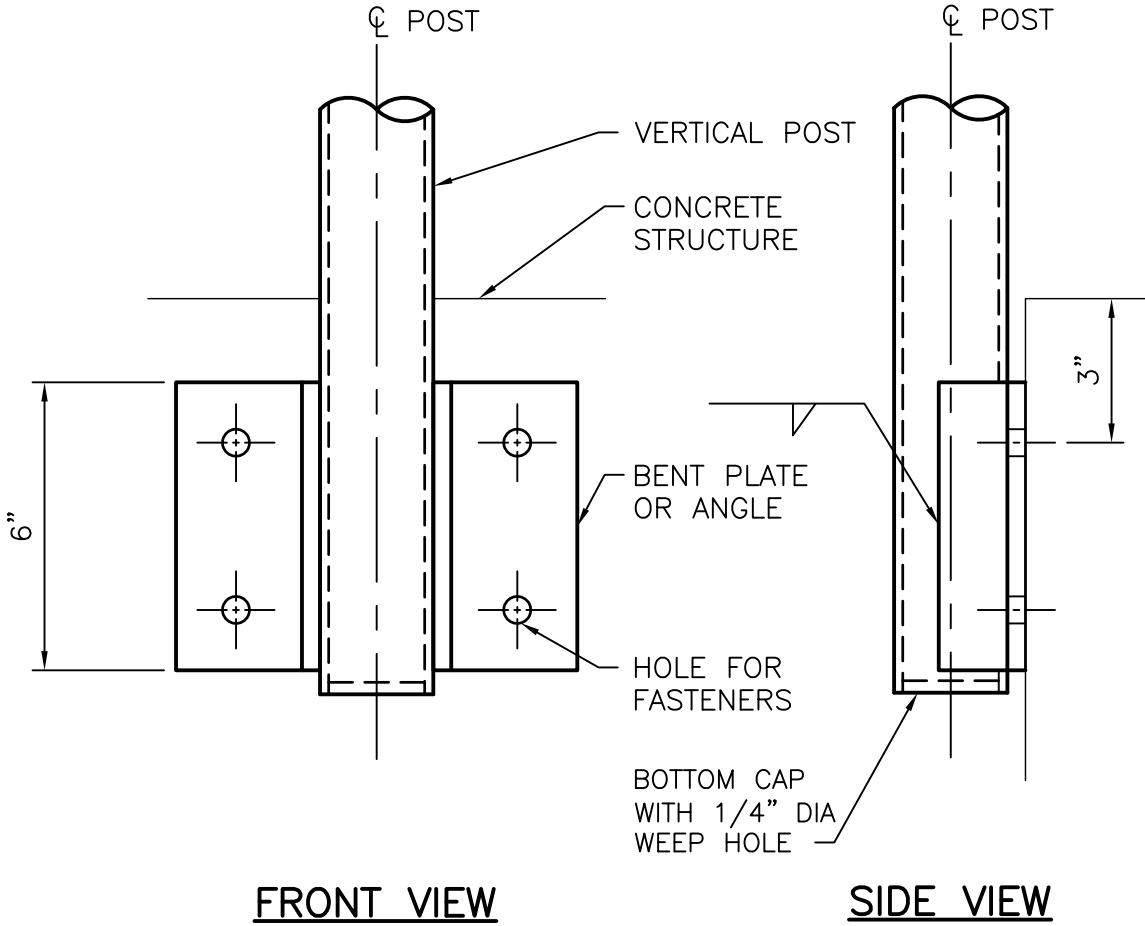
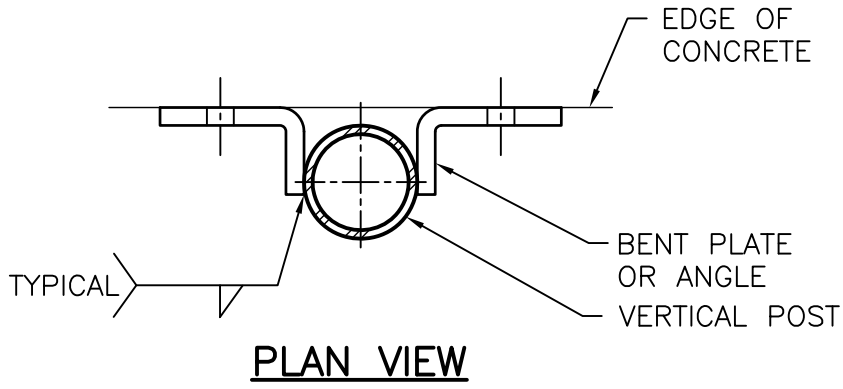
AS NOTED ON DRAWINGS

05 52 02-05

GUARDRAIL (TYPE 3)

NTS

05 52 02-09



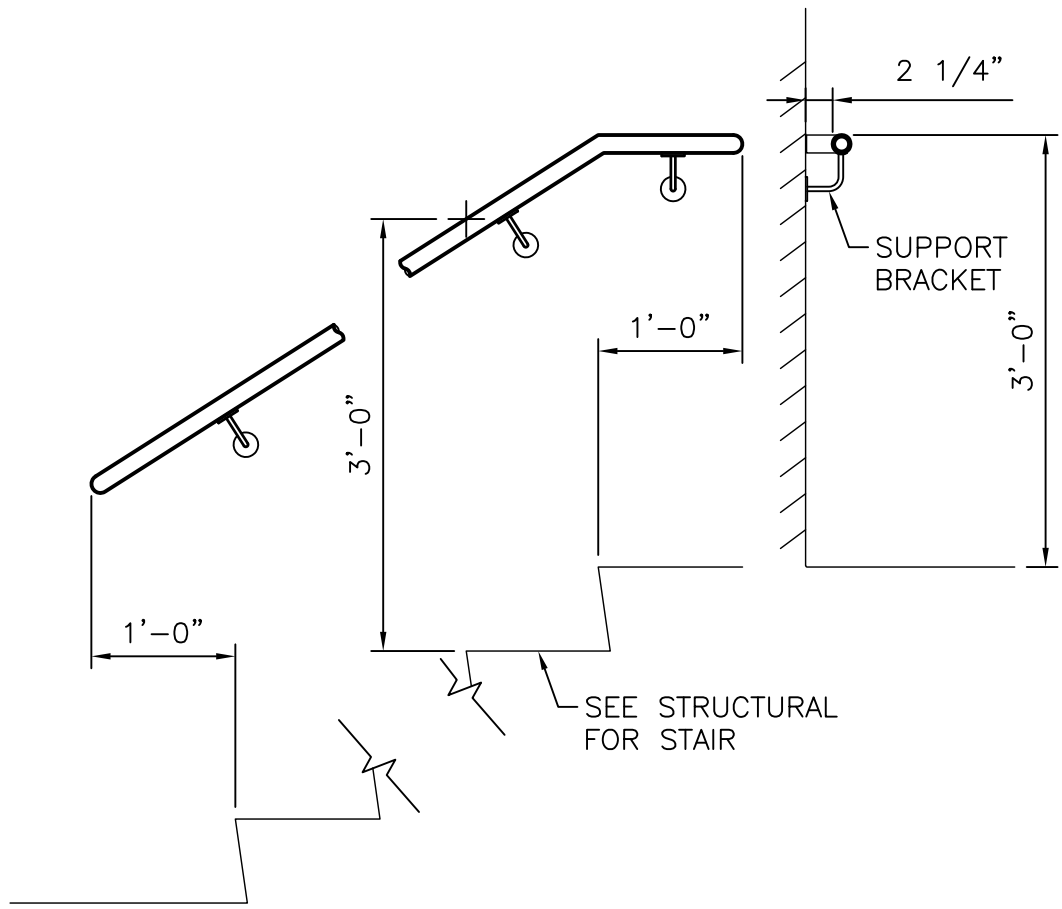
NOTE:

1. TOEBOARD NOT SHOWN.

ALUMINUM GUARDRAIL POST

NTS

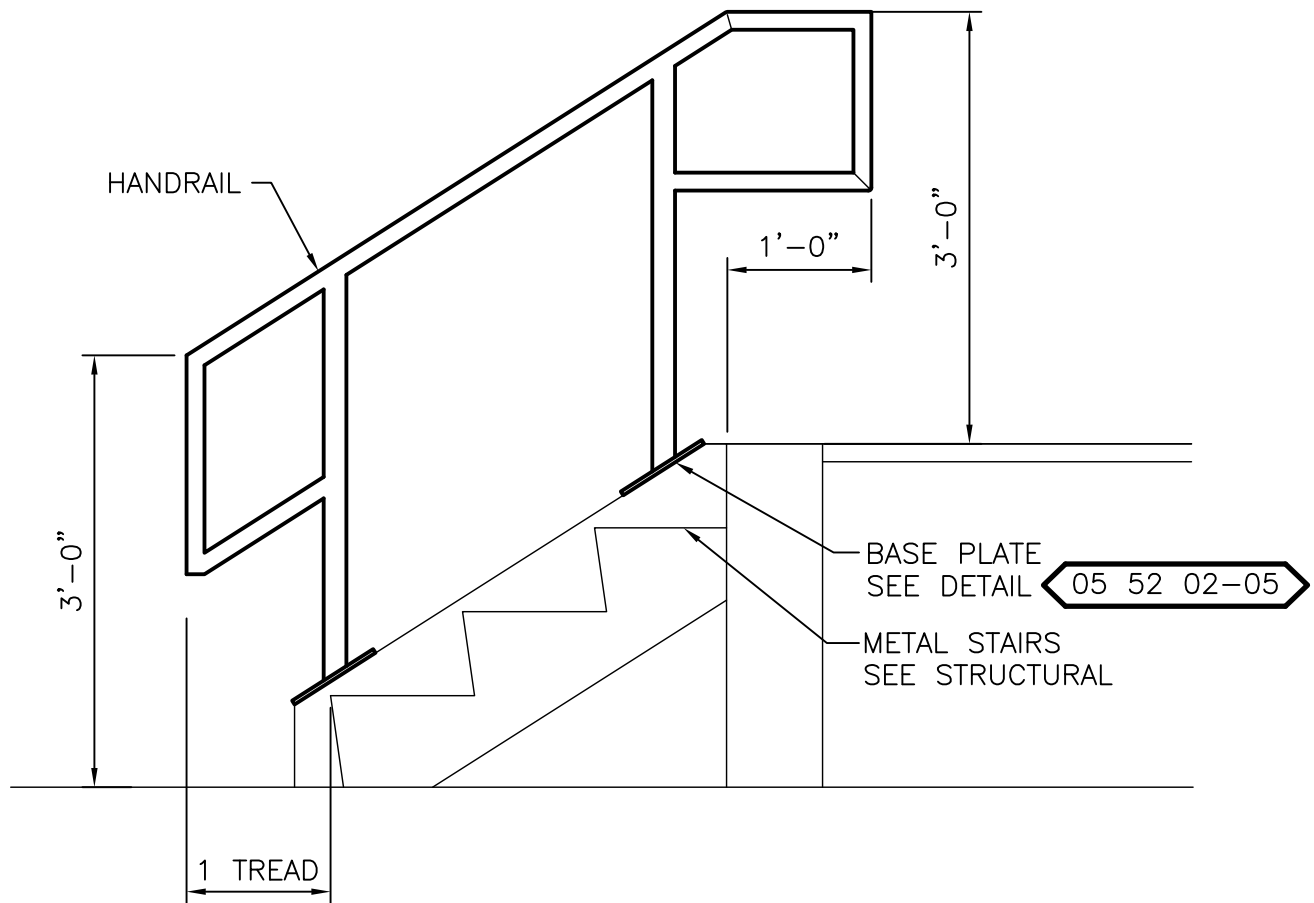
05 52 02-10



WALL MOUNTED HANDRAIL DETAIL

NOT TO SCALE

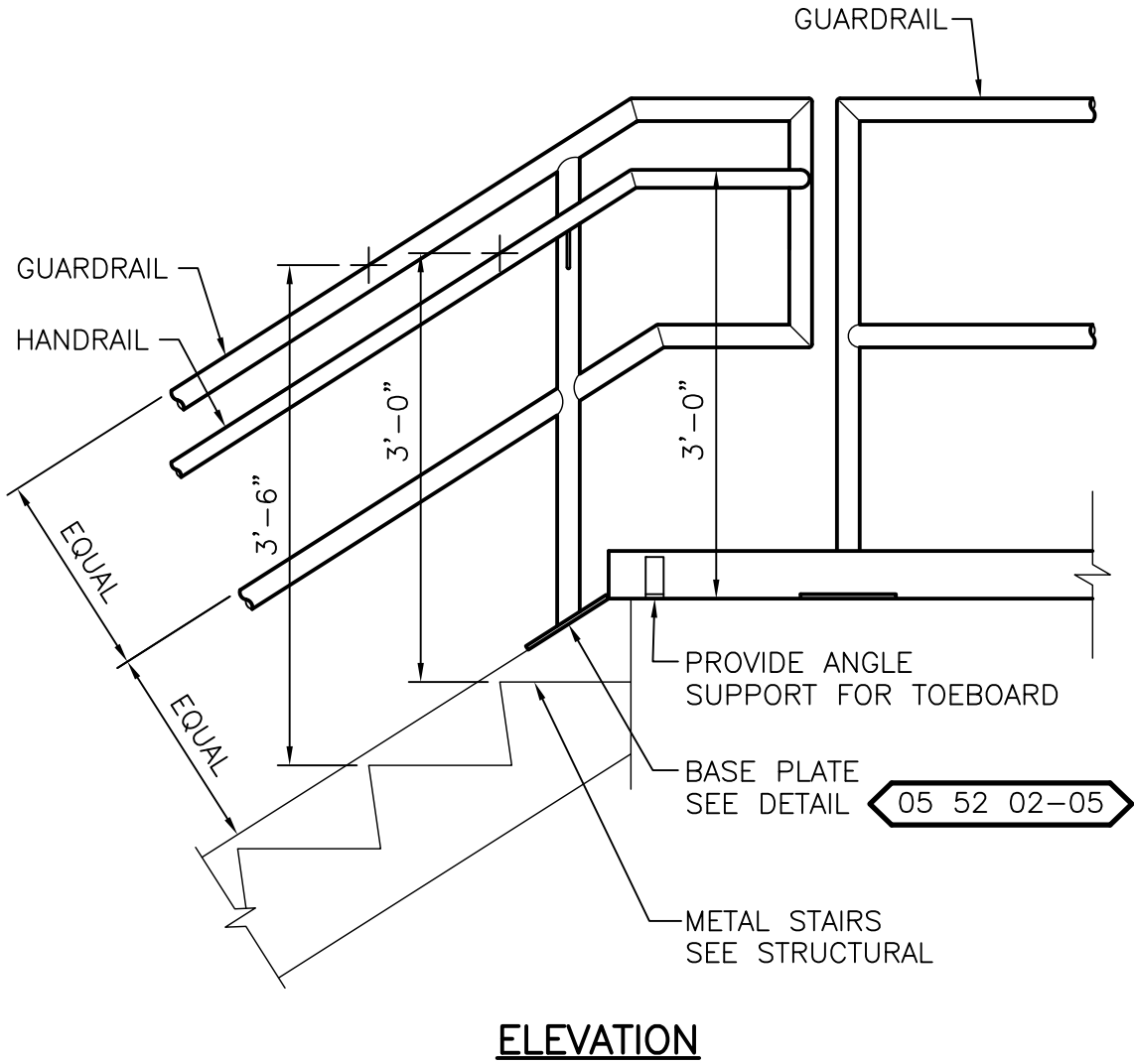
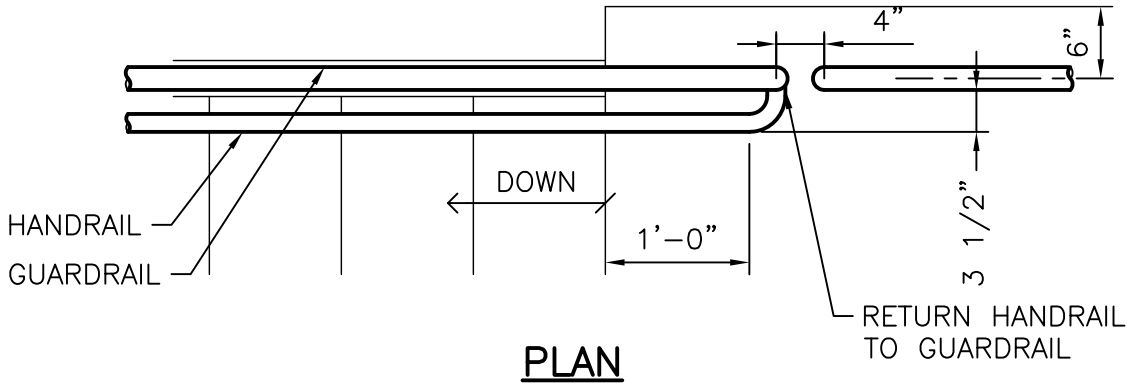
05 52 02-16



HANDRAIL DETAIL

NOT TO SCALE

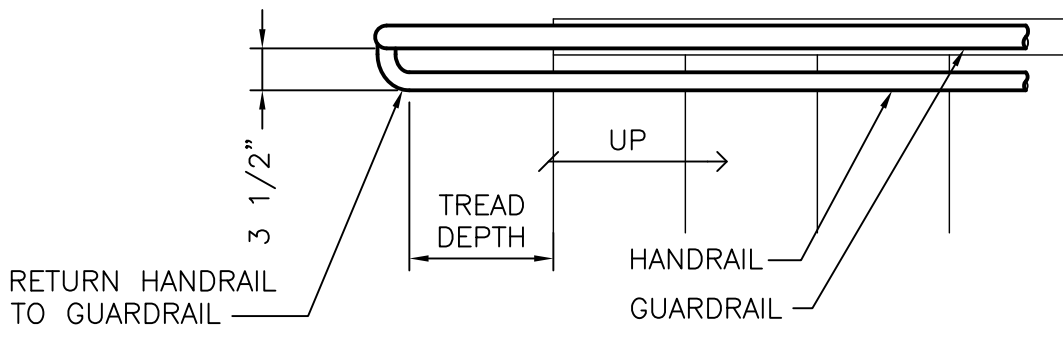
05 52 02-17



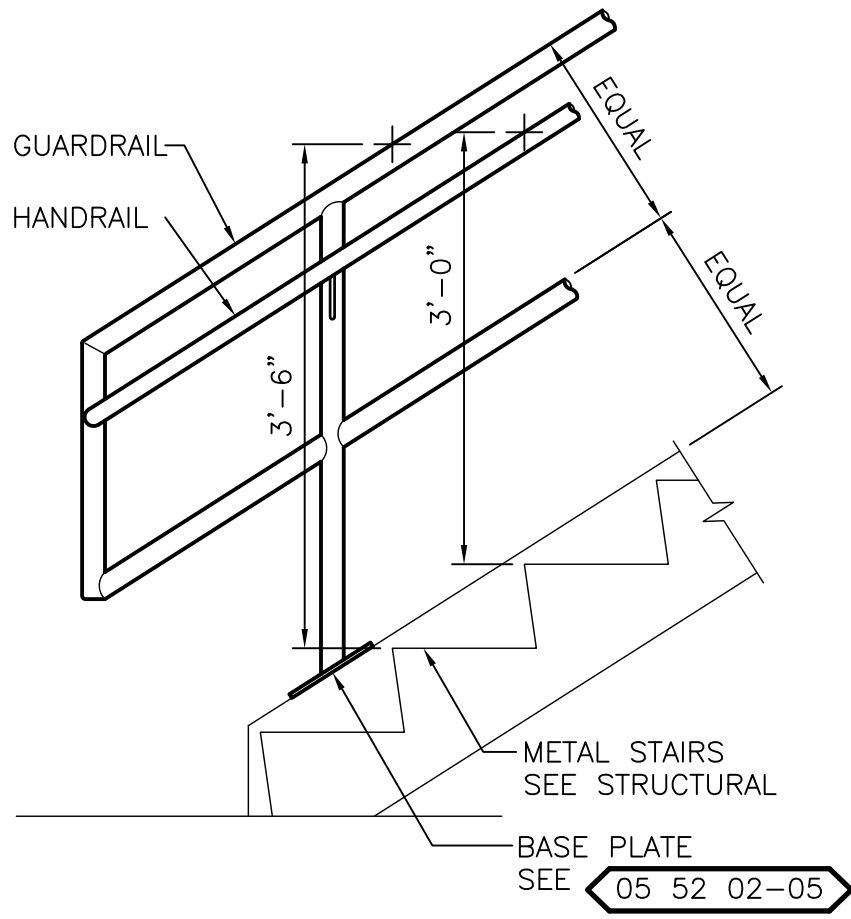
STAIR RAIL DETAIL

NOT TO SCALE

05 52 02-18



PLAN

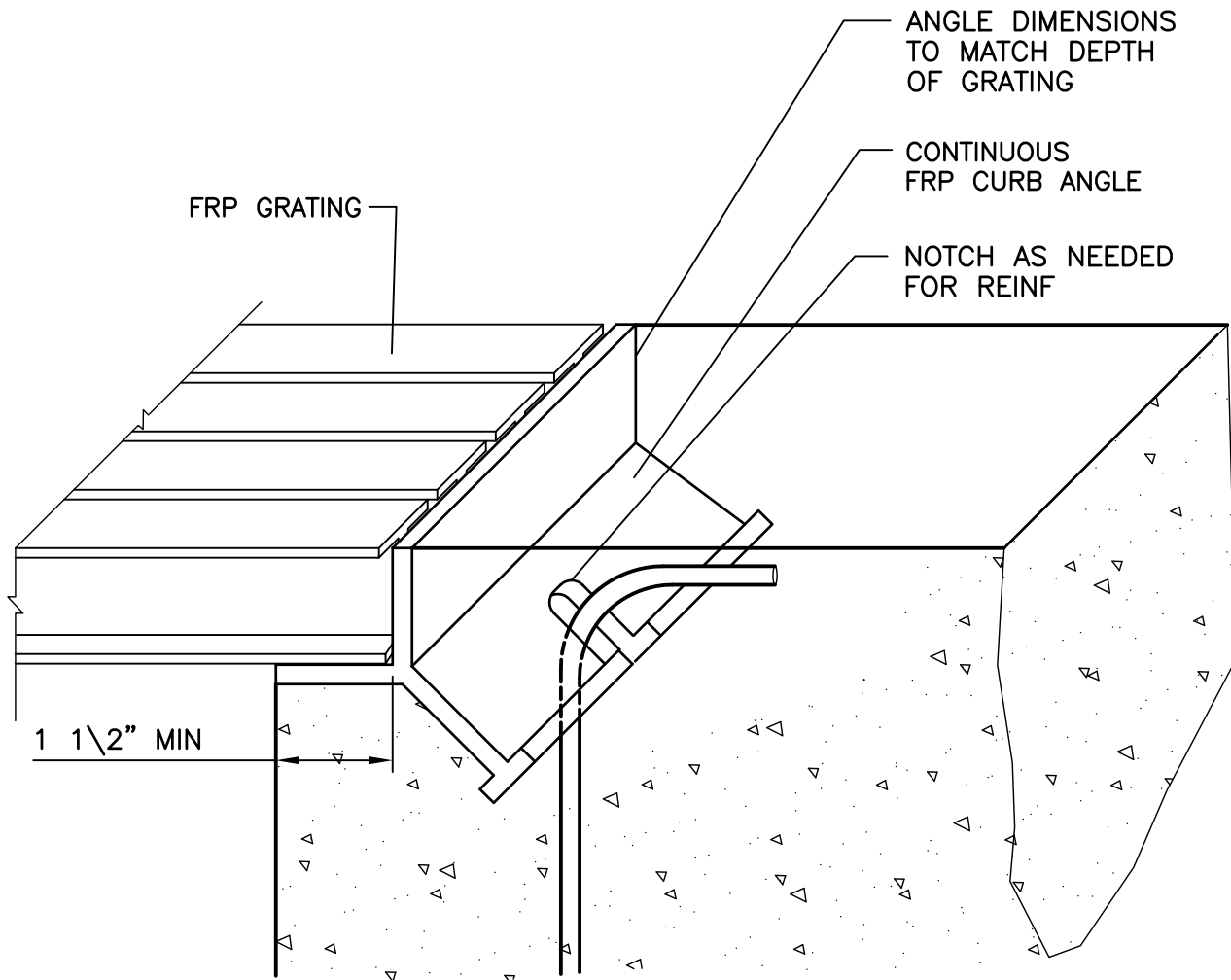


ELEVATION

STAIR RAIL DETAIL

NOT TO SCALE

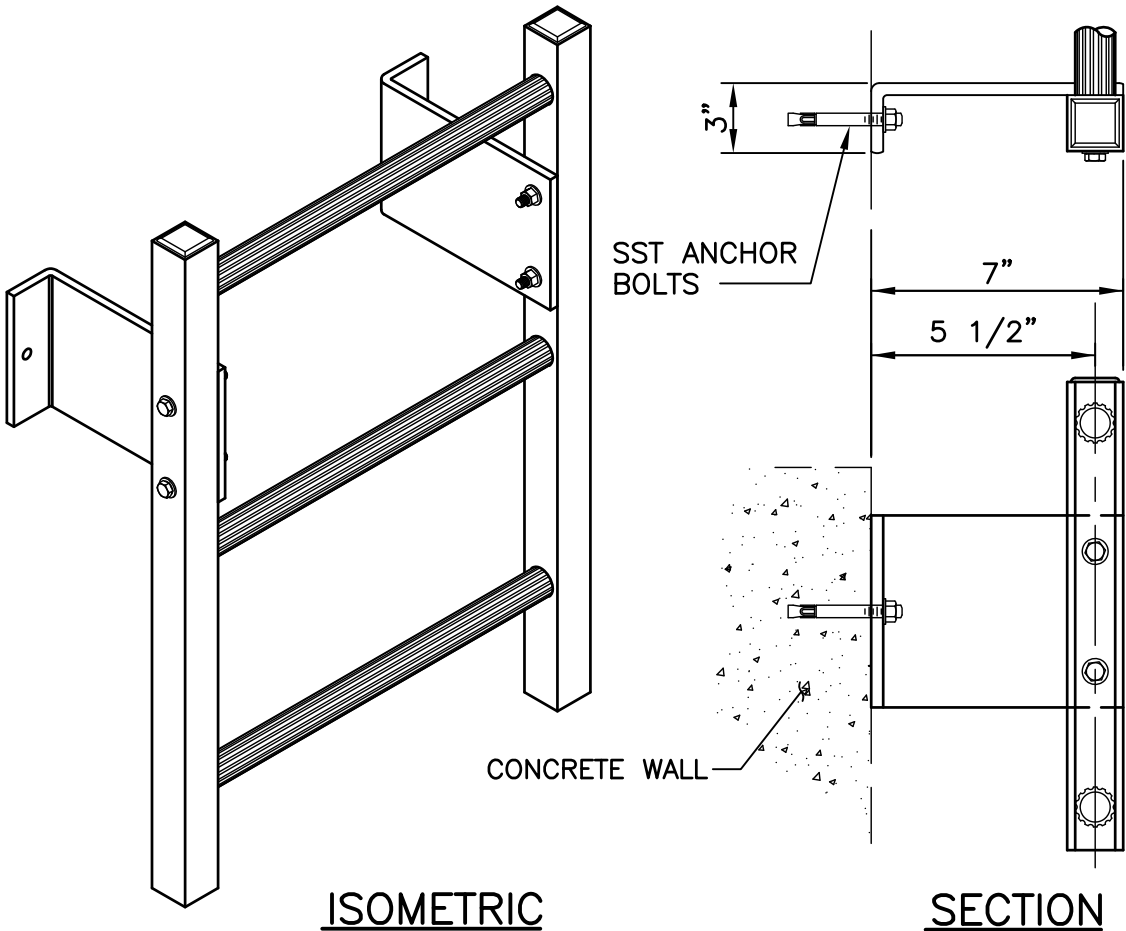
05 52 02-19



FRP CURB ANGLE

NTS

06 82 00-04



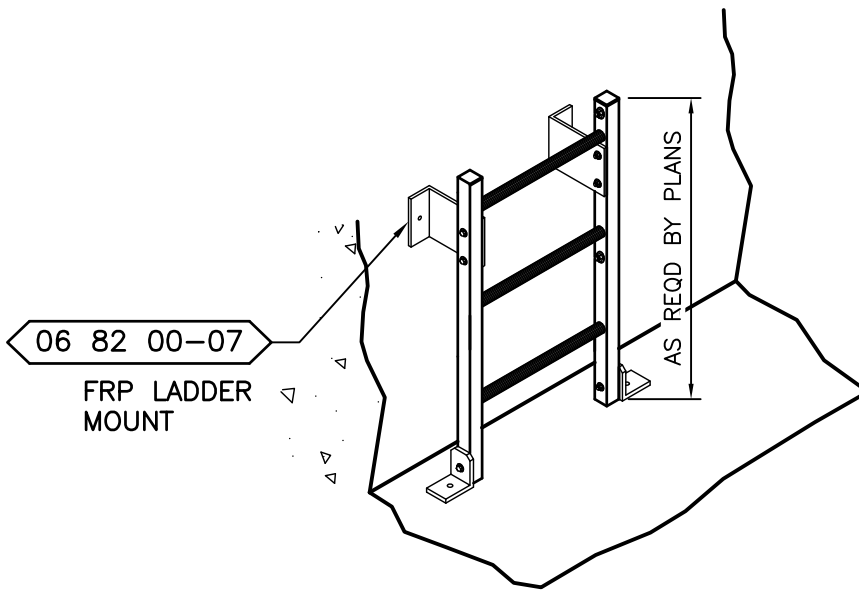
NOTE: ALL GRATING IN AREA C SHALL BE FRP CONSTRUCTION.

FRP LADDER MOUNT

NTS

06 82 00-07





FRP LADDER

NTS

06 82 00-08

POLYISO INSULATION

PVC MEBRANE ROOFING

WATER CUT-OFF MASTIC

SEALANT

PREFINISHED METAL FASCIA

WOOD NAILER

VAPOR BARRIER

WATER BARRIER

CONT. R-15 INSULATION

MESH

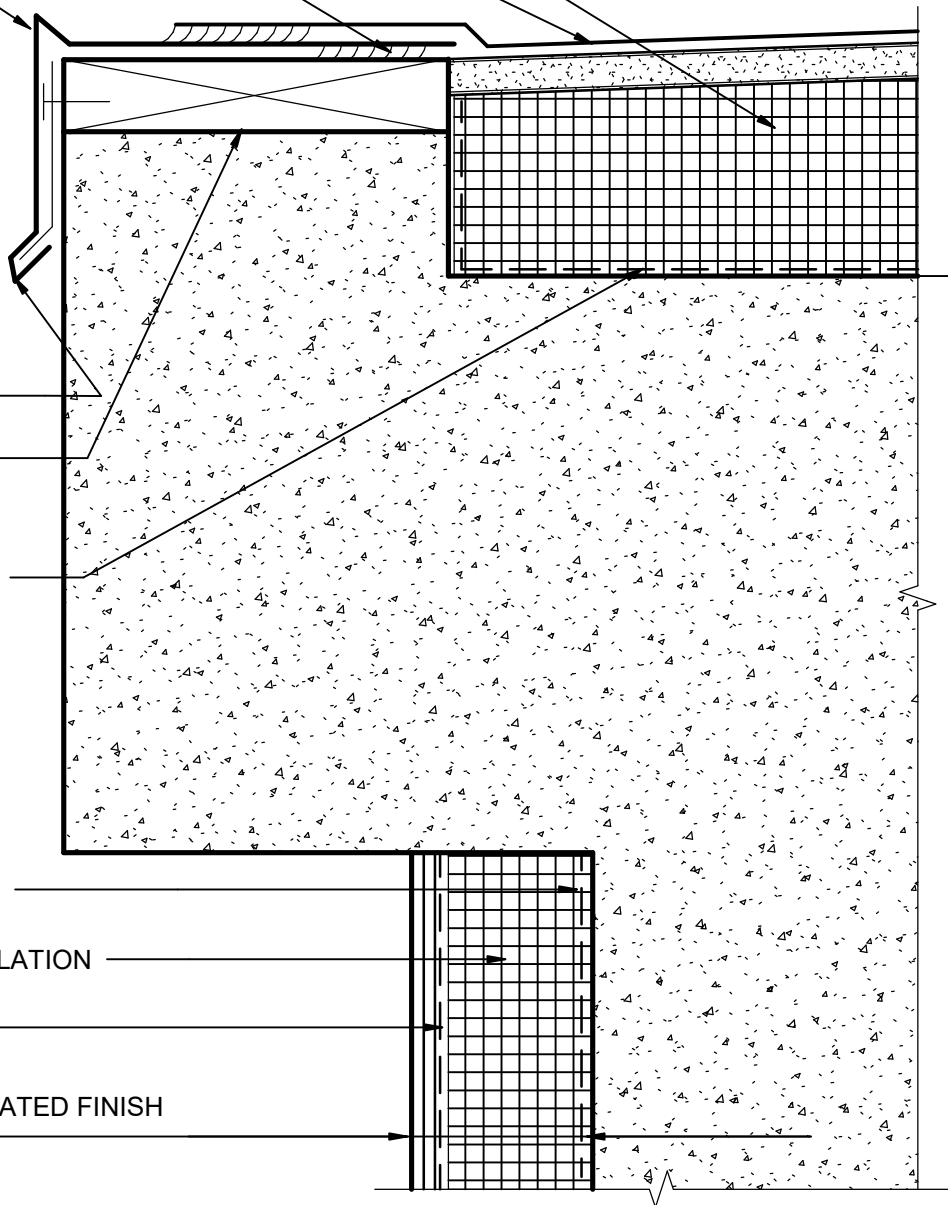
EXTERIOR INSULATED FINISH SYSTEM (EIFS)

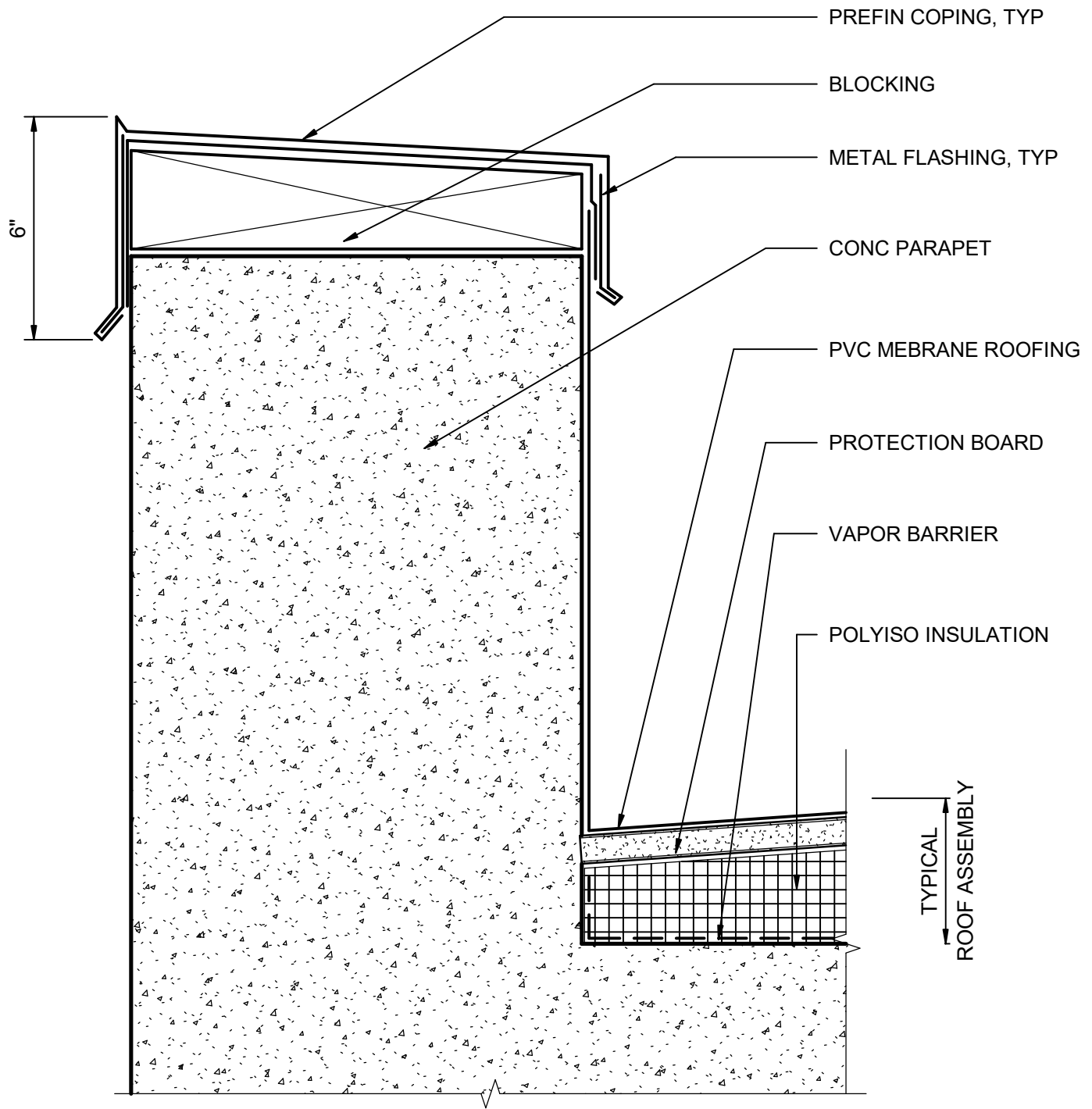
TYPICAL
ROOF ASSEMBLY

EIFS & PVC ROOFING AT DIGESTER

3" = 1'-0"

07 24 13-01



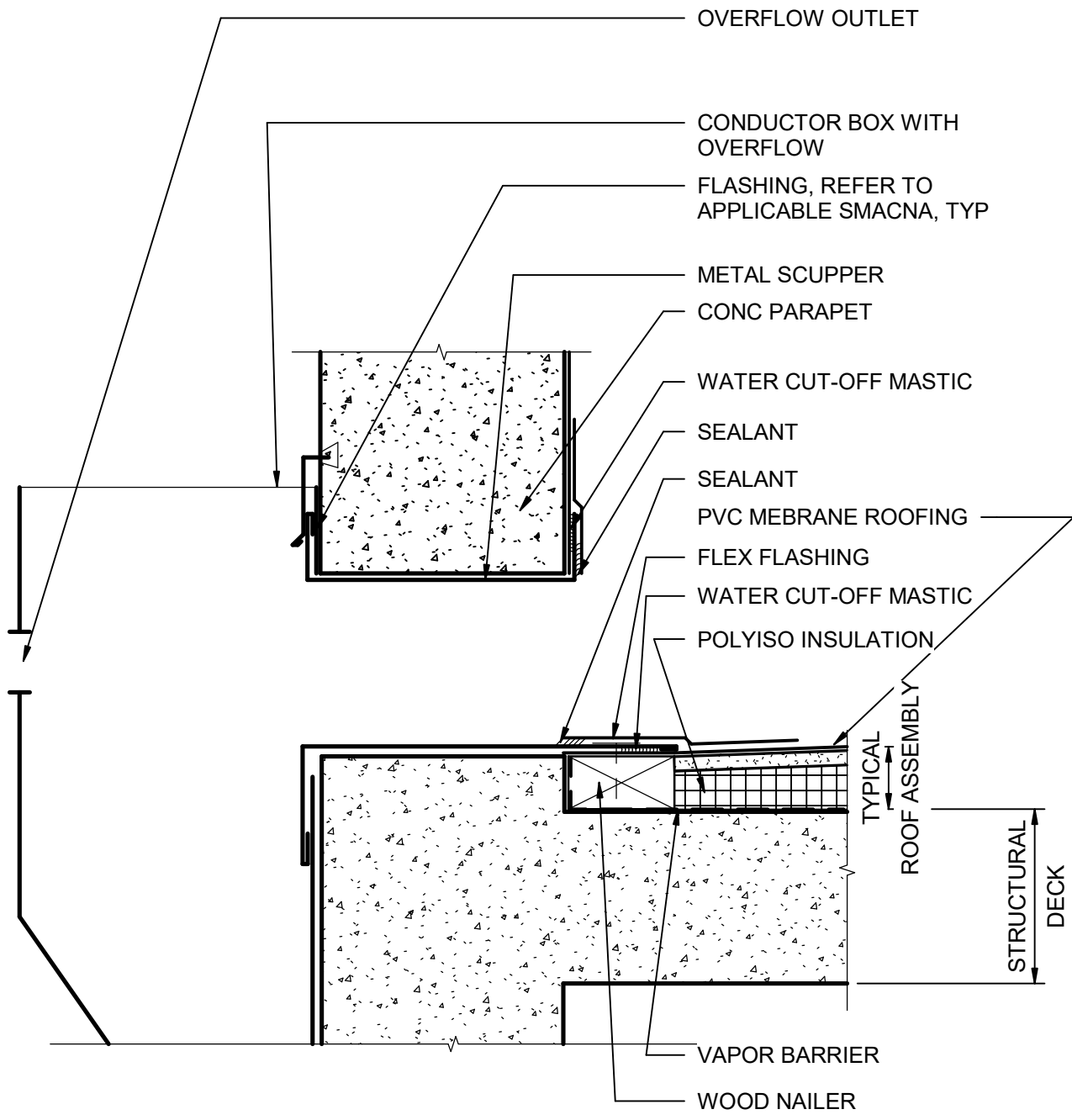


COPING DETAIL

3" = 1'-0"

07 62 00-01





SCUPPER & CONDUCTOR BOX

1 1/2" = 1'-0"

07 62 00-02



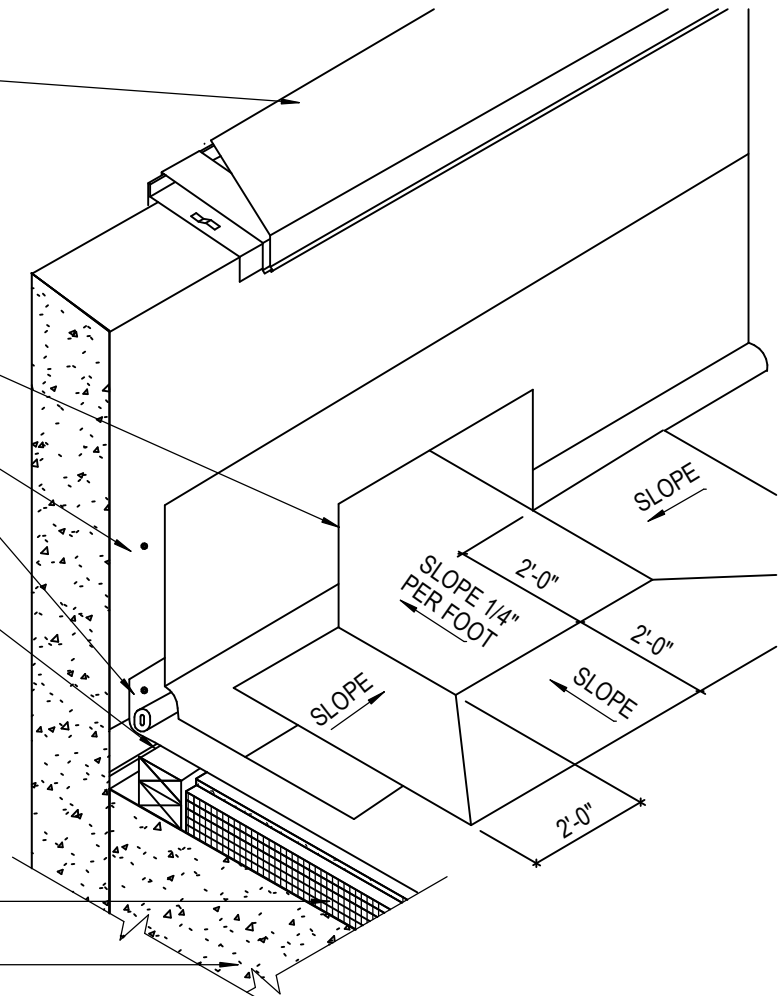
PREFINISHED METAL CAP FLASHING.
COORDINATE WITH FALL ARREST
SYSTEM WHERE FACADE
MAINTENANCE IS PERFORMED VIA
ROOF ANCHORS TO ENSURE
INTEGRITY OF PARAPET IS MAINTAINED

FULLY FLASHED SCUPPER SIZE AND
CONFIGURATION AS PER DETAILS.
TERMINATION BAR FASTENED PER
MANUFACTURERS' INSTRUCTIONS

ROOFING MEMBRANE OVER
DEFLECTION GAP, ATTACHED TO TOP
OF BLOCKING AND WALL

ROOFING SYSTEM AS SPECIFIED

ROOF STRUCTURE

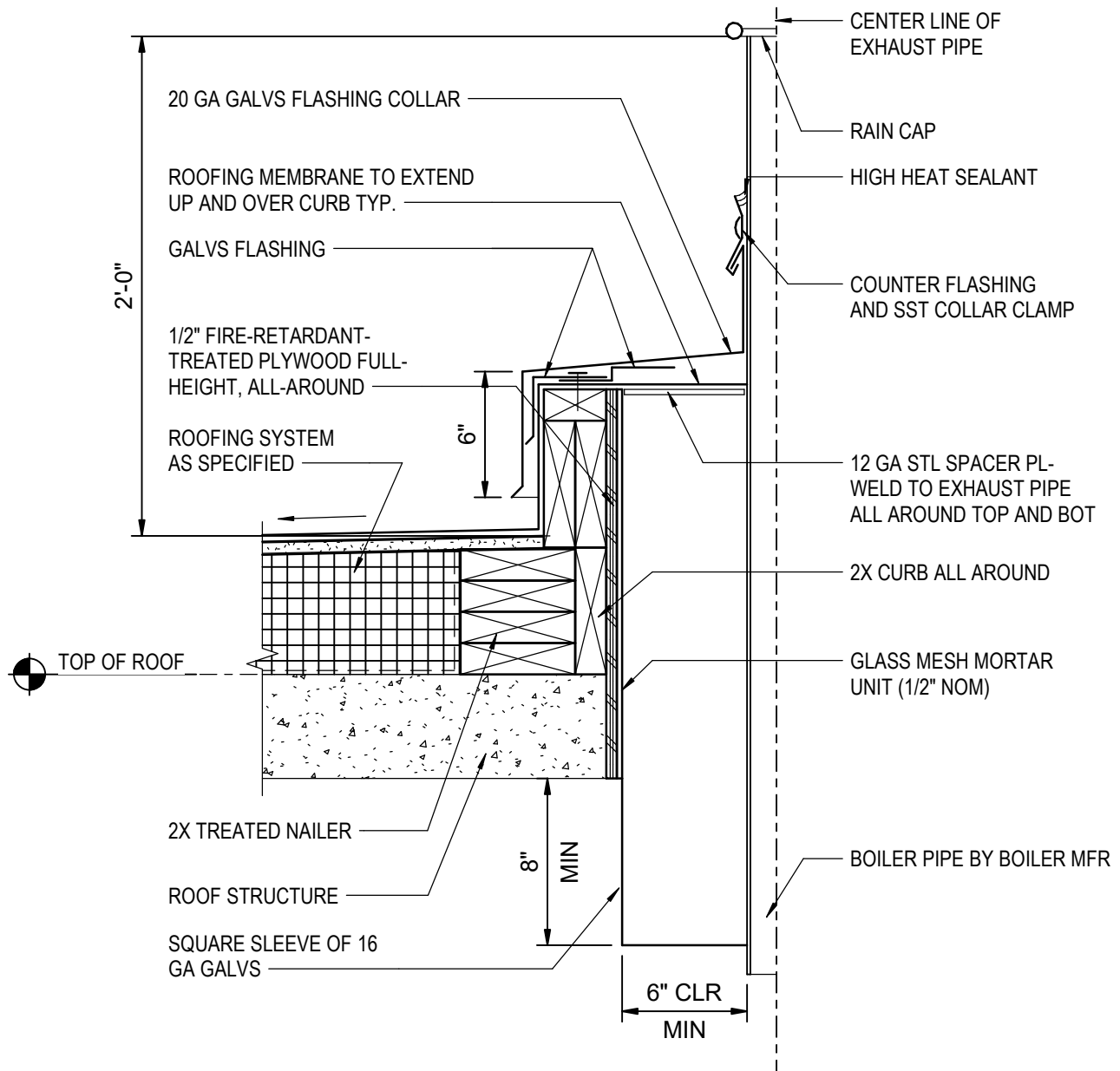


SCUPPER DETAIL

3/4" = 1'-0"

07 62 00-03





BOILER STACK

1 1/2" = 1'-0"

07 62 00-04



NOTES:

1. THIS DETAIL IS TO BE USED AT ROOFTOP EQUIPMENT DESIGNED TO REST ON A CURB.
2. THE ROOFTOP EQUIPMENT SHOULD NOT BE SET UNTIL ROOF MEMBRANE WRAPS TOP OF PREFABRICATED CURB
3. ATTACHMENT OF ALL BLOCKING, CURBS & OTHER ROOF COMPONENTS SHALL BE DESIGNED AND INSTALLED PER ALL MANUFACTURERS CRITERIA AT MINIMUM.
4. COORDINATE TAPERED INSULATION SYSTEM / FLOW LINES OF SLOPED SUBSTRATE WITH CURBS SUCH THAT WATER FLOW IS DIRECTED AROUND THE UNIT AND POSITIVE DRAINAGE IS ACHIEVED IN ALL LOCATION

CURB MOUNTED ROOFTOP EQUIPMENT

CONTINUOUS SEALING / GASKETING MATERIAL AS PER MANUFACTURERS REQUIREMENTS

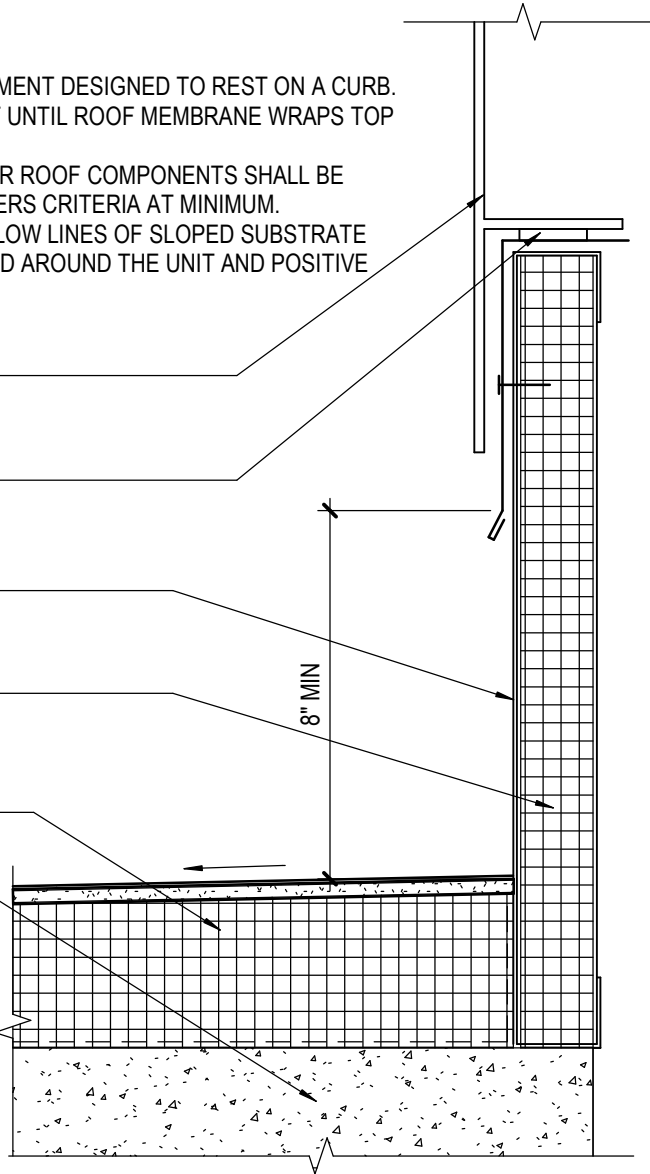
ROOFING MEMBRANE TO EXTEND UP AND OVER CURB TYP.

PREFABRICATED INSULATED METAL PANELS

ROOFING SYSTEM AS SPECIFIED

ROOF STRUCTURE

TOP OF ROOF

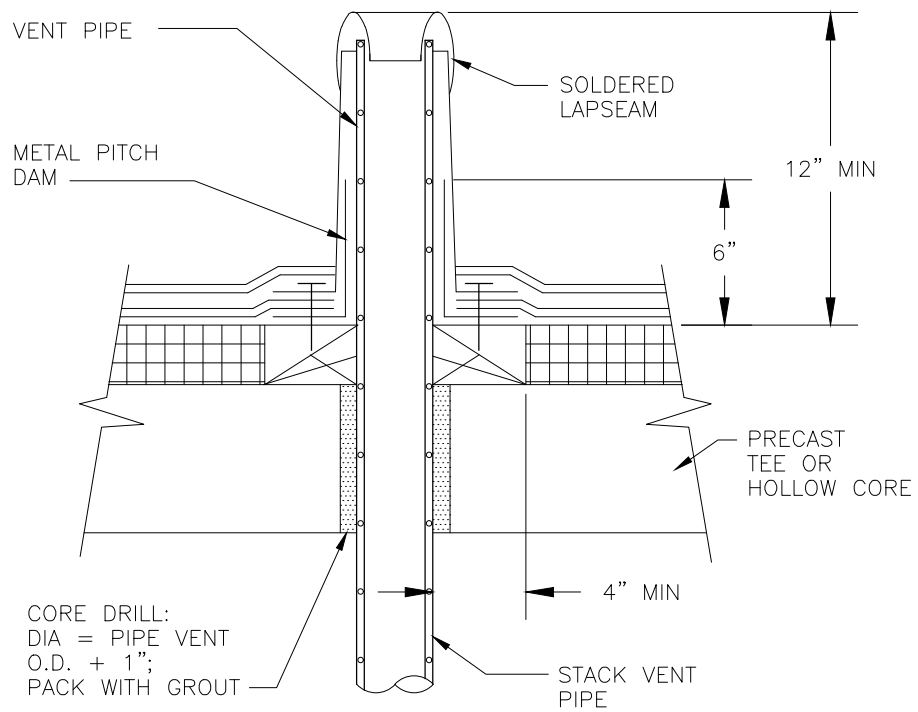


ROOF CURB FOR ROOF EQUIPMENT

1 1/2" = 1'-0"

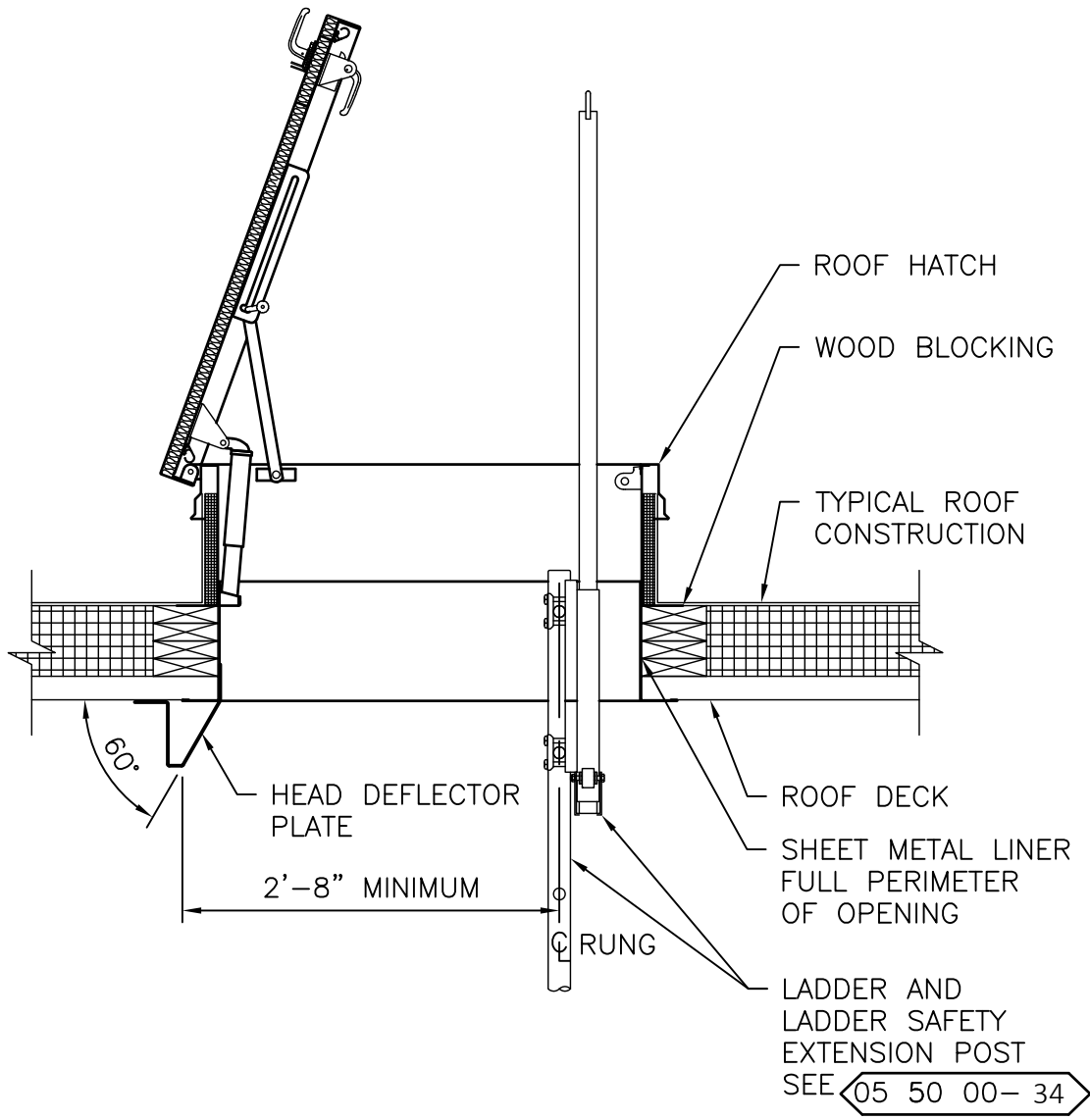
07 62 00-05





VENT THRU ROOF (VTR)

07 62 00-06

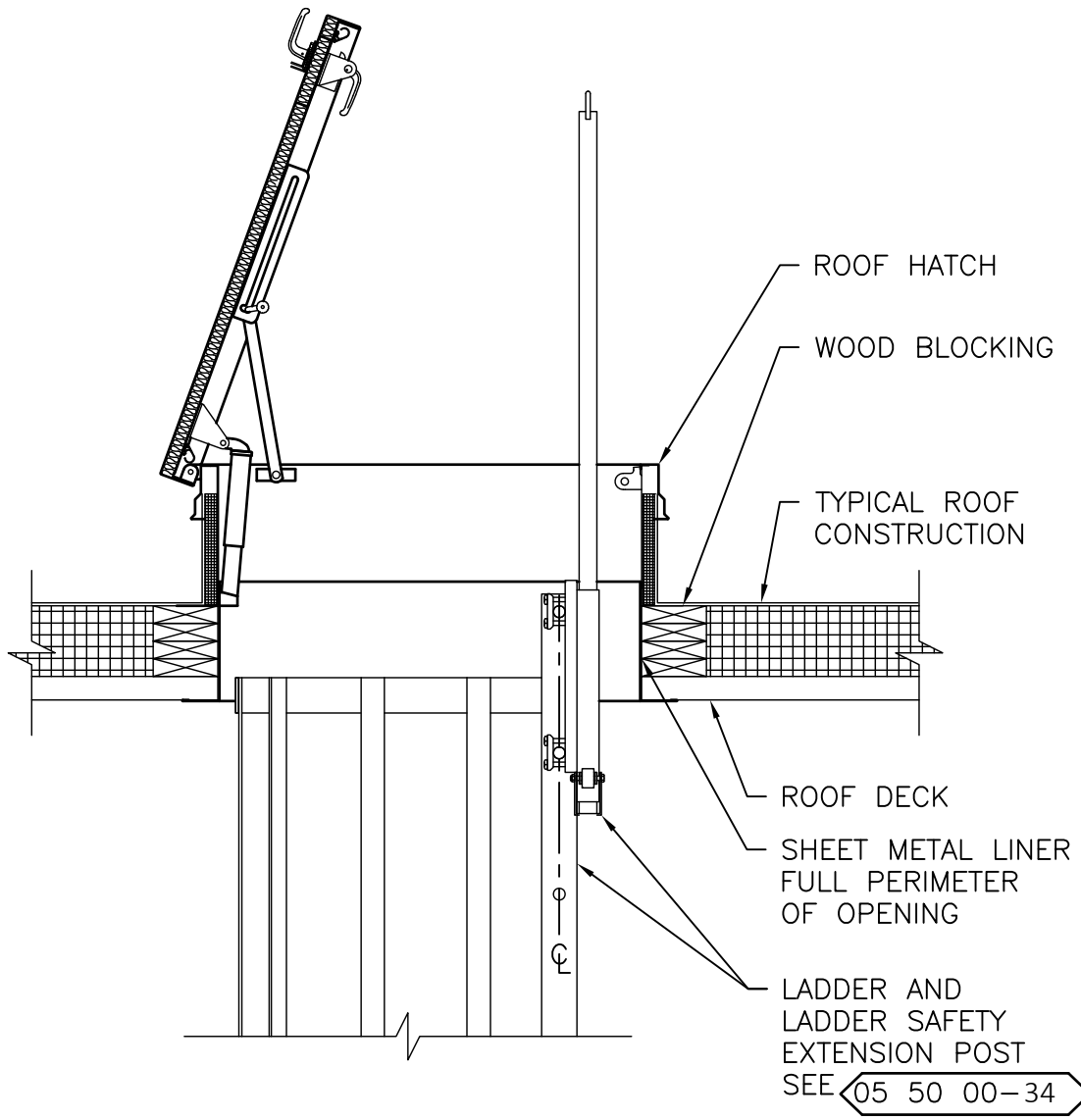


ROOF HATCH AT LADDER WITHOUT CAGE

NTS

07 72 33-01





ROOF HATCH AT LADDER WITH CAGE

NTS

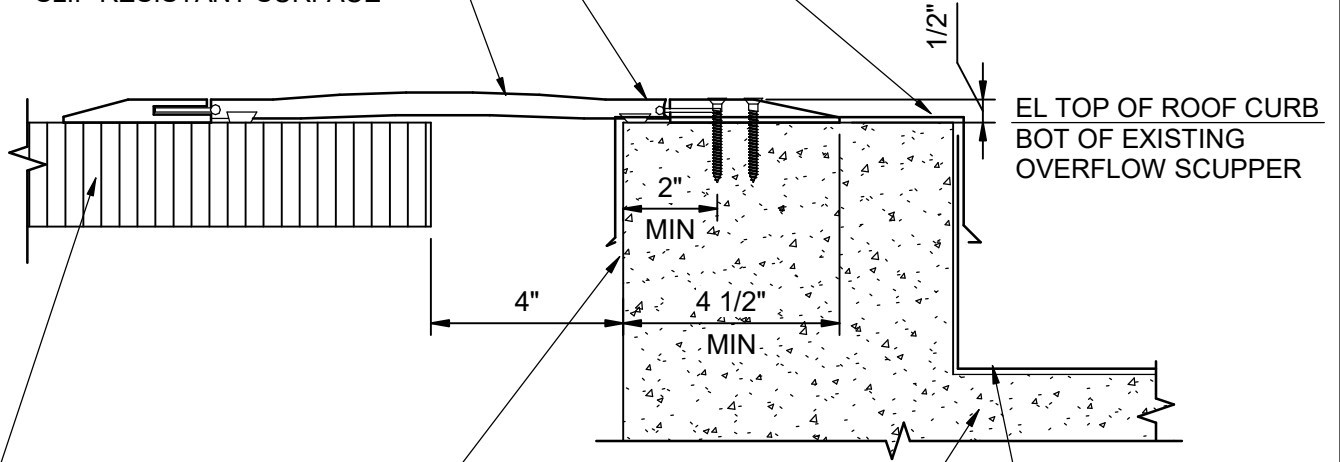
07 72 33-02



PREFINISHED METAL COPING,
FINISH TO MATCH EXISTING

JOINT COVER SYSTEM

SLIP RESISTANT SURFACE



EL TOP OF ROOF CURB
BOT OF EXISTING
OVERFLOW SCUPPER

FACE OF EXISTING SLAB

CONNECTOR SURFACE

EXISTING SOLID HANDLING
BUILDING ROOF LEVEL

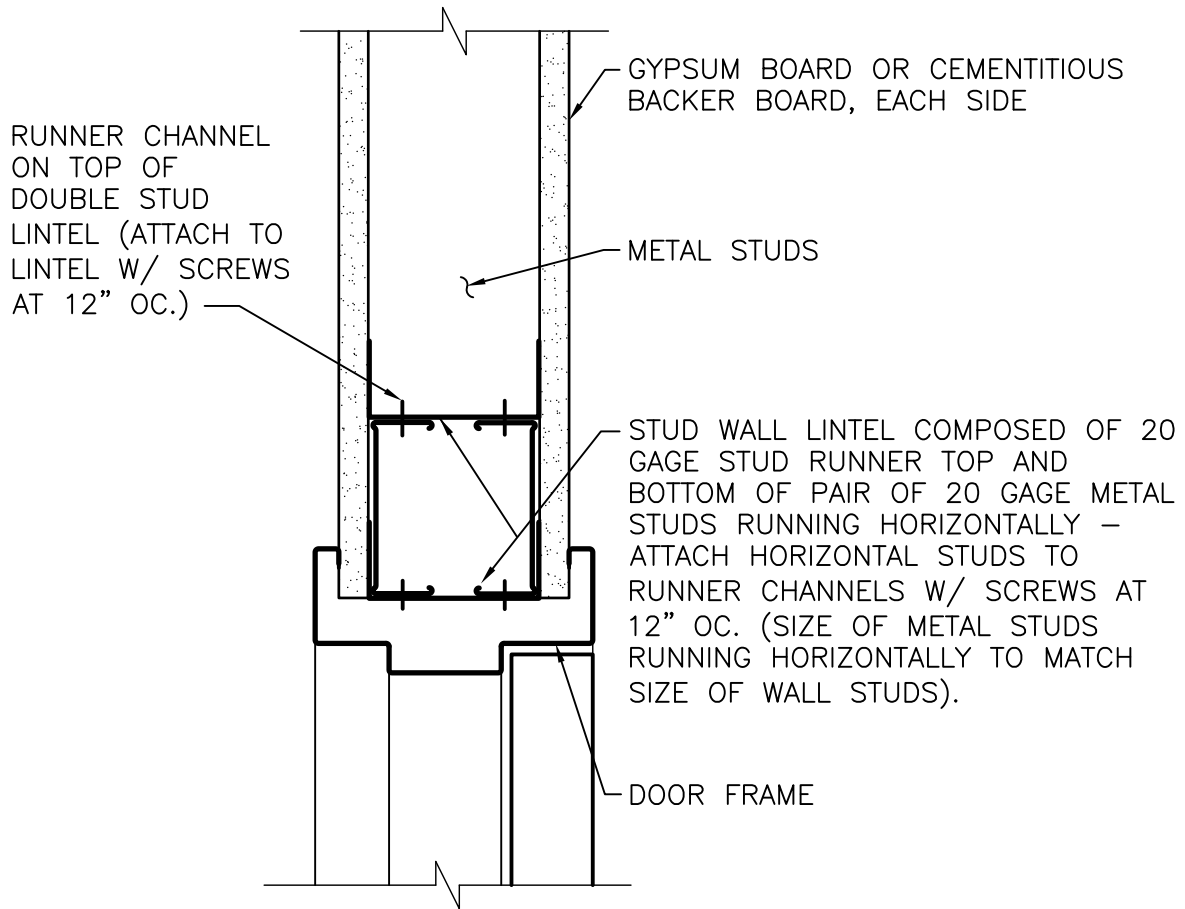
PVC ROOFING MEMBRANE

FLOOR JOINT COVER

3" = 1'-0"

07 95 13-01





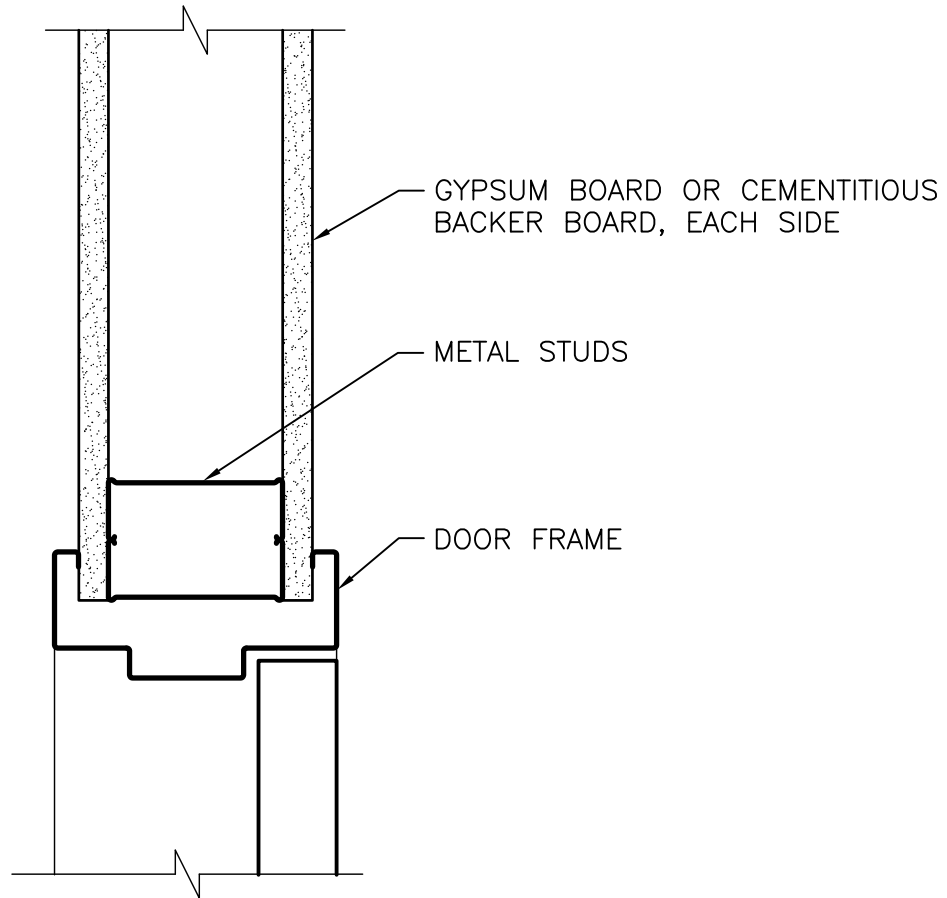
NOTE:

1. INSULATION NOT SHOWN. SEE WALL TYPES.

DOOR HEAD

NTS

08 11 00-01



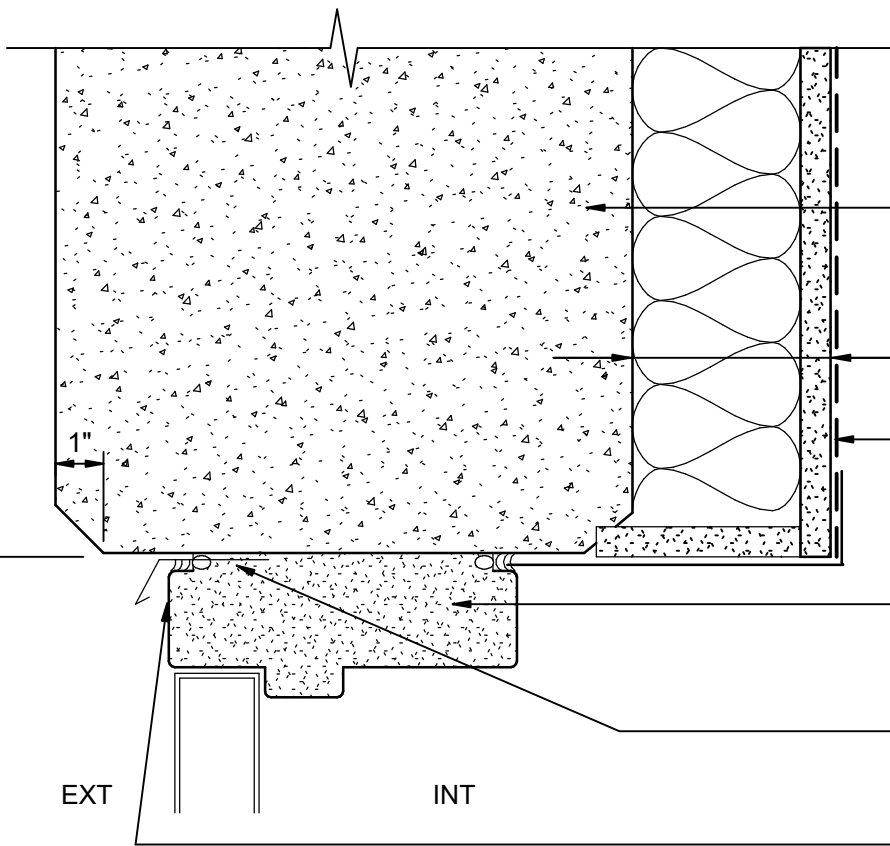
NOTE:

1. INSULATION NOT SHOWN. SEE WALL TYPES.

DOOR JAMB

NTS

08 11 00-02



CONCRETE WALL
REFER TO STRUCT DWG

WALL TYPE PER PLAN

FINISH PER SCHED

SS DR FRAME, GROUT
SOLID

BACKER ROD W/ SEALANT
CAULKING

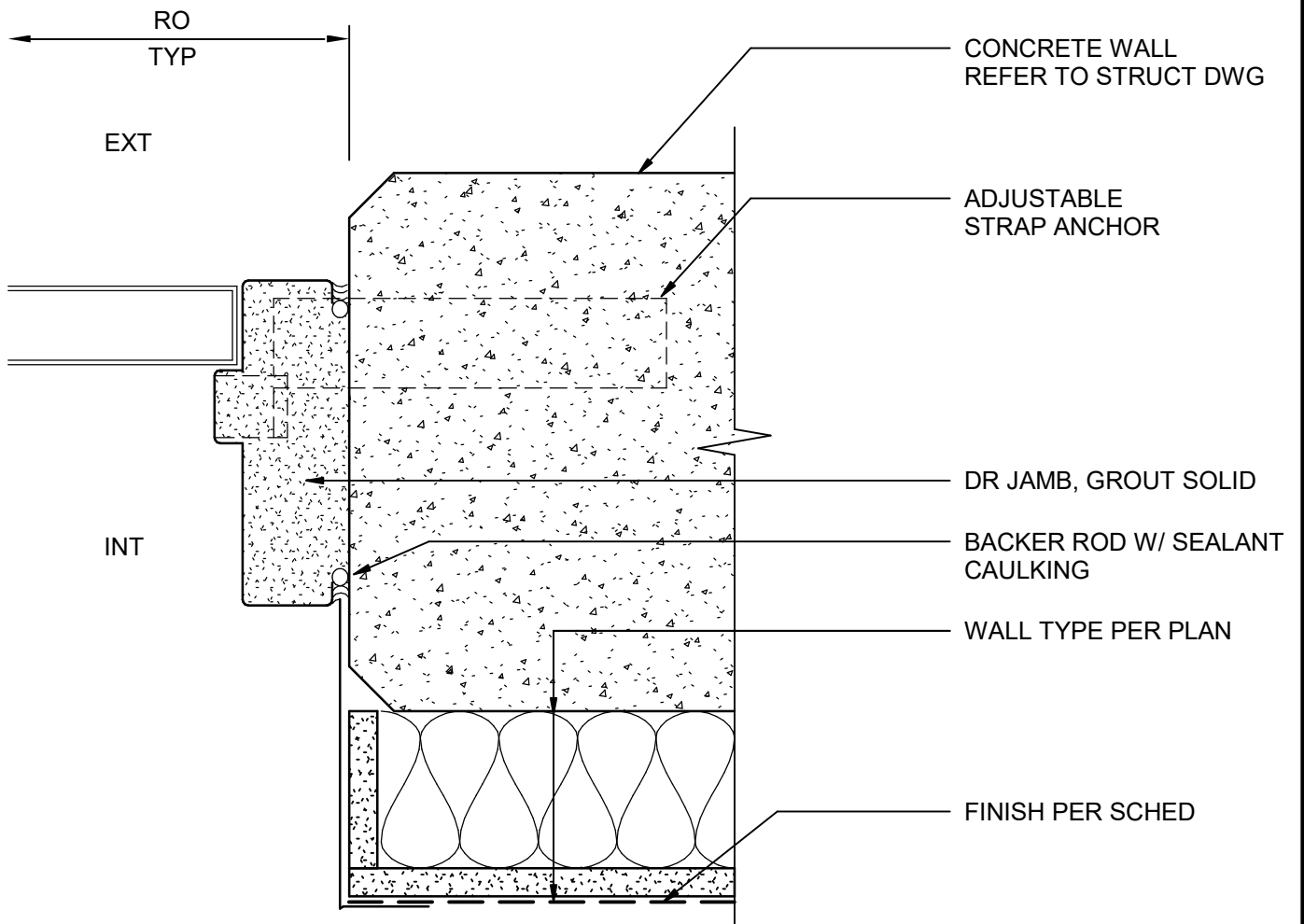
FLASHING

DOOR HEAD

3" = 1'-0"

08 11 00-05





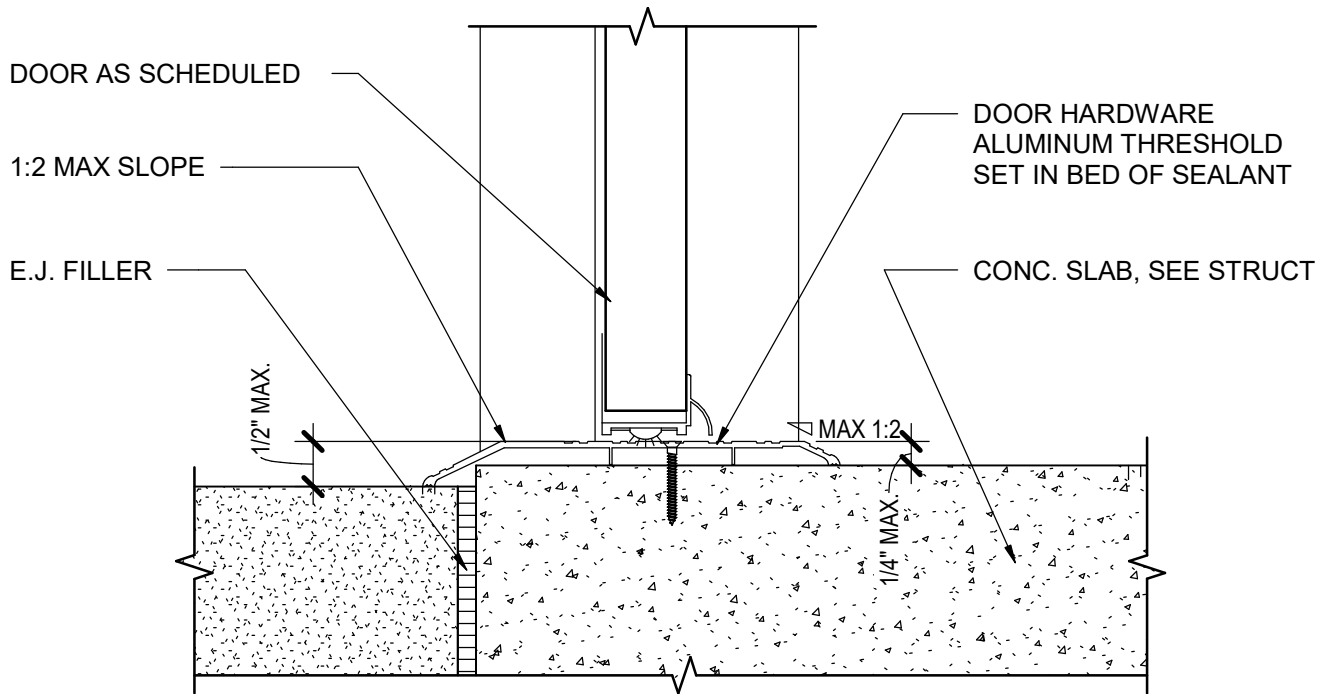
EXT DOOR JAMB

3" = 1'-0"

08 11 00-06

EXTERIOR

INTERIOR

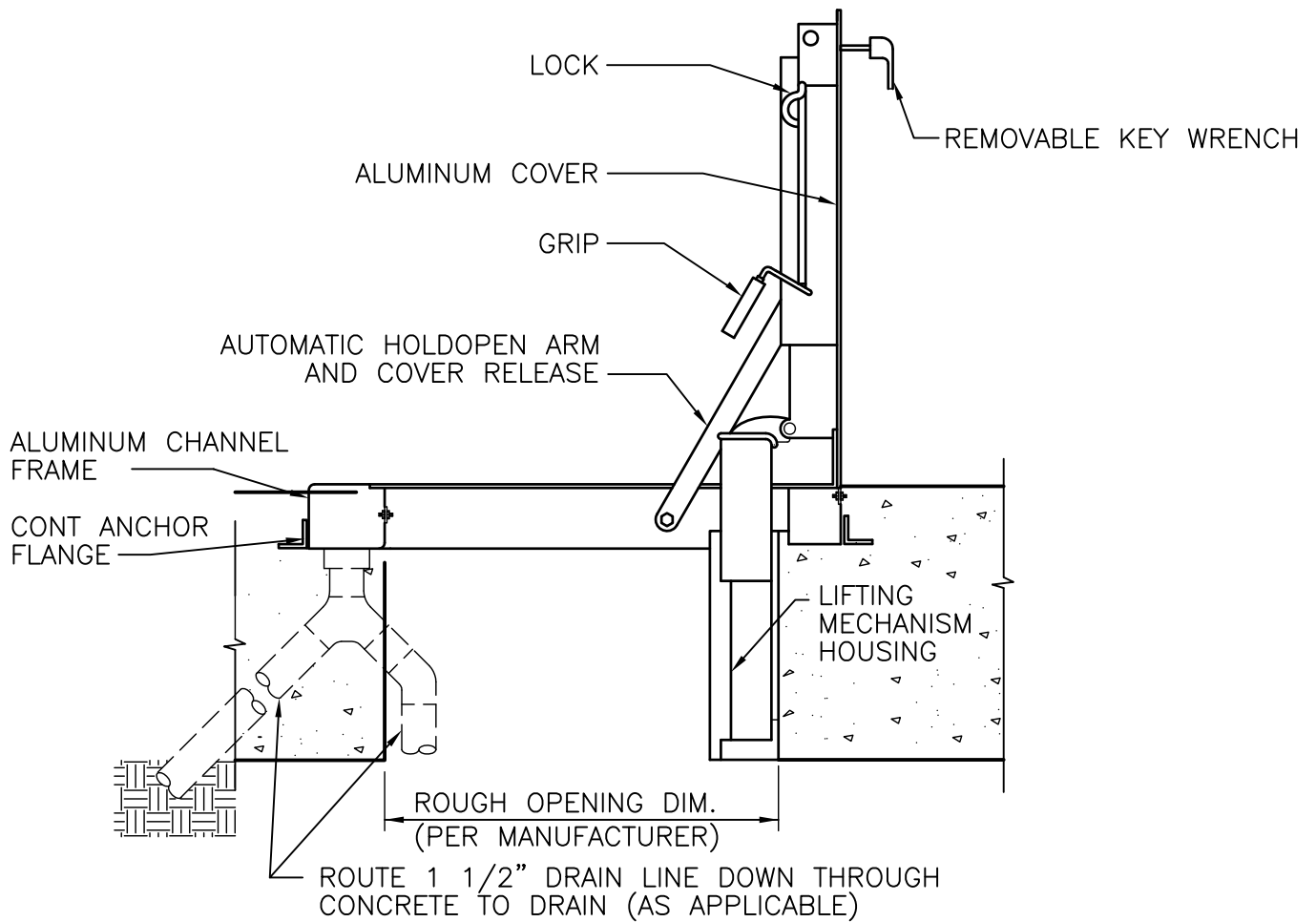


THRESHOLD DETAIL

3" = 1'-0"

08 11 00-07



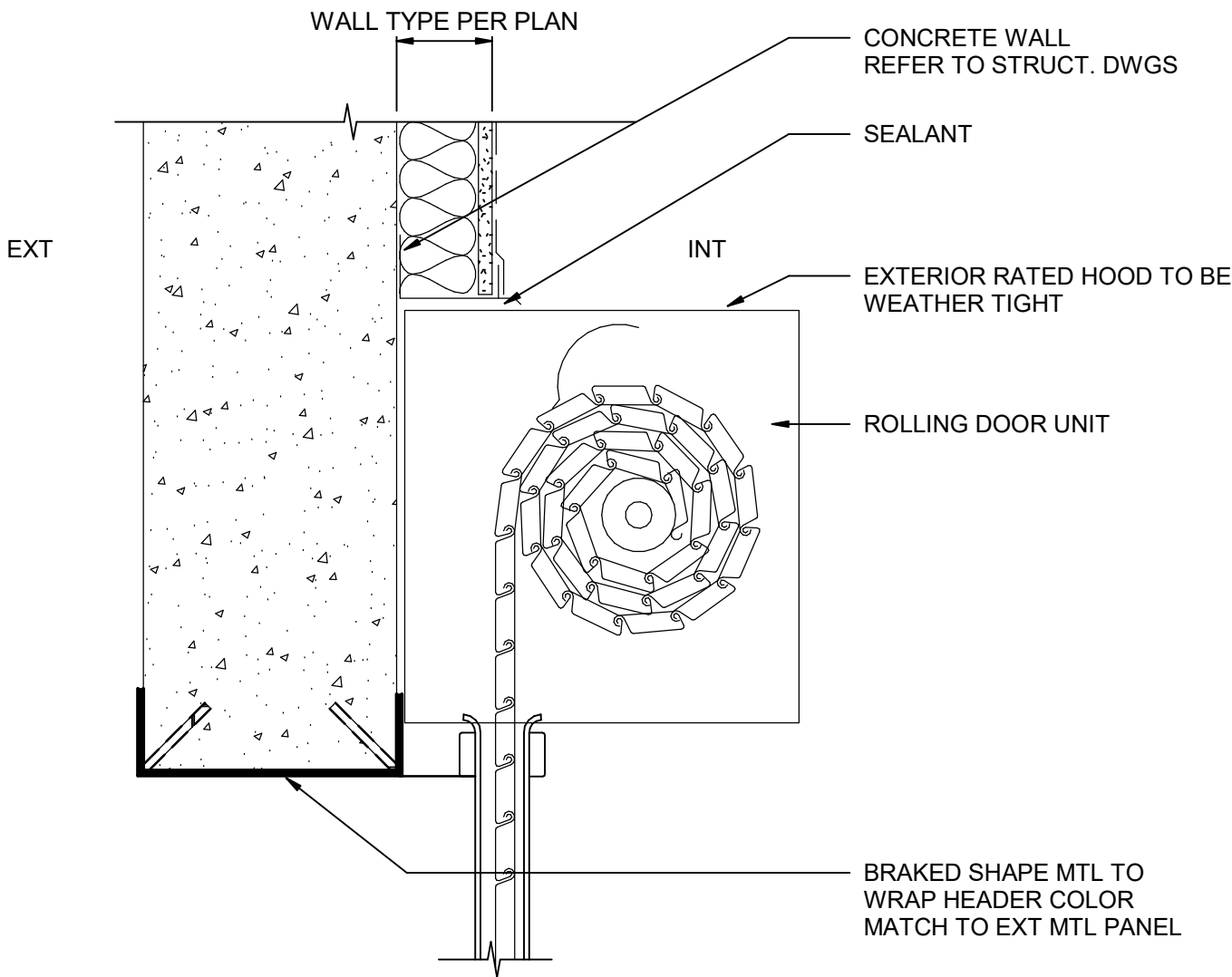


HATCH DETAIL

NTS

08 31 00-01



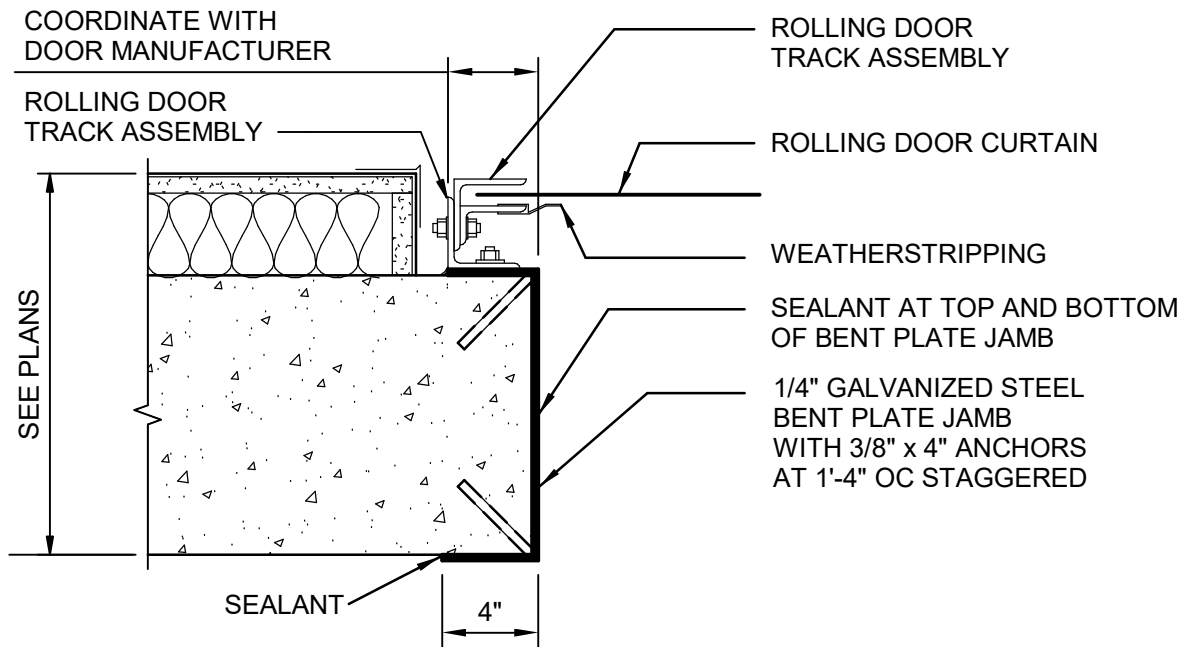


OH ROLLING DOOR HEAD

1 1/2" = 1'-0"

08 33 22-01





NOTES:

1. FINISH PAINT ENTIRE BENT PLATE JAMB PRIOR TO INSTALLATION.
2. SEE STRUCTURAL FOR VERTICAL REINFORCEMENT.
3. HORIZONTAL REINFORCEMENT NOT SHOWN.
4. PROVIDE DISSIMILAR METAL PROTECTION TYP

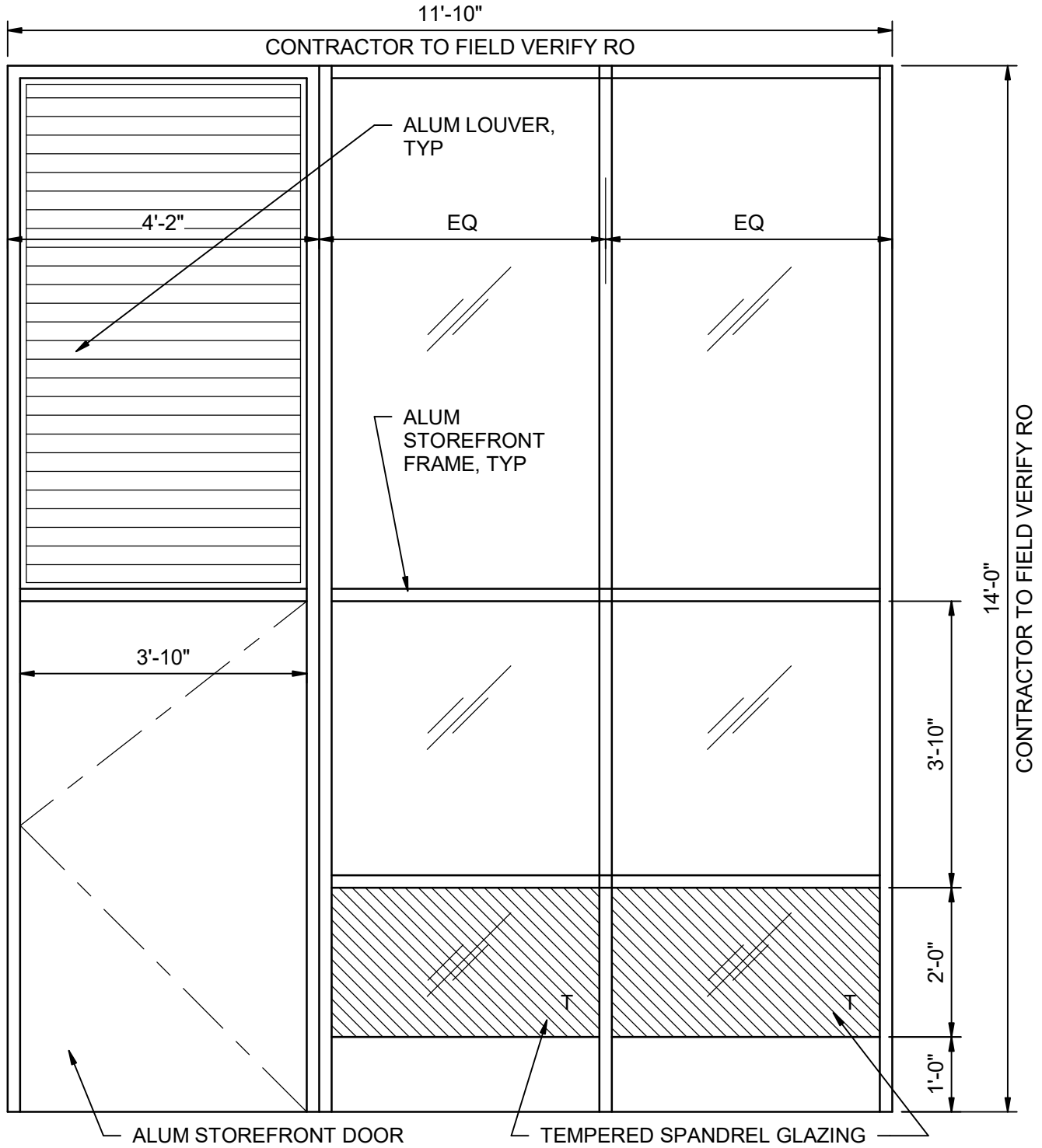
OH ROLLING DOOR JAMB

1 1/2" = 1'-0"

08 33 22-02

ELEVATION NOTES:

CONTRACTOR TO FIELD VERIFY EXISTING STOREFRONT ROUGH OPENINGS DIMENSIONS, AND CONFIGURATION. PROPOSE MODIFIED STOREFRONT CONFIGURATION AS NEEDED.

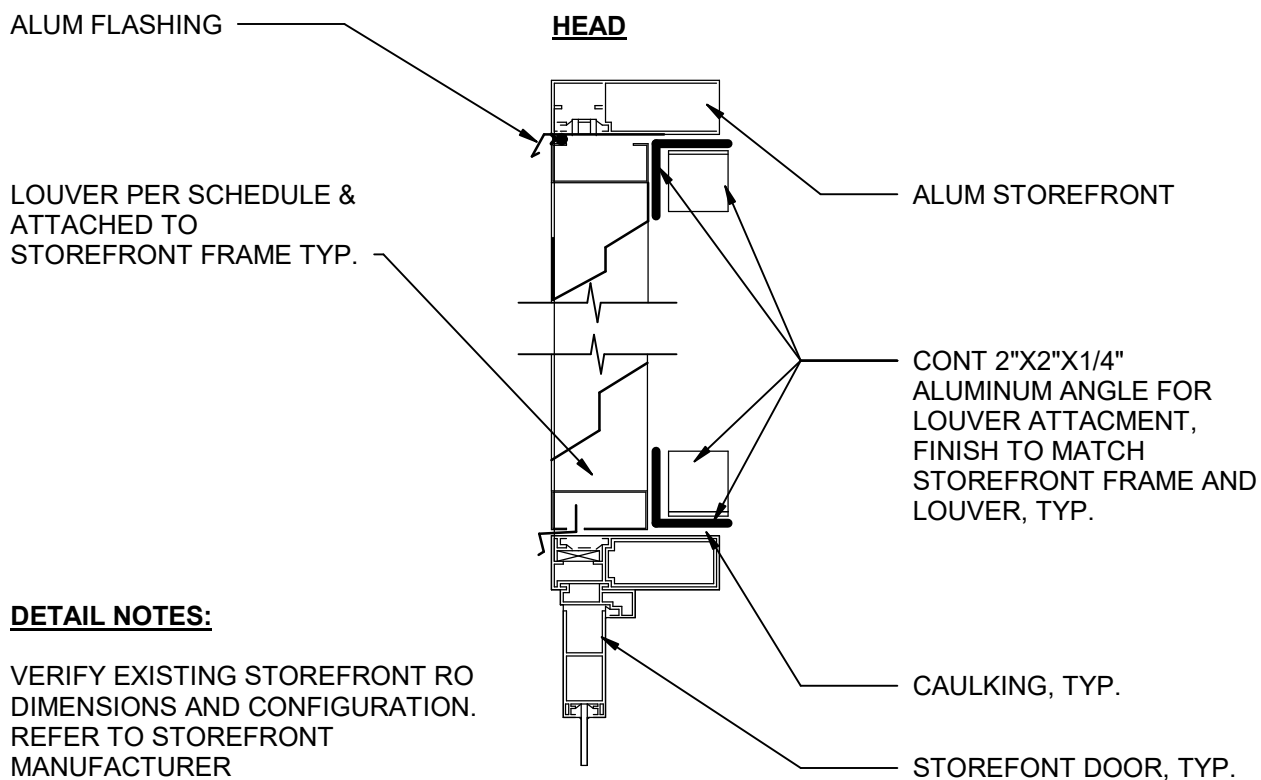
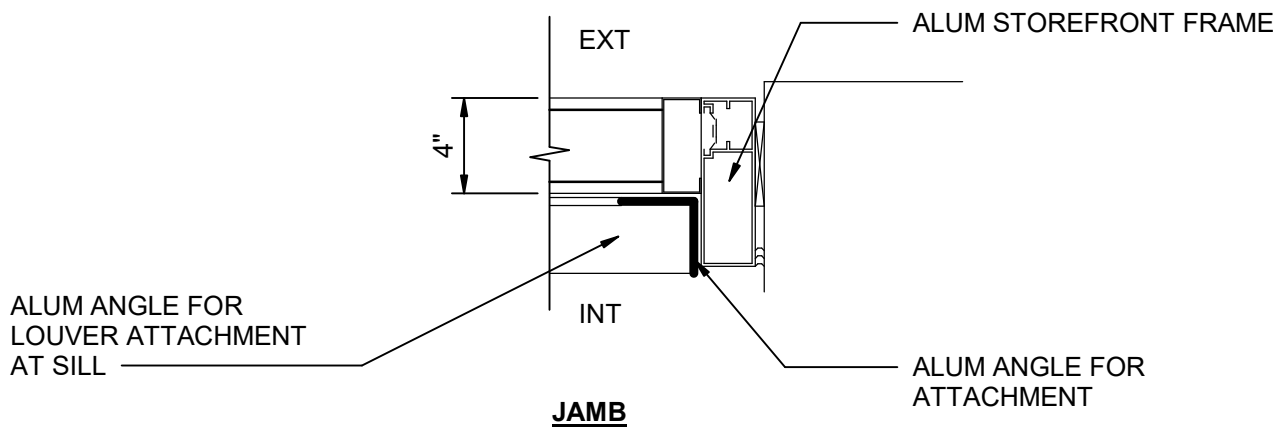


STOREFRONT ELEVATION

1/2" = 1'-0"

08 41 10-01





DETAIL NOTES:

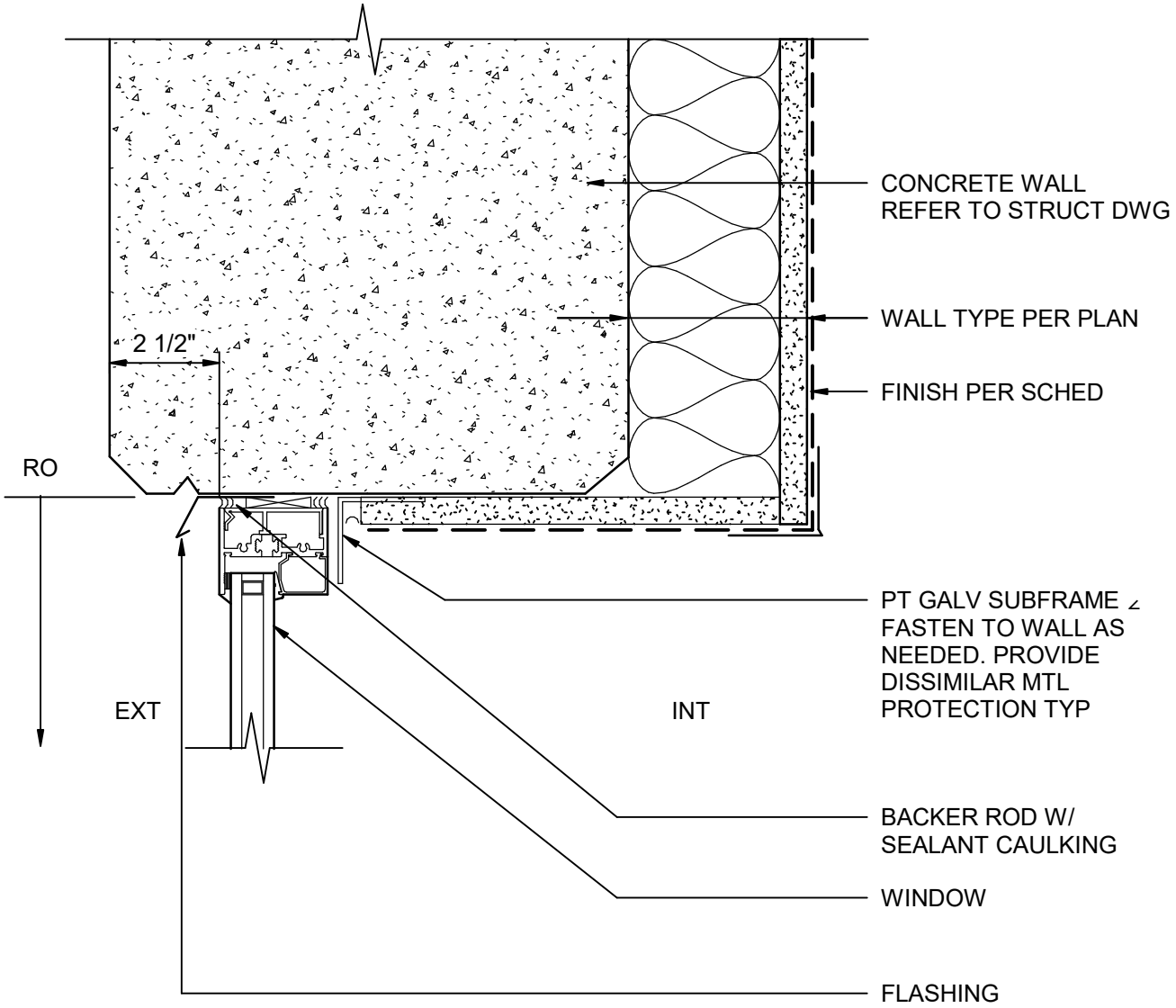
VERIFY EXISTING STOREFRONT RO DIMENSIONS AND CONFIGURATION. REFER TO STOREFRONT MANUFACTURER RECOMMENDATION FOR LOUVER ATTACHMENT. ATTACHMENT ANGLE IS OPTIONAL

STOREFRONT WITH LOUVER

1 1/2" = 1'-0"

08 41 10-02



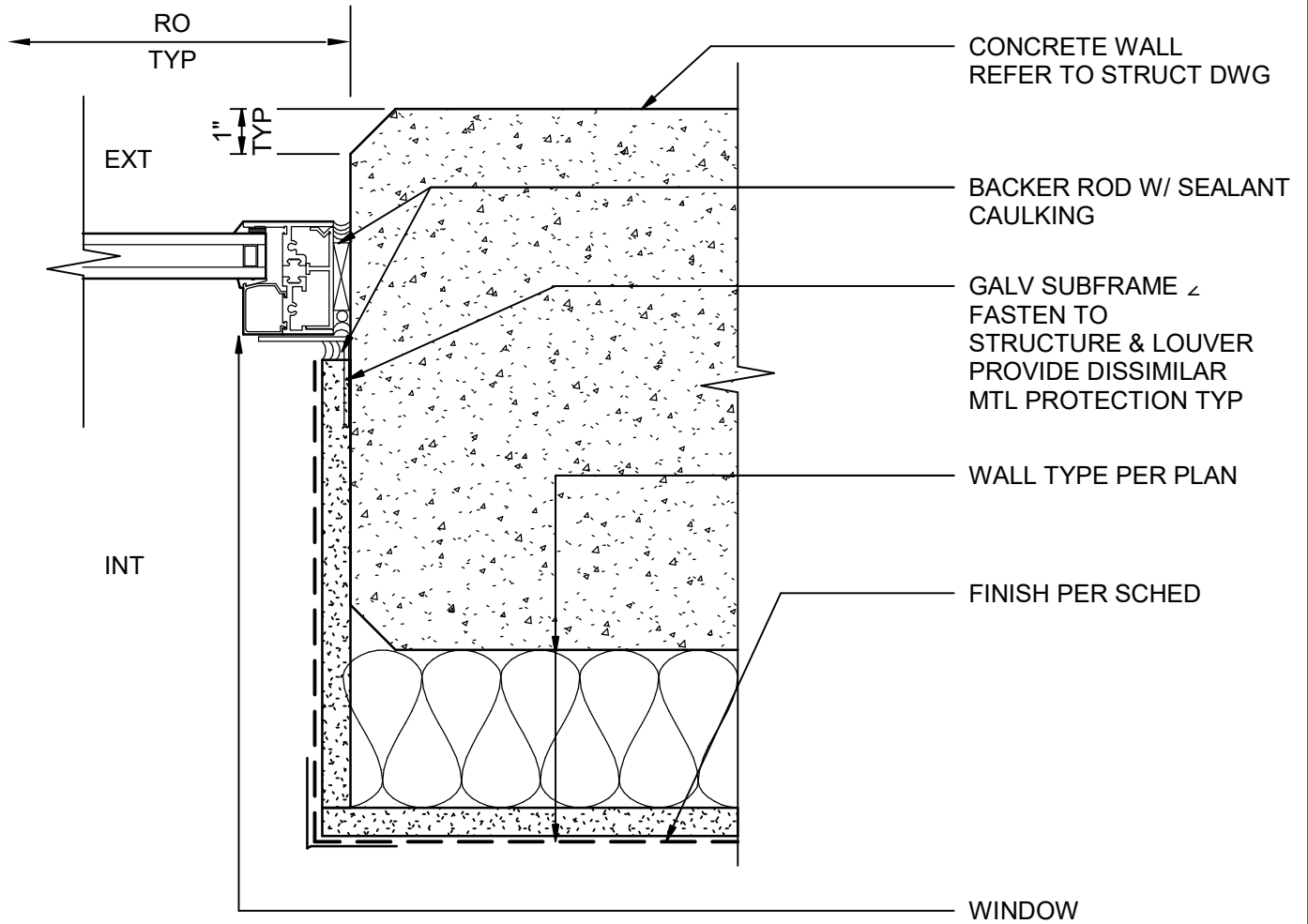


ALUMINUM WINDOW HEAD

3" = 1'-0"

08 51 13-01



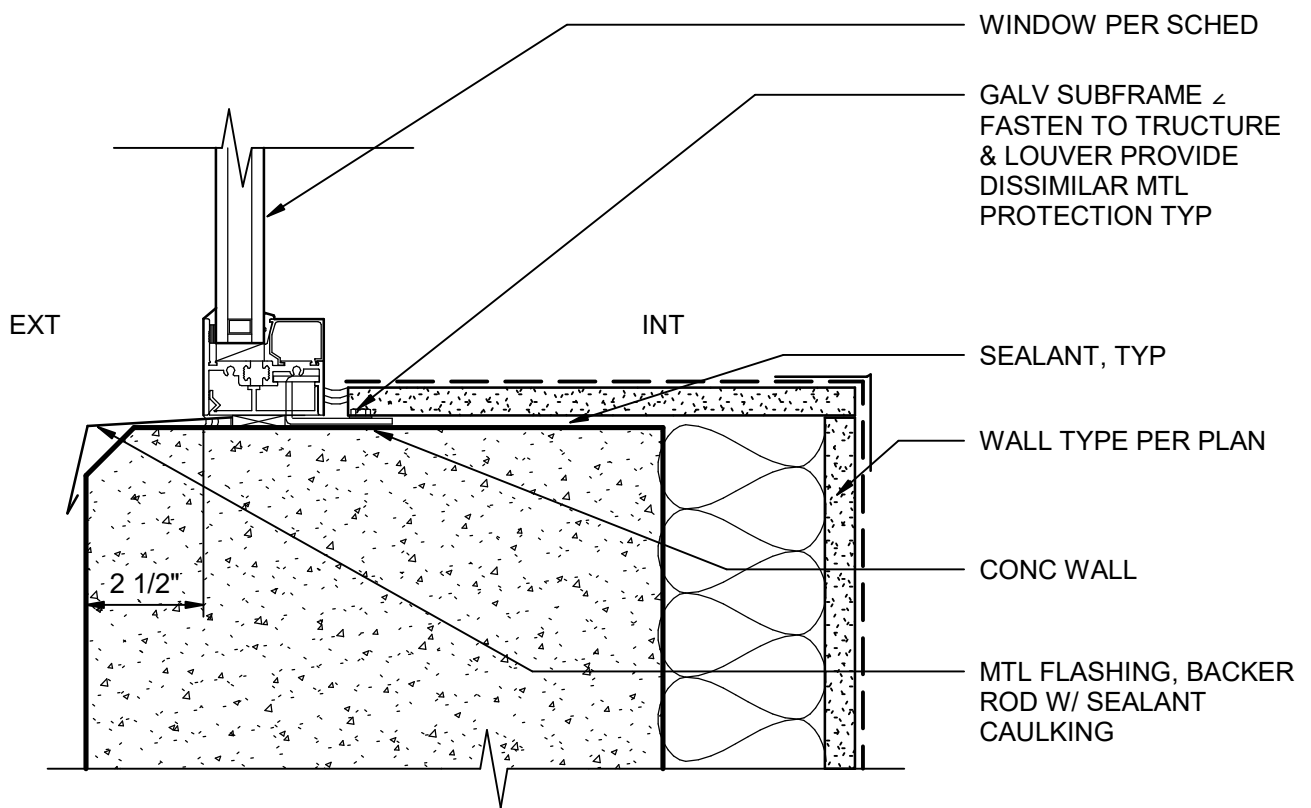


ALUMINUM WINDOW JAMB

3" = 1'-0"

08 51 13-02

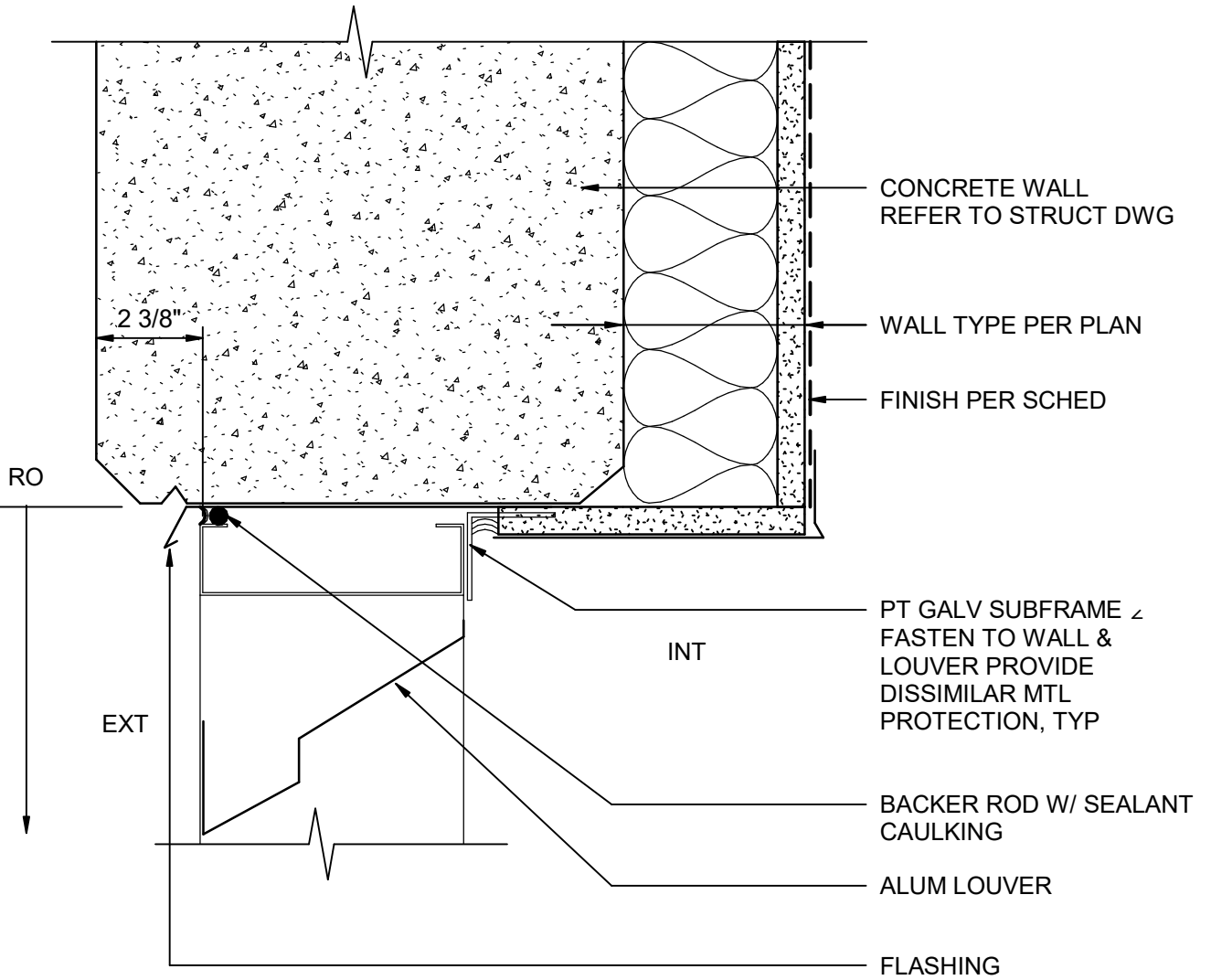




ALUMINUM WINDOW SILL

3" = 1'-0"

08 51 13-03

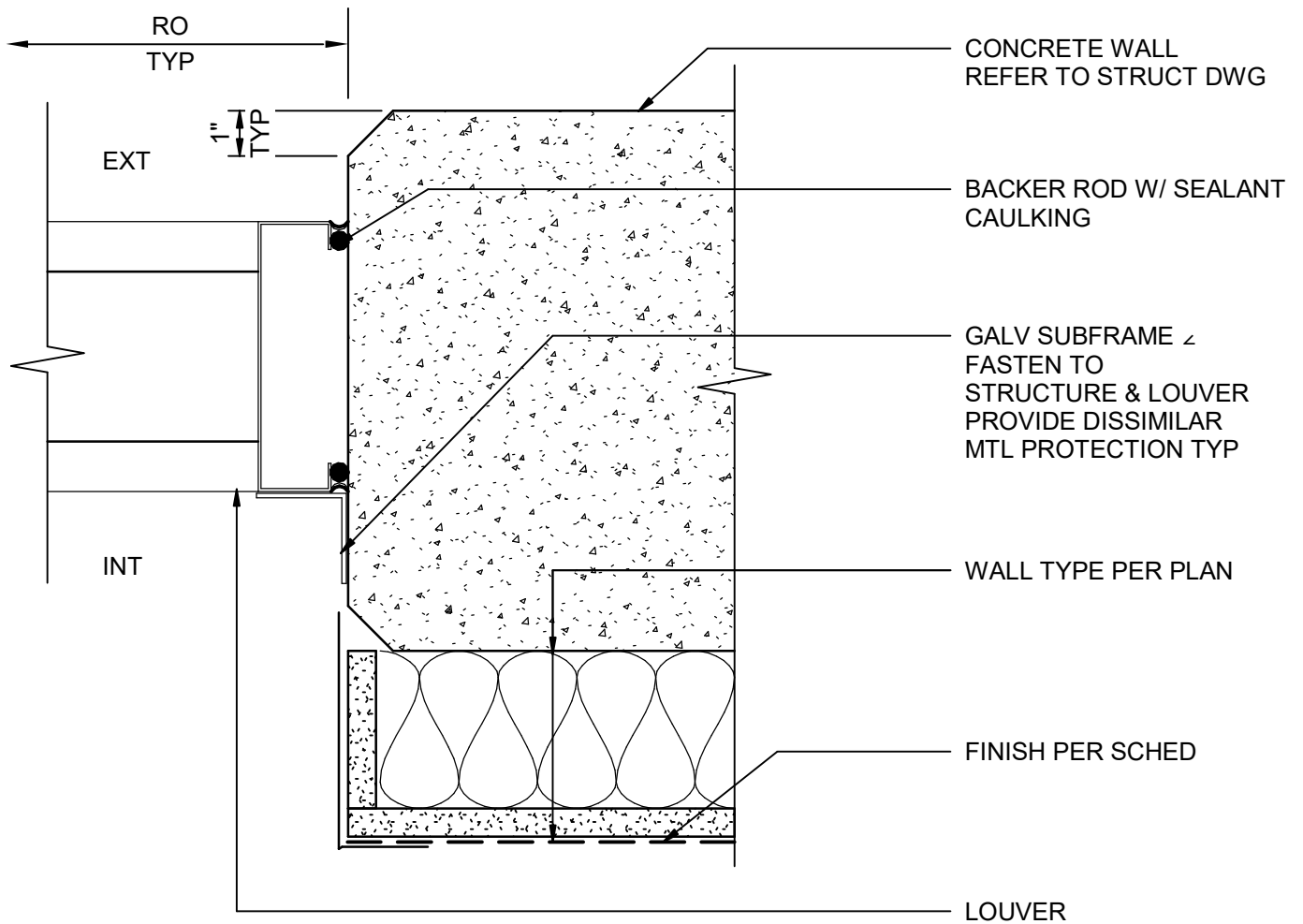


LOUVER HEAD

3" = 1'-0"

08 90 00-01

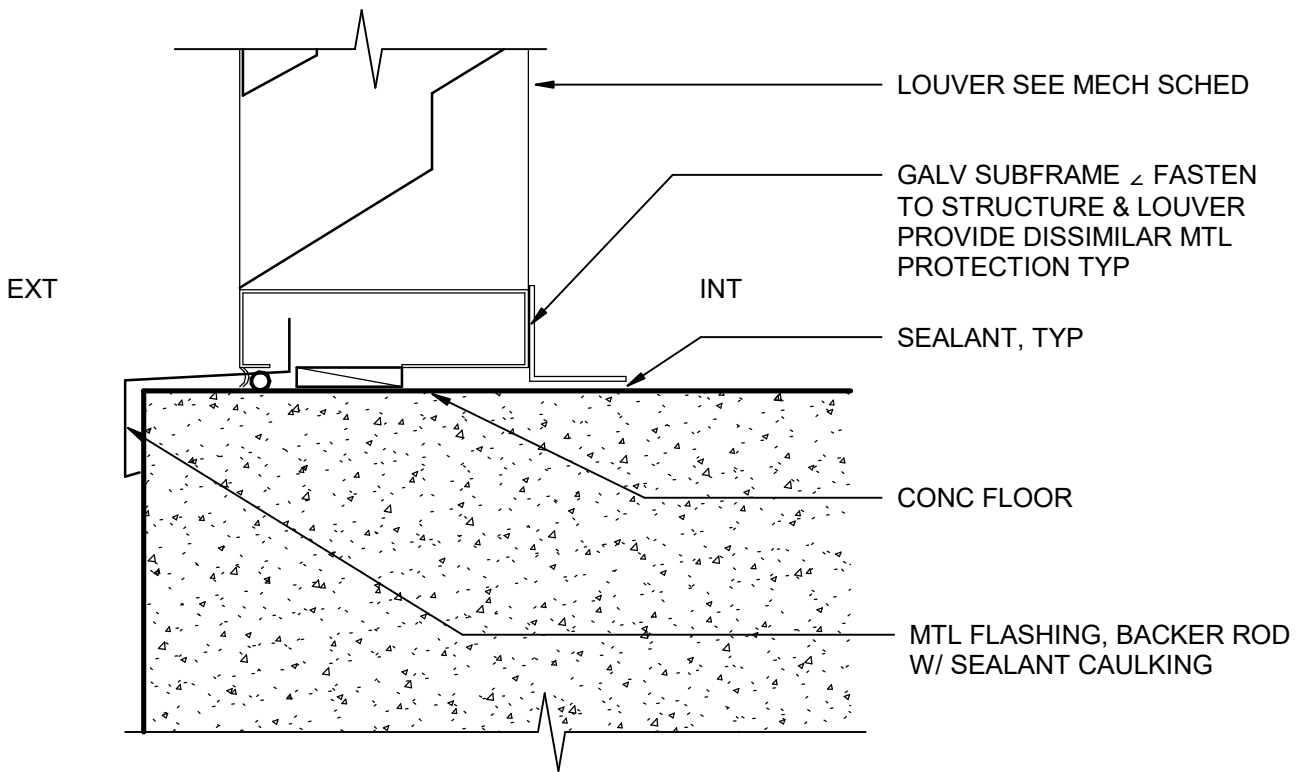




LOUVER JAMB

3" = 1'-0"

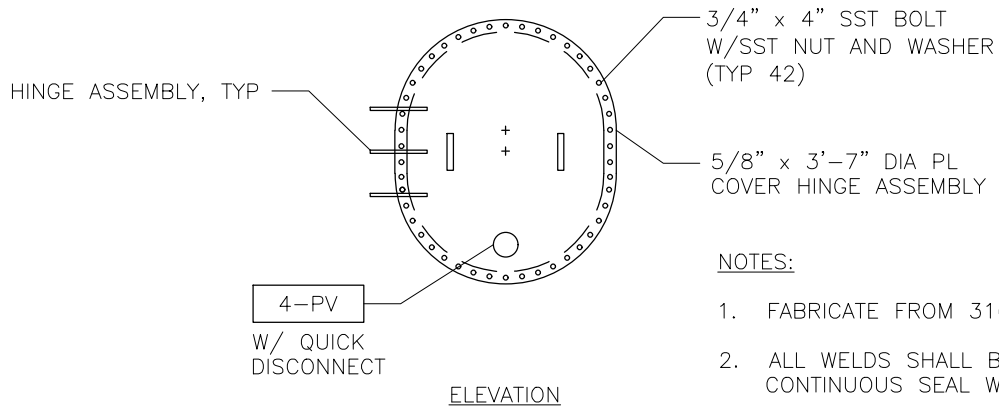
08 90 00-02



LOUVER SILL

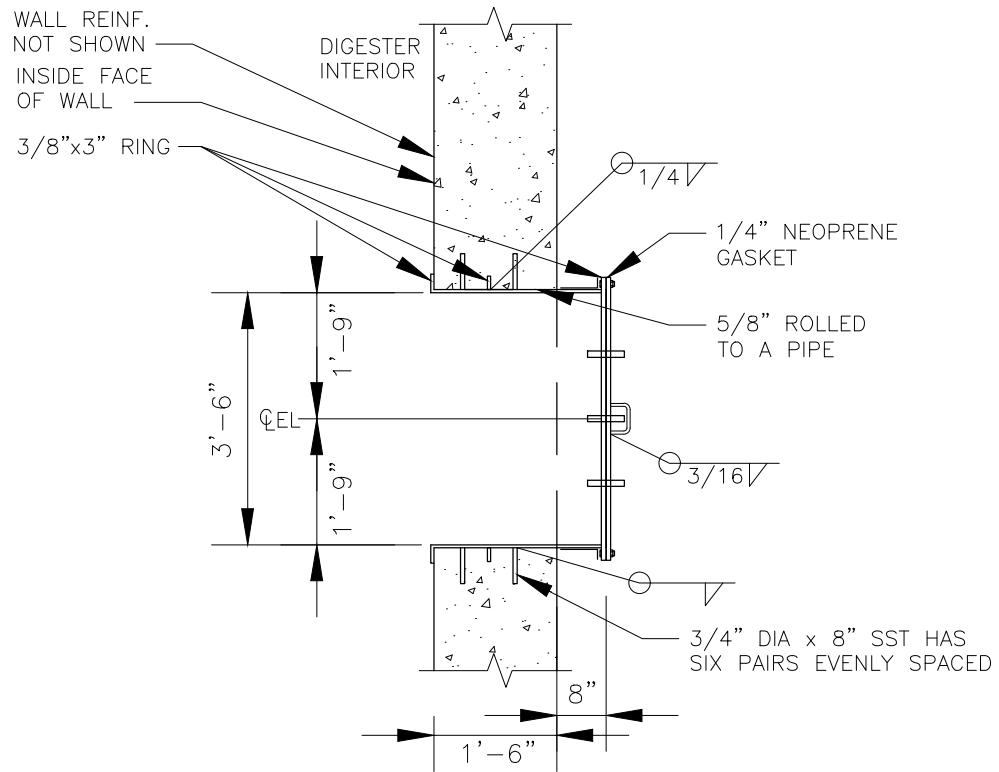
3" = 1'-0"

08 90 00-03



NOTES:

1. FABRICATE FROM 316L SST.
2. ALL WELDS SHALL BE CONTINUOUS SEAL WELDS.

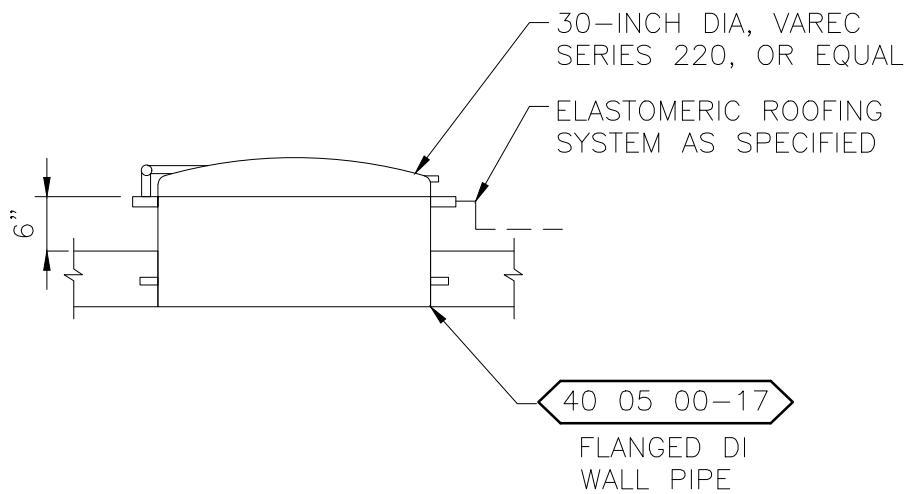


ACCESS MANWAY DETAIL

NTS

08 90 00-04





NOTES:

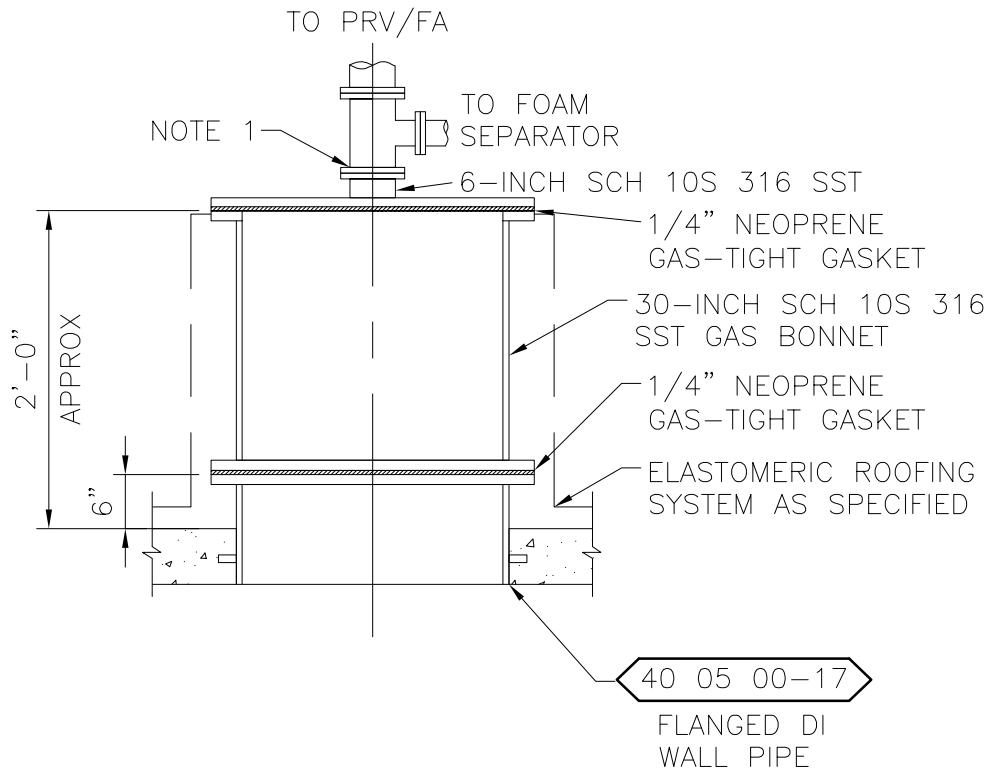
1. EMERGENCY RELIEF MANWAY COVER SIM TO THIS DETAIL, 24" DIAMETER WITH VAREC SERIES 400W, OR EQUAL.

ACCESS HATCH DETAIL

NTS

08 90 00-05





NOTES:

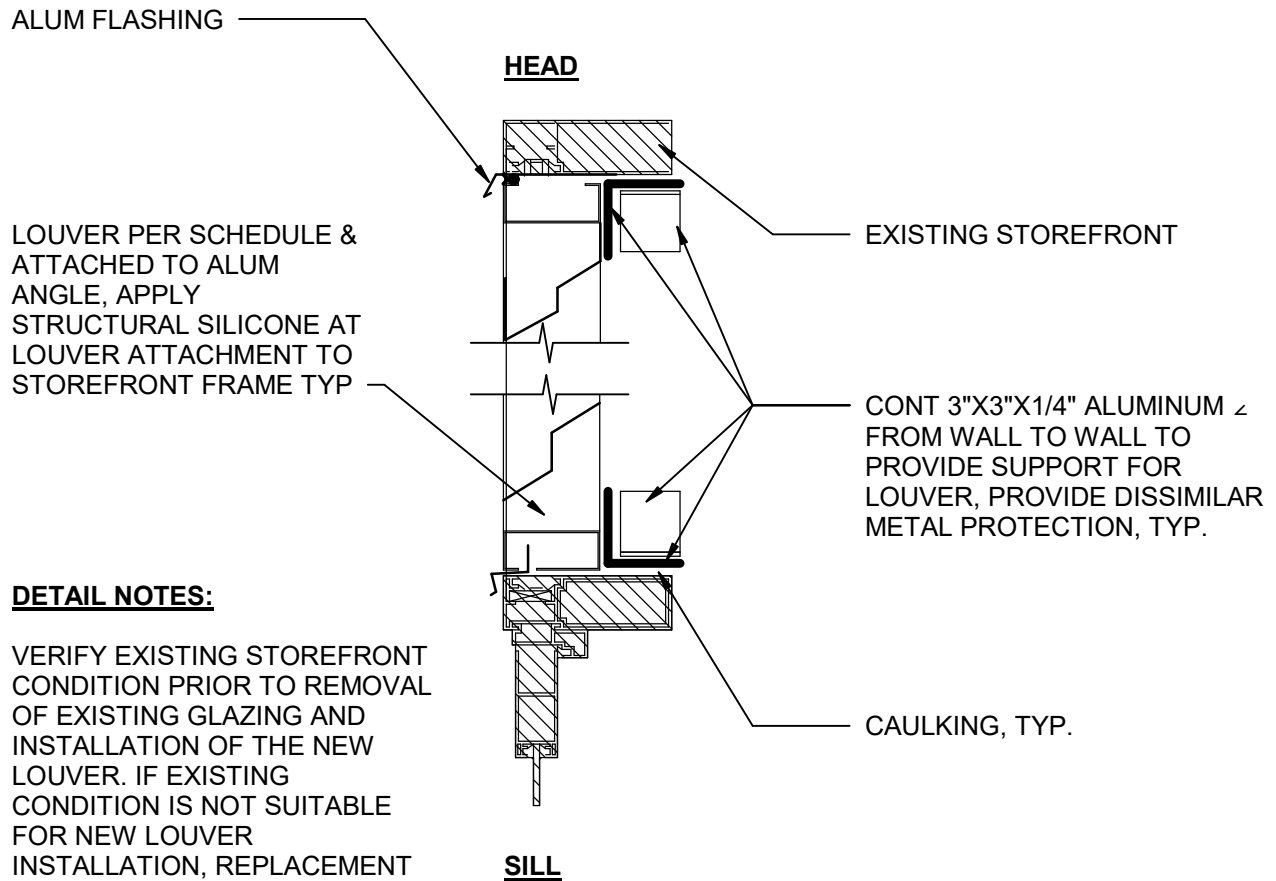
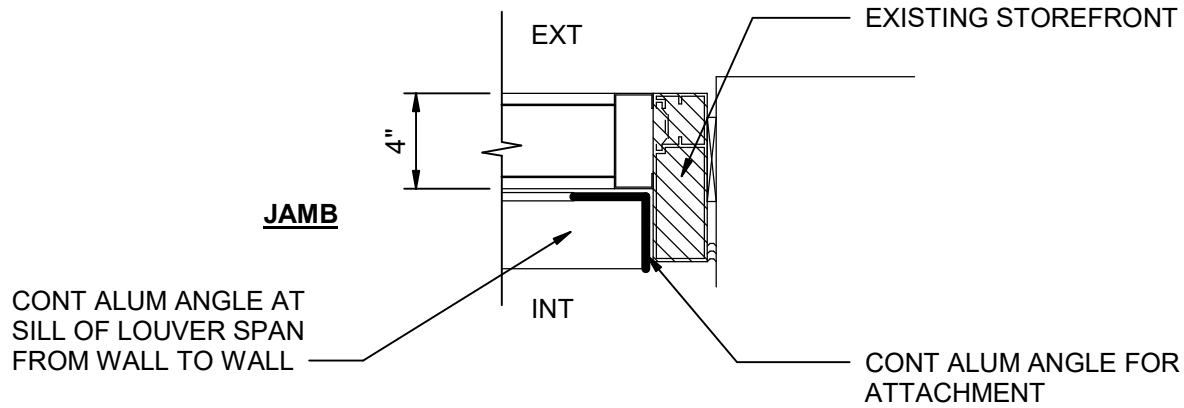
1. GAS BONNET SHALL BE INSTALLED SUCH THAT THE FACE OF THE FLANGE IS LEVEL

GAS BONNET DETAIL

NTS

08 90 00-06





DETAIL NOTES:

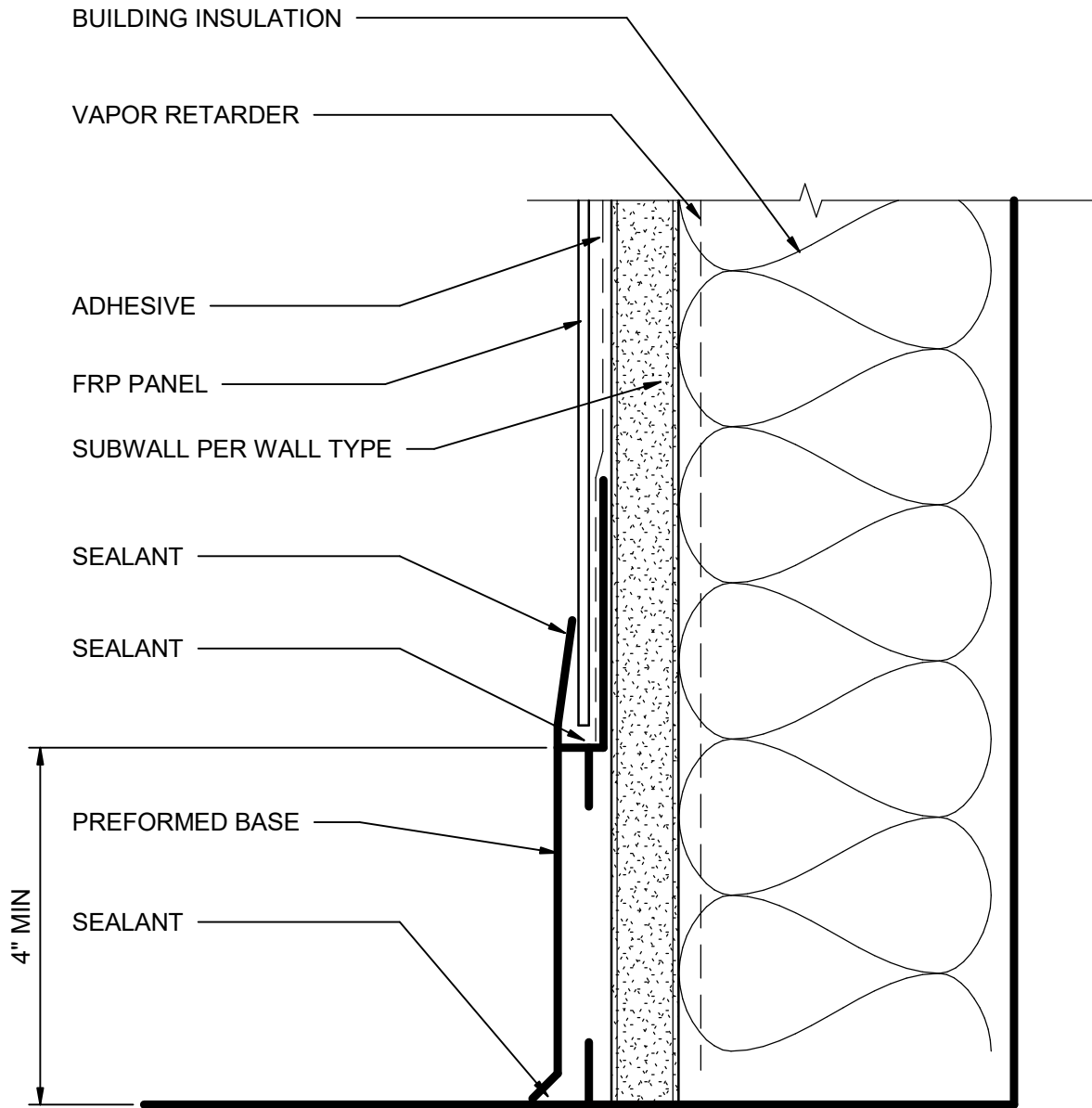
VERIFY EXISTING STOREFRONT CONDITION PRIOR TO REMOVAL OF EXISTING GLAZING AND INSTALLATION OF THE NEW LOUVER. IF EXISTING CONDITION IS NOT SUITABLE FOR NEW LOUVER INSTALLATION, REPLACEMENT OF ENTIRE STOREFRONT SYSTEM SHALL BE PROPOSED.

LOUVER AT EXISTING STOREFRONT

1 1/2" = 1'-0"

08 90 00-07



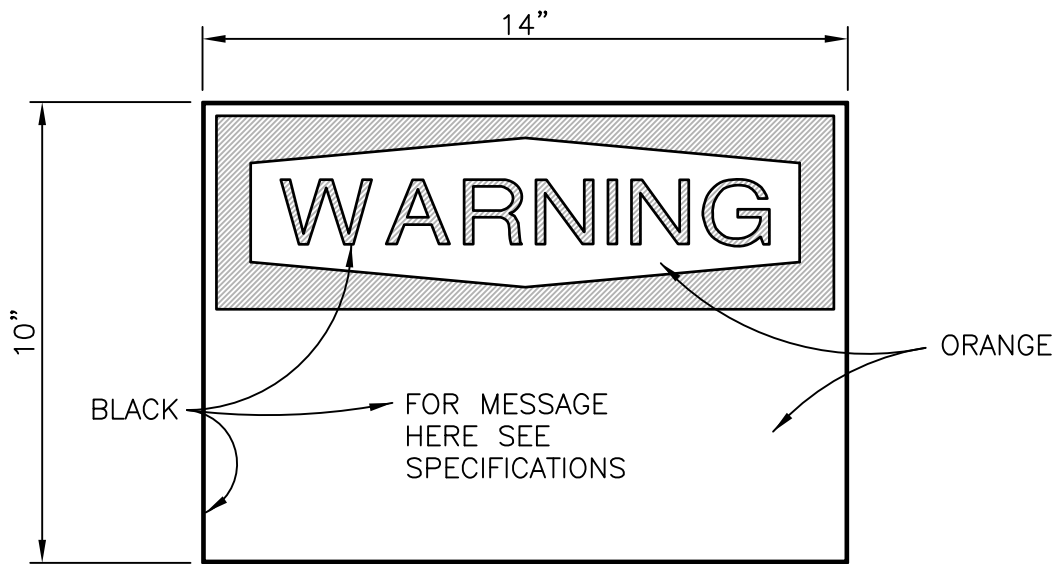


FRP WALL PANEL

6" = 1'-0"

09 77 61-01

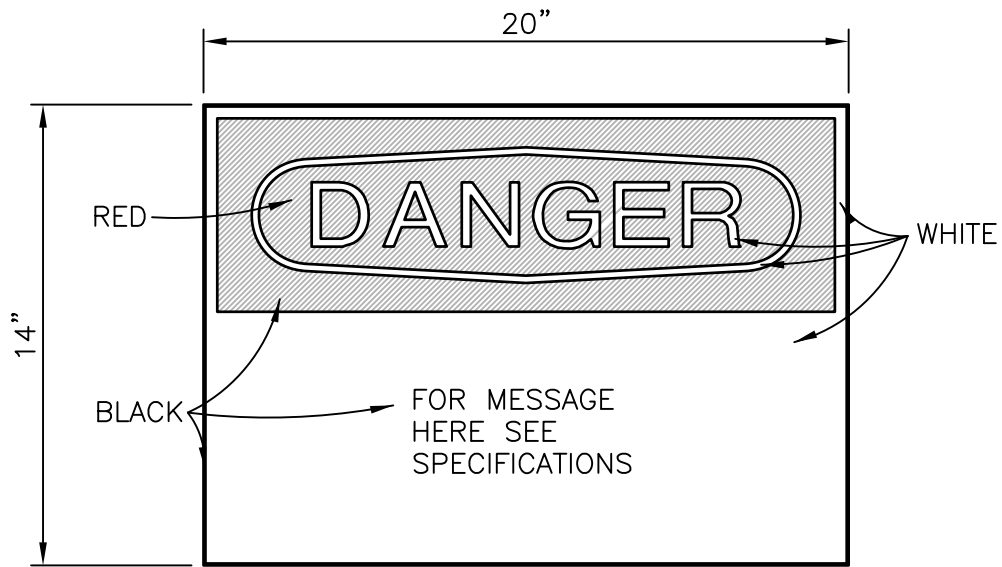




SIGN DETAIL

NTS

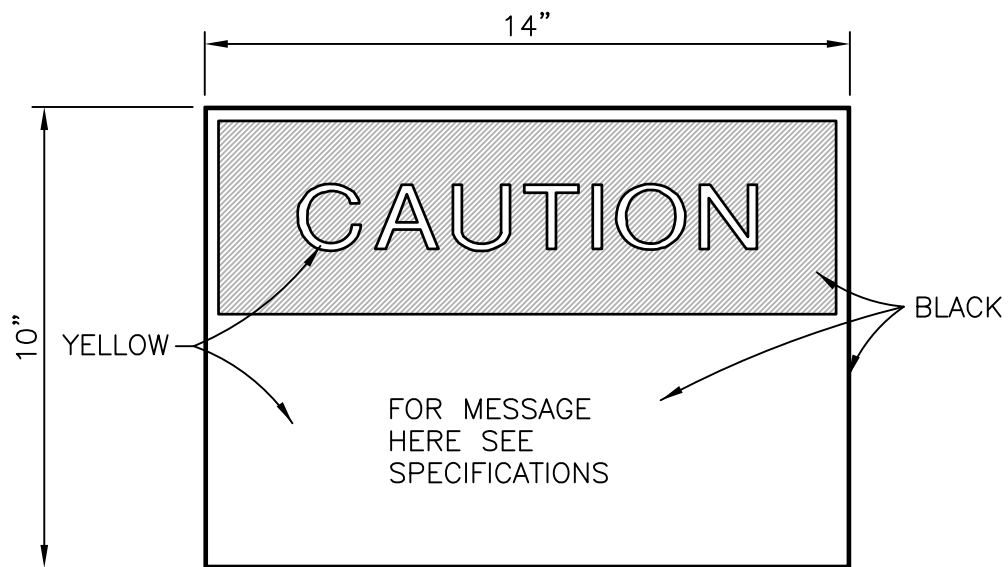
10 14 23-01



SIGN DETAIL

NTS

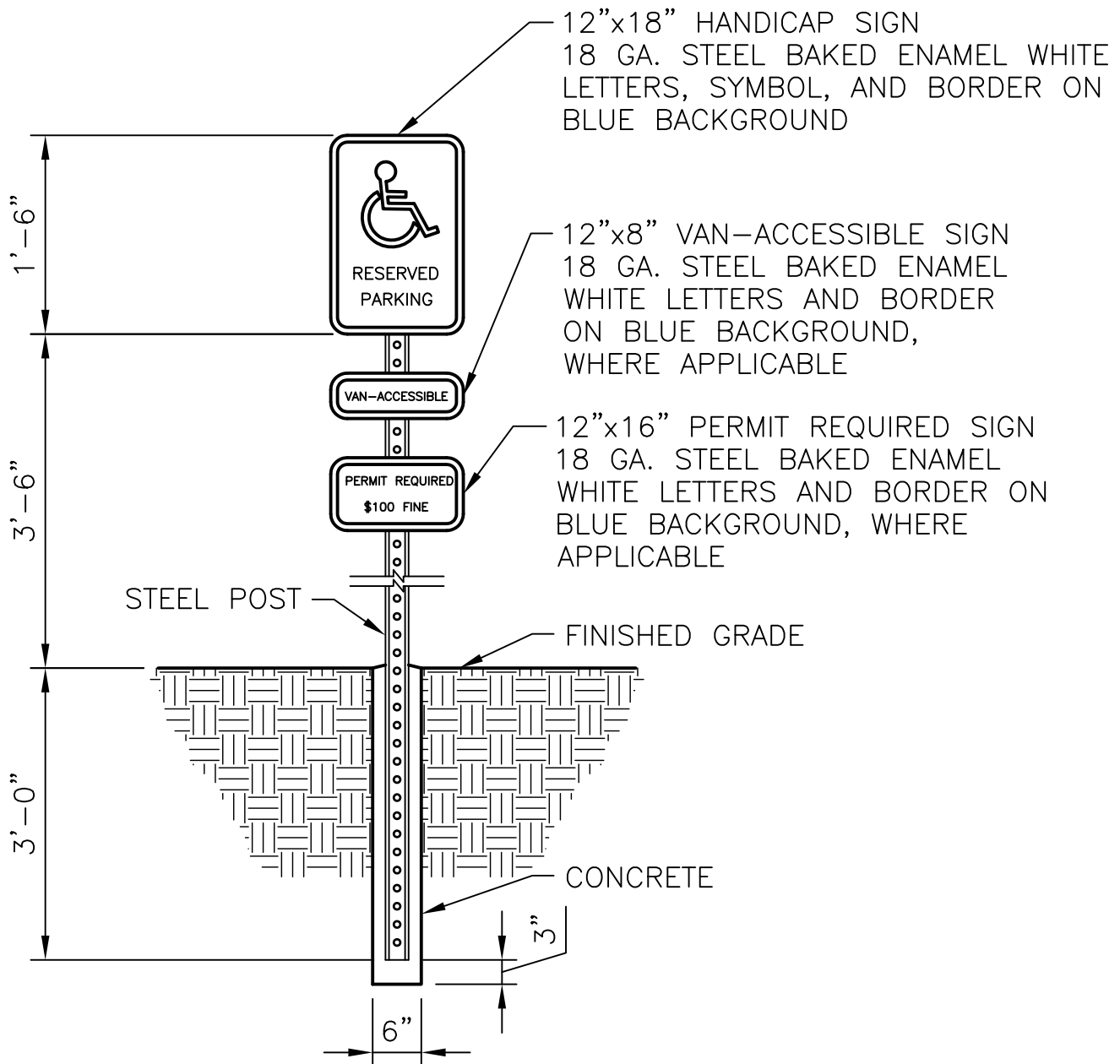
10 14 23-02



SIGN DETAIL

NTS

10 14 23-03



NOTES:

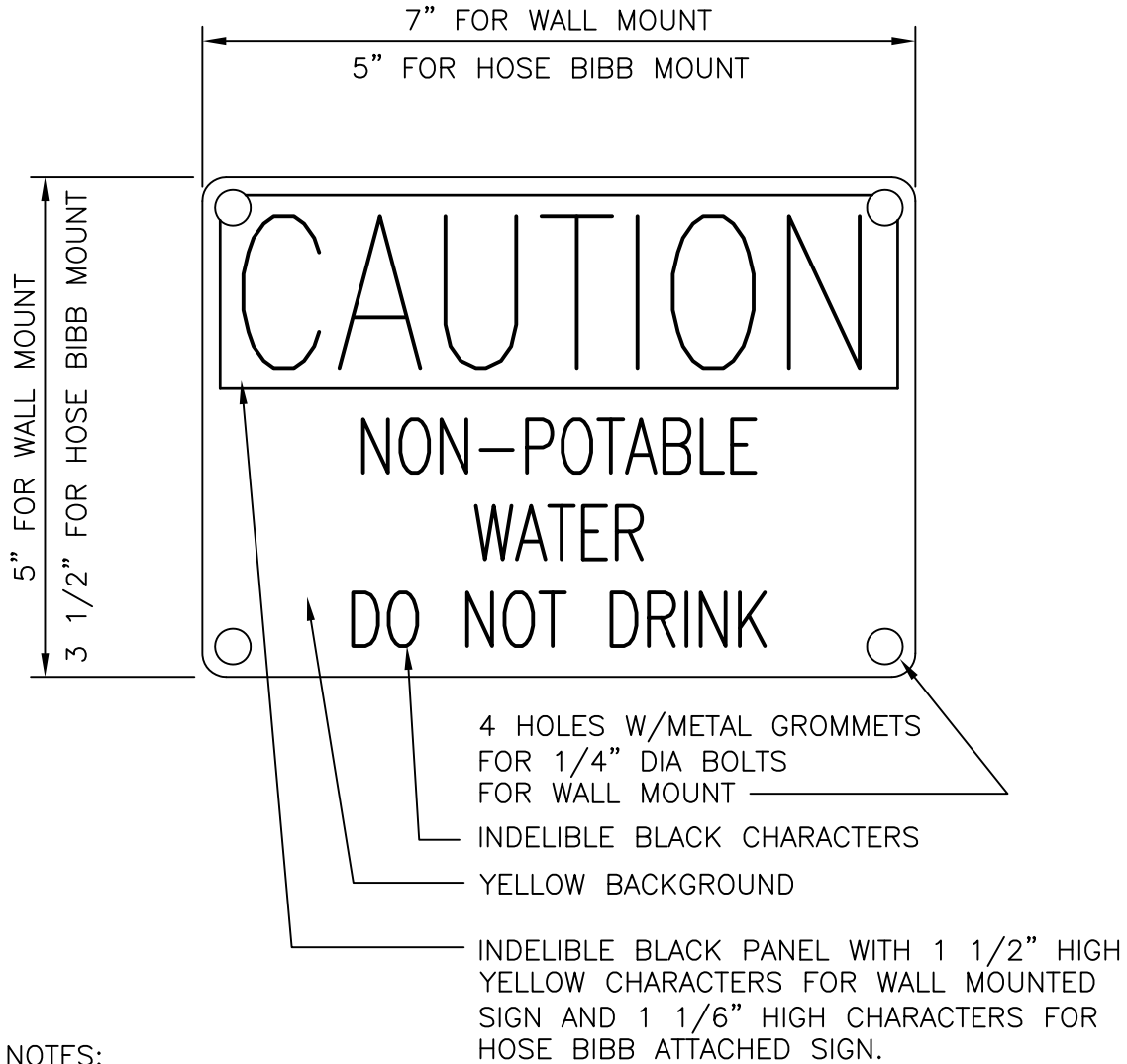
1. POSTS SHALL BE 8' LONG (MIN) HOT-ROLLED HIGH TENSILE RAIL STEEL, PERFORATED WITH 3/8" HOLES AT 1" CENTERS, FINISHED WITH GREEN BAKED ENAMEL.

HANDICAP SIGNAGE

NTS

10 14 23-04





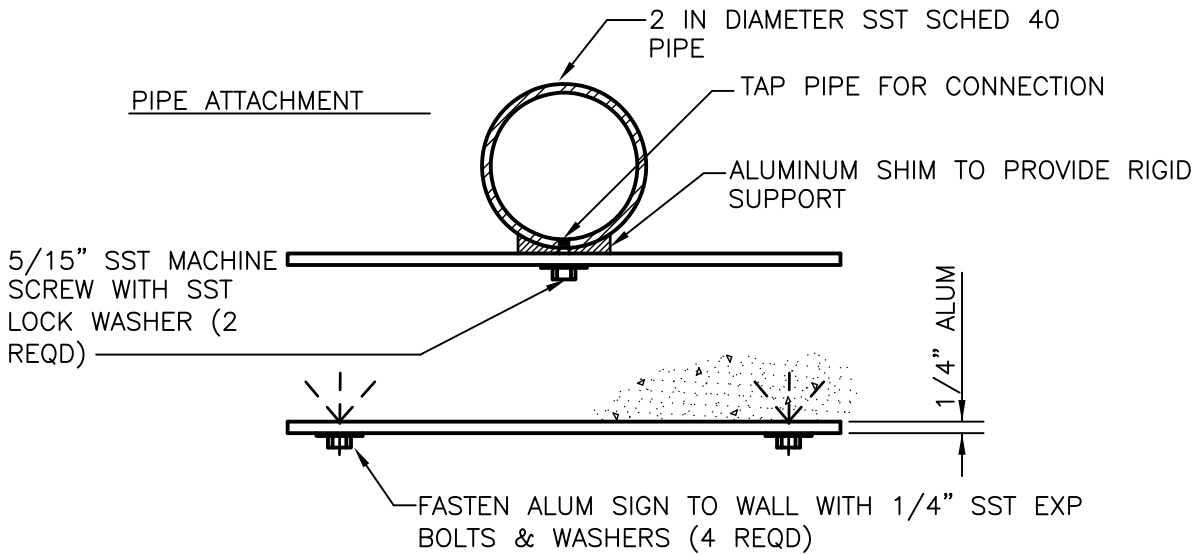
NOTES:

1. MATERIAL TO BE SIMI-RIGID BUTYRATE OR APPROVED EQUAL, AS MFR'D BY W.H. BRADY CO., MILWAUKEE, WIS. 53201 OR EQUAL.
2. COLORS AND LETTER SIZES TO BE PER OSHA STD'S FOR CAUTION SIGNS.
3. PROVIDE AND INSTALL THIS SIGN AT ALL HOSE BIBB LOCATIONS DELIVERING NON-POTABLE WATER.
4. ATTACH TO HOSE BIBB WITH PLASTIC STRAPS AROUND VERTICAL RISER, OR SUSPEND FROM VALVE W/RETAINER CHAIN, AS DIRECTED BY OWNER.

WARNING SIGN FOR NON-POTABLE WATER

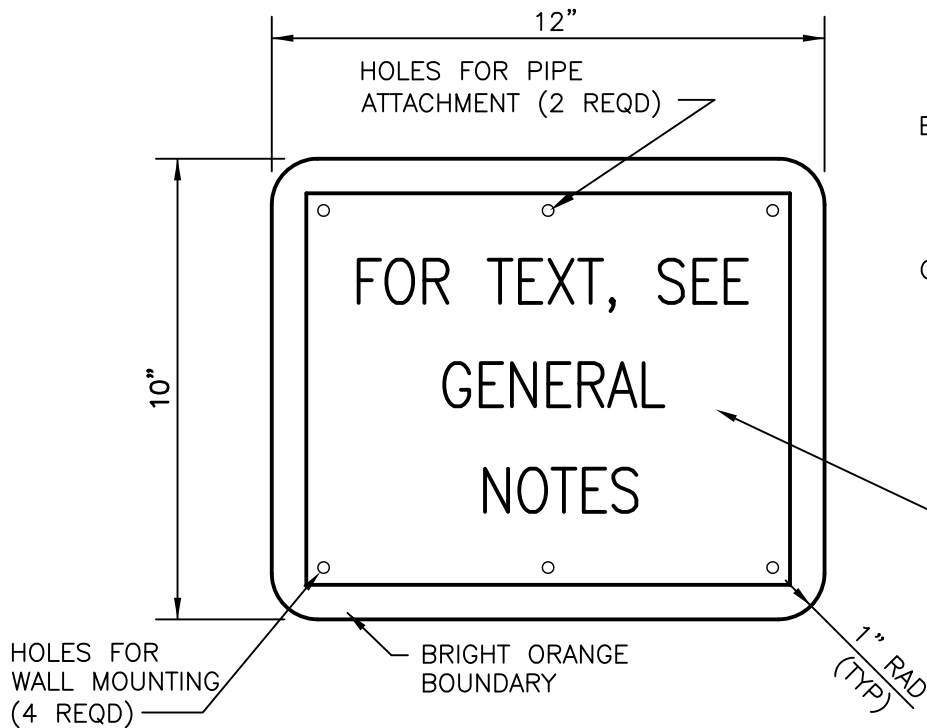
NTS

10 14 23-05



ATTACHMENT TO WALLS

PLAN VIEWS



GENERAL NOTES:

- A. PROVIDE ONE SIGN AT EACH HOSE BIBB, FIRE HYDRANT, AND YARD HYDRANT. TEXT SHALL BE "WARNING NON-POTABLE WATER- NOT FOR DRINKING".
- B. WHERE REQUIRED, UTILIZE WALL ATTACHMENT AND CENTER MOUNT DIRECTLY BEHIND HYDRANT.
- C. WHERE PIPE ATTACHMENT IS REQUIRED, MOUNT PIPE IN CONCRETE BELOW GRADE.

BLACK 1 1/2" LETTERS ON WHITE BACKGROUND. INSURE LETTERING & COLOR COATING IS WEATHER PROOFED BY CLEAR ACRYLIC SHIELDING

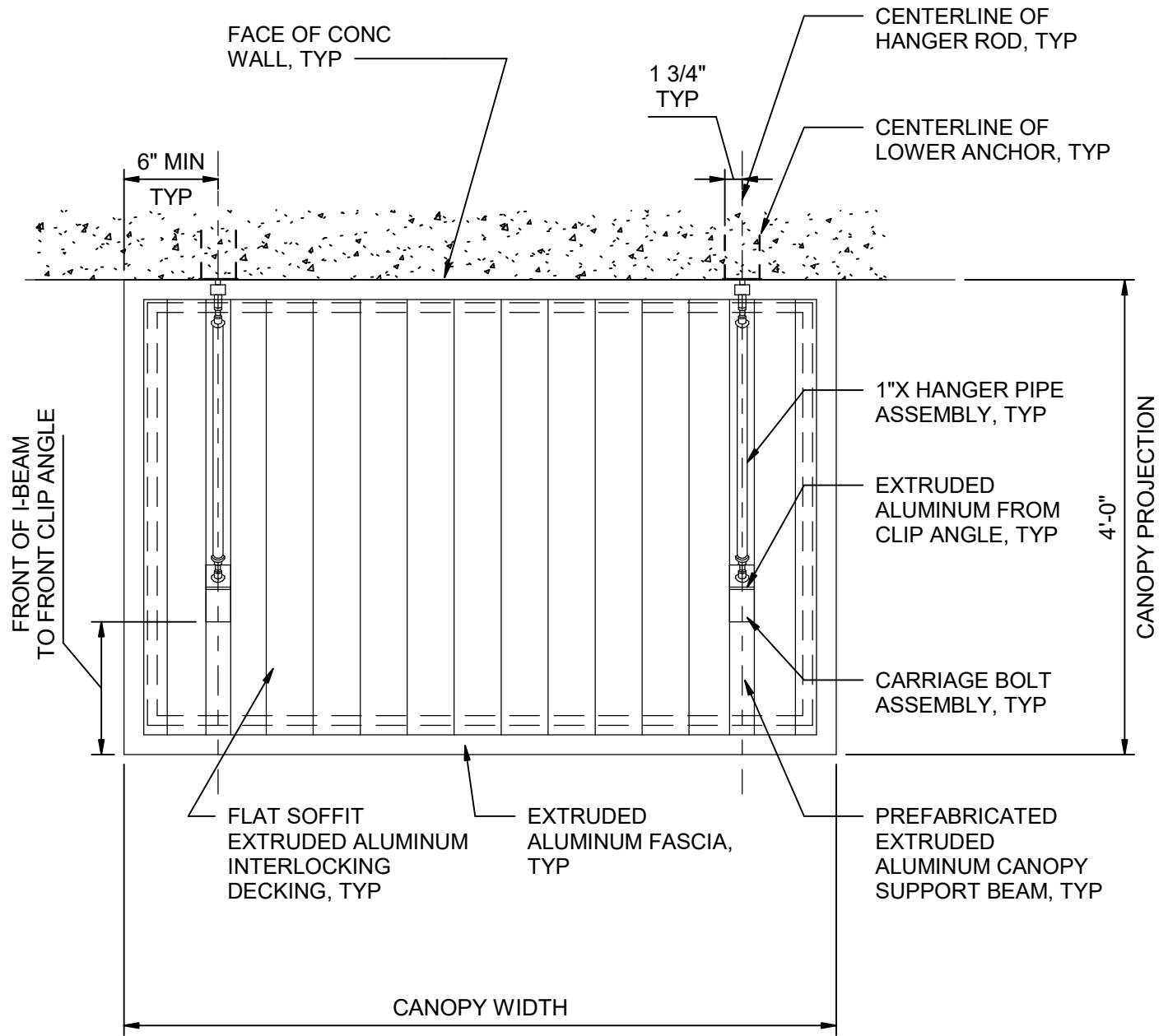
ELEVATION

TYPICAL SIGN MOUNTING

NTS

10 14 23-06



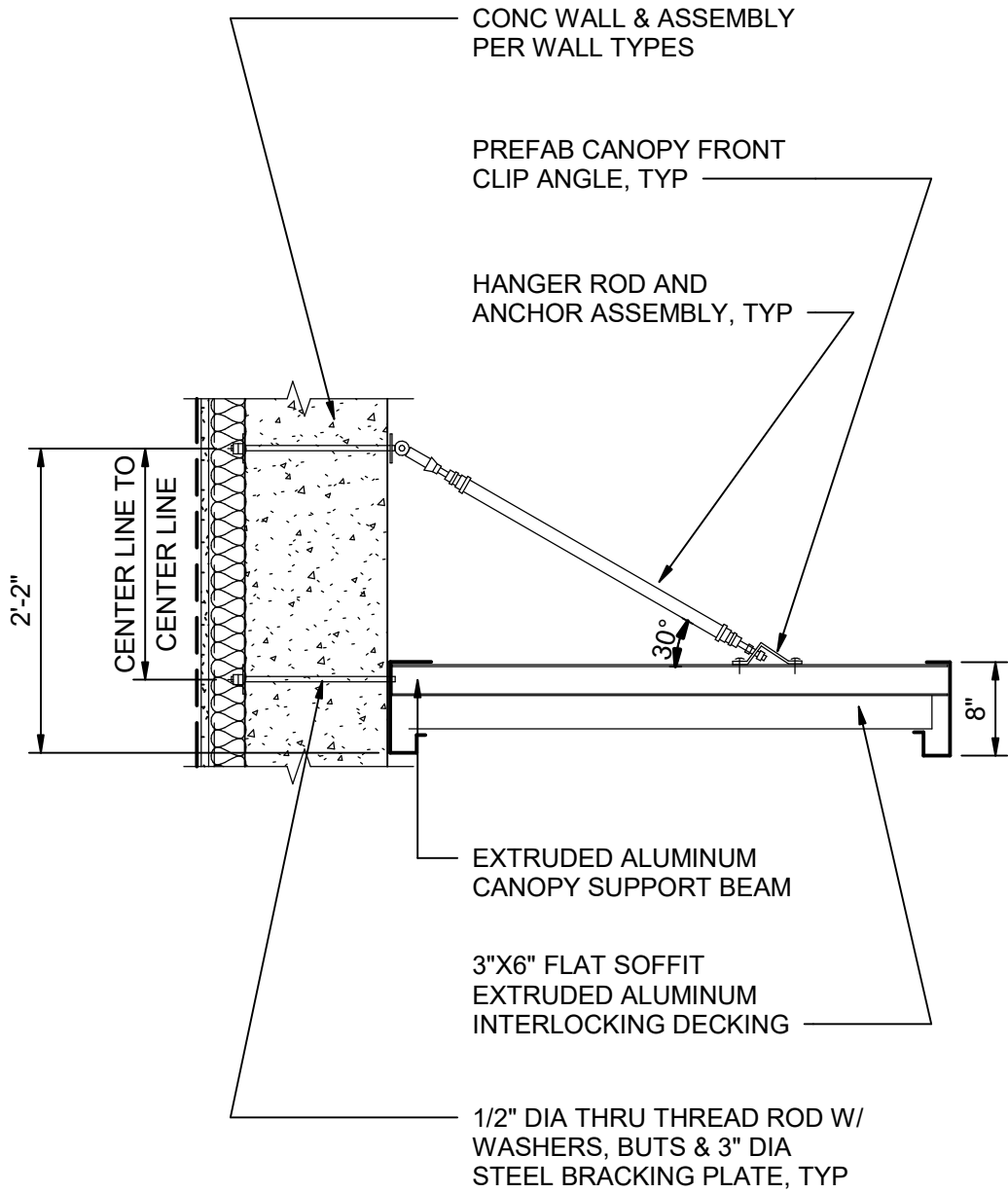


CANOPY PLAN

3/4" = 1'-0"

10 73 16-01





CANOPY SECTION

3/4" = 1'-0"

10 73 16-02



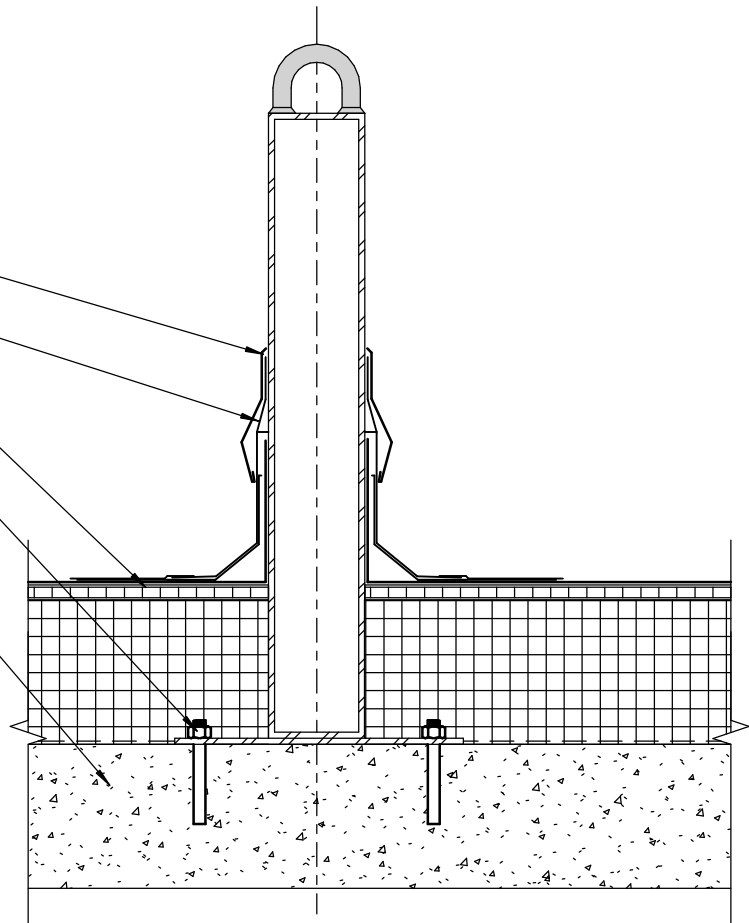
SEAMLESS SPUN ALUMINUM FLASHING

RUBBER COLLAR FLASHING

ROOFING SYSTEM AS SPECIFIED

TIE-BACK ANCHORED TO
CONCRETE STRUCTURE

ROOF STRUCTURE



NOTES:

1. ROOF PENETRATIONS SHALL HAVE A MIN. 12" CLEARANCE ON ALL SIDES FROM WALLS, CURBS AND OTHER ROOF PENETRATIONS.

2. PENETRATIONS SHALL BE RIGID, ROUND OR SQUARE TUBE AND EXTEND PERPENDICULAR FROM THE ROOF STRUCTURE.

3. TIE-BACK ANCHORS SHALL BE COMPLETELY WATER TIGHT ABOVE ROOF MEMBRANE FLASHING.

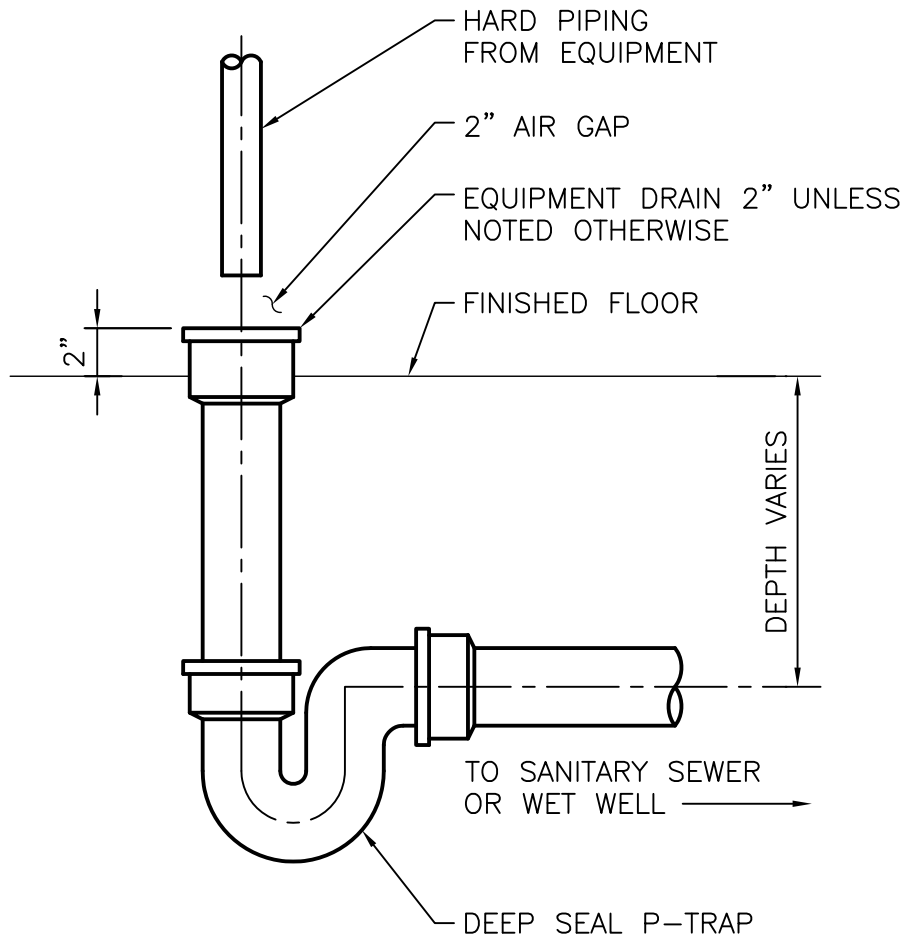
4. REFER TO STRUCTURAL DRAWINGS FOR ATTACHMENT AND LOCATION OF TIE-BACK ANCHORS.

SAFETY TIE-BACK

1 1/2" = 1'-0"

11 24 26-01





NOTE:

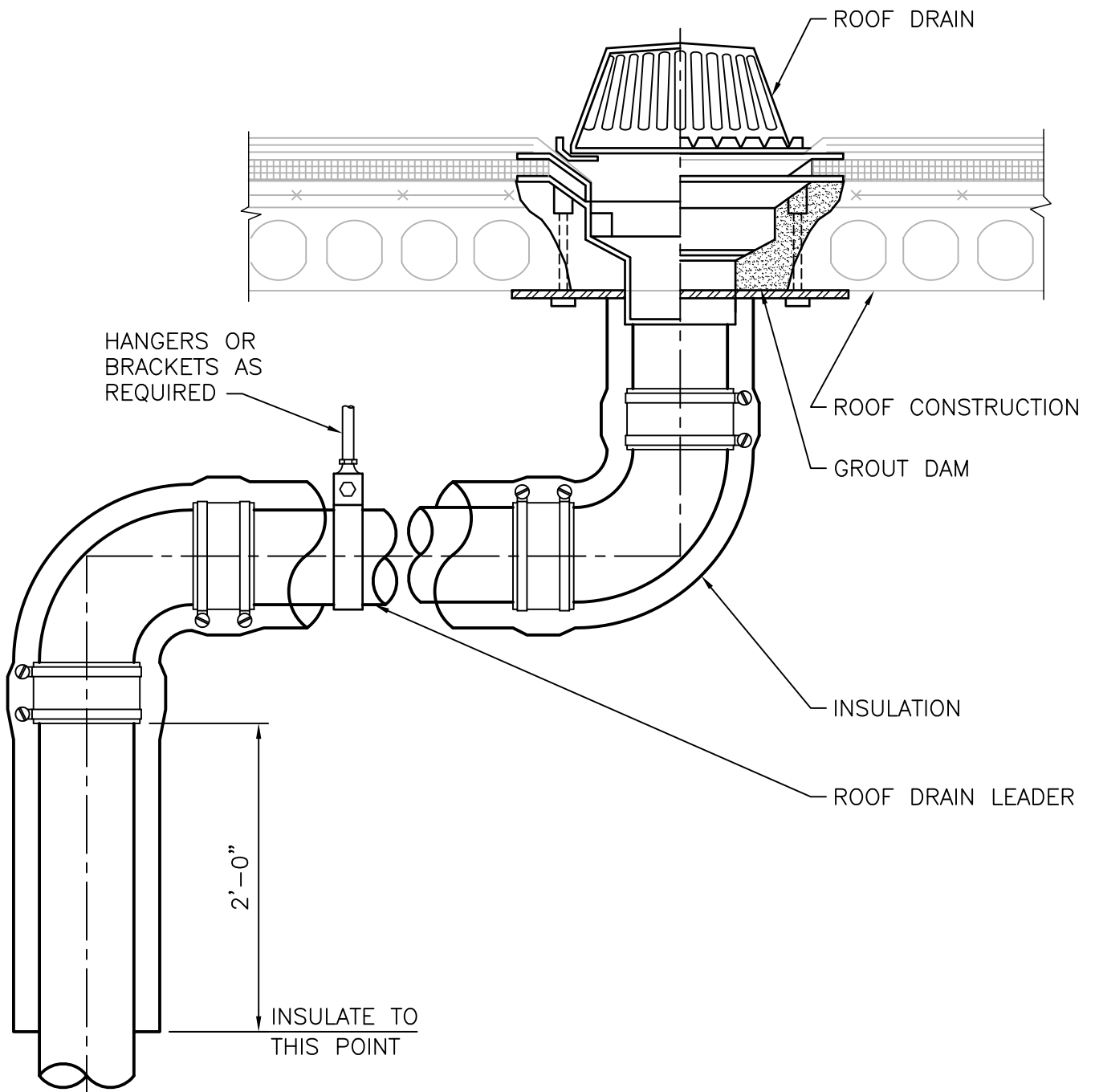
1. IF PROCESS DRAINS (NO SANITARY SEWAGE), P-TRAP NOT REQUIRED.

TRAPPED EQUIPMENT DRAIN

NTS

22 20 00-01



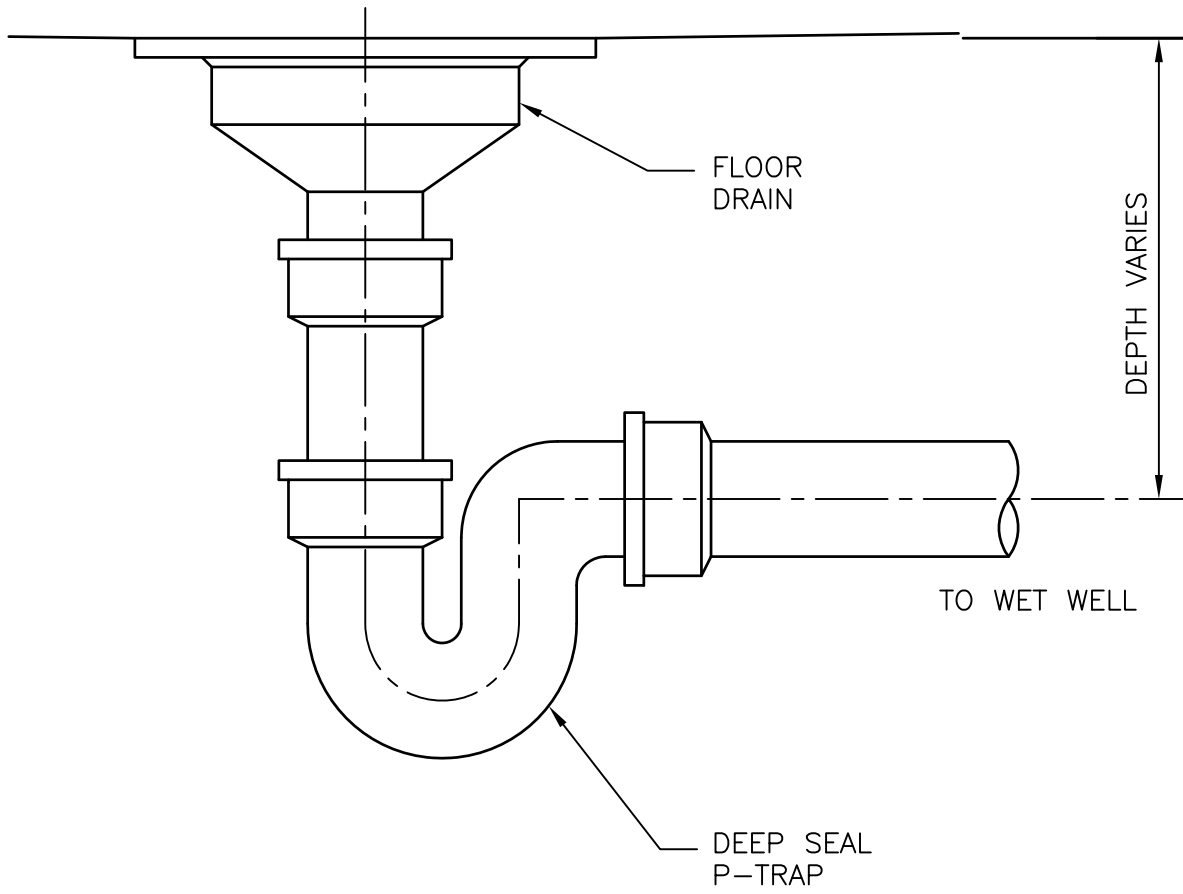


ROOF DRAIN

NTS

22 20 00-03



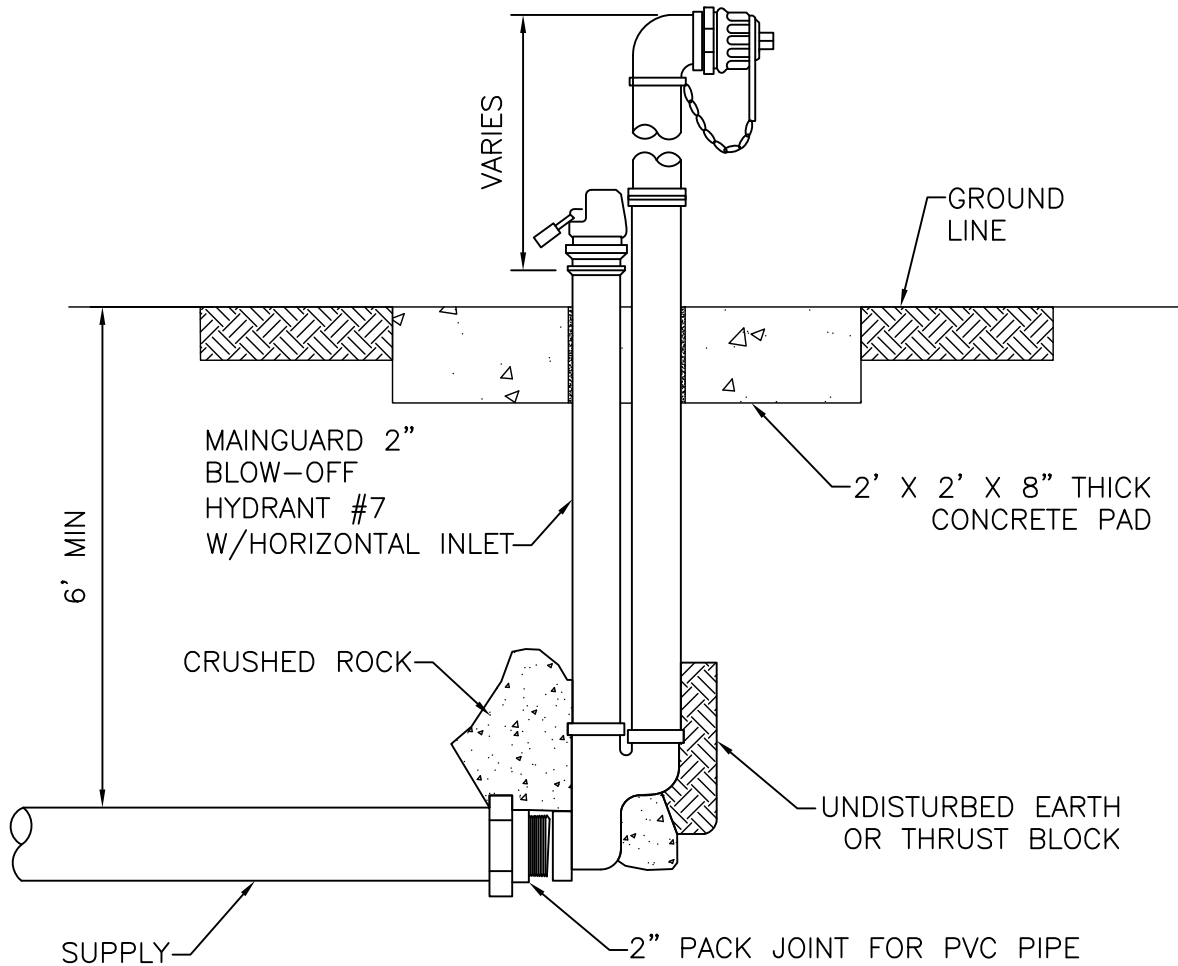


FLOOR DRAIN

NTS

22 20 00-04





NOTES:

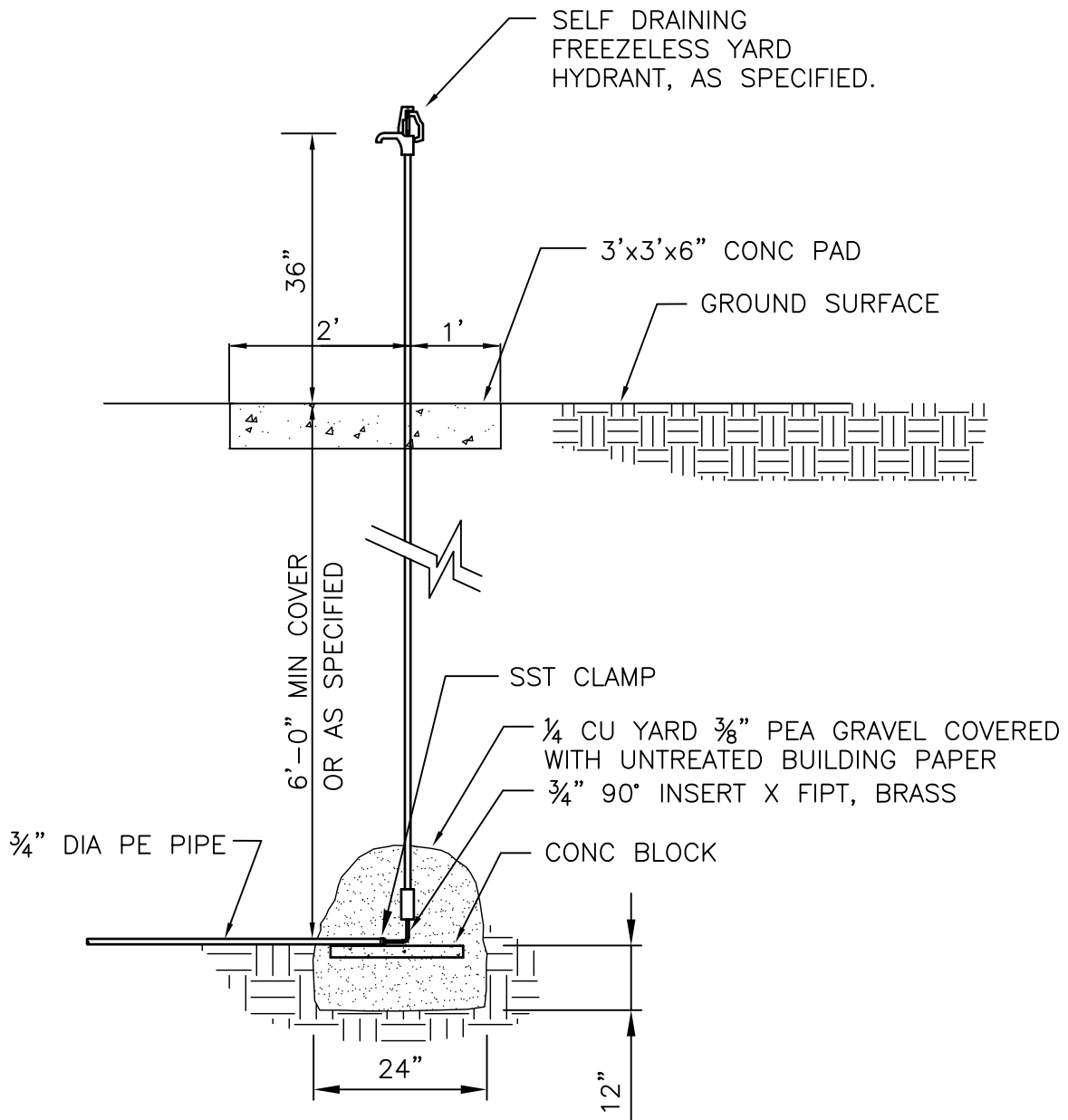
1. POST HYDRANTS SHALL BE NON-FREEZING, SELF DRAINING TYPE. HYDRANTS SHALL BE FURNISHED WITH A 2" HORIZONTAL INLET, A NON-TURNING OPERATING ROD, AND HALL OPEN TO THE LEFT. ALL OF THE WORKING PARTS SHALL BE OF BRONZE-TO-BRONZE DESIGN, AND BE SERVICEABLE FROM ABOVE GRADE WITH NO DIGGING. THE OUTLET SHALL ALSO BE BRONZE AND BE 2-1/2" NST. HYDRANTS SHALL BE LOCKABLE TO PREVENT UNAUTHORIZED USE AS MANUFACTURED BY KUPFERLE FOUNDRY CO., ST. LOUIS, MO, OR APPROVED EQUAL.
2. MATCH DRAIN PORT SIZE PROVIDED BY MANUFACTURER.
3. PROVIDE WARNING SIGN WHEN SUPPLY IS NON-POTABLE PER 10 14 23-05
4. PROVIDE HOSE RACK FOR EACH YARD HYDRANT.

YARD HYDRANT YH-1

NTS

22 20 00-06

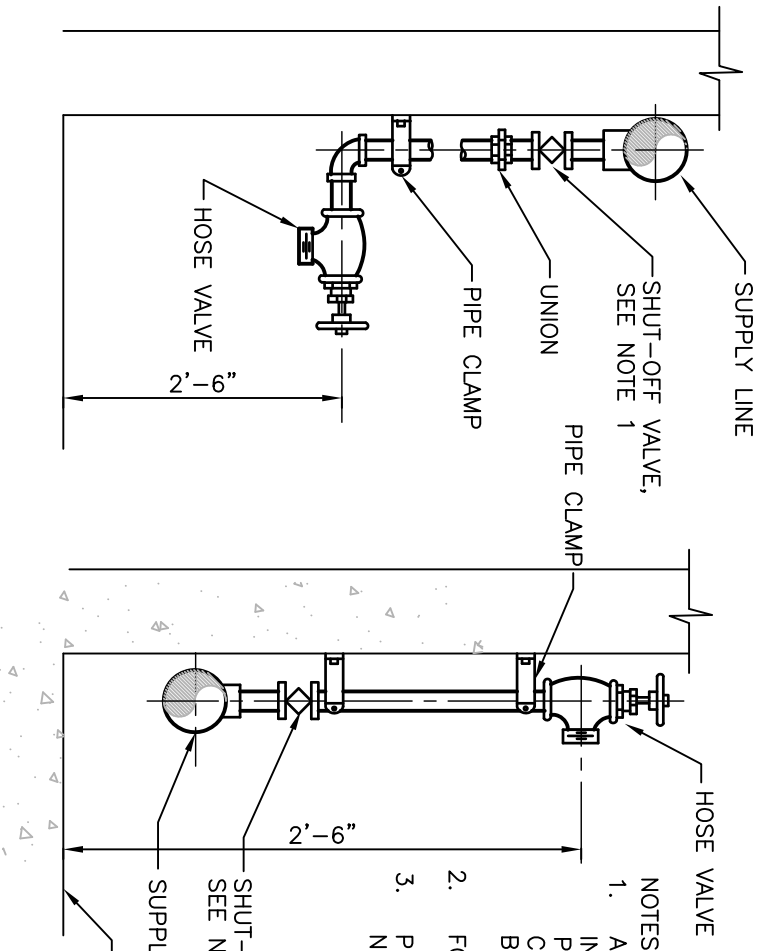




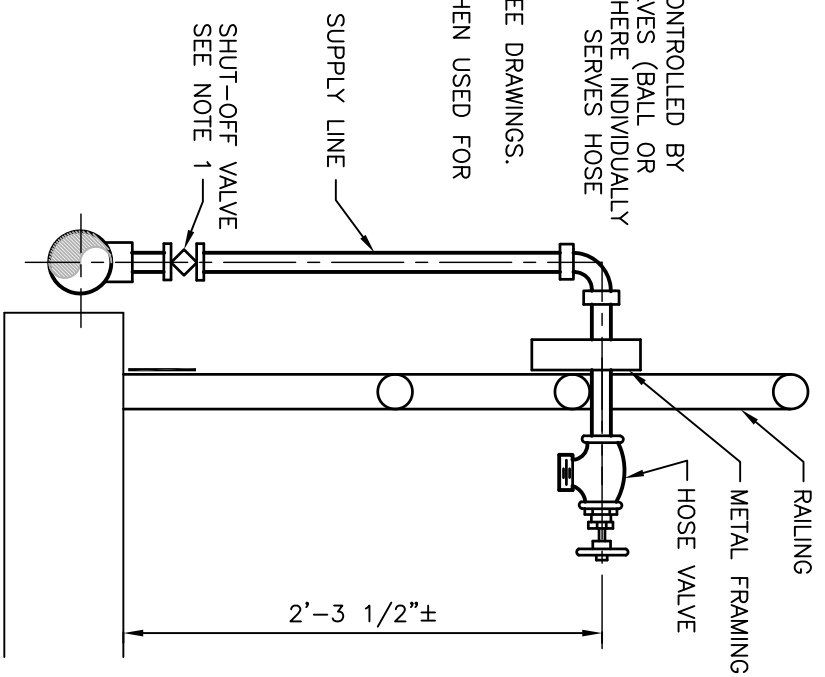
TYP RESIDENTIAL RURAL WATER YARD HYDRANT INSTALLATION

NTS

22 20 00-09

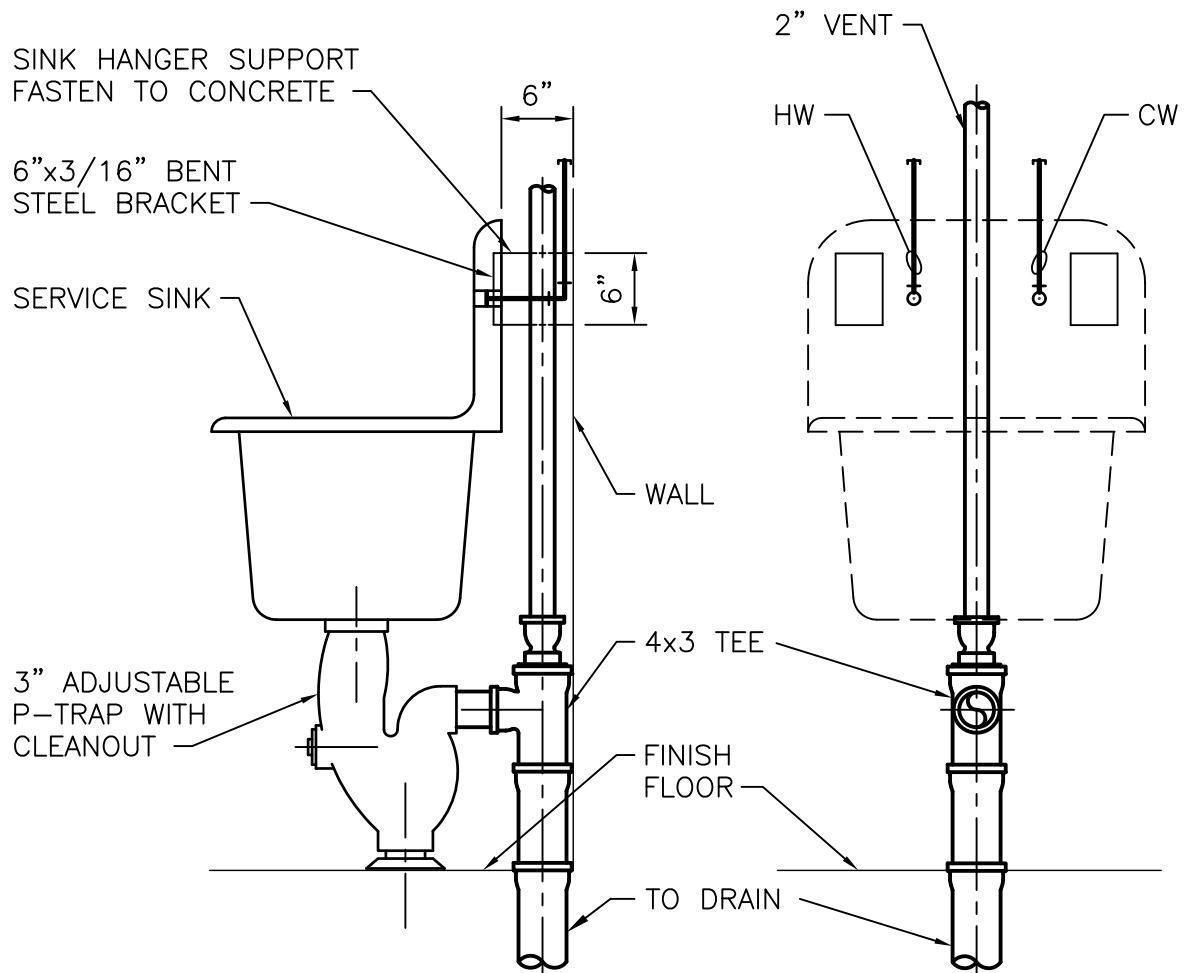


- NOTES:
1. ALL HOSE BIBBS TO BE CONTROLLED BY INDIVIDUAL SHUT-OFF VALVES (BALL OR PLUG VALVES), EXCEPT WHERE INDIVIDUALLY CONTROLLED BRANCH MAIN SERVES HOSE BIBBS ONLY.
 2. FOR SIZE AND LOCATION SEE DRAWINGS.
 3. PROVIDE WARNING SIGN, WHEN USED FOR NON-POTABLE WATER.



HOSE BIBB HB-1
NTS

22 20 00-11



SIDE VIEW
PIPING EXPOSED

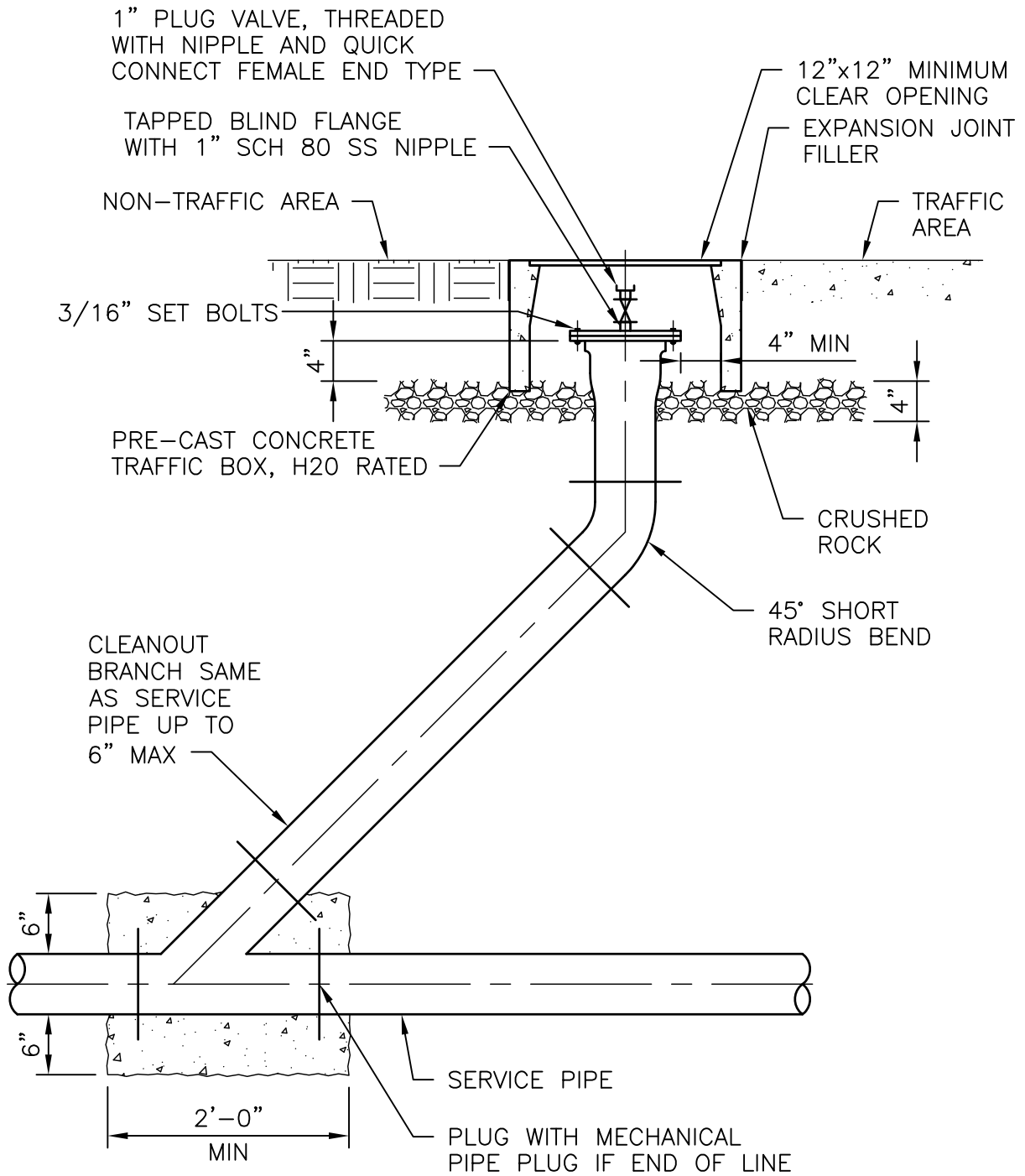
FRONT VIEW
BACK PIPING ONLY
WITH SINK REMOVED

SERVICE SINK (SSK-1)

NTS

22 20 00-12





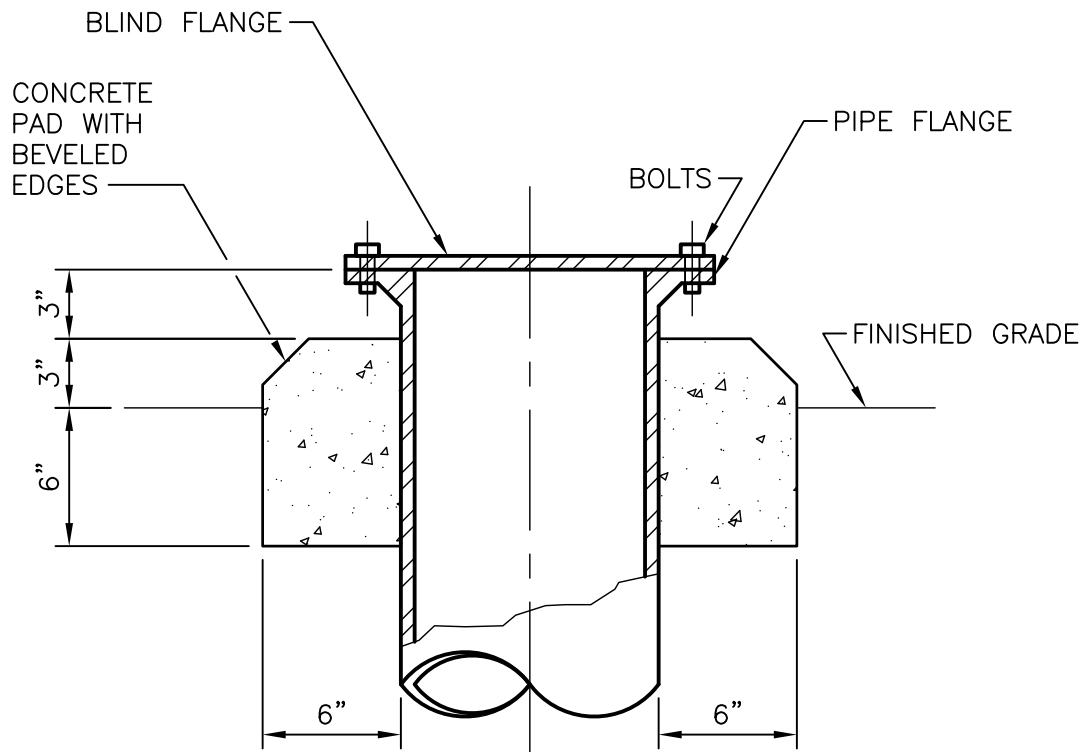
NOTE:

1. PROVIDE RESTRAINED JOINTS

PRESSURE CLEANOUT AT GRADE

NTS

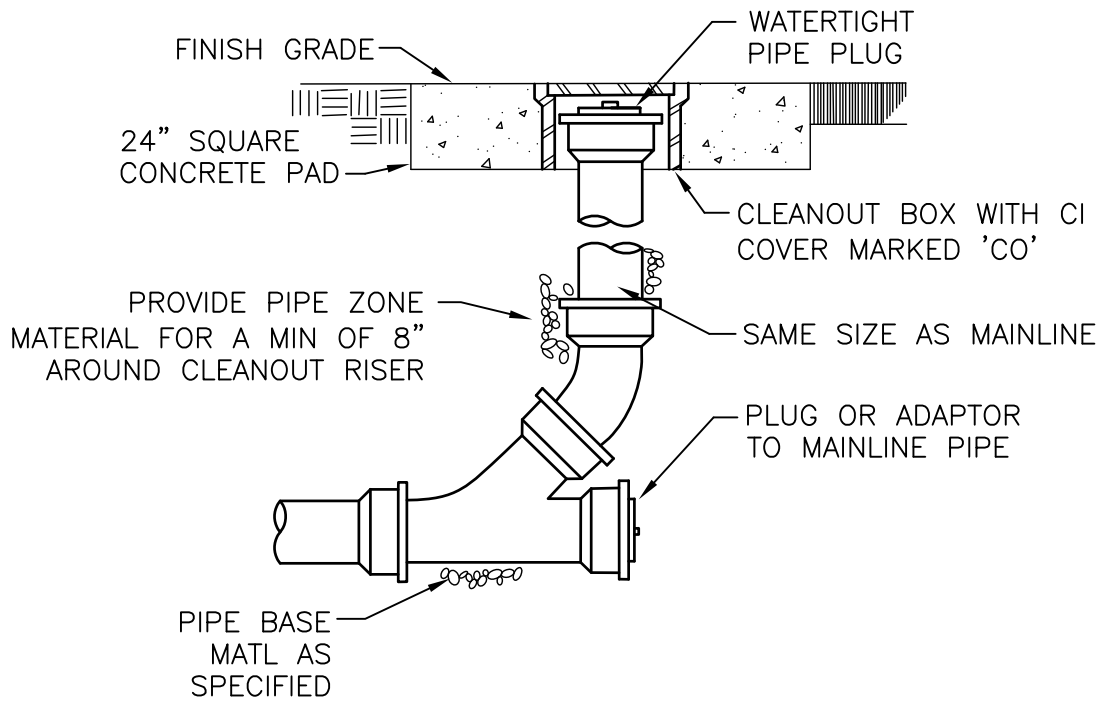
22 20 00-13



PRESSURIZED SYSTEM CLEANOUT ABOVE GRADE

NTS

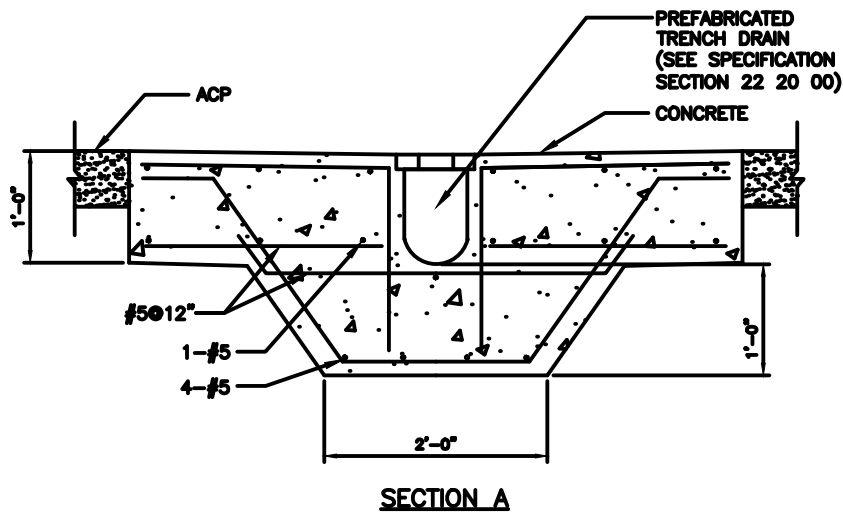
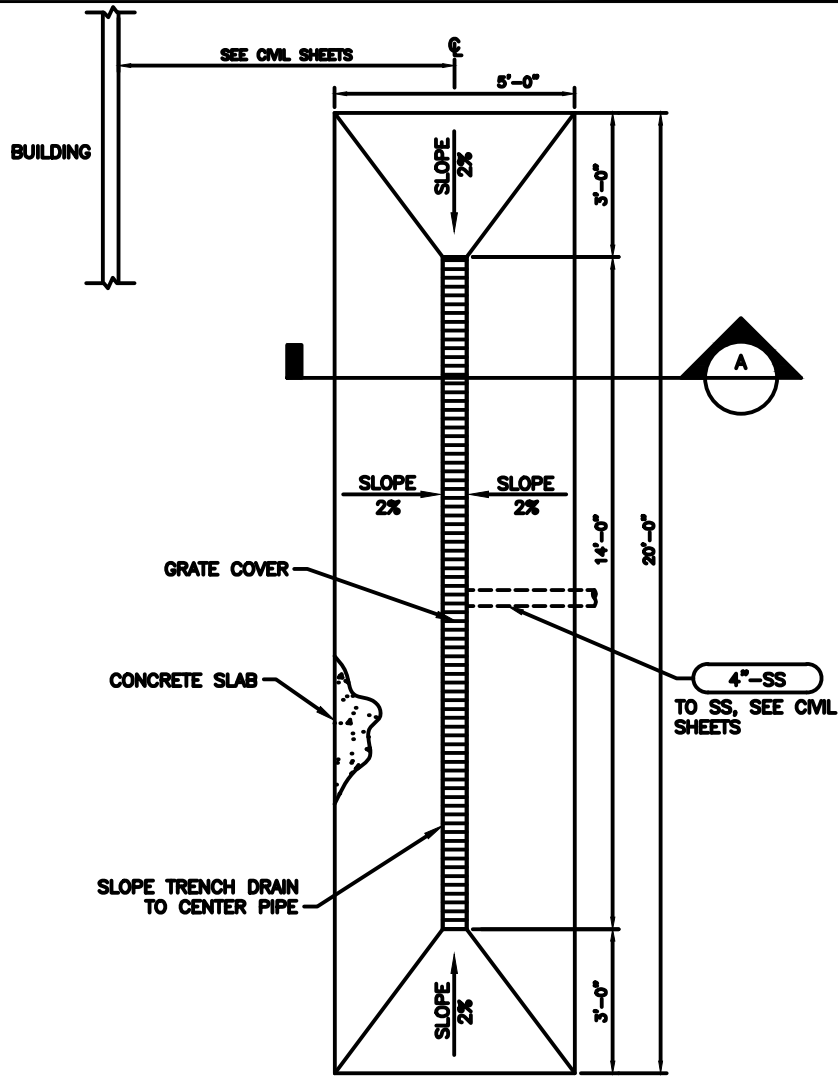
22 20 00-14



GRAVITY CLEANOUT

NTS

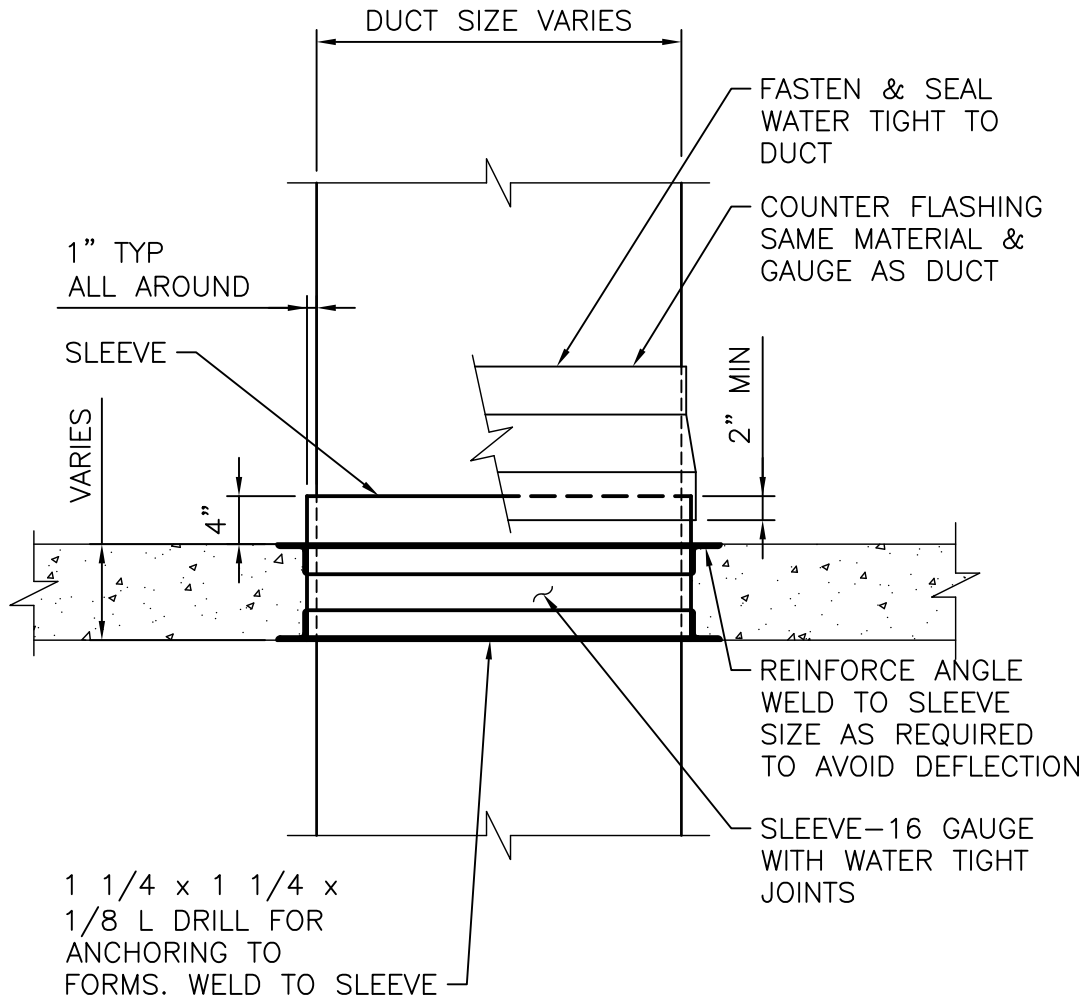
22 20 00-15



OUTDOOR TRENCH DRAIN

NTS

22 20 00-17



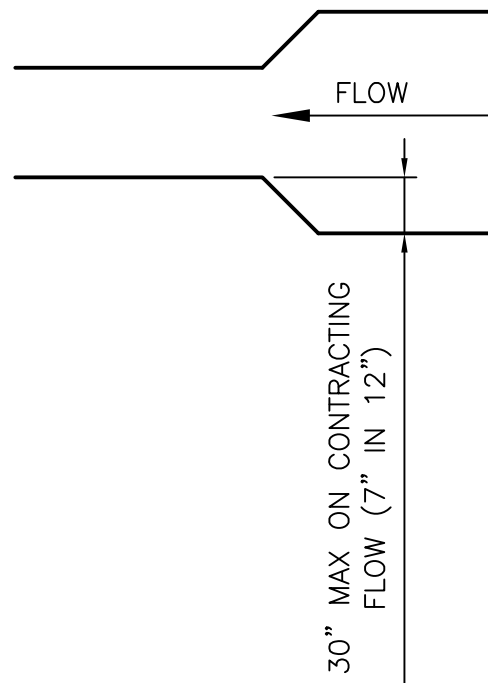
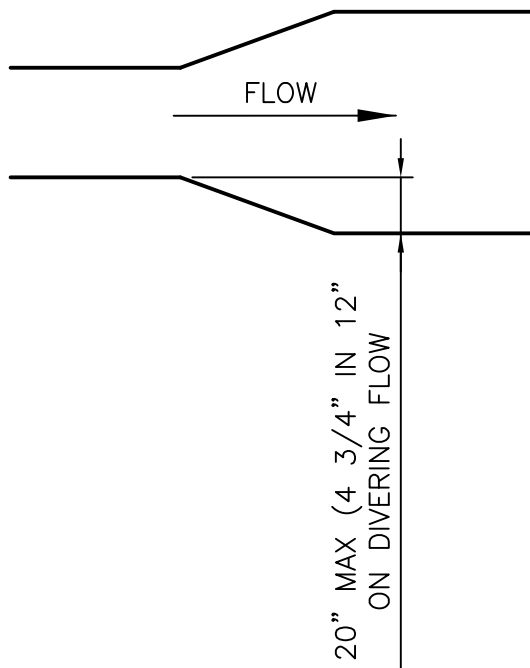
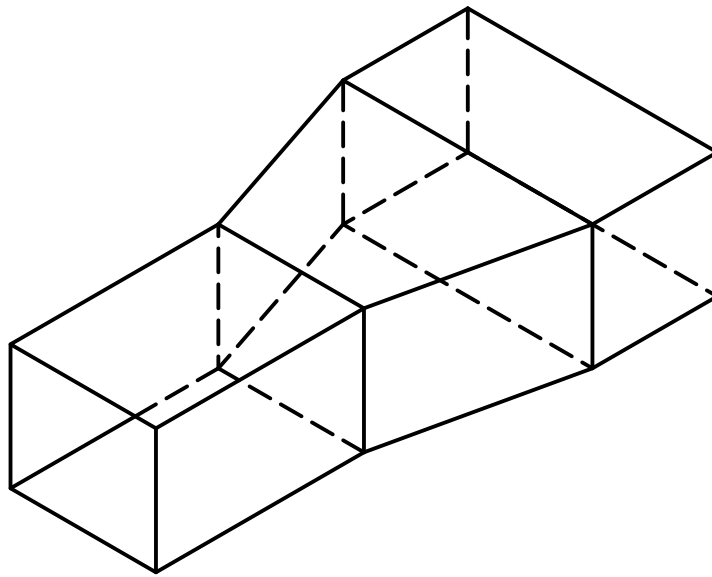
NOTE:

1. DETAIL FOR DUCT PENETRATION IN WET PROCESS AREAS.

CAST-IN-PLACE SLEEVE

NTS

23 31 00-01



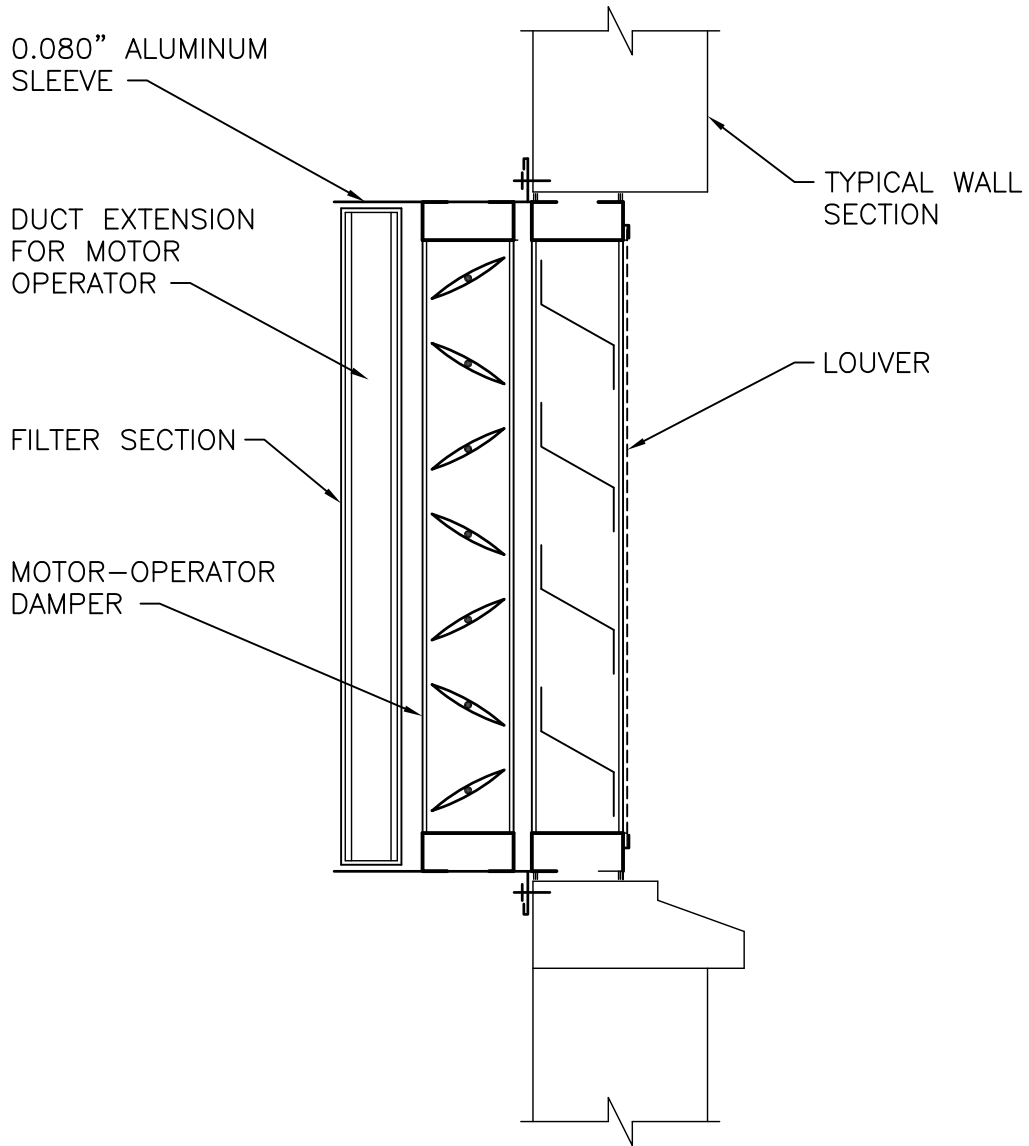
NOTE:

1. LARGEST DIMENSION GOVERNS CONSTRUCTION.

DUCT TRANSITION

NTS

23 31 00-02



COMBINATION LOUVER DAMPER/FILTER

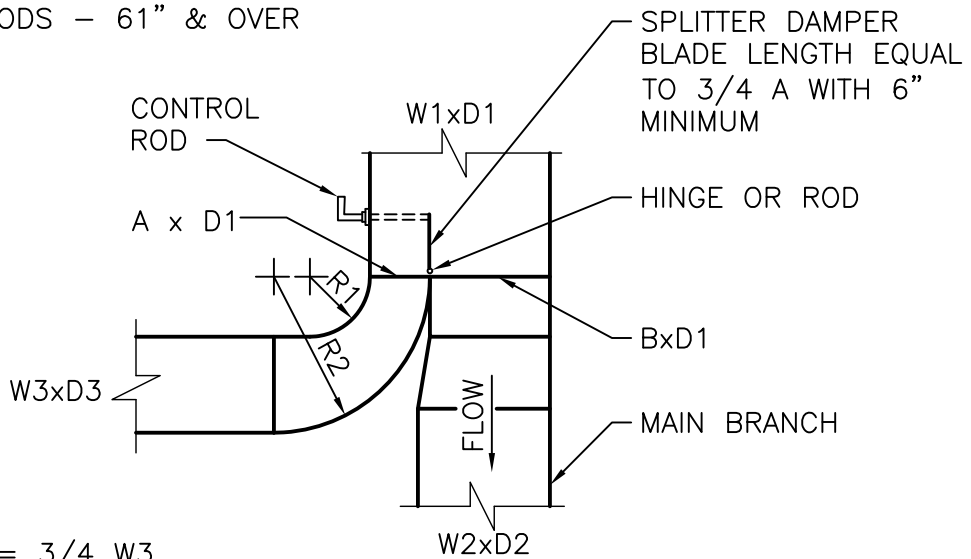
NTS

23 31 00-04



CONTROL ROD

- 1 ROD - 24" DEPTH
- 2 RODS - 25" TO 60"
- 3 RODS - 61" & OVER



$$R1 = 3/4 W3$$

$$R2 = A + 3/4 W3$$

WHEN CFM IS NOT LISTED TRUNK
MAY BE DIVIDED AS FOLLOWS:

$$A = 4" \text{ MIN}$$

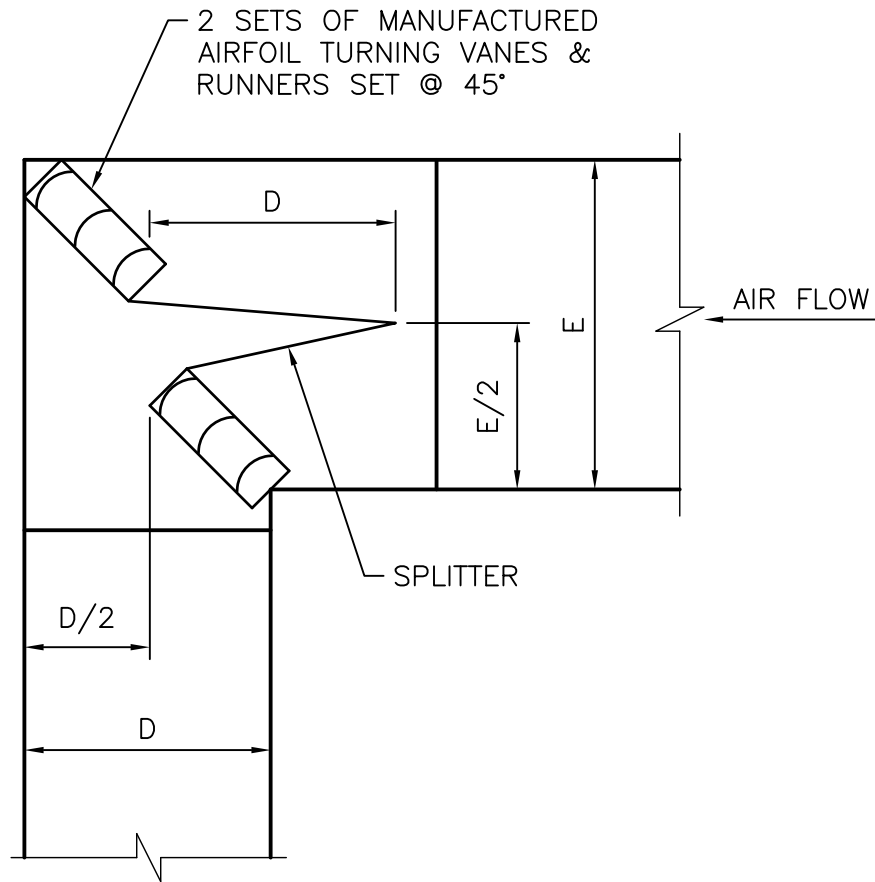
$$A = \left[\frac{(W3) (D3)}{(W2) (D2) + (W3) (D3)} \right] W1$$

$$B = W1 - A$$

SPLITTER DAMPER

NTS

23 31 00-05

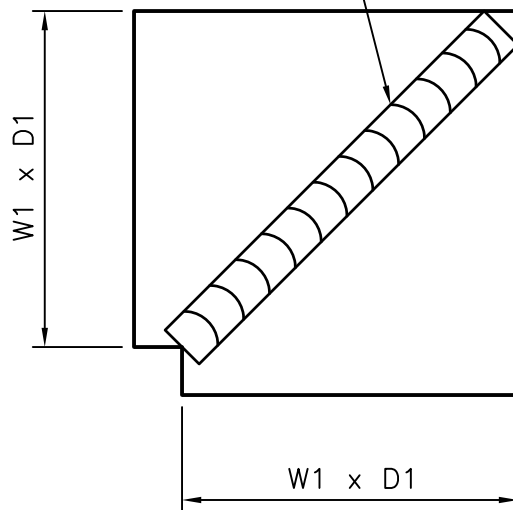


SQUARE THROAT 90° ELBOW WHEN DUCT SIZES UNEQUAL

NTS

23 31 00-07

MANUFACTURED AIRFOIL
TURNING VANES & RUNNER
(NOT SHOP MANUFACTURED)



SQUARE THROAT 90° ELBOW WHEN DUCT SIZE EQUAL

NTS

23 31 00-08

CRIMP FABRIC TO DUCT
PER MANUFACTURERS
RECOMMENDATIONS

SEE SPECS
FOR DUCT TYPE

POSITIVE
PRESSURE

NEGATIVE OR
ATMOSPHERIC SIDE

2" MIN
TO
4" MAX

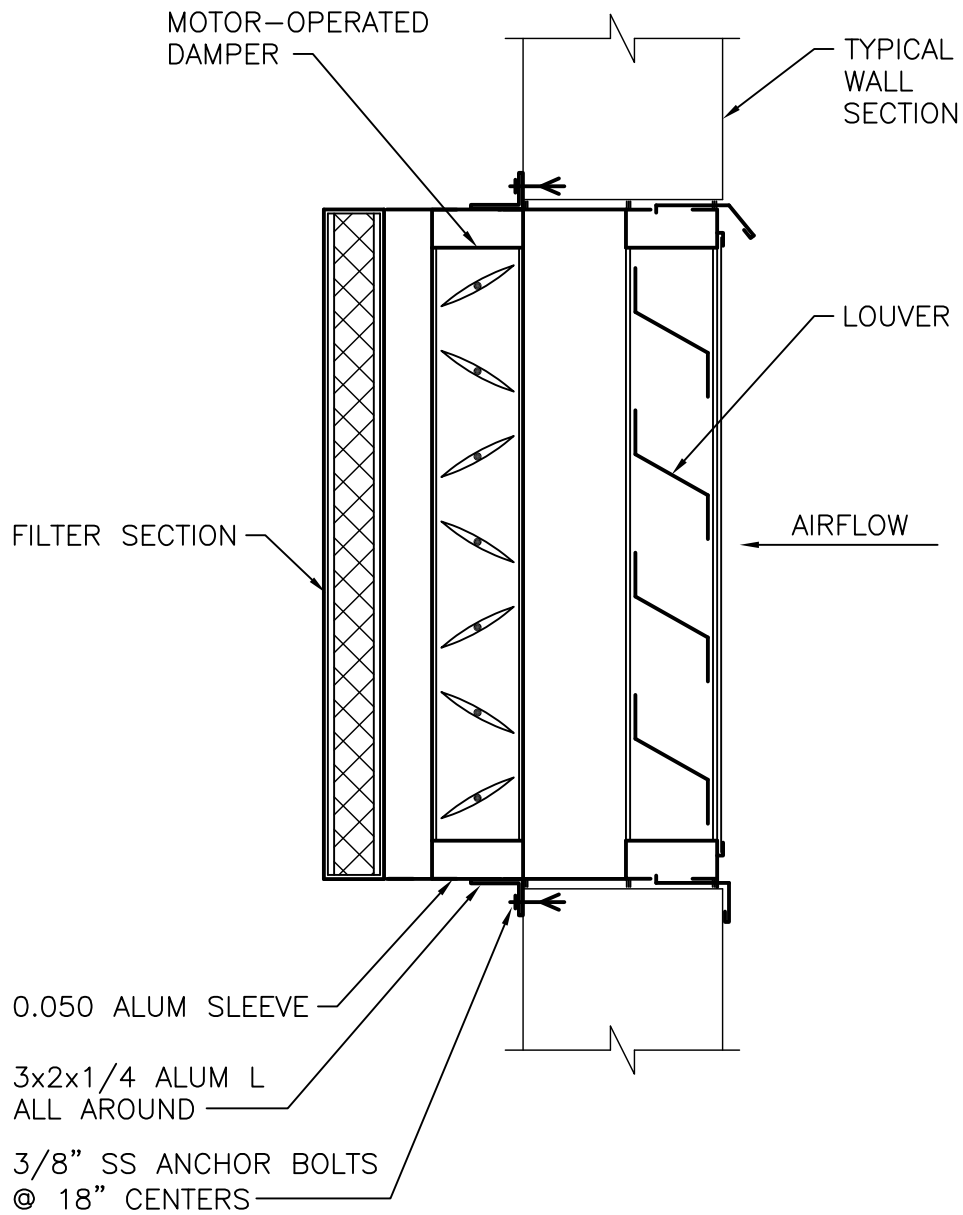
RECTANGULAR
OR ROUND TO
SUIT OPENING

FLEXIBLE DUCT CONNECTION

NTS

23 31 00-09



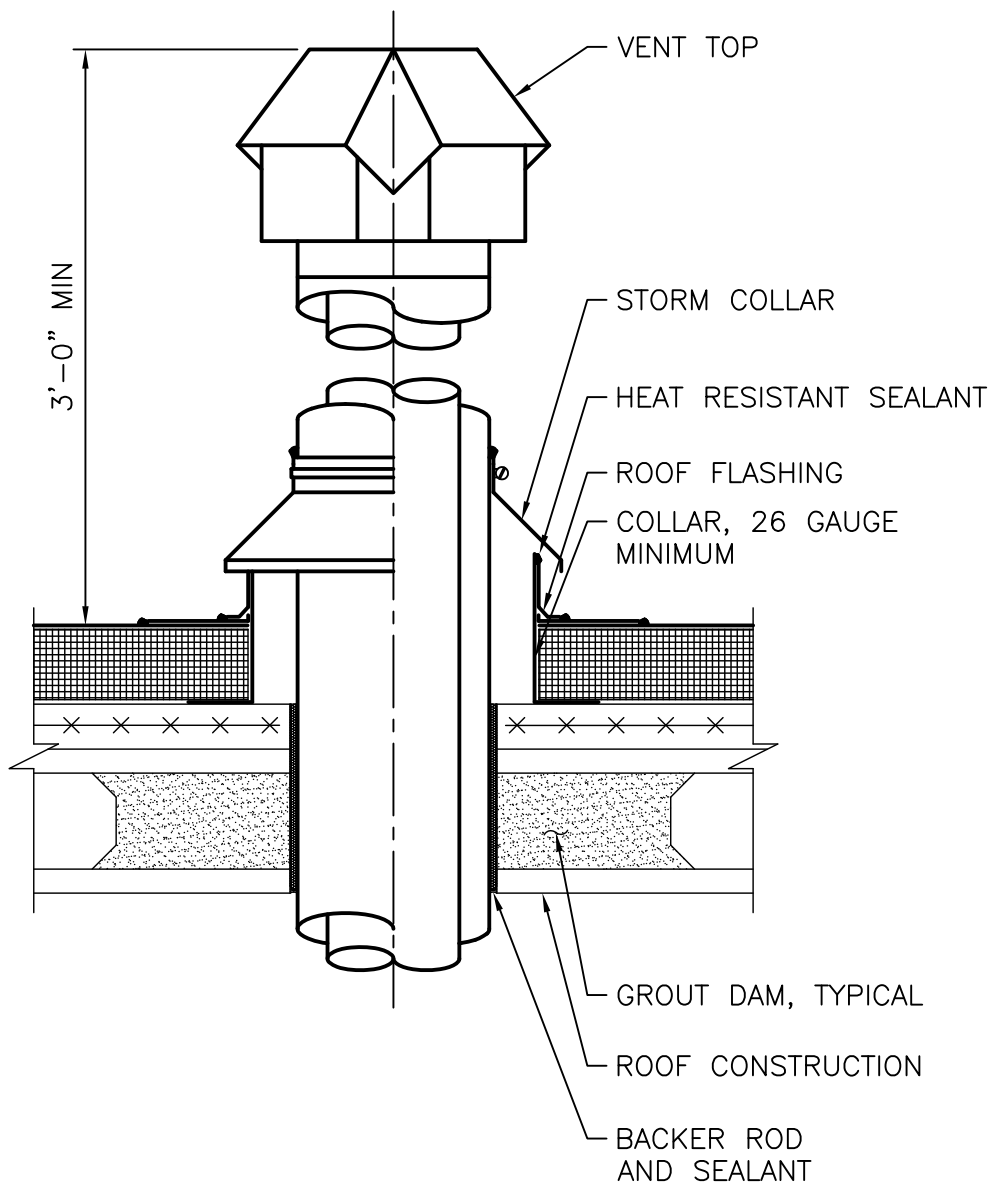


FILTERED AIR INTAKE

NTS

23 31 00-10

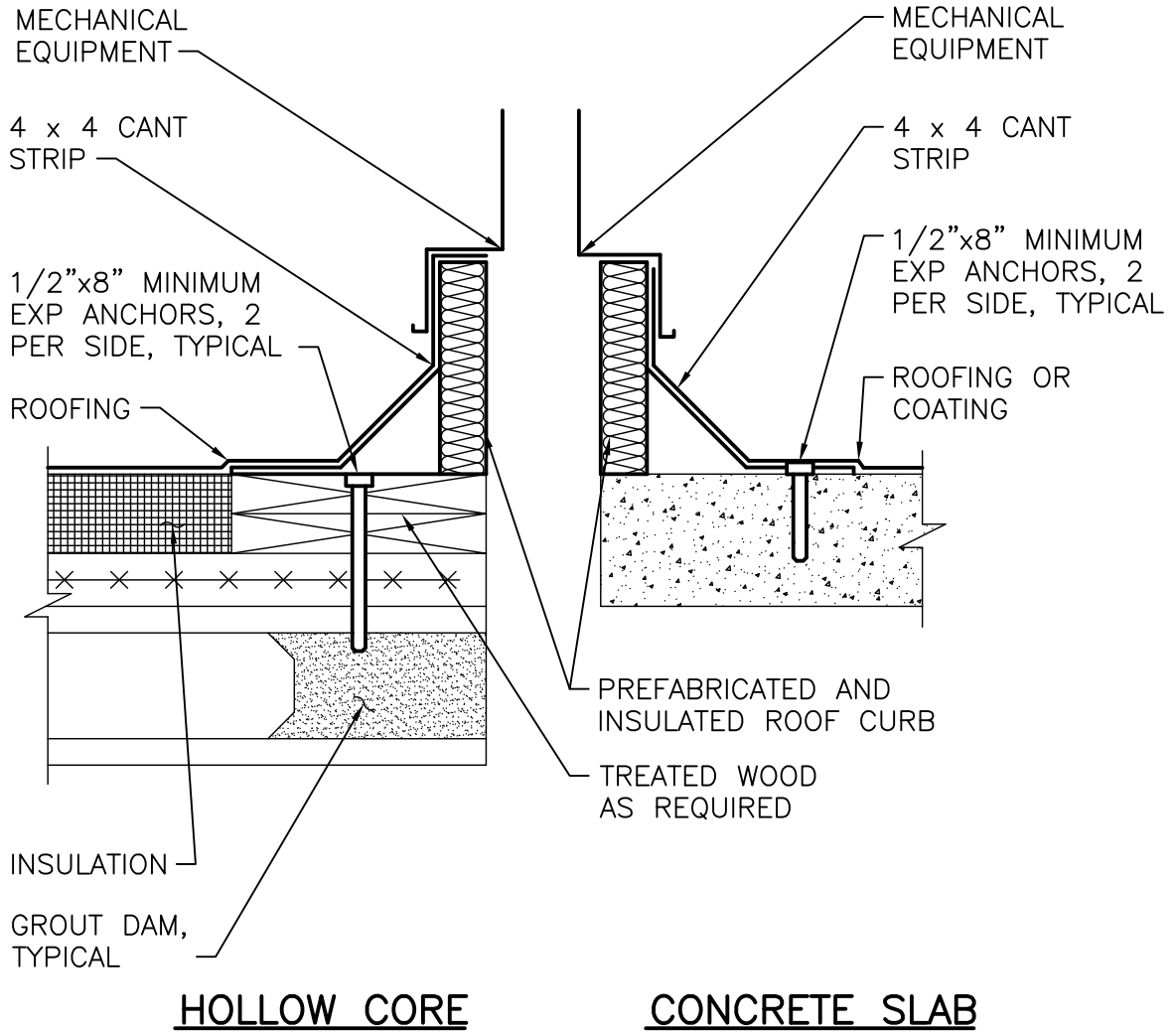




GAS APPLIANCE VENT

NTS

23 80 00-01

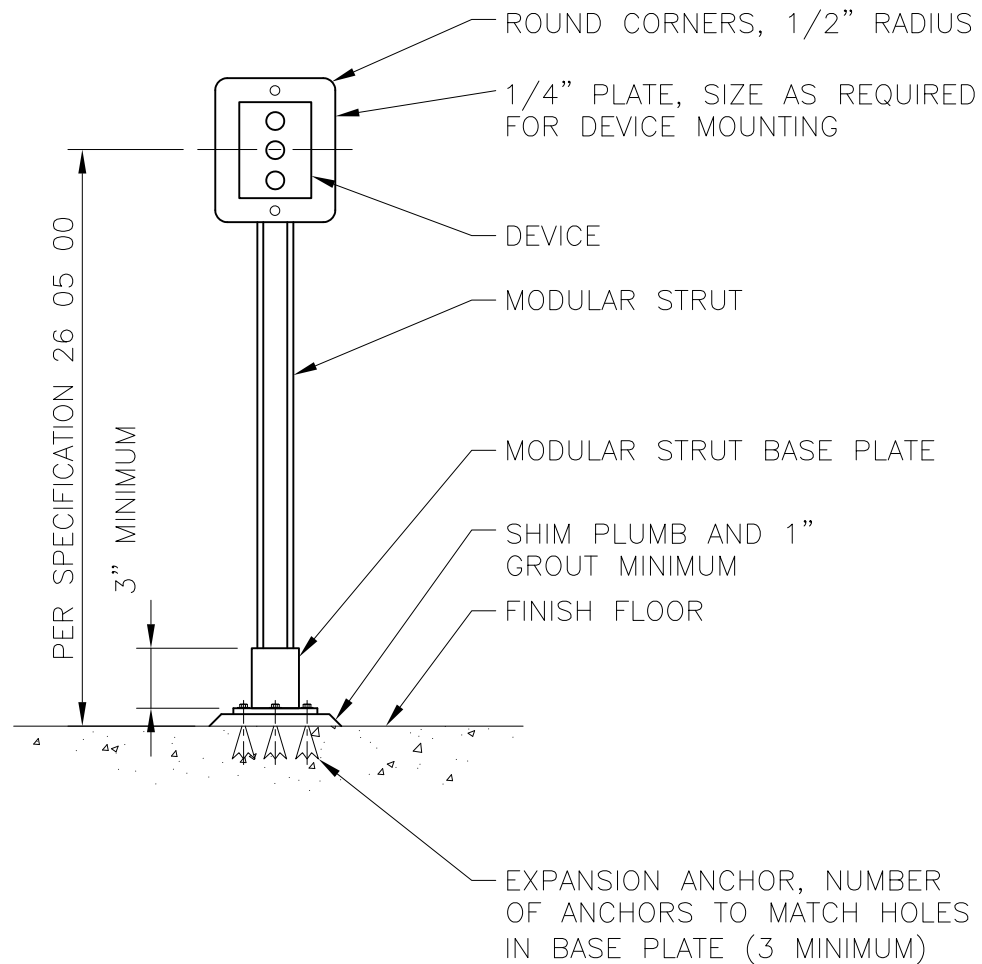


MECHANICAL EQUIPMENT ROOF PENETRATION

NTS

23 80 00-02





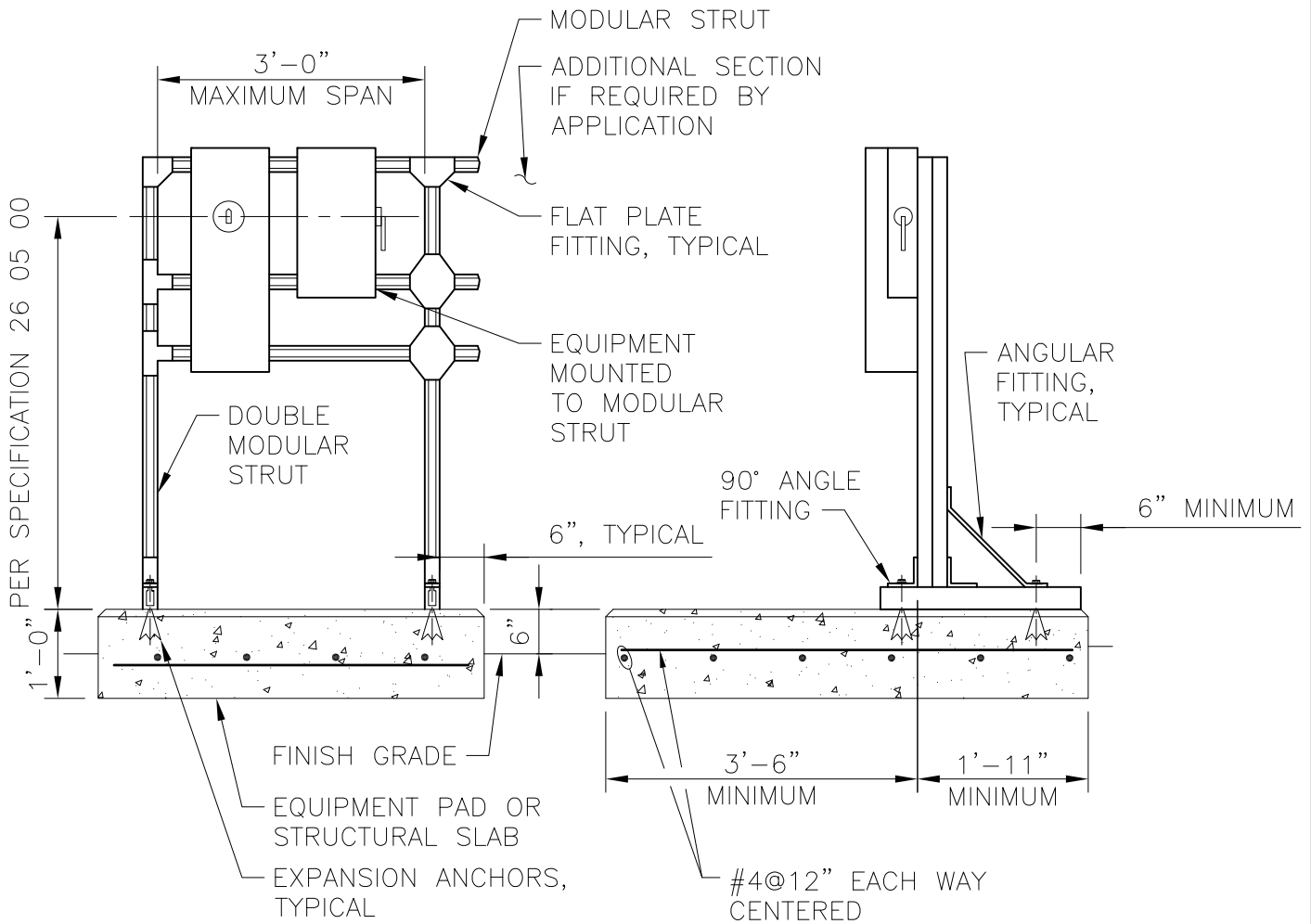
NOTES:

1. DEVICE LOAD SHALL NOT EXCEED 25 LBS.
2. PEDESTAL MATERIAL: GALVANIZED STEEL PER SPECIFICATION 26 05 00.
3. MODULAR STRUT WIDTH: 1 5/8".
4. ANCHORS: STAINLESS STEEL, 1/2" DIAMETER, 3 1/2" EMBEDMENT, PER SPECIFICATION 05 50 00.
5. PROTECT SURFACES WITH DISSIMILAR MATERIALS IN ACCORDANCE WITH SPECIFICATION 09 96 00.
6. REPAIR CUT ENDS AND DAMAGED SURFACES IN ACCORDANCE WITH SPECIFICATION 05 50 00.

MODULAR DEVICE PEDESTAL

NTS

26 05 00-01



FRONT VIEW

SIDE VIEW

NOTES:

1. COMBINED EQUIPMENT LOADS PER 36" SPAN SHALL NOT EXCEED 500 LBS.
2. PROVIDE GROUNDING FOR OUTDOOR INSTALLATIONS, PER SPECIFICATION 26 05 26.
3. MODULAR STRUT WIDTH: 1 5/8".
4. RACK ASSEMBLY MATERIAL: GALVANIZED PER SPECIFICATION 26 05 00.
5. ANCHORS: STAINLESS STEEL, 1/2" DIAMETER, 3 1/2" EMBEDMENT, PER SPECIFICATION 05 50 00.
6. PROTECT SURFACES WITH DISSIMILAR MATERIALS IN ACCORDANCE WITH SPECIFICATION 09 96 00.
7. REPAIR CUT ENDS AND DAMAGED SURFACES IN ACCORDANCE WITH SPECIFICATION 05 50 00.

MODULAR EQUIPMENT RACK

NTS

26 05 00-02



EQUIPMENT
MOUNTED TO
MODULAR
STRUT

DOUBLE
MODULAR
STRUT

EQUIPMENT
PAD

EXPANSION ANCHOR.
NUMBER OF ANCHORS
TO MATCH HOLES IN FLANGES

PER SPECIFICATION
26 05 00

WING
SHAPE
FITTINGS,
TYPICAL

90° ANGLE
FITTING

2 1/2" MINIMUM

FRONT VIEW

SIDE VIEW

NOTES:

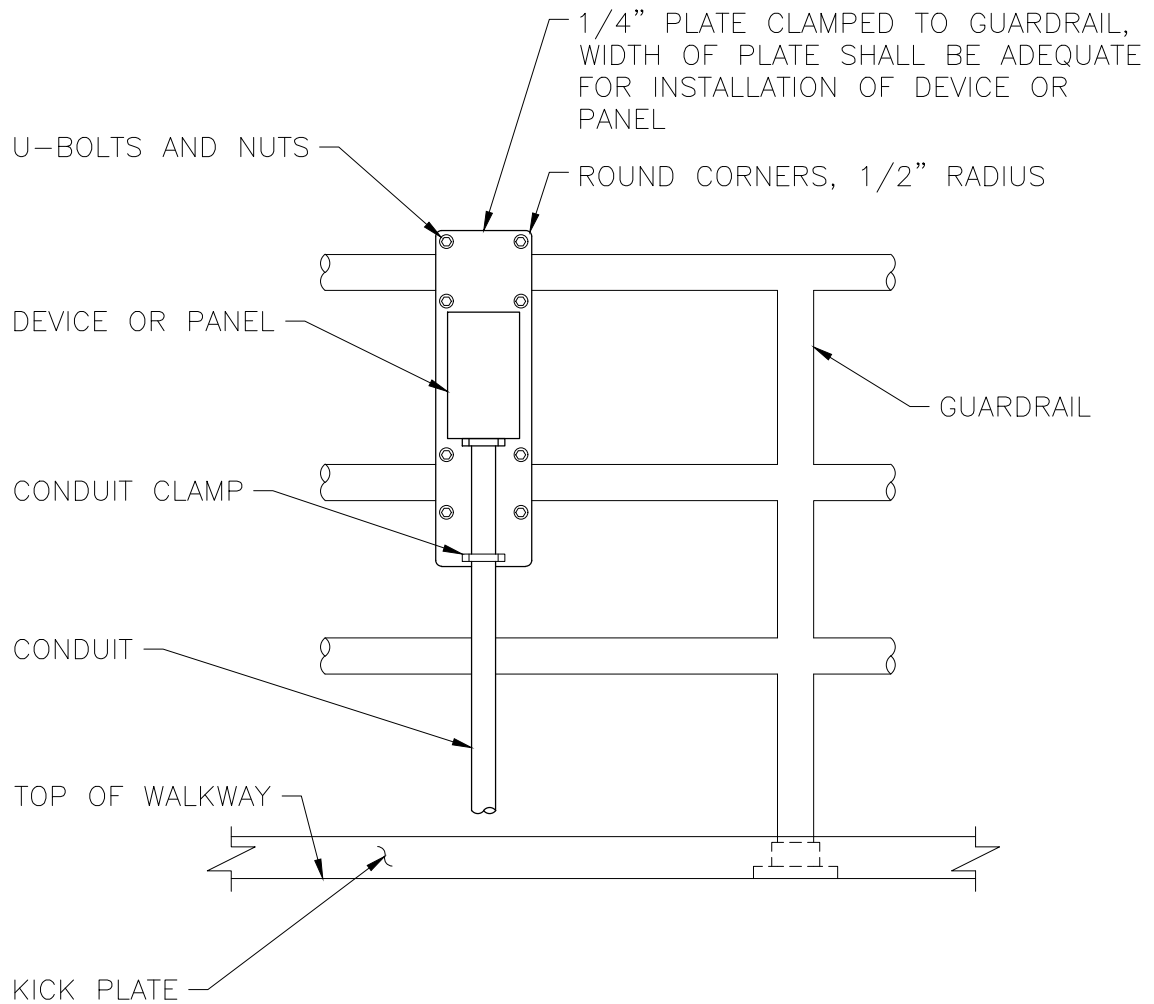
1. EQUIPMENT LOAD SHALL NOT EXCEED 200 LBS.
2. RACK ASSEMBLY MATERIAL: GALVANIZED PER SPECIFICATION 26 05 00.
3. MODULAR STRUT WIDTH: 1 5/8".
4. ANCHORS: STAINLESS STEEL, 3/8" DIAMETER, 3 1/2" EMBEDMENT PER SPECIFICATION 05 50 00
5. PROTECT SURFACES WITH DISSIMILAR MATERIALS IN ACCORDANCE WITH SPECIFICATION 09 06 00.
6. REPAIR CUT ENDS AND DAMAGED SURFACES IN ACCORDANCE WITH SPECIFICATION 05 50 00.

MODULAR SUPPORT RACK

NTS

26 05 00-03





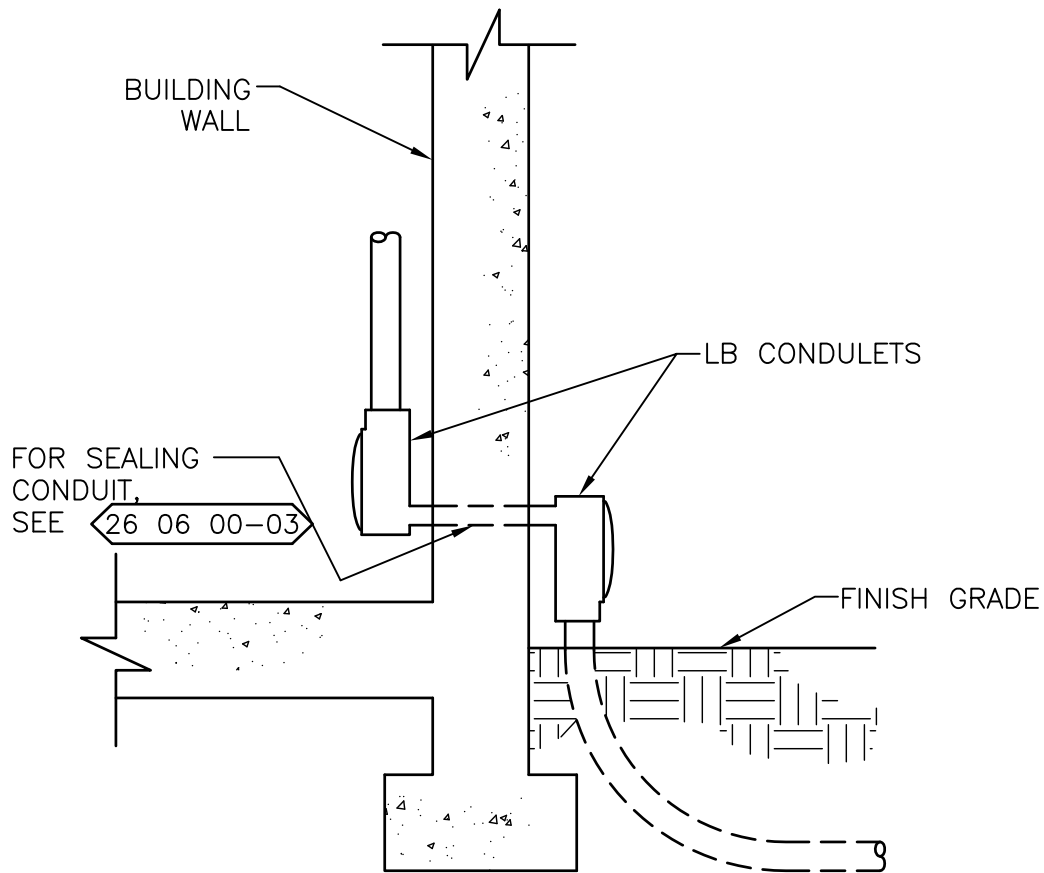
NOTES:

1. MOUNTING ASSEMBLY MATERIAL: ALUMINUM, PER SPECIFICATION 05 50 00.
2. ANCHORS: STAINLESS STEEL, 3/8" DIAMETER WITH WASHERS AND NUTS.
3. PROTECT SURFACES WITH DISSIMILAR MATERIALS IN ACCORDANCE WITH SPECIFICATION 09 96 00.

GUARDRAIL MOUNTED DEVICE

NTS

26 05 00-06



CONDUIT ENTRANCE DETAIL

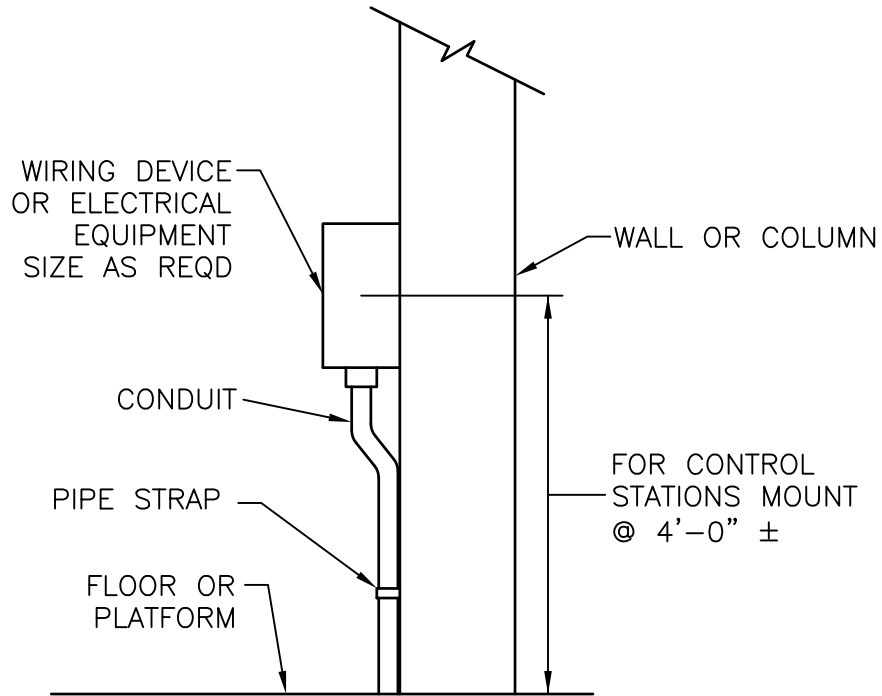
NTS

26 05 00-07



NOTE:

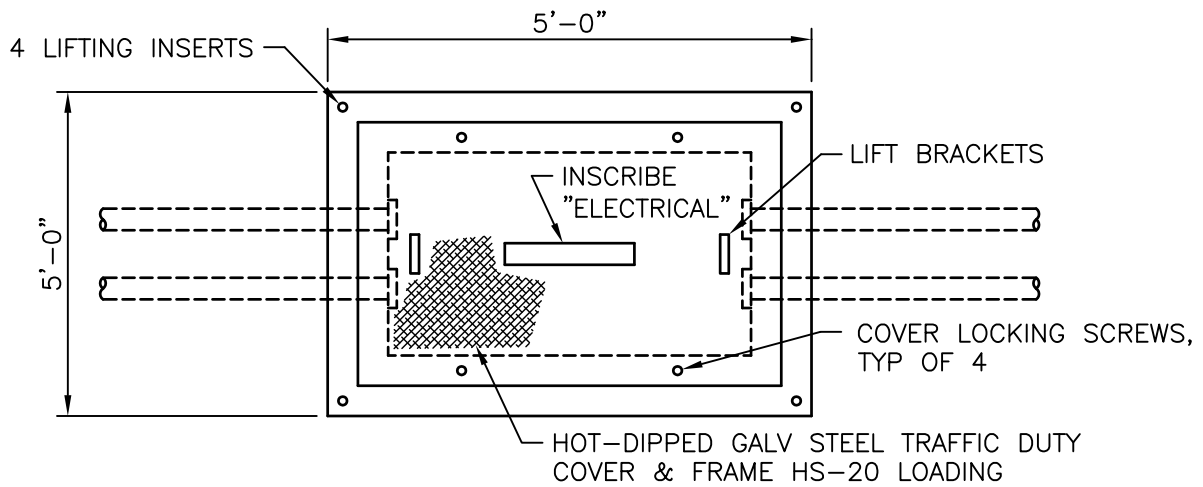
ALL MOUNTING HARDWARE SHALL BE GALVANIZED STEEL (UNLESS SST NOTED). ON CONC WALLS, USE MALLEABLE IRON INSERTS. MOUNT ENCLOSURE ON ¼" SPACERS OF ½" RIGID CONDUIT.



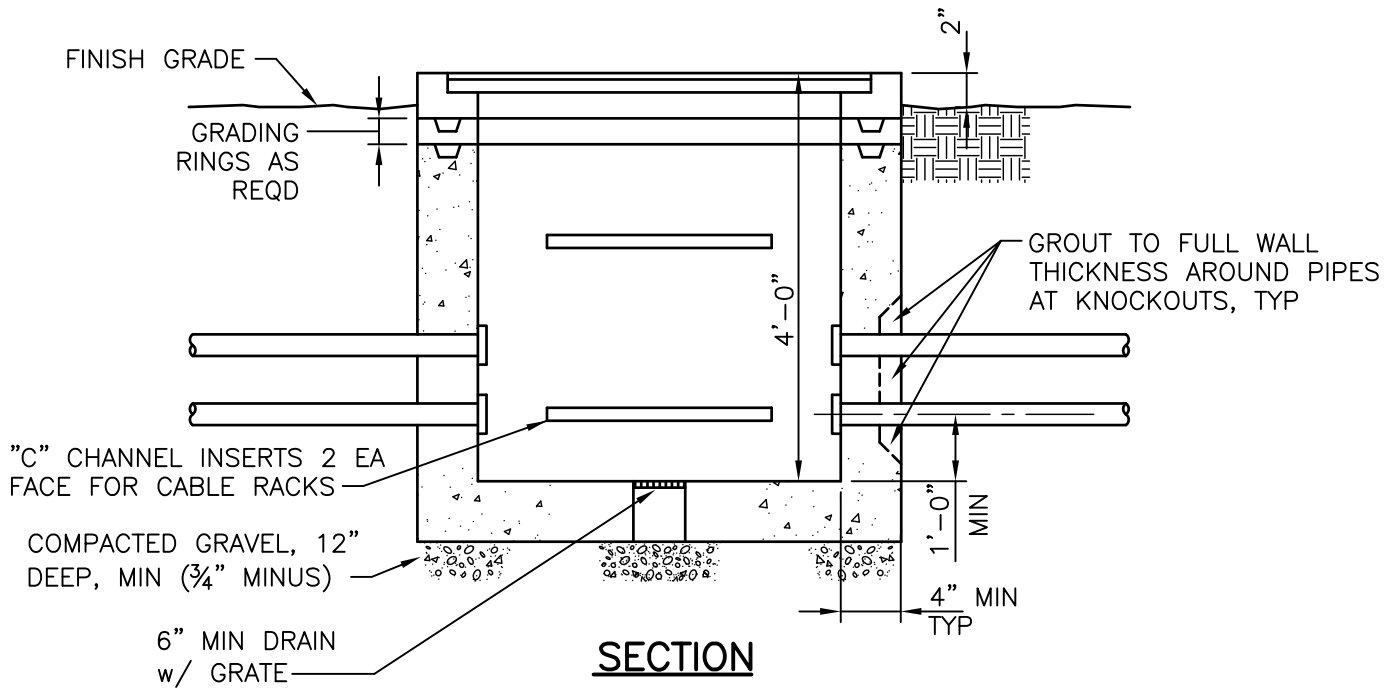
WALL OR COLUMN MOUNTED DEVICE

NTS

26 05 00-08



PLAN



SECTION

TYPE 'A' HANDHOLE

NTS

26 05 00-10



CAST IRON ROUND COVER
w/ BRONZE LOCKING
BOLTS & SEALING RING

FINISH GRADE

GRADING
RINGS AS
REQD

4 LIFTING INSERTS

"C" CHANNEL
INSERTS 3 EA
FACE FOR
CABLE RACKS

2'-6" MIN

1'-0"
MIN

1'-0"
MIN

6"
MIN

1'-6"
MIN

6'-0"

VARIES AS
REQD PER
NO. OF DUCTS

CABLE RACK
GROUND, TYP

#6 AWG BC
GROUND

GROUT TO FULL WALL
THICKNESS AROUND PIPES AT
KNOCKOUTS, TYP

8 PULLING IRONS, 2 EA
CORNER (TOP & BOTTOM)

COMPACTED
GRAVEL, 12"
DEEP MIN, ($\frac{3}{4}$ "
MINUS)

GROUND ROD

10 CF 1" TO 1½" GRAVEL
ALL AROUND DRAIN

8" MIN DRAIN w/ GRATE

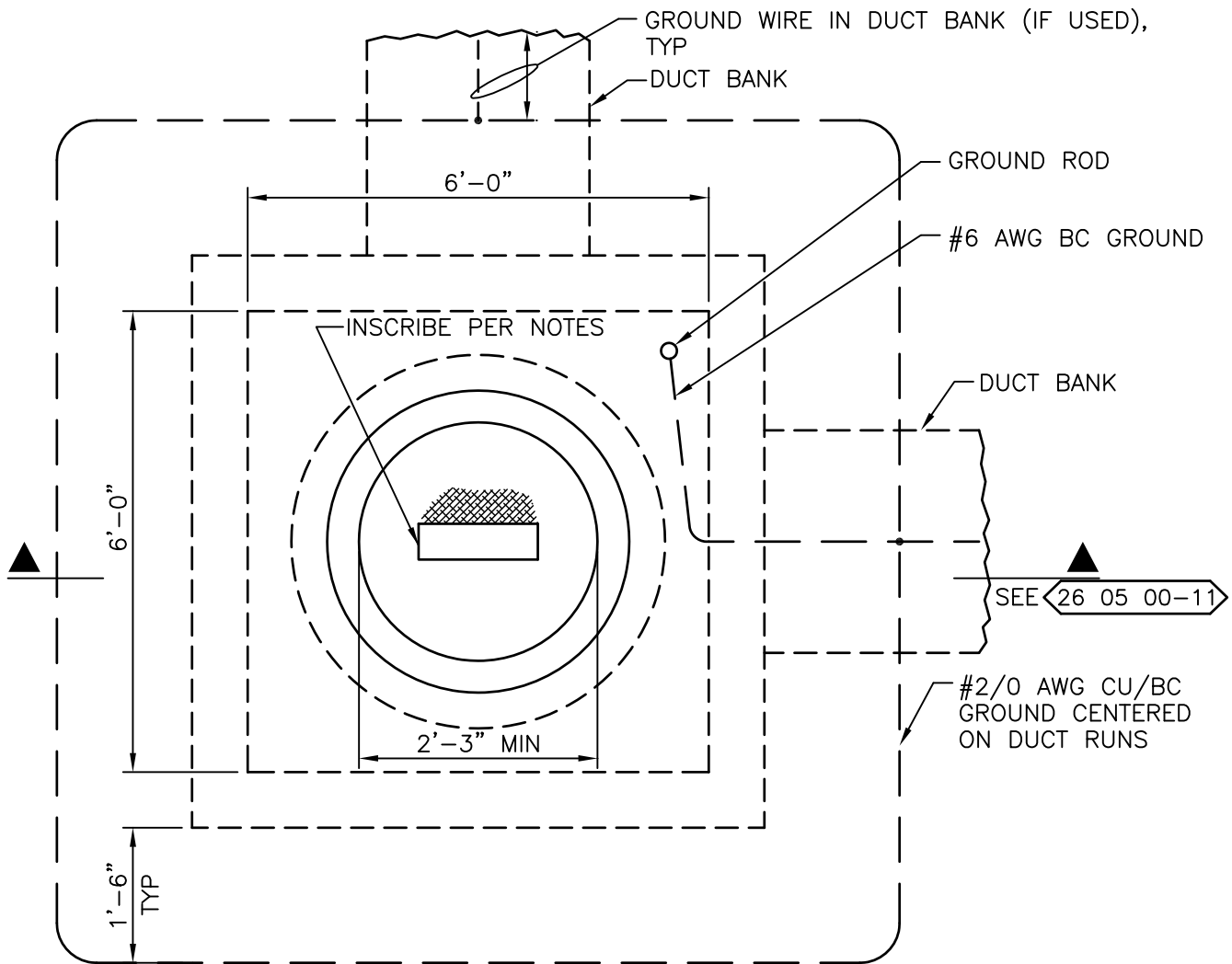
FOR PLAN VIEW, SEE 26 05 00-12

SECTION

TYPE 'B' HANDHOLE

NTS

26 05 00-11



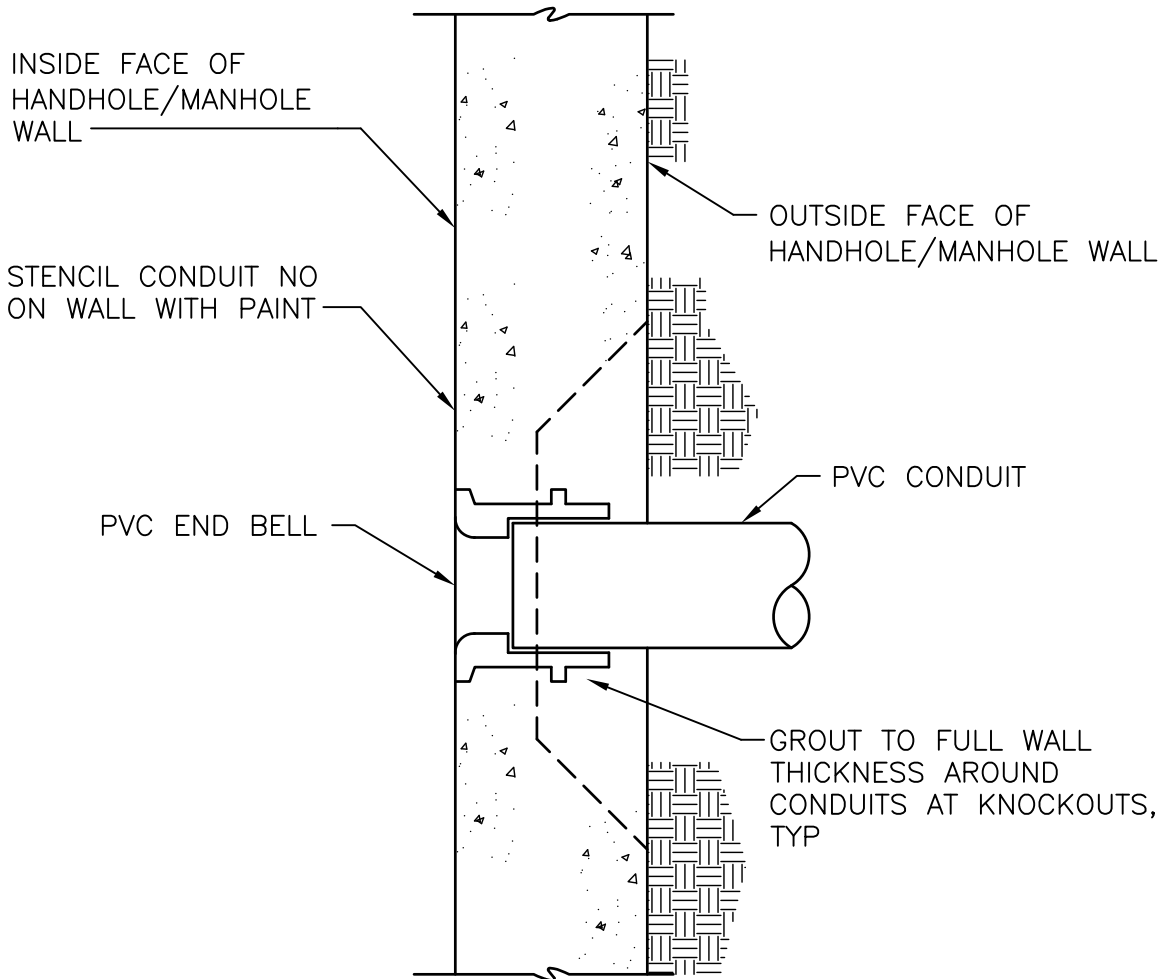
NOTE: INSCRIBE "ELECTRICAL LOW VOLTAGE" IF ALL CIRCUITS IN HANDHOLE ARE 600V OR LESS.

HANDHOLE PLAN

NTS

26 05 00-12

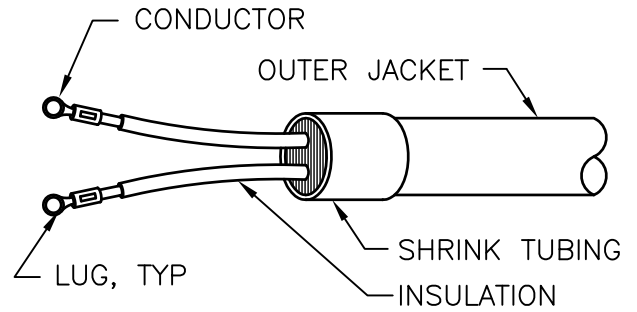
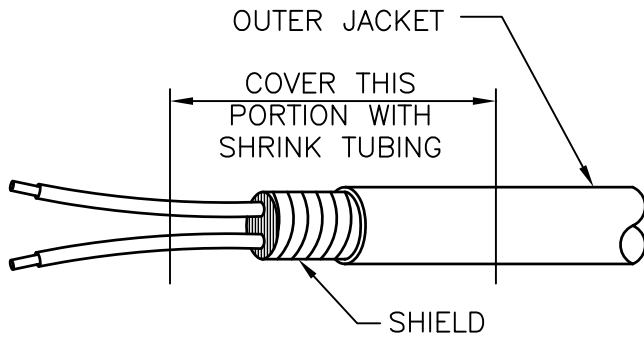




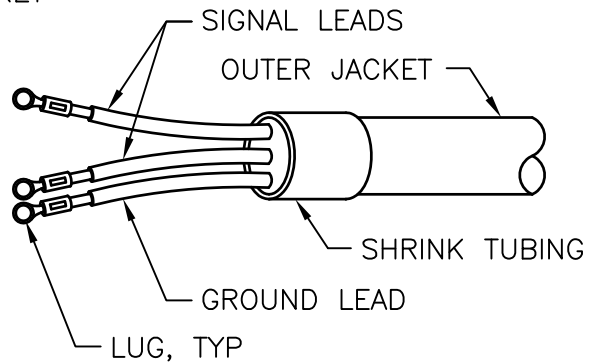
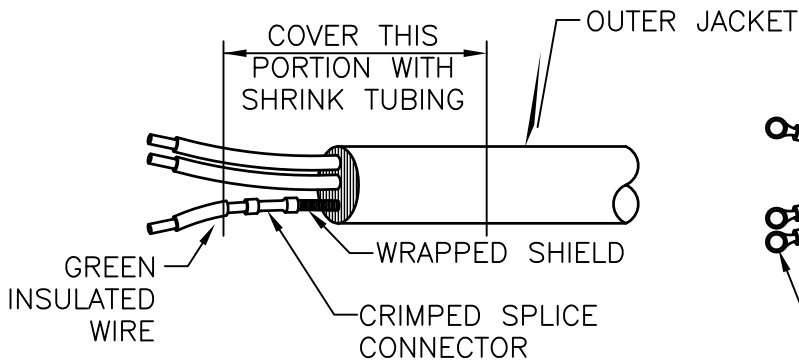
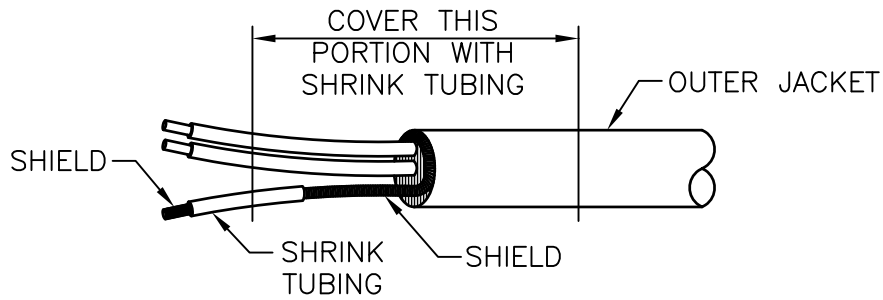
CONDUIT HANDHOLE/MANHOLE ENTRANCE

NTS

26 05 00-13



NOTE:
SHIELD NOT GROUNDED AT TERMINATION

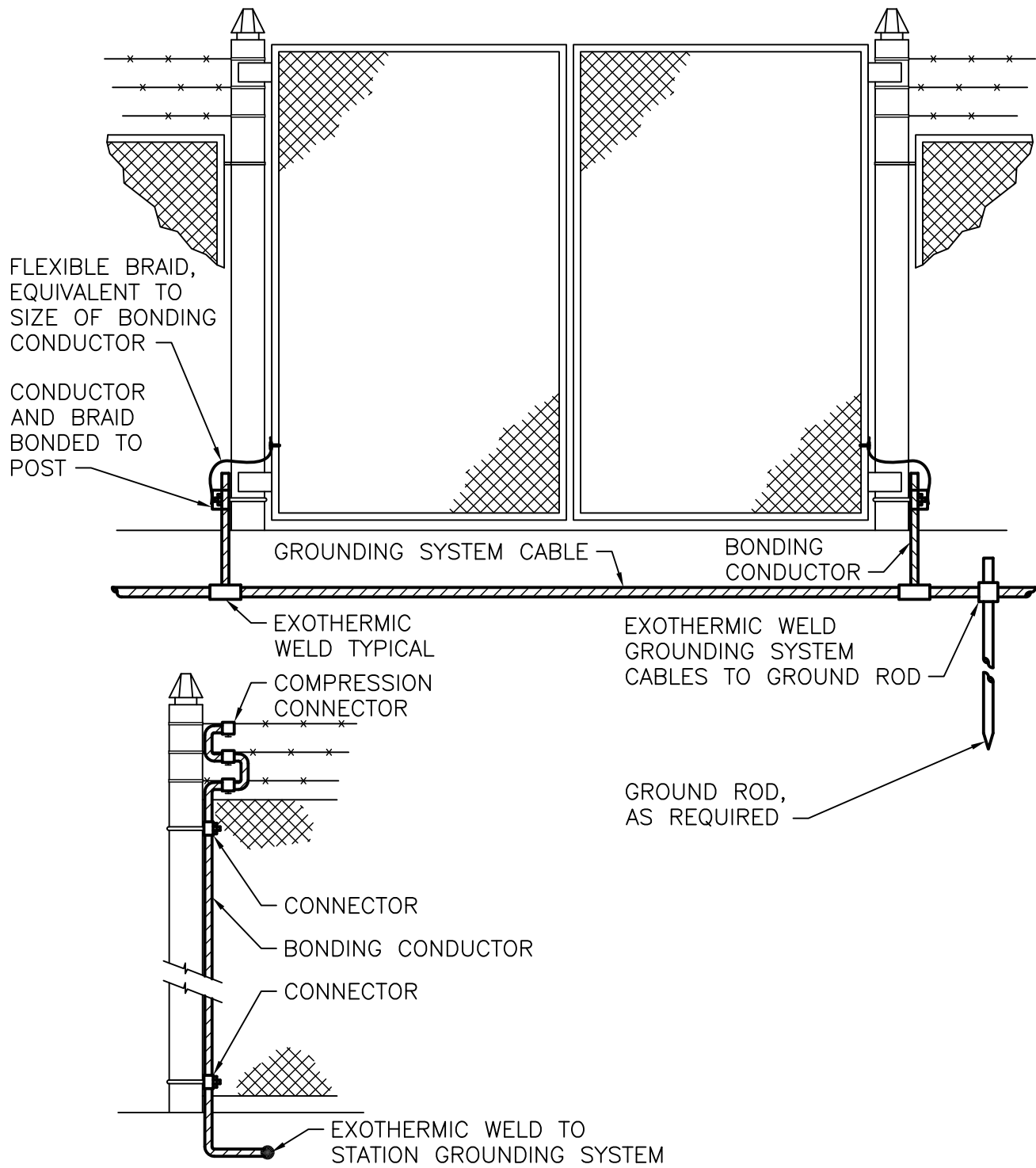


NOTE:
SHIELD NOT GROUNDED AT TERMINATION

TERMINATION OF SHIELDED CONTROL CABLE

NTS

26 05 00-14



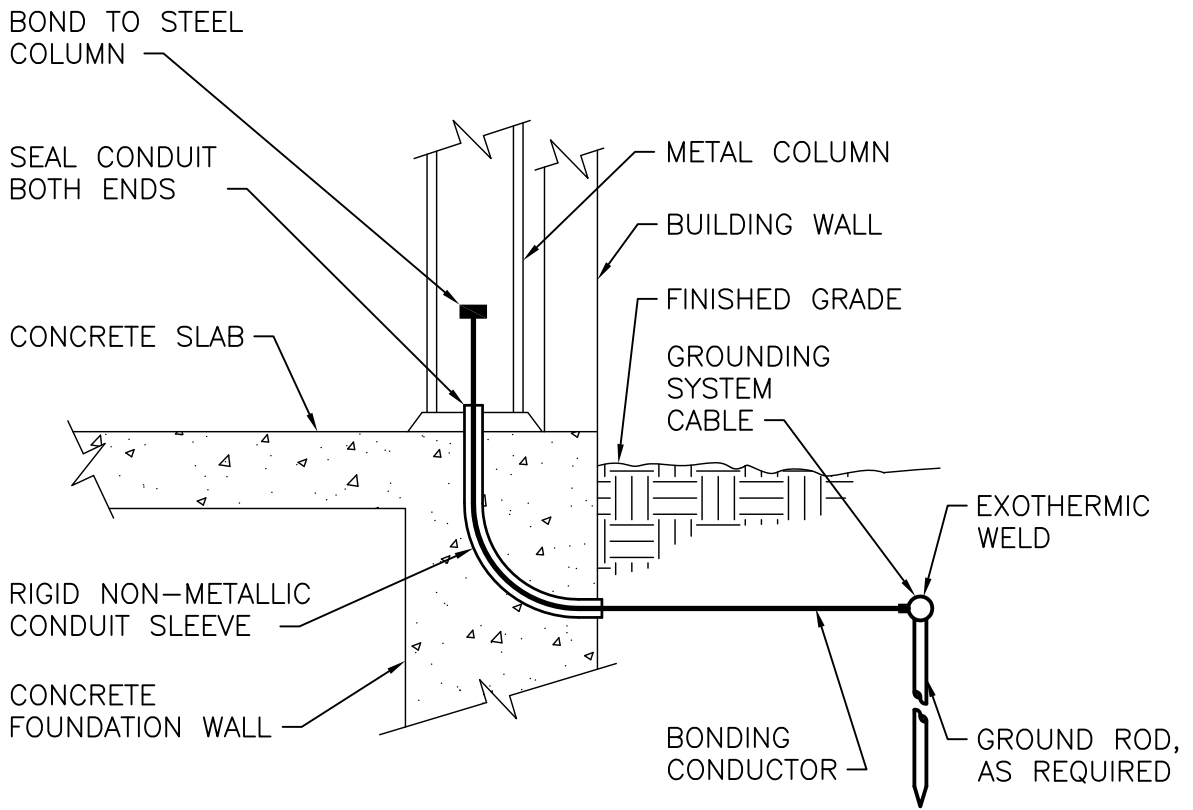
POST GROUNDING

GATE AND FENCE GROUNDING

NTS

26 05 26-01



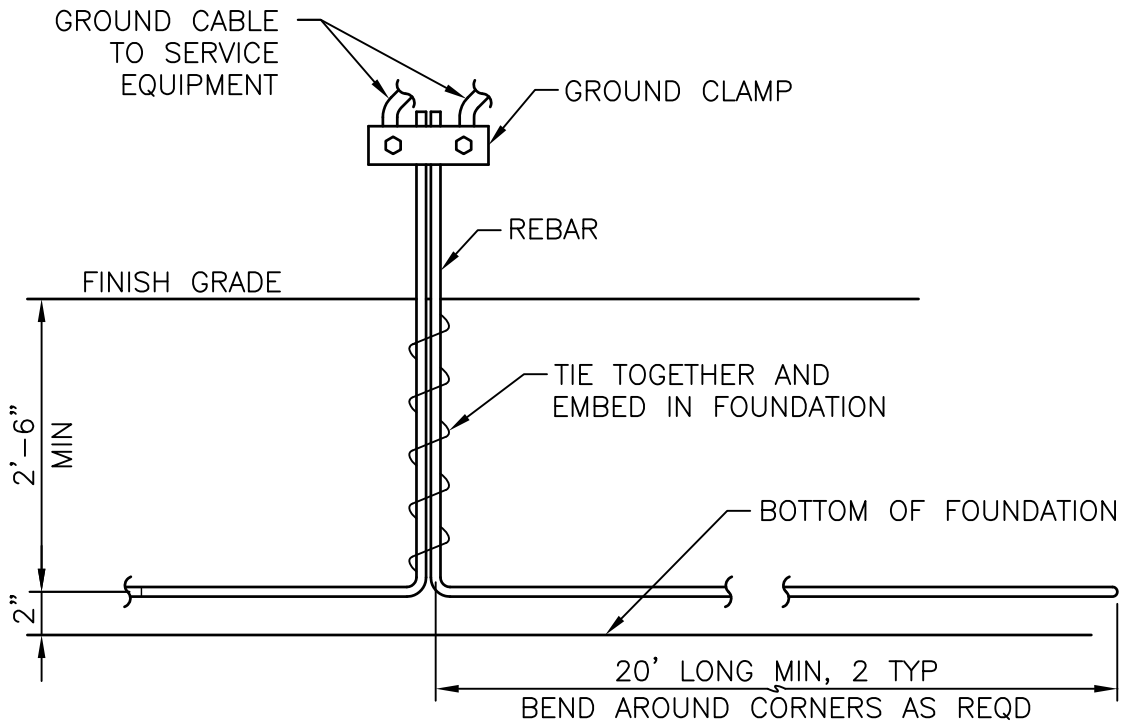


COLUMN GROUND CONNECTION

NTS

26 05 26-02



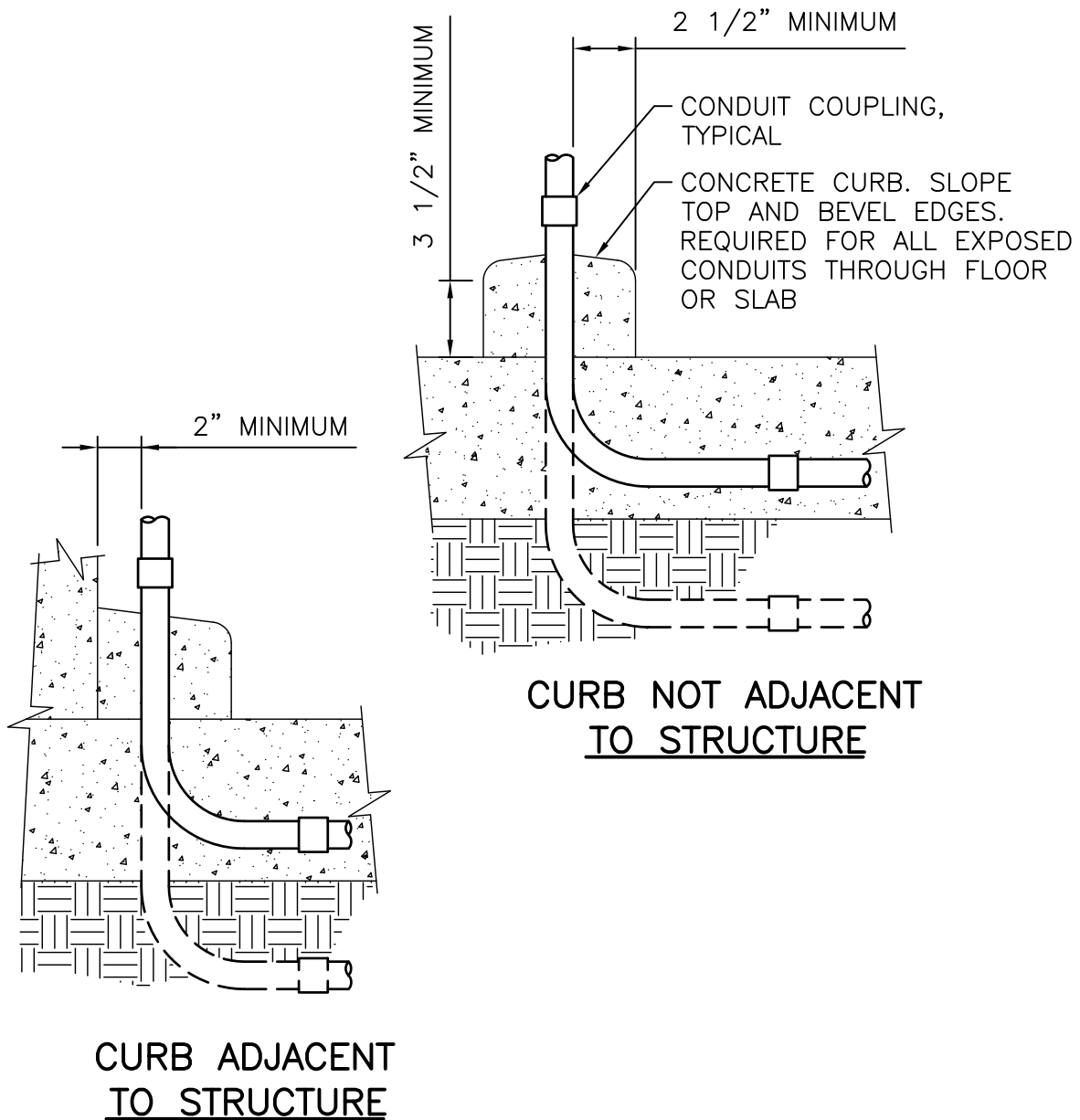


GROUND ELECTRODE

NTS

26 05 26-03



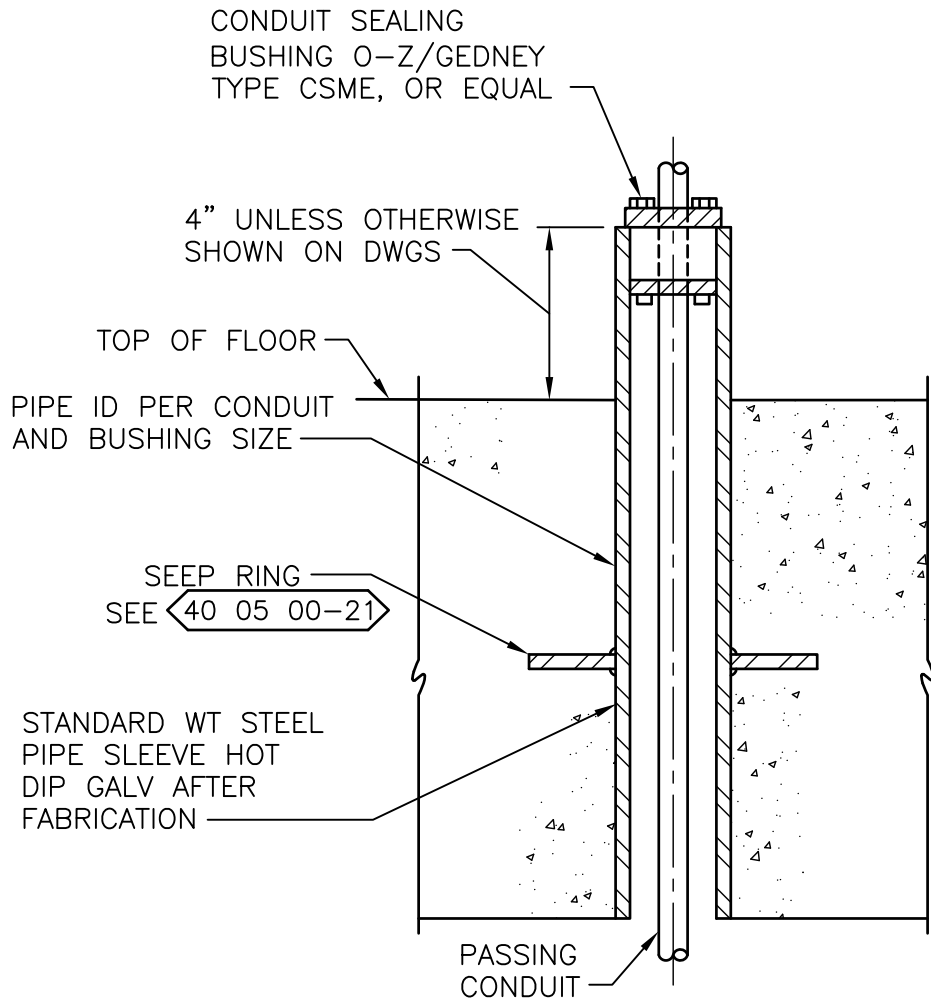


CONDUIT CURB

NTS

26 05 33-01



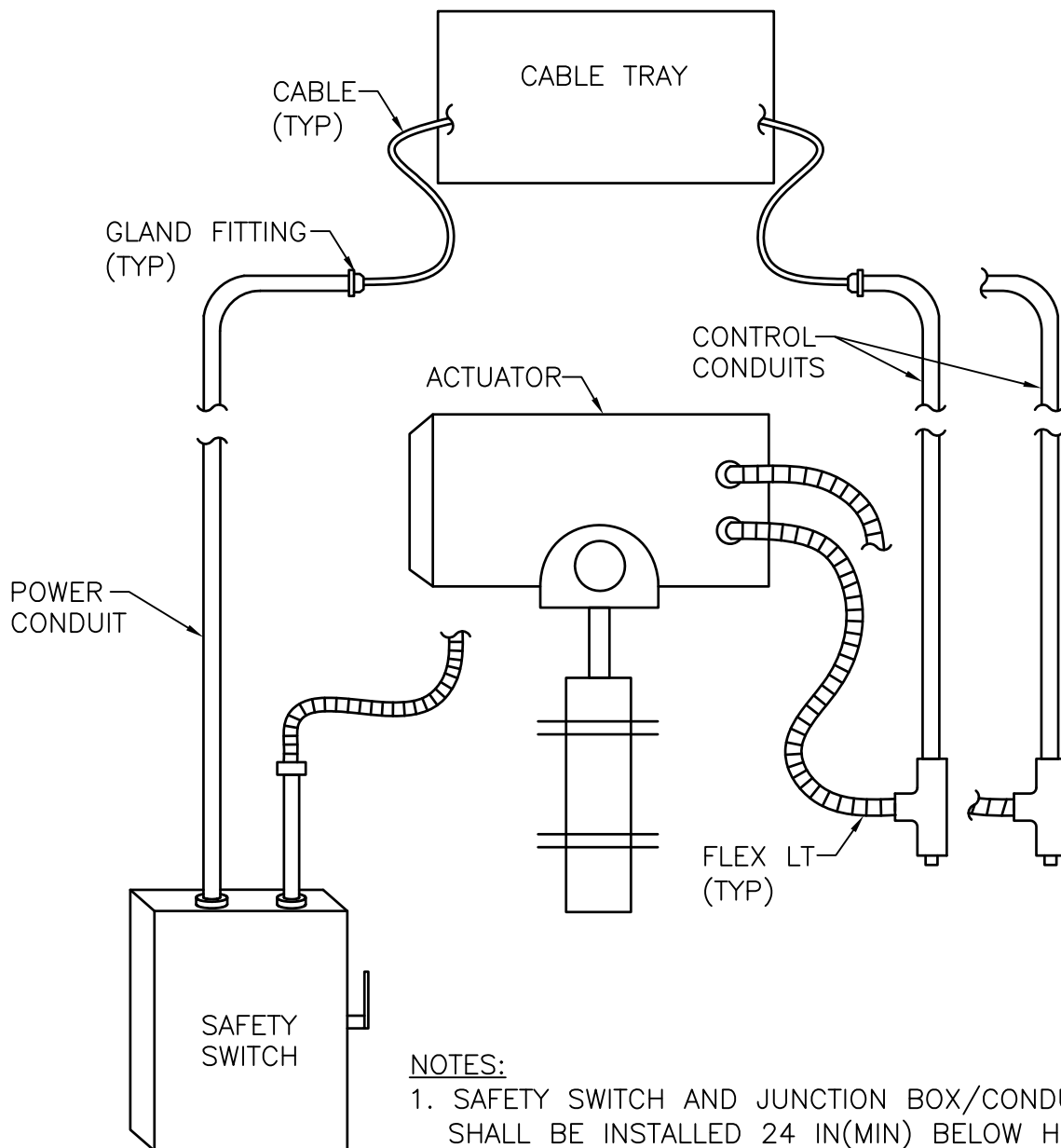


CONDUIT FLOOR SLEEVE

NTS

26 05 33-02





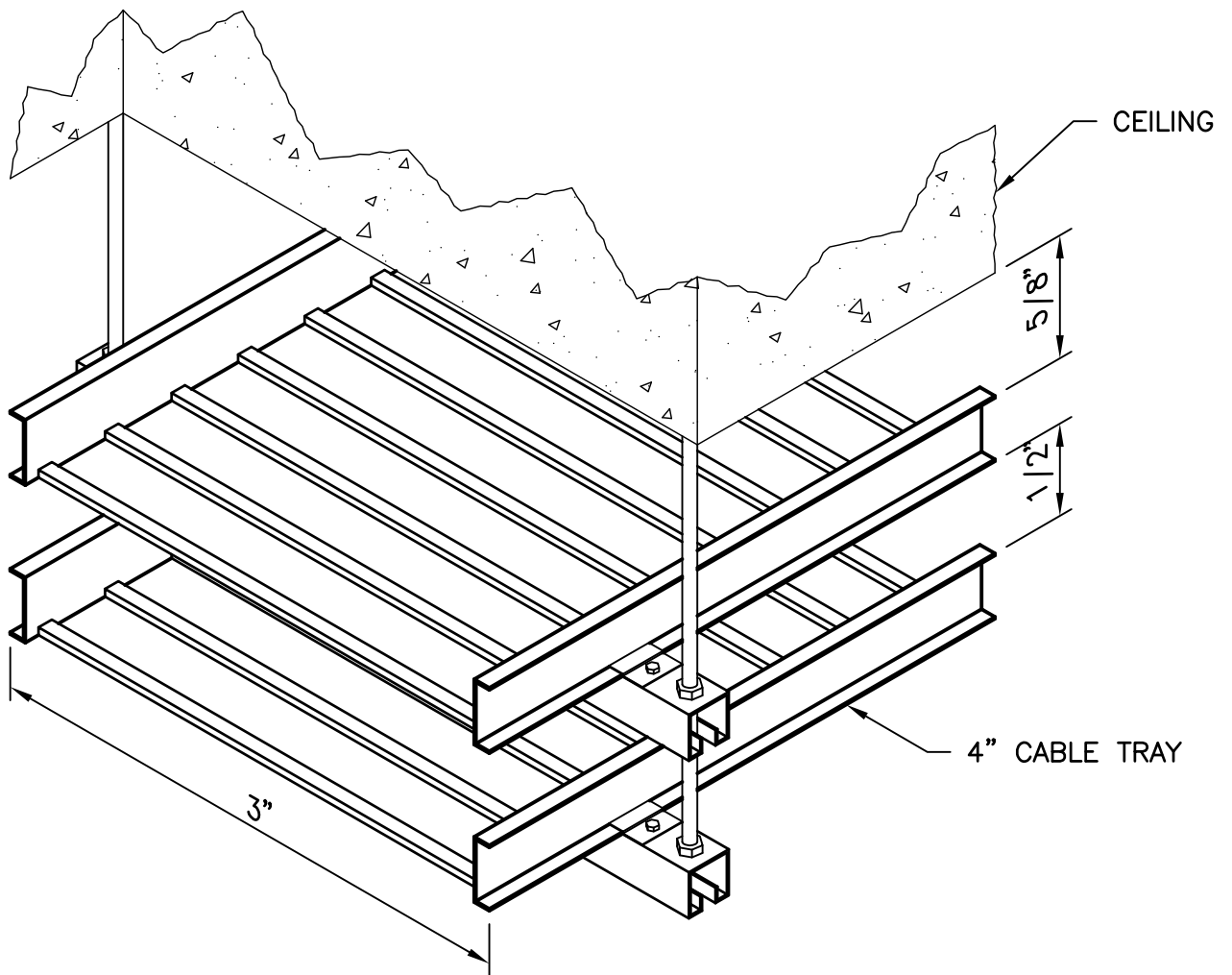
NOTES:

1. SAFETY SWITCH AND JUNCTION BOX/CONDULET SHALL BE INSTALLED 24 IN(MIN) BELOW HEIGHT OF VALVE ACTUATOR TO PROMOTE DRAINING OF MOISTURE AWAY FROM ACTUATORS. FLEX LT SHALL CONTINUOUSLY SLOPE DOWN AND AWAY FROM ACTUATOR.
2. SEAL CONDUIT OPENINGS AT CABLE TRAY AS REQUIRED TO PREVENT MOISTURE FROM ENTERING THE CONDUIT.

MOTOR ACTIVATED VALVE FEED FROM ABOVE

NTS

26 05 33-03

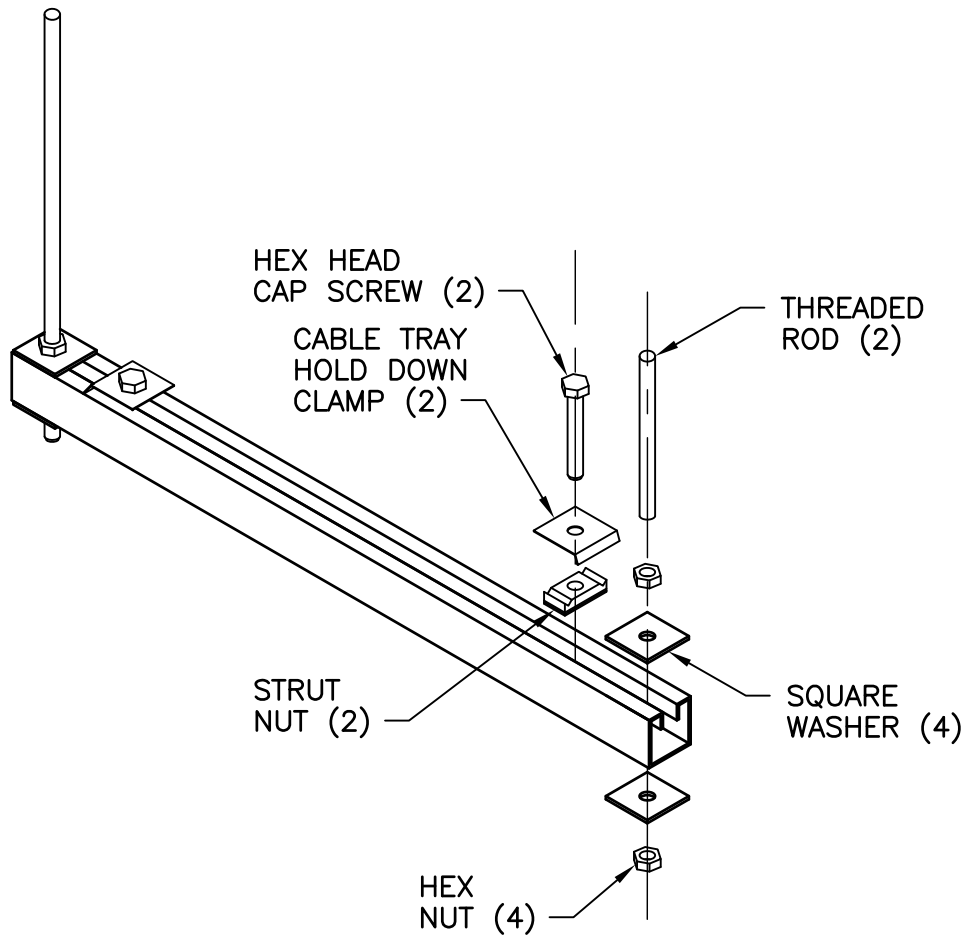


NOTE: INSTALL IN ACCORDANCE WITH DETAILS 26 05 36-02, & 26 05 36-03,
AND 05 50 00-17

TYPICAL STRUT INSTALLATION

NTS

26 05 36-01



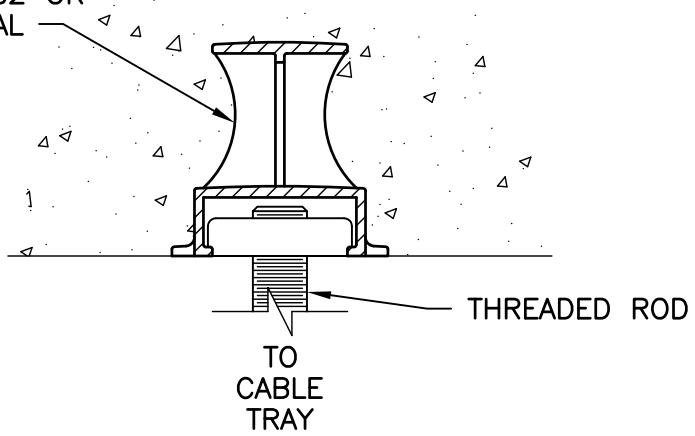
STRUT EXPLODED VIEW

NTS

26 05 36-02



CONCRETE INSERT,
GRIMMEL FIG 282 OR
APPROVED EQUAL



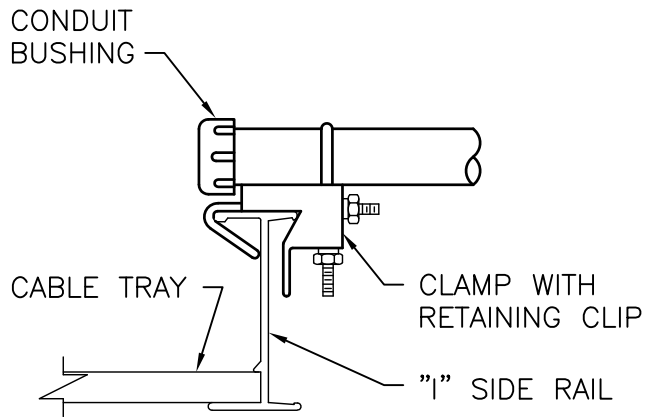
NOTE:

SEE 05505-16 FOR HOLLOW CORE CONSTRUCTION

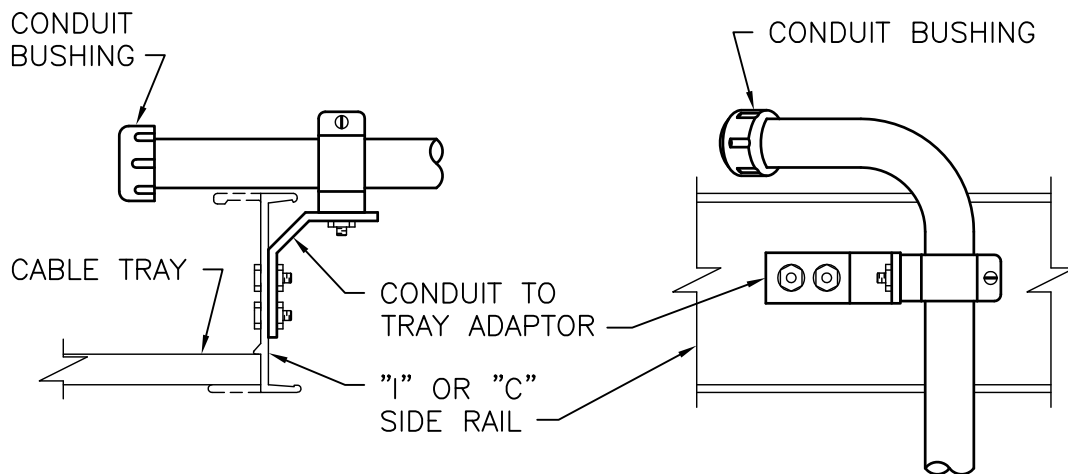
STRUT MOUNTING DETAIL

NTS

26 05 36-03



END VIEW



END VIEW

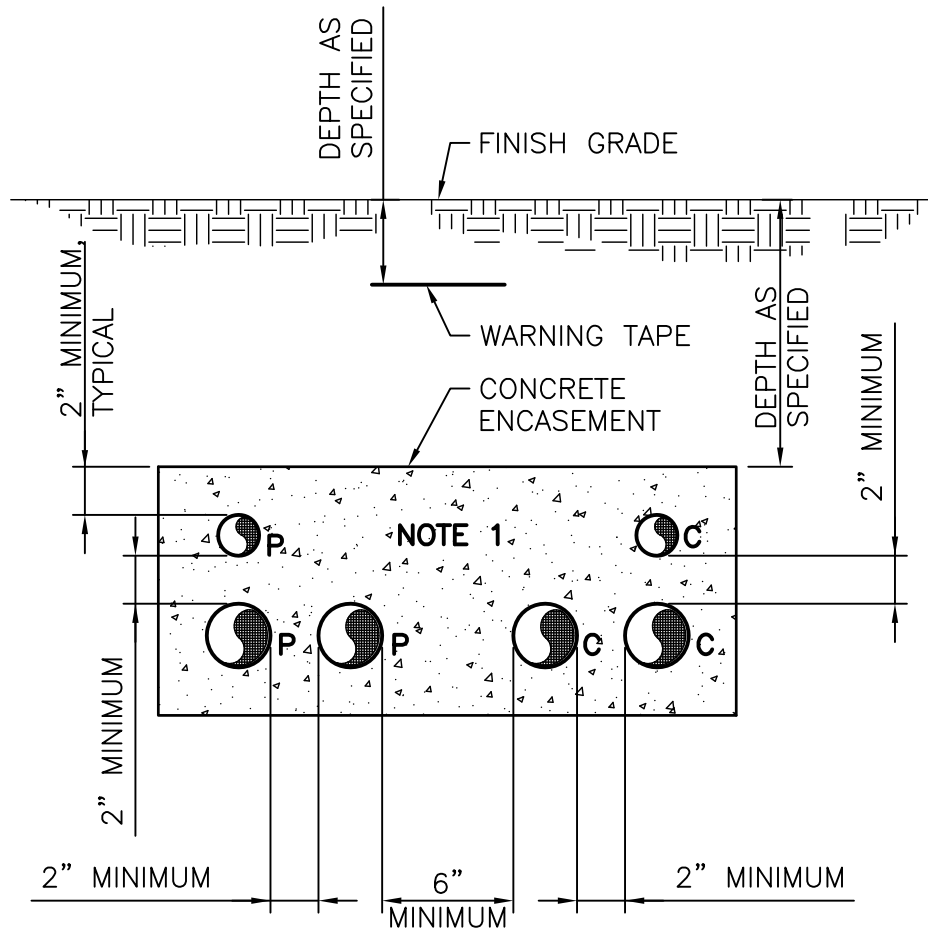
SIDE VIEW

CONDUIT TO CABLE TRAY

NTS

26 05 36-04





NOTES:

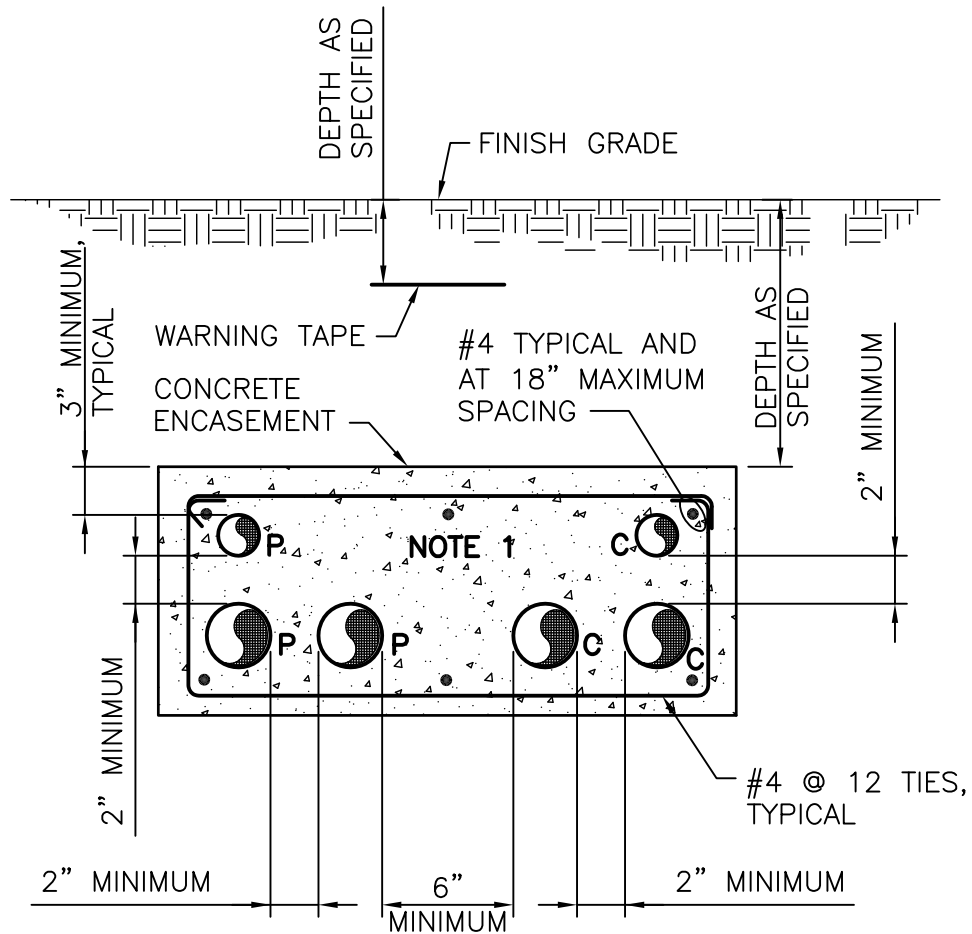
1. NUMBER OF CONDUITS AS REQUIRED FOR THE APPLICATION.
2. P SUBSCRIPT ELECTRICAL POWER OR CONTROL CONDUIT.
3. C SUBSCRIPT COMMUNICATION (TELEPHONE, DATA, INSTRUMENTATION) CONDUIT.

CONCRETE ENCASED DUCTBANK

NTS

26 05 43-02





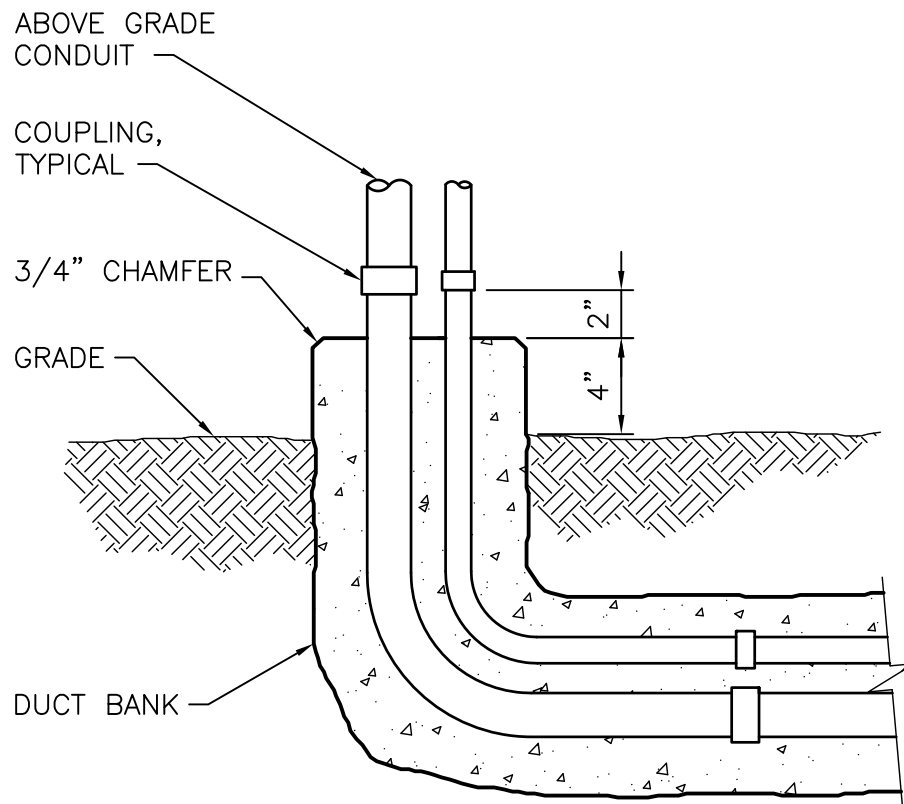
NOTES:

1. NUMBER OF CONDUITS AS REQUIRED FOR THE APPLICATION.
2. P SUBSCRIPT ELECTRICAL POWER OR CONTROL CONDUIT.
3. C SUBSCRIPT COMMUNICATION (TELEPHONE, DATA, INSTRUMENTATION) CONDUIT.

REINFORCED CONCRETE ENCASED DUCTBANK

NTS

26 05 43-03



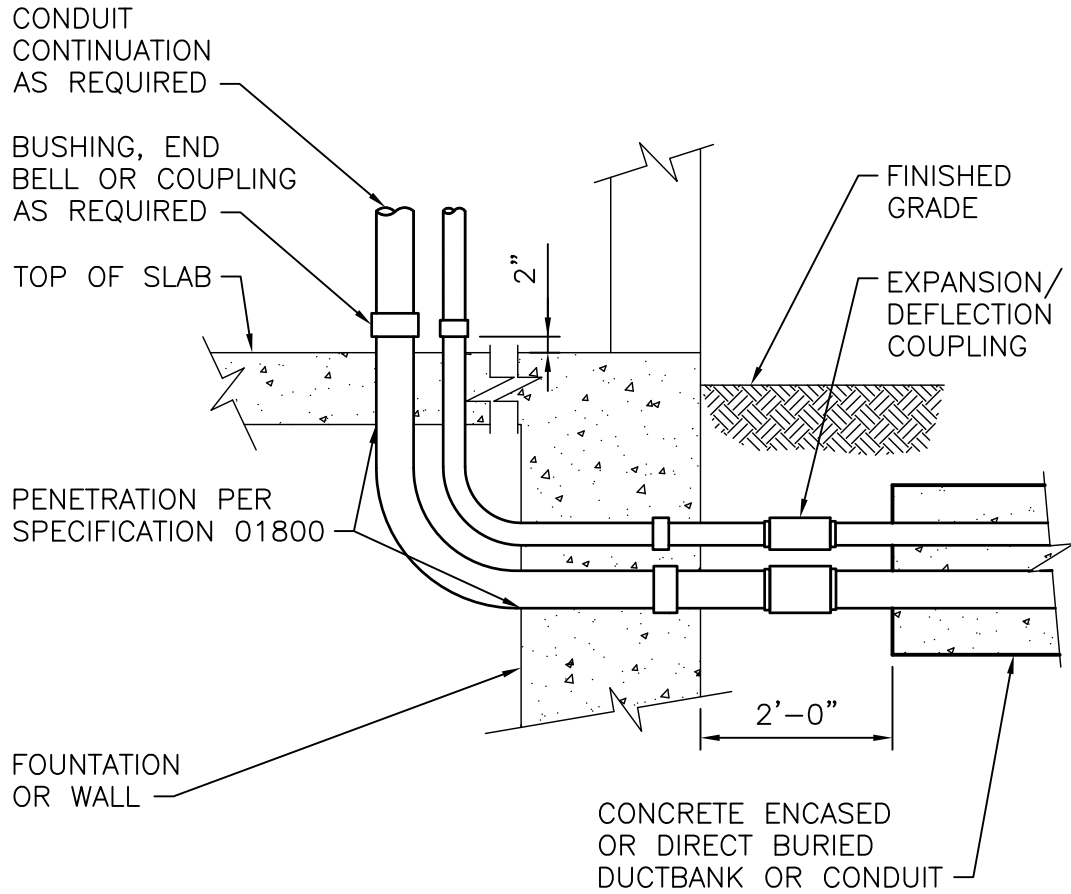
NOTE:

1. SEE DUCTBANK SECTION DETAIL FOR ADDITIONAL REQUIREMENTS.

CONDUIT TRANSITION TO ABOVE GRADE (EXTERIOR)

NTS

26 05 43-04



NOTE:

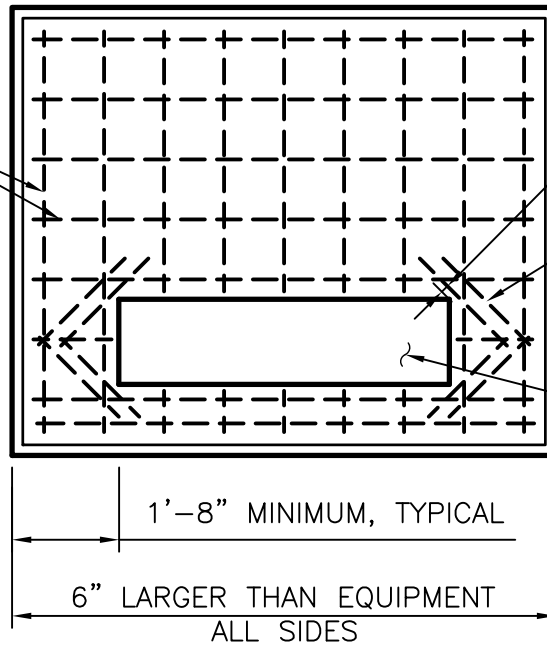
1. SEE DUCTBANK DETAIL FOR ADDITIONAL REQUIREMENTS.

CONDUIT TRANSITION TO ABOVE GRADE (EXTERIOR TO INTERIOR)

NTS

26 05 43-05

#5@12 EACH WAY
CENTERED IN SLAB,
TYPICAL



1 1/2" CLEAR,
TYPICAL

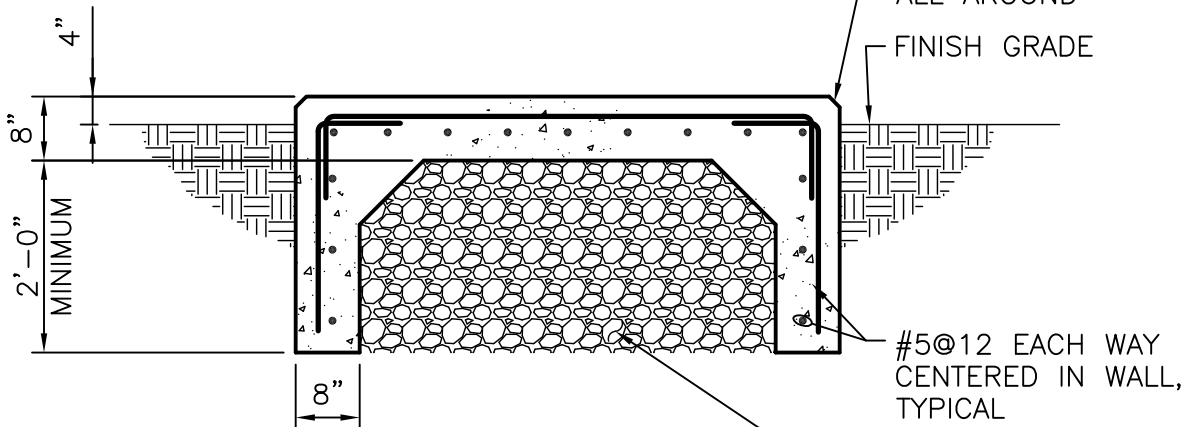
2-#5x2'-0",
TYPICAL

CONDUIT OPENING
AS REQUIRED FOR
EQUIPMENT

1'-8" MINIMUM, TYPICAL

6" LARGER THAN EQUIPMENT
ALL SIDES

PLAN



3/4" CHAMFER
ALL AROUND

FINISH GRADE

4"
8"
2'-0"
MINIMUM

8"

#5@12 EACH WAY
CENTERED IN WALL,
TYPICAL

SECTION

2'-0" THICK LAYER
OF COMPACTED
GRANULAR FILL

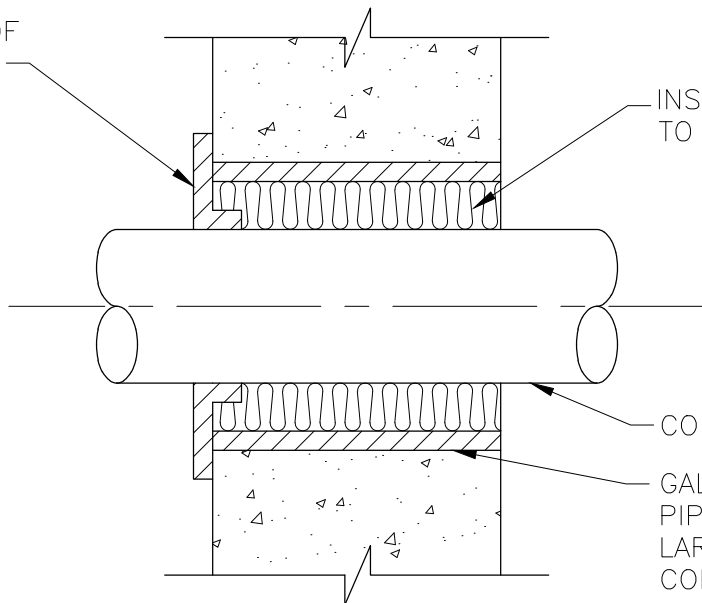
REINFORCED CONCRETE PAD FOR OUTDOOR ELECTRICAL EQUIPMENT

NTS

26 05 43-06



GALVANIZED STEEL
SHEET METAL
ESCUTCHEON ON
MECHANICAL
ROOM SIDE OF
PENETRATION



INSULATION AS REQD
TO FILL CAVITY

CONDUIT

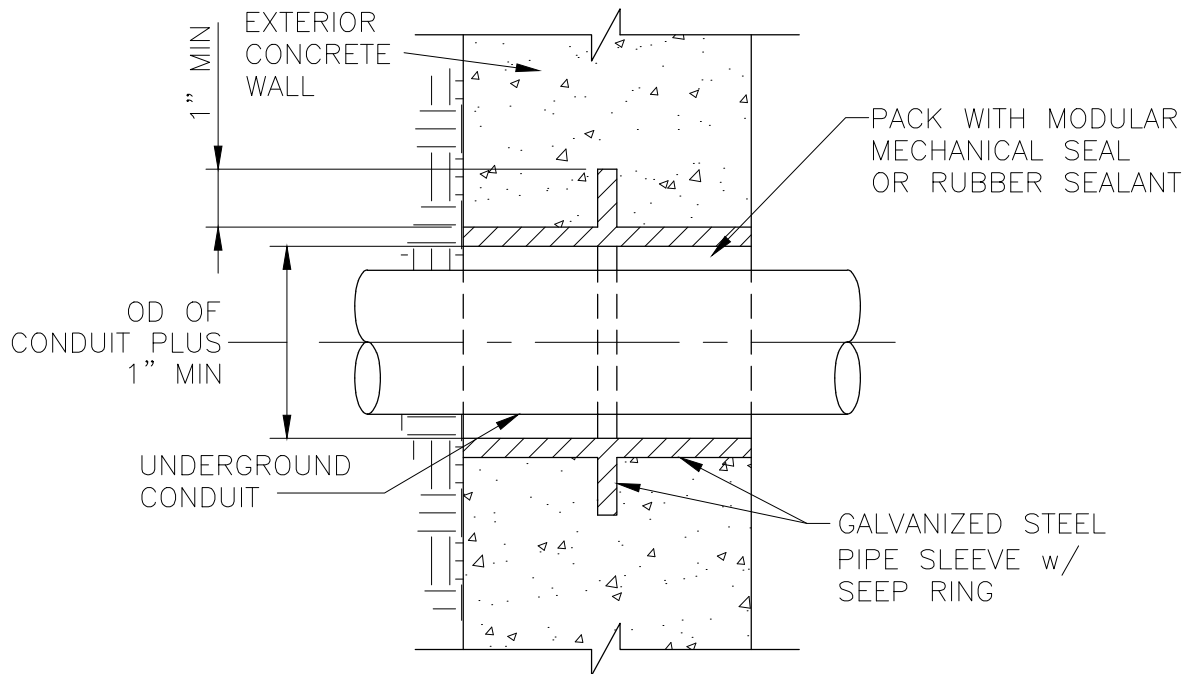
GALVANIZED STEEL
PIPE SLEEVE
LARGER SIZE THAN
CONDUIT

CONDUIT ENTRY THRU WALL & FLOOR

NTS

26 06 00-01



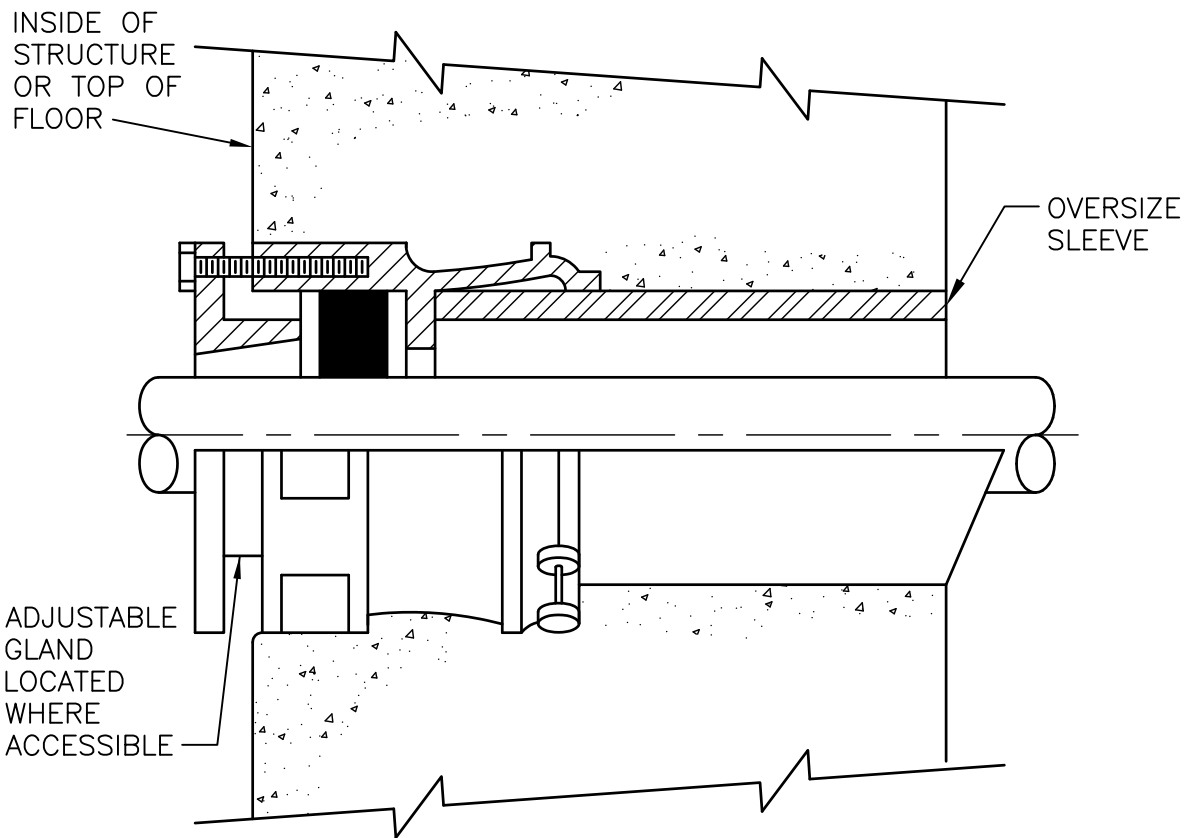


CONDUIT UNDERGROUND ENTRANCE

NTS

26 06 00-02





NOTES:

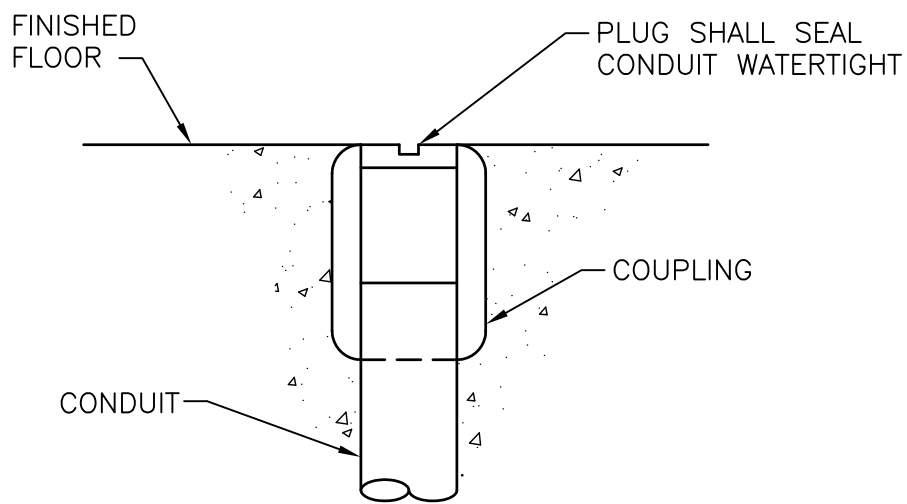
1. USE WATERTIGHT CONDUIT SEAL WHERE CONDUIT PENETRATIONS OF BUILDING EXTERIOR WALLS ARE BELOW GRADE, OR FOR IDENTIFIED PENETRATIONS OF FLOOR SLABS ON GRADE.
2. SPACING BETWEEN OUTSIDE EDGES OF SLEEVES SHALL BE AS FOLLOWS:
 - 3" FOR 2" CONDUIT AND LARGER
 - 2" FOR 1½" CONDUIT AND SMALLER

WATERTIGHT CONDUIT SEAL

NTS

26 06 00-03



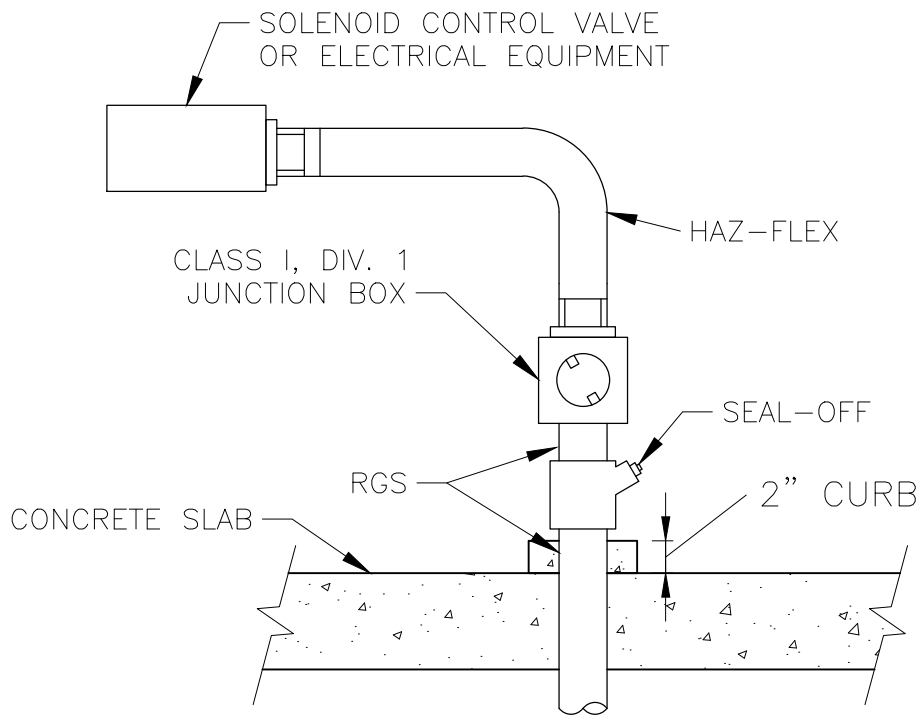
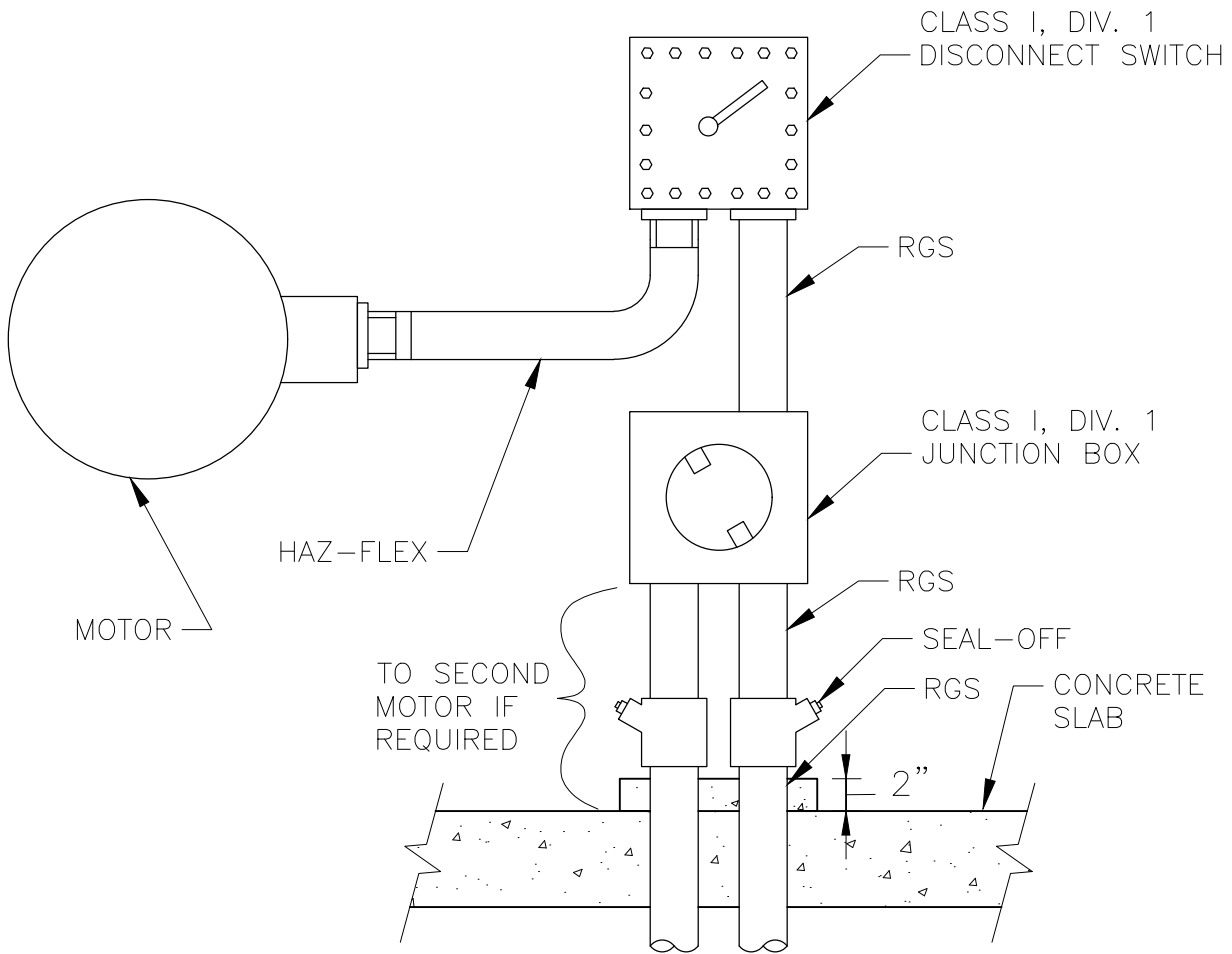


FLUSH CONDUIT STUB

NTS

26 06 00-04



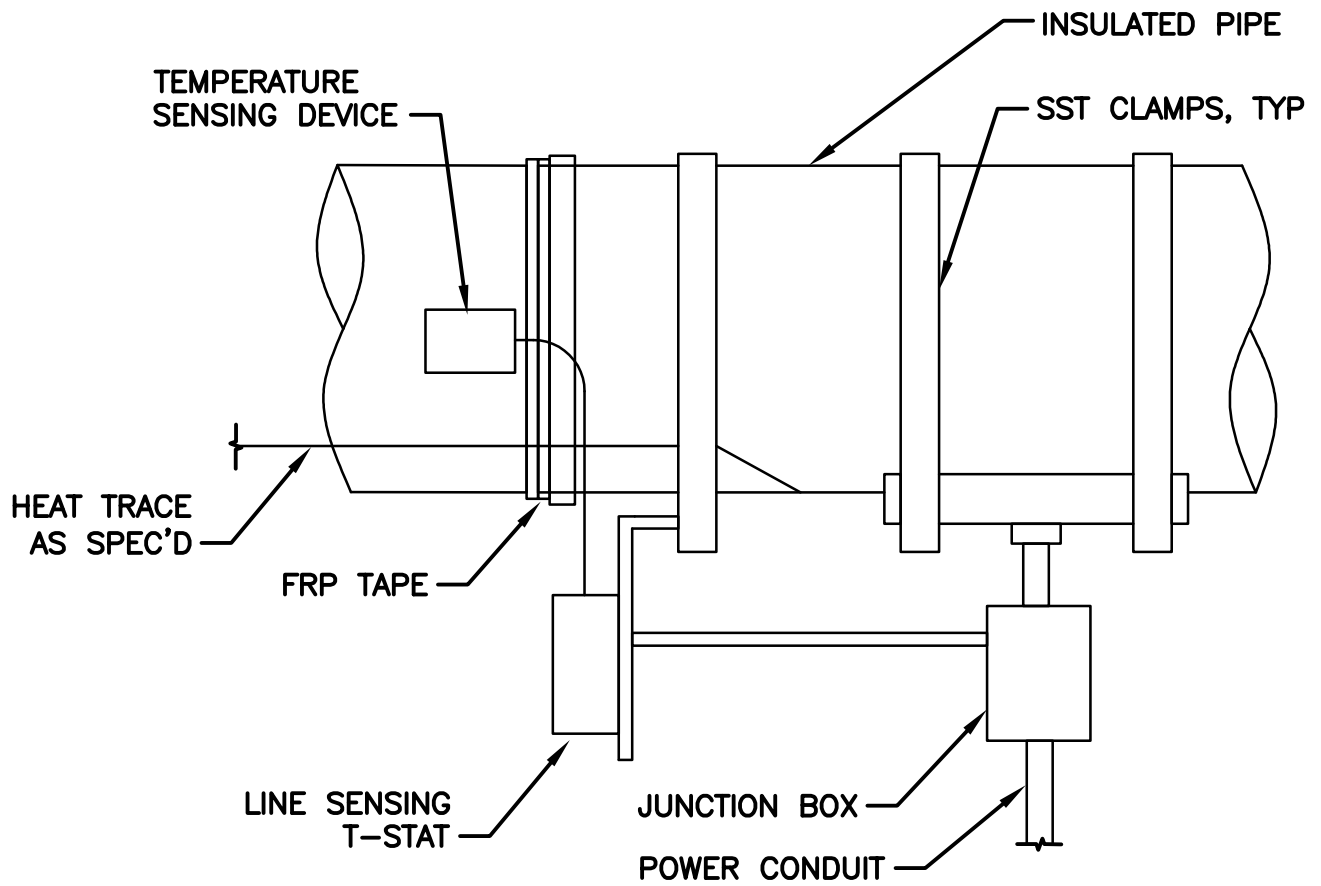


HAZARDOUS LOCATION CONDUIT STUB

NTS

26 06 00-05



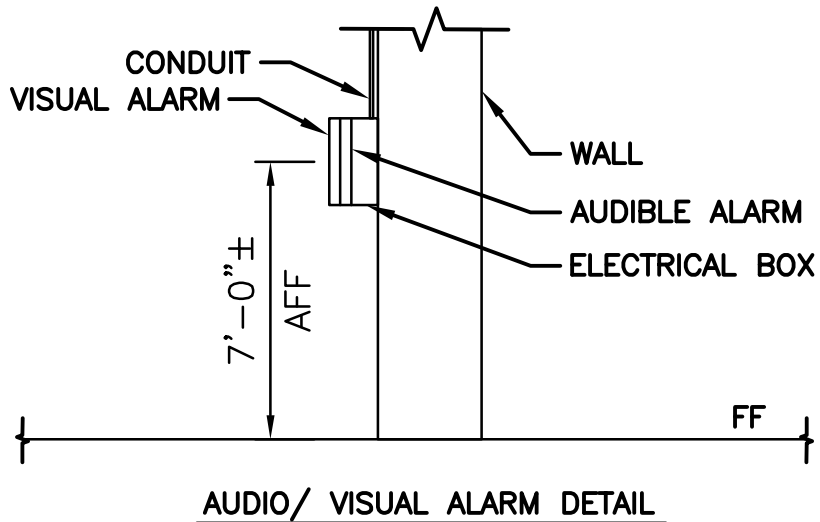
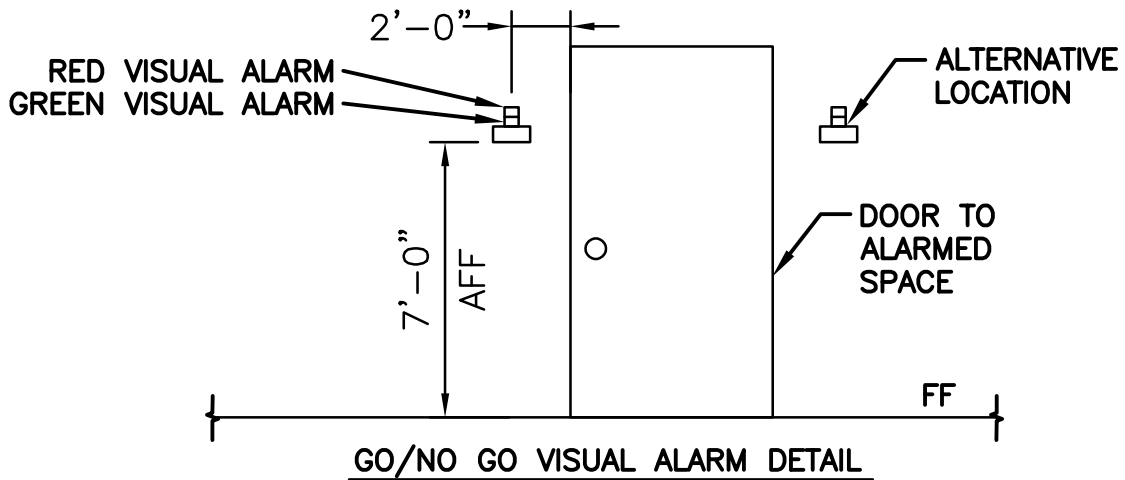


TYPICAL HEAT TRACE CONNECTION

NTS

26 06 00-06





NOTES:

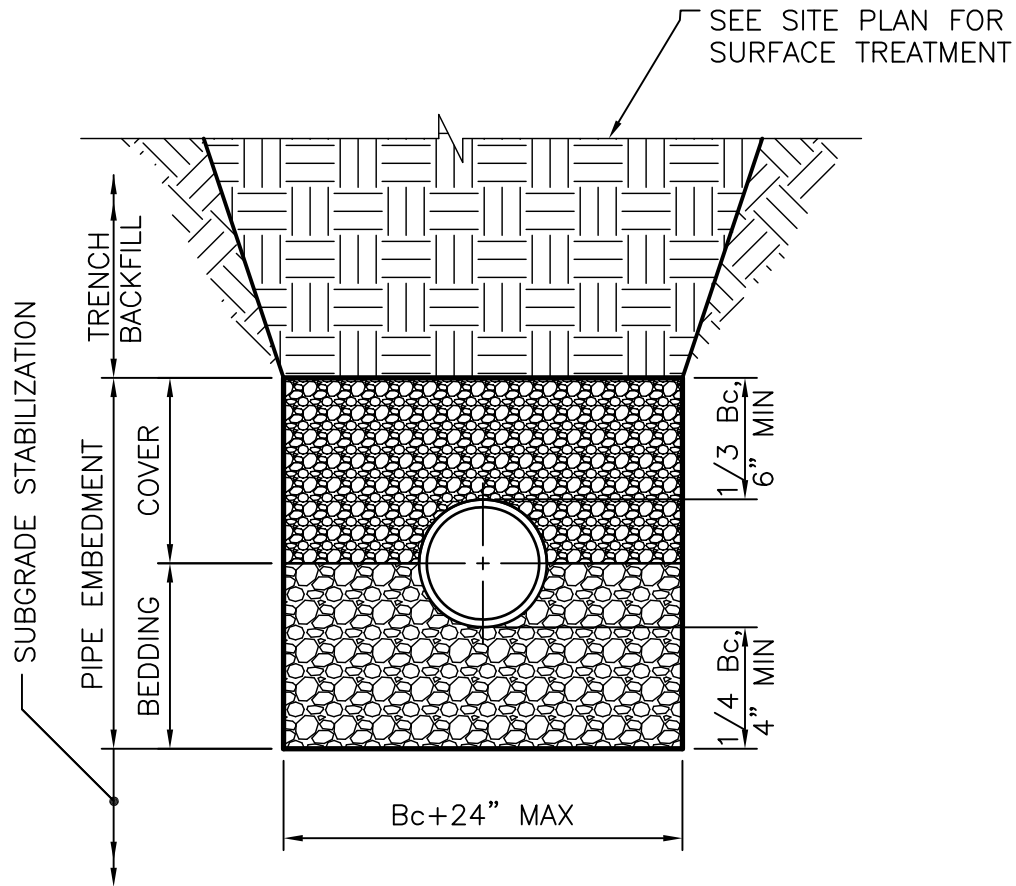
1. LOCATE GO/NO GO VISUAL ALARM AND AUDIO /VISUAL ALARM AS SPECIFIED AND LOCATIONS SHOWN ON DRAWING.

AUDIO/VISUAL ALARM DETAIL

NTS

26 06 00-07





NOTE:

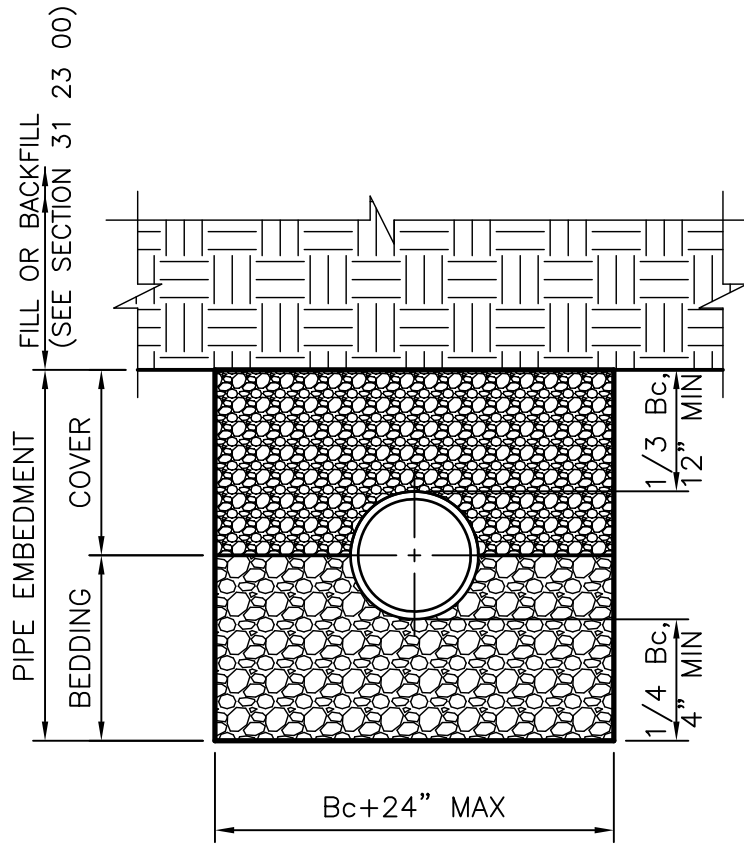
1. B_c = OUTSIDE DIAMETER OF PIPE.

CLASS B TRENCH BACKFILL

NTS

31 23 33-01





NOTE:

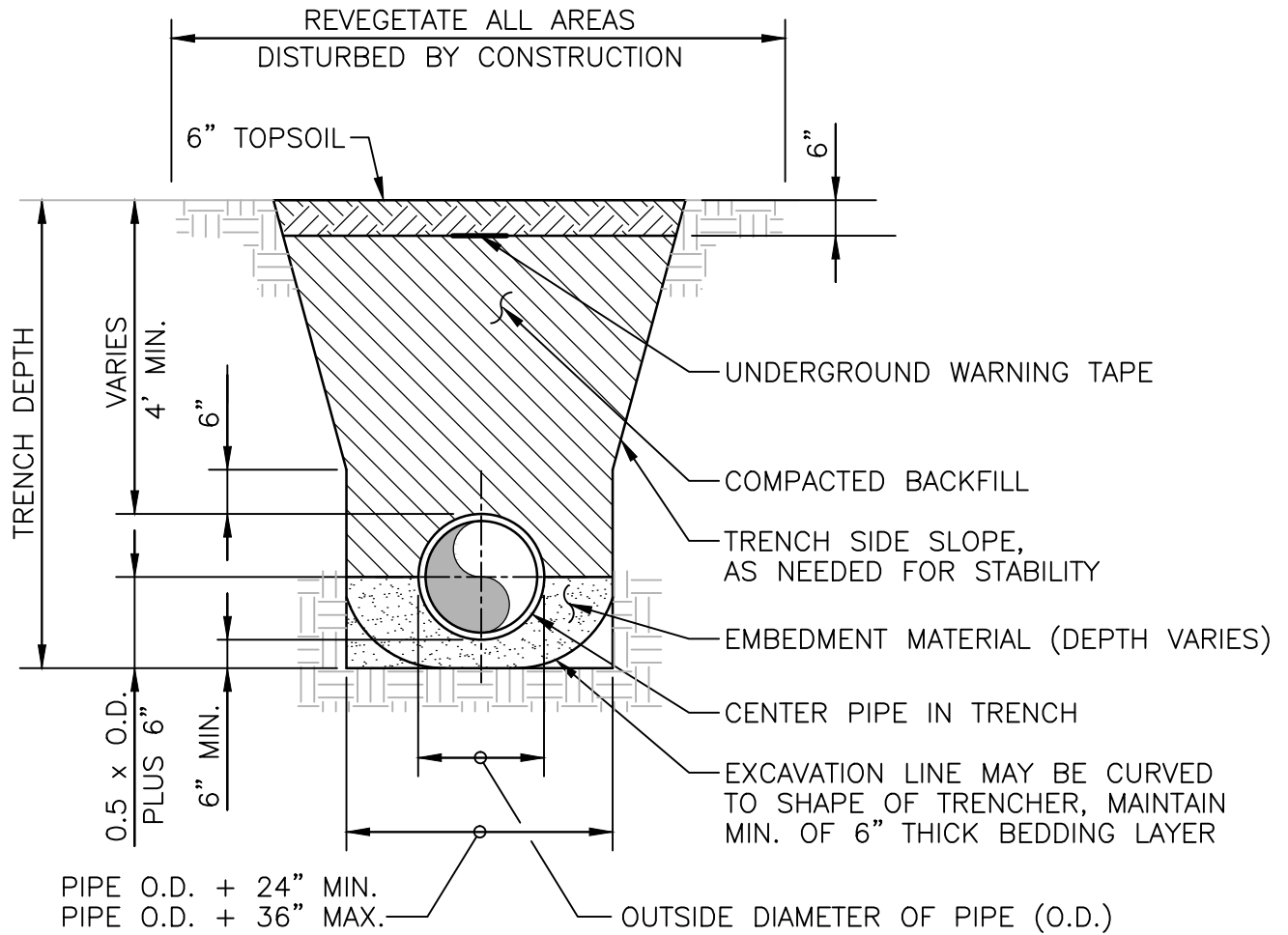
1. B_c =OUTSIDE DIAMETER OF PIPE.

CLASS C TRENCH BACKFILL

NTS

31 23 33-02

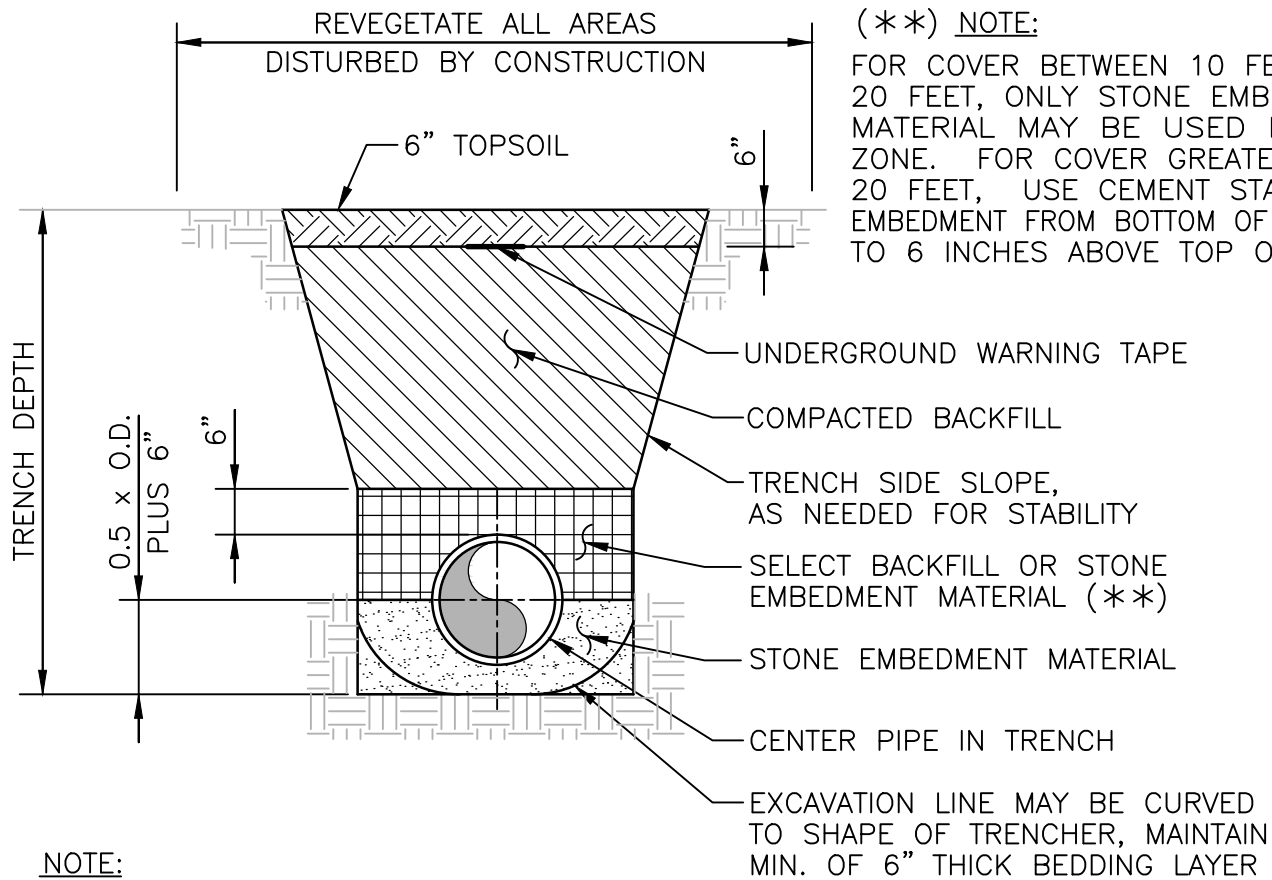




TYPICAL PIPE EMBEDMENT DIMENSIONS

NTS

31 23 33-03



(**) NOTE:
 FOR COVER BETWEEN 10 FEET AND 20 FEET, ONLY STONE EMBEDMENT MATERIAL MAY BE USED IN THIS ZONE. FOR COVER GREATER THAN 20 FEET, USE CEMENT STABILIZED EMBEDMENT FROM BOTTOM OF TRENCH TO 6 INCHES ABOVE TOP OF PIPE.

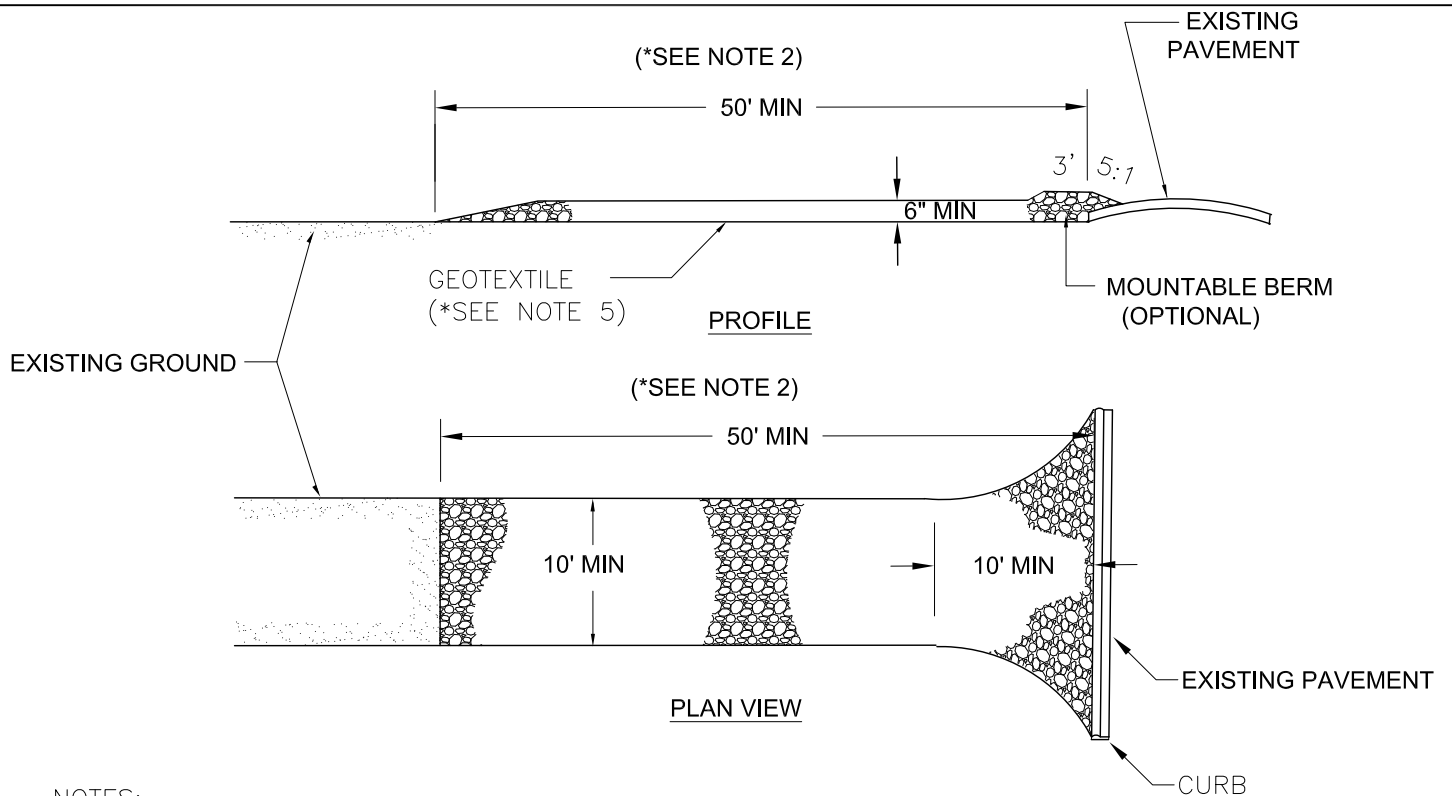
NOTE:
 FOR ADDITIONAL TRENCH DIMENSION REQUIREMENTS SEE TYPICAL PIPE EMBEDMENT DIMENSIONS DETAIL.

TYPICAL DUCTILE IRON PIPE EMBEDMENT

NTS

31 23 33-04





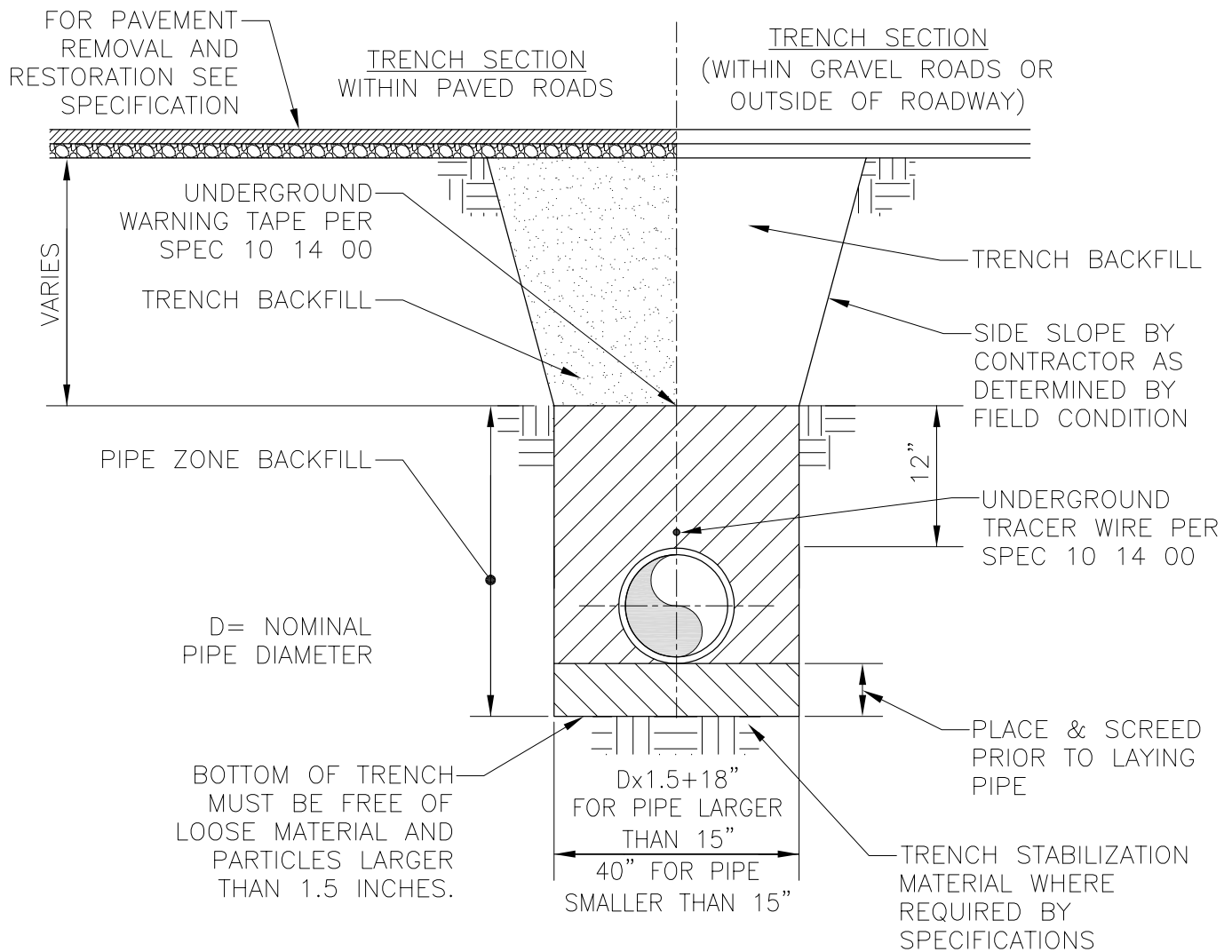
NOTES:

1. STONE SIZE – USE 2” STONE OR RECLAIMED OR RECYCLED CONCRETE EQUIVALENT.
2. LENGTH – AS REQUIRED, BUT NOT LESS THAN 50 FEET.
3. THICKNESS – NOT LESS THAN 6 INCHES.
4. WIDTH – 10 FOOT MINIMUM, BUT NOT LESS THAN THE FULL WIDTH AT POINTS WHERE INGRESS AND EGRESS OCCURS.
5. GEOTEXTILE – WILL BE PLACED OVER THE ENTIRE AREA PRIOR TO PLACING OF STONE.
6. SURFACE WATER – ALL SURFACE WATER FLOWING OR DIVERTED TOWARD CONSTRUCTION ENTRANCES SHALL BE PIPED ACROSS THE ENTRANCE. IF PIPING IS IMPRACTICAL, A MOUNTABLE BERM WITH 5:1 SLOPES WILL BE REQUIRED.
7. MAINTENANCE – THE ENTRANCE SHALL BE MAINTAINED IN A CONDITION WHICH WILL PREVENT TRACKING OR FLOWING OF SEDIMENT ONTO PUBLIC RIGHT-OF-WAY. THIS MAY REQUIRE PERIODIC TOP DRESSING WITH ADDITIONAL STONE AS CONDITIONS DEMAND AND REPAIR AND/OR CLEANOUT OF ANY MEASURES USED TO TRAP SEDIMENT. ALL SEDIMENT SPILLED, DROPPED, WASHED OR TRACKED ONTO PUBLIC RIGHT-OF-WAY MUST BE REMOVED IMMEDIATELY.
8. WASHING – WHEELS SHALL BE CLEANED TO REMOVE SEDIMENT PRIOR TO ENTRANCE ONTO PUBLIC RIGHT-OF-WAY. WHEN WASHING IS REQUIRED, IT SHALL BE DONE IN AN AREA STABILIZED WITH STONE AND WHICH DRAINS INTO AN APPROVED SEDIMENT TRAPPING DEVICE.
9. PERIODIC INSPECTION AND NEEDED MAINTENANCE SHALL BE PROVIDED AFTER EACH RAIN.
10. REMOVE ENTIRE STABILIZED CONSTRUCTION ENTRANCE AT PROJECT COMPLETION.

CONSTRUCTION ENTRANCE

NTS

31 23 33-05



NOTES:

1. TRENCH BACKFILL AND PIPE ZONE BACKFILL SHALL BE COMPACTED PER SPECIFICATION SECTION 31 23 33.

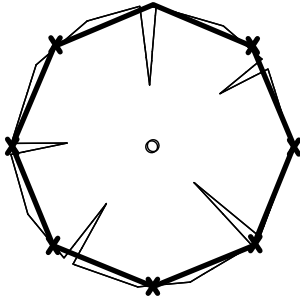
TYPICAL FLEXIBLE PIPE TRENCH SECTION

NTS

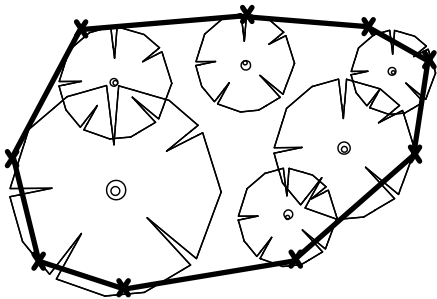
31 23 33-06



CRITICAL ROOT ZONE (C.R.Z.)
RADIUS = 1 FT. PER INCH
OF TRUNK DIAMETER

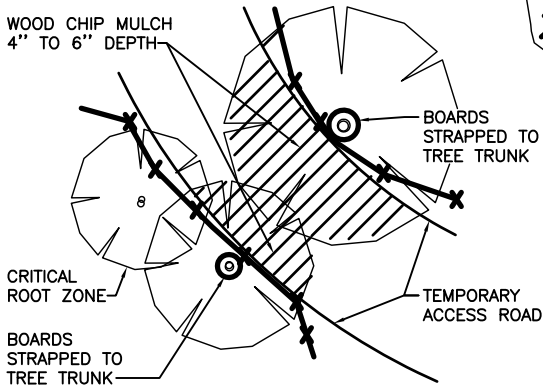


INDIVIDUAL TREE

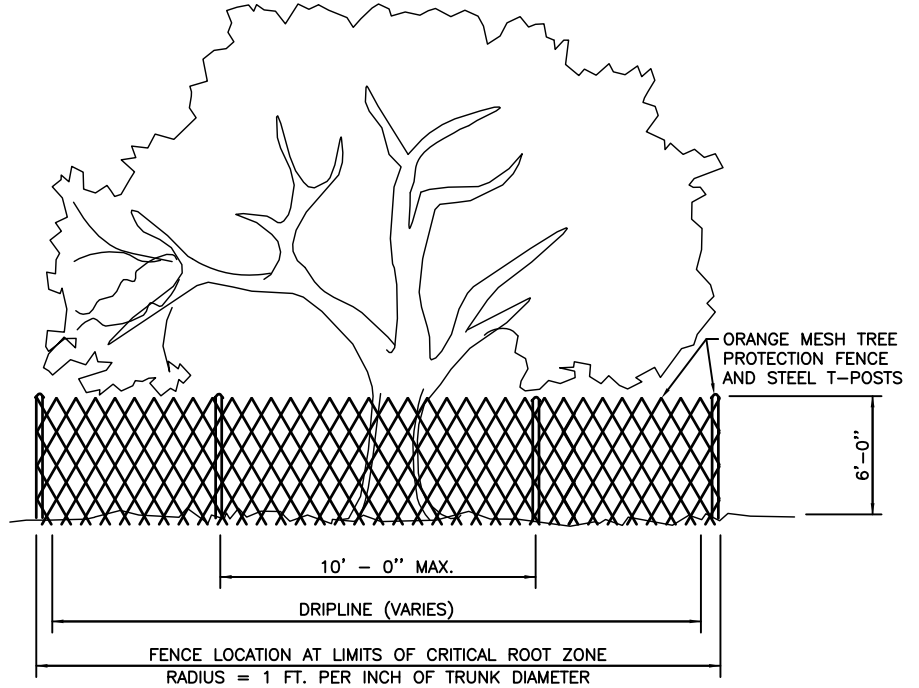


GROUP OF TREES

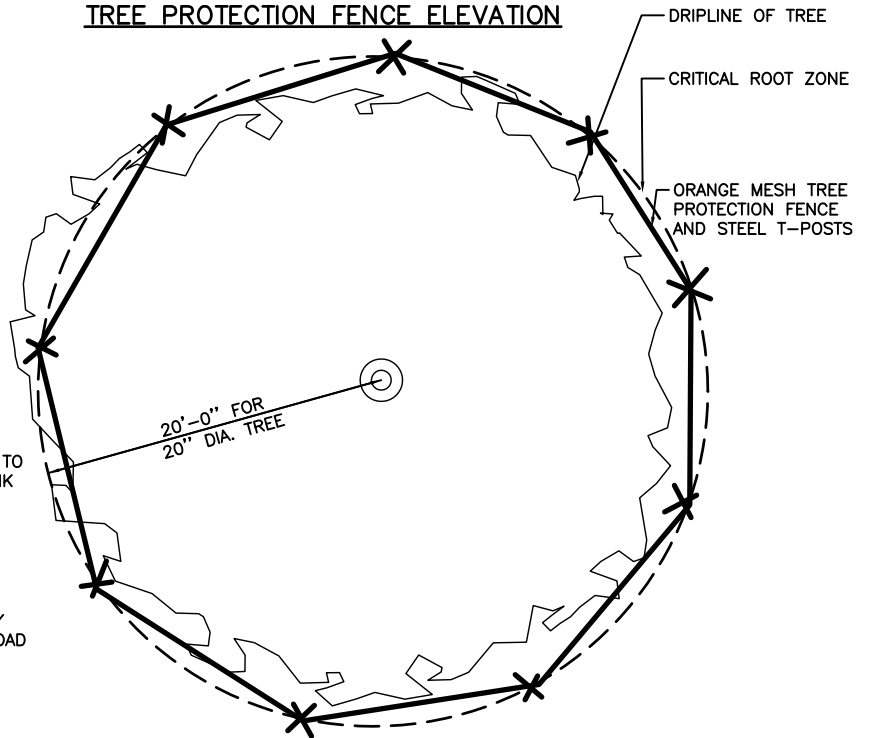
WOOD CHIP MULCH
4" TO 6" DEPTH



LINEAR CONSTRUCTION
THROUGH TREES



TREE PROTECTION FENCE ELEVATION



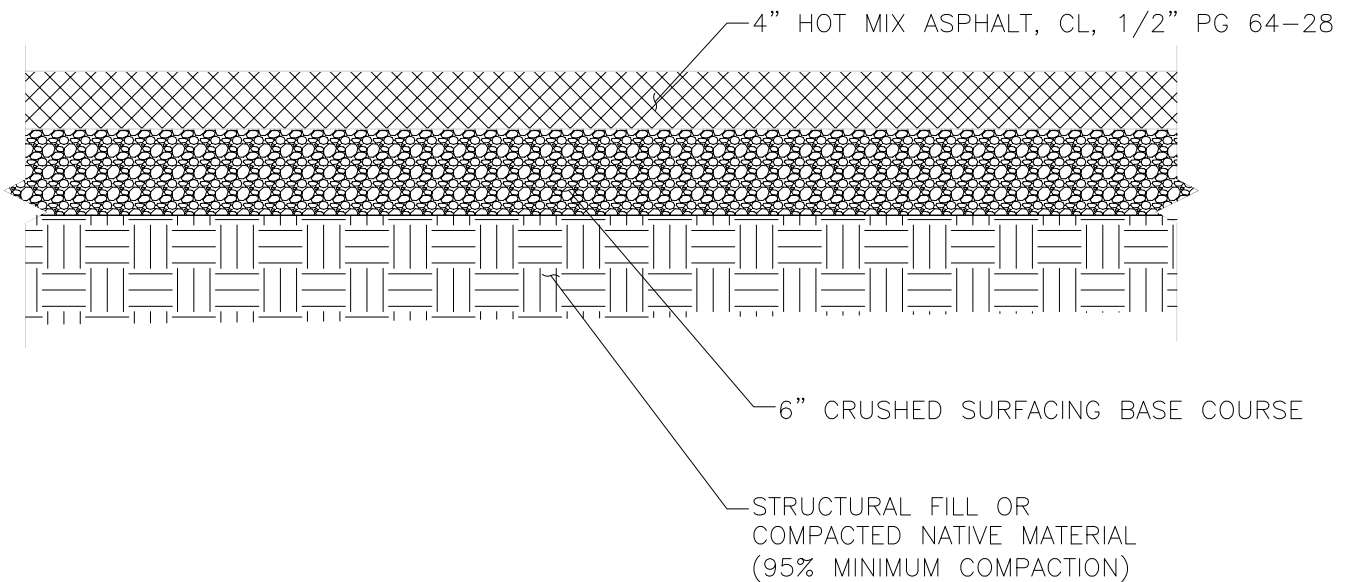
TREE PROTECTION FENCE PLAN

TREE PROTECTION FENCE

NTS

31 25 00-03





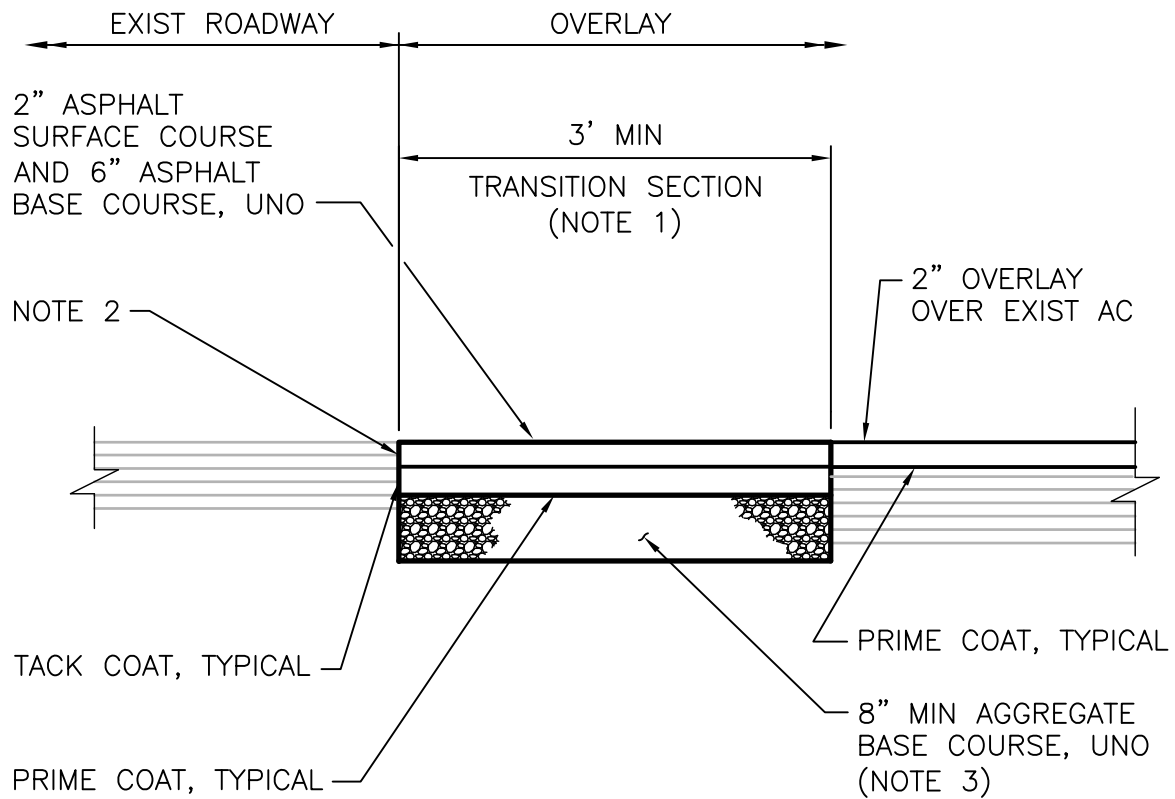
NOTE:

1. ALL GRADING , ROCK AND PAVING SHALL CONFORM TO 2020 WSDOT STANDARD SPECIFICATIONS.
 - SECTIONS 9-03.8 AGGREGATES FOR HOT MIX ASPHALT.
 - SECTION 9-03.9 (3) CRUSHED SURFACE BASE COURSE.
2. COMPACT STRUCTURAL FILL OR SUBGRADE TO 95% MAXIMUM DRY DENSITY ASTM D1557.

ASPHALT PAVEMENT DETAIL

NTS

32 12 16-01



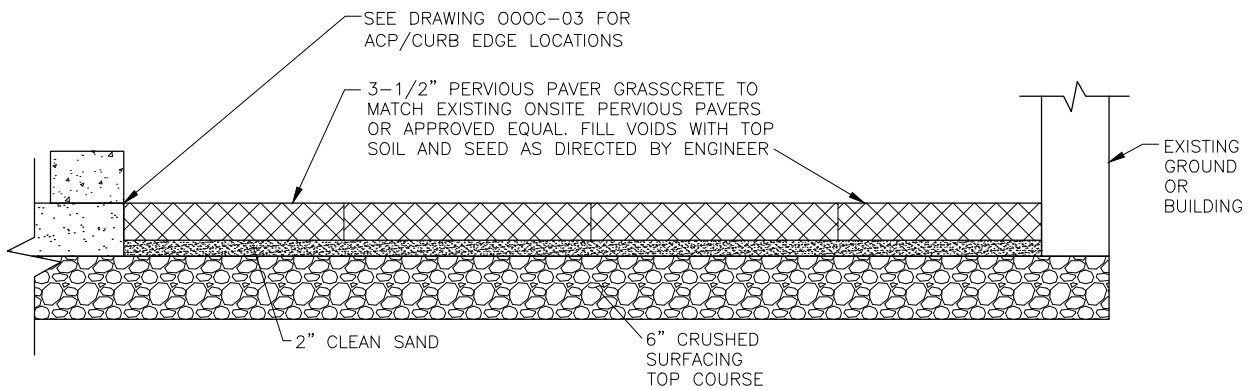
NOTES:

1. USE WHERE OVERLAY ABUTS EXISTING CONCRETE OR AC PAVEMENT.
2. SAW CUT FINAL JOINTS.
3. REMOVE ALL EXISTING PAVEMENT AND AGGREGATE IN TRANSITION SECTION.

AC PAVEMENT OVERLAY TRANSITION

NTS

32 12 16-02



NOTE:

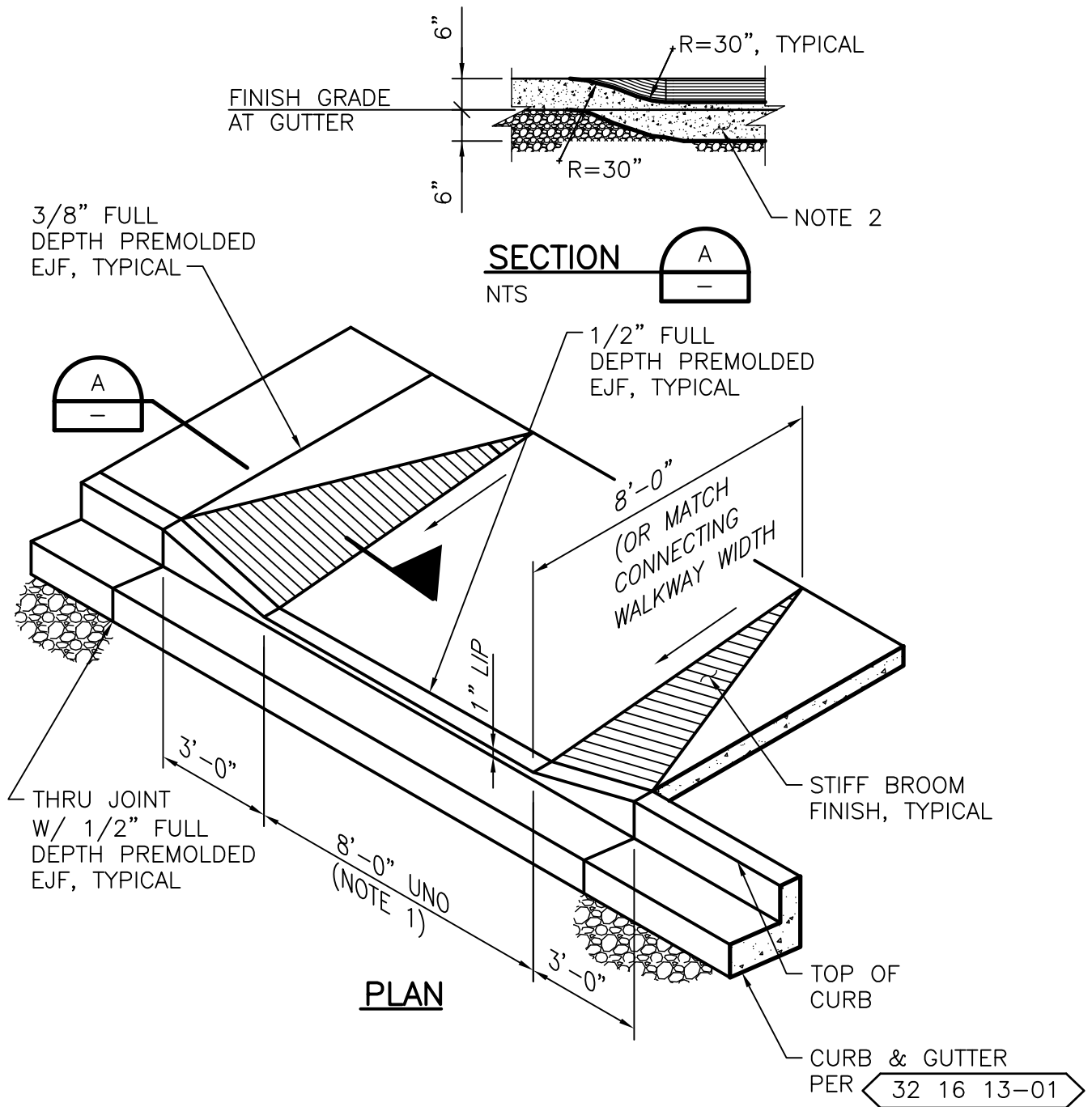
1. INSTALL PAVERS PER MANUFACTURER RECOMMENDATIONS.
2. GRADE TO DRAIN AWAY FROM BUILDINGS AND STRUCTURES, MINIMUM 2% SLOPE.
3. COORDINATE WITH LANDSCAPE IRRIGATION CONTRACTOR FOR INSTALLATION OF IRRIGATION PIPING AND HEADS.

PERVIOUS PAVER SECTION

NTS

32 12 16-03





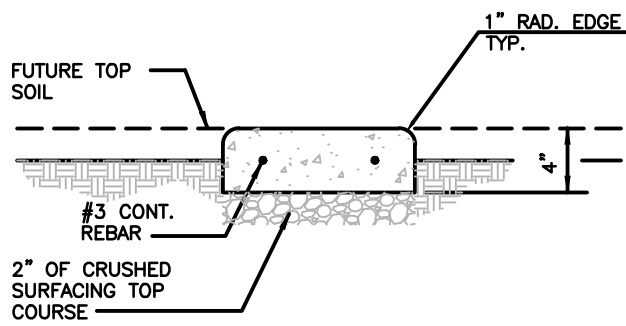
NOTES:

1. PLACE THRU JOINT AT MID-WIDTH WHEN TOTAL WIDTH OVER 24'-0".
2. RAMP CONCRETE TO BE A MINIMUM 6" IN THICKNESS AND PLACED ON 2" COMPACTED LEVELING COURSE OVER COMPACTED SUBGRADE.

LOWERED CURB

NTS

32 16 13-02

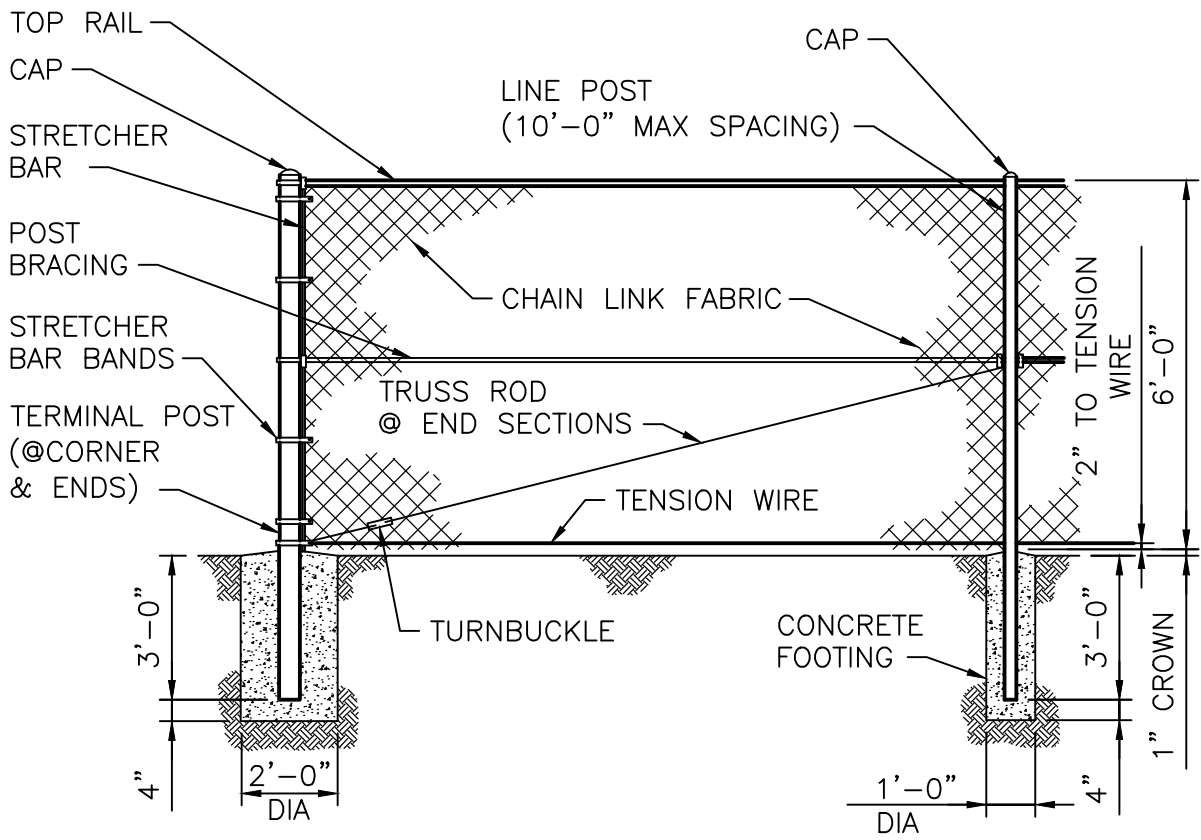


MAINTENANCE STRIP

NTS

32 16 13-05



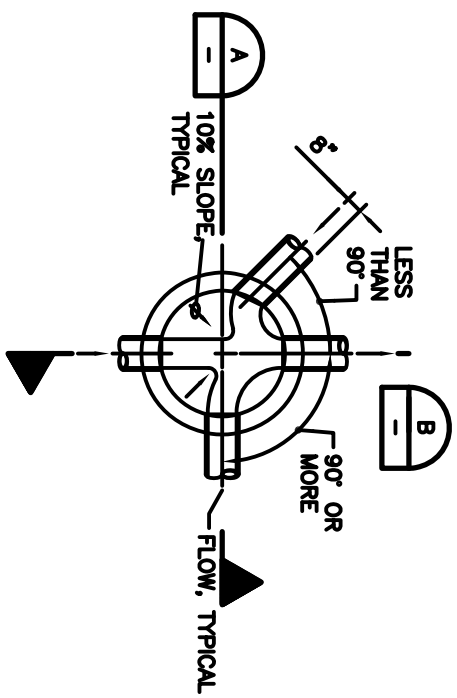


CHAIN LINK FENCE

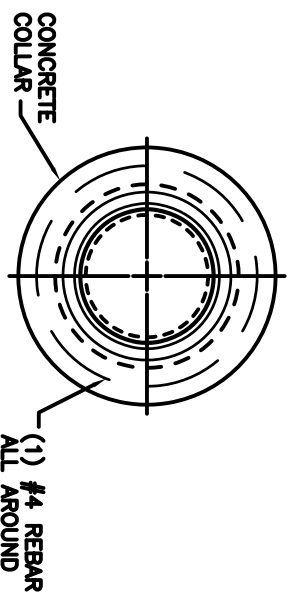
NTS

32 31 13-01

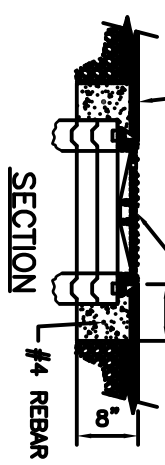




PLAN VIEW OF MANHOLE SHOWING INTERSECTING SEWERS
NTS



3/4" OPEN GRADE OR SEAL COAT OVER SLAB
PLAN
MANHOLE FRAME AND COVER
SECTION



SECTION

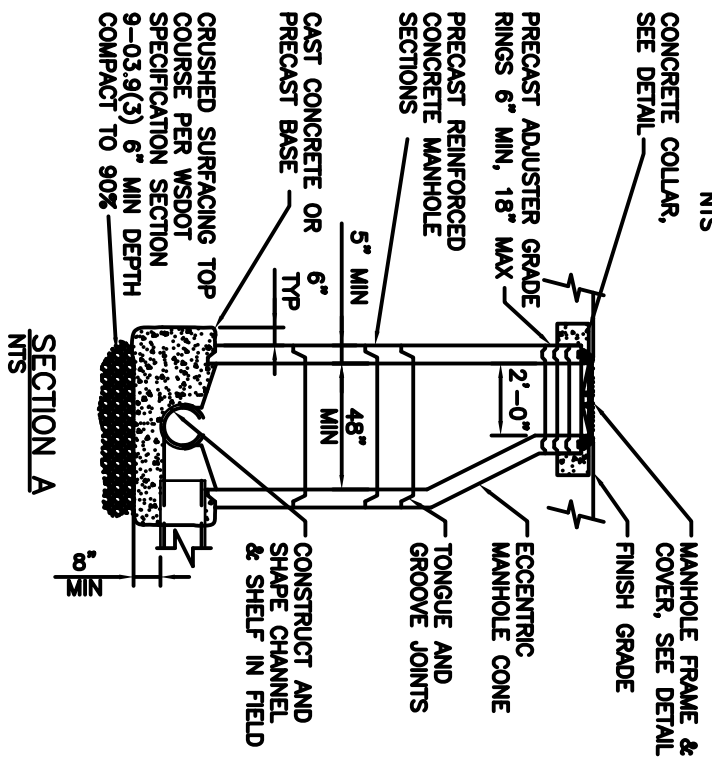
NOTE:

1. COLLAR NOT REQUIRED IN LANDSCAPED OR UNPAVED AREAS

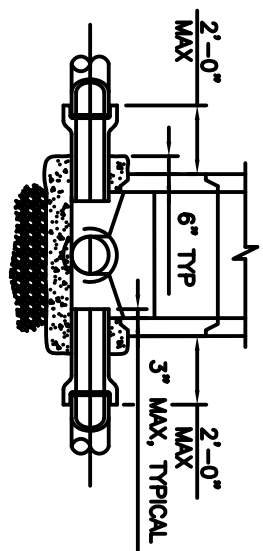
CONCRETE COLLAR DETAIL
NTS

NOTES:

1. IN UNIMPROVED NON-TRAFFIC AREAS, TOP OF MANHOLE SHALL BE 6" TO 9" ABOVE GRADE UNO.
2. PIPES SHALL NOT PROTRUDE MORE THAN 3" INSIDE OF MANHOLE SECTION. CONSTRUCT WATER TIGHT CONNECTION TO MANHOLE.
3. MANHOLE SECTION LENGTHS ARRANGED TO FIT DEPTH.
4. SET AND SEAL MANHOLE SECTION JOINTS AS FOLLOWS
5. ESTABLISHED HIGH GROUNDWATER ELEVATION: 625 FT.



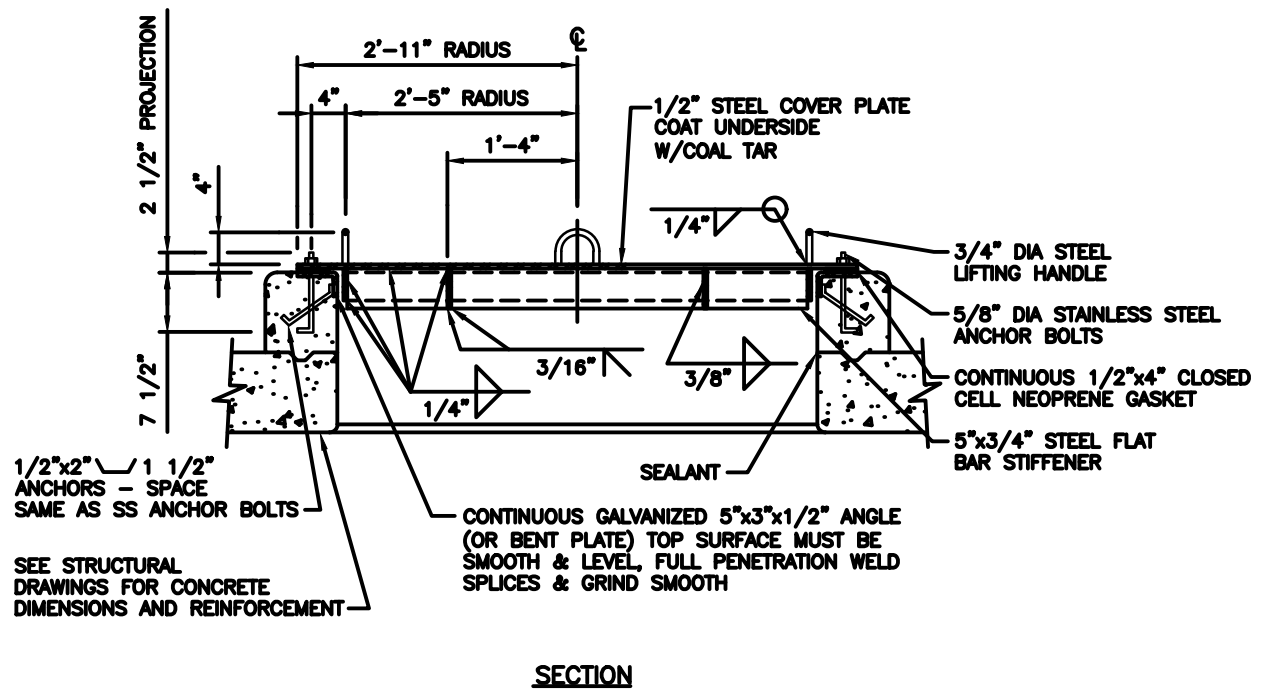
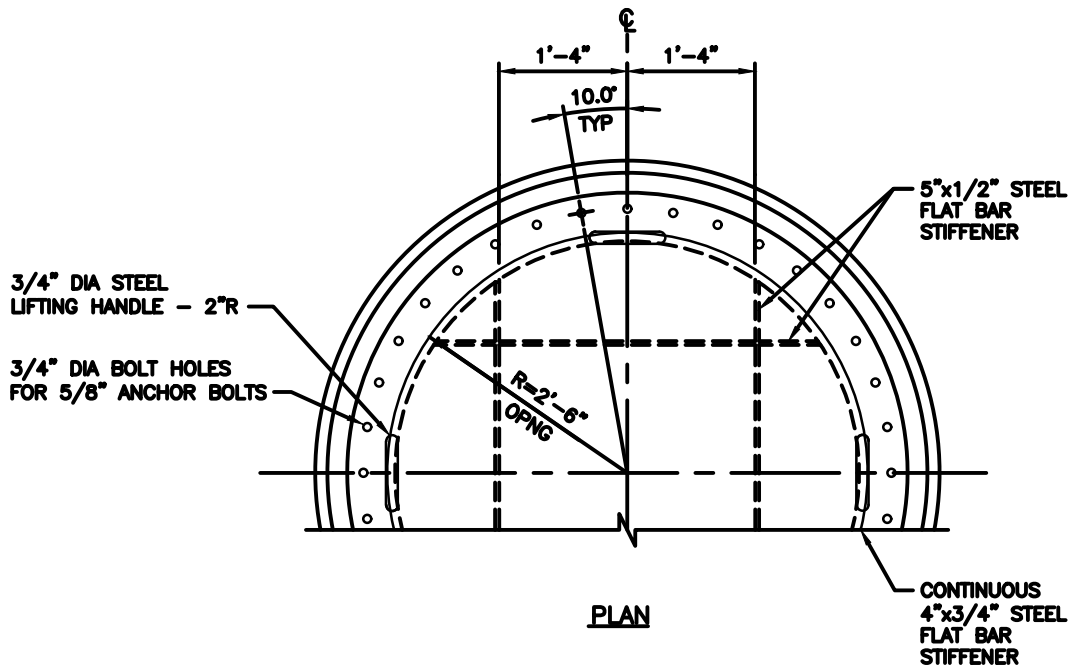
SECTION A
NTS



SECTION B
NTS

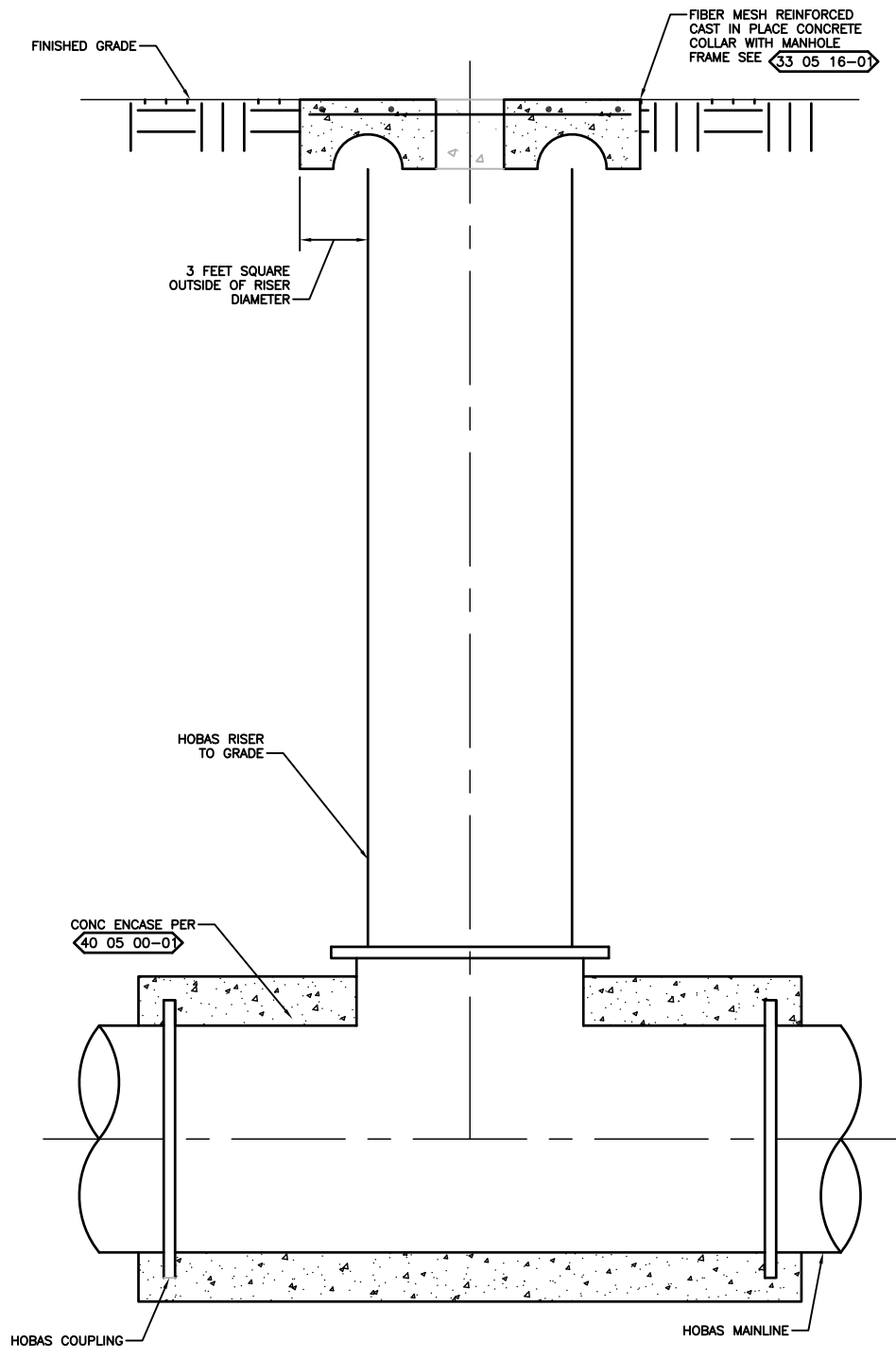
PRECAST ECCENTRIC MANHOLE

NTS



ACCESS COVER
NTS

33 05 16-02

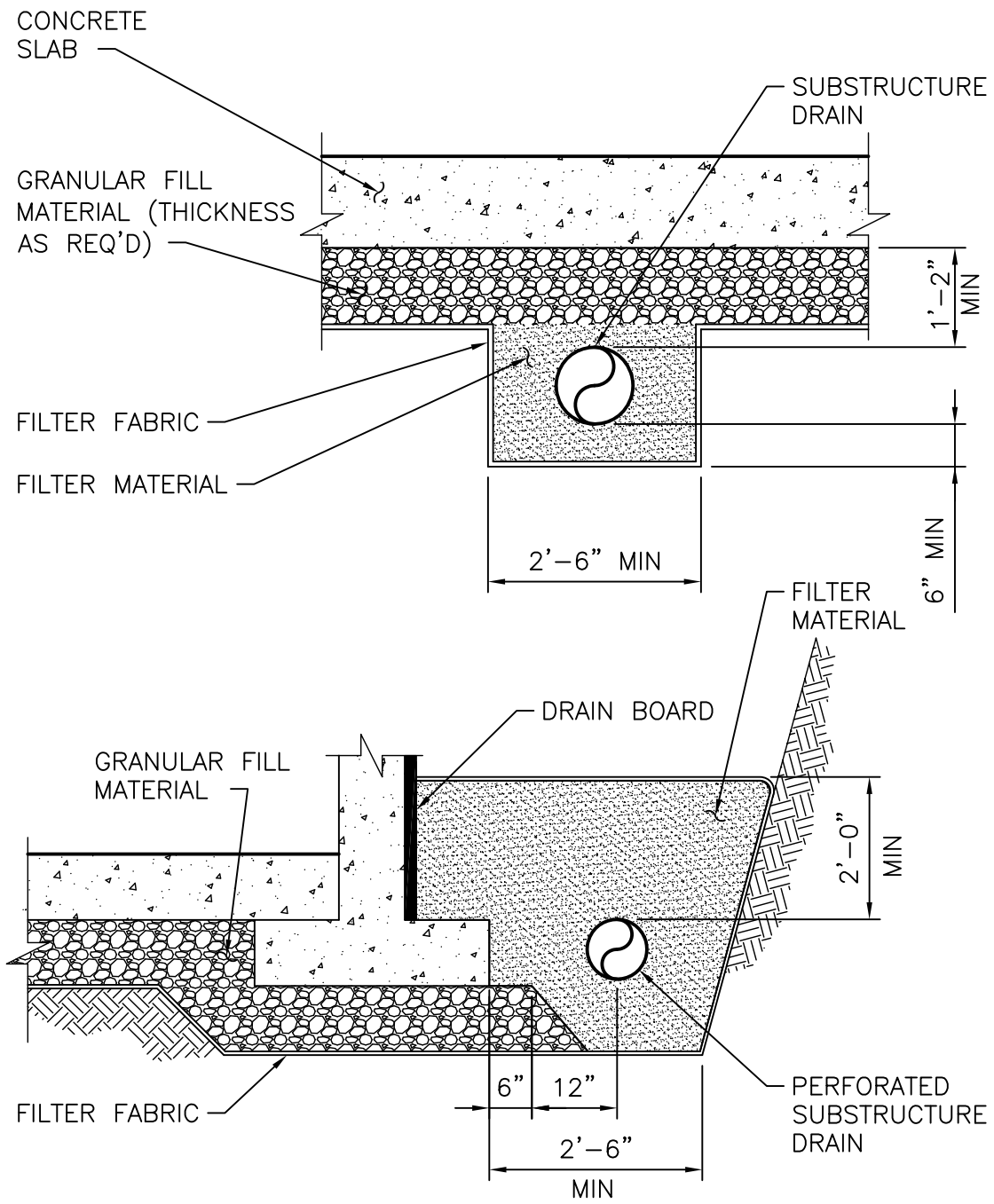


MANHOLE TEE BASE DETAIL

33 05 16-04

NTS



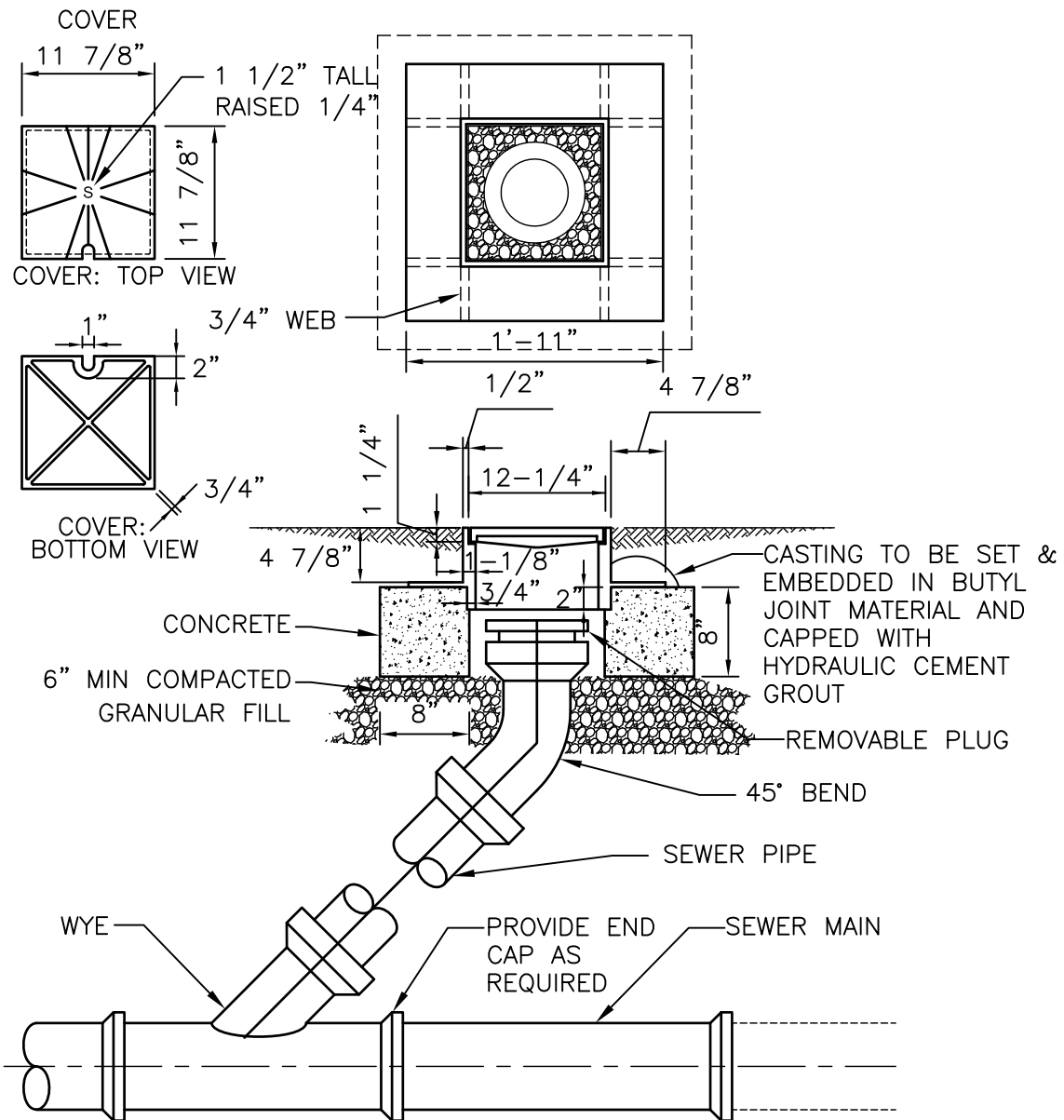


SUBSTRUCTURE DRAIN

NTS

33 46 13-02





NOTES:

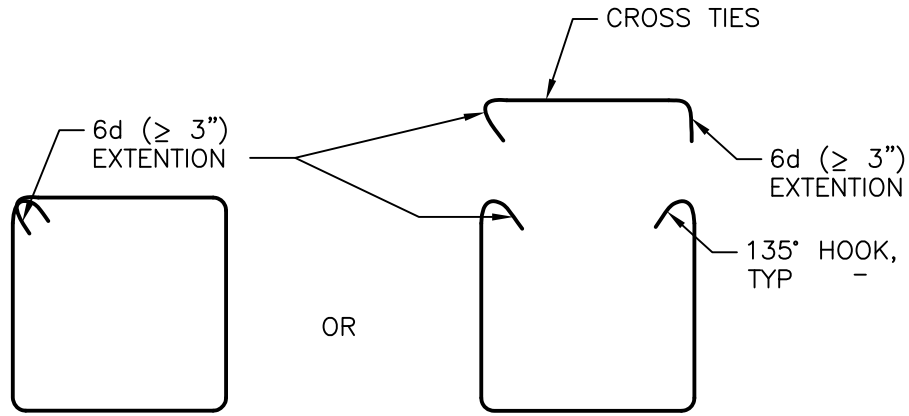
1. CLEANOUT PIPE MUST BE FREE OF ANY WEIGHT TRANSMITTED BY THE INSPECTION BOX.
2. ALL GRAY IRON CASTINGS SHALL CONFORM TO LATEST EDITION OF ASTM A-48, CLASS 30, AND SHALL BE OF UNIFORM QUALITY.
3. ALL CASTING DIMENSIONS SHALL HAVE A TOLERANCE OF 1/8"±.
4. ALL CASTINGS SHALL BE CLEANED BY SHOT BLASTING AND HAND CHIPPING UTILIZING STANDARD INDUSTRY PRACTICES PRIOR TO SHOP APPLICATION OF ASPHALTIC COATING, BY DIPPING.

ROOF DRAIN CLEANOUT

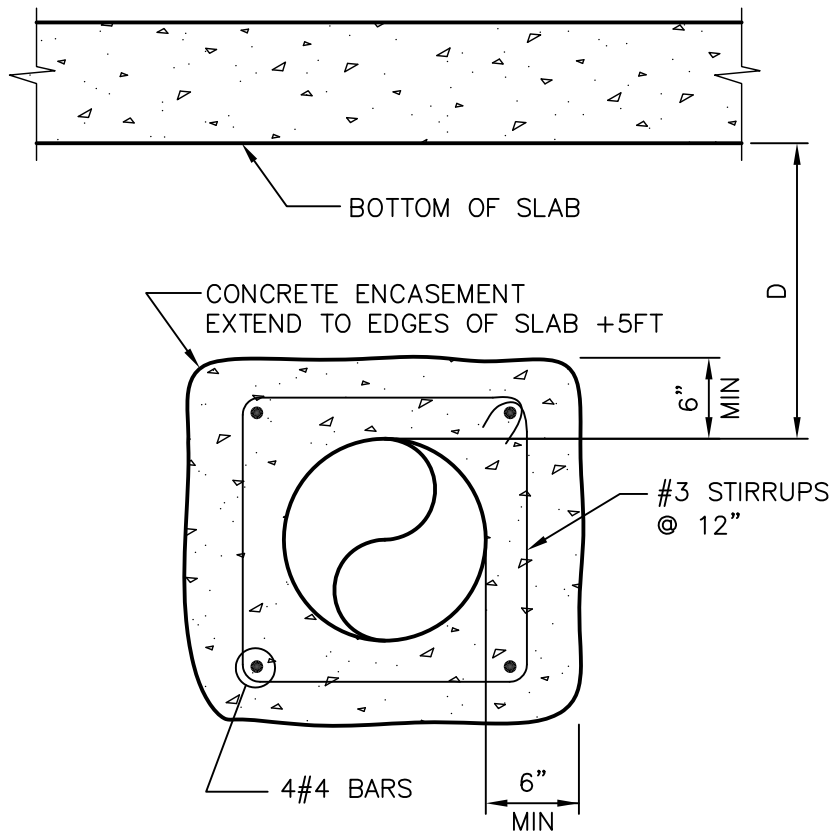
NTS

33 46 13-03

ALTERNATE CROSS
TIES ALONG MEMBER



STIRRUP OPTIONS



NOTE:

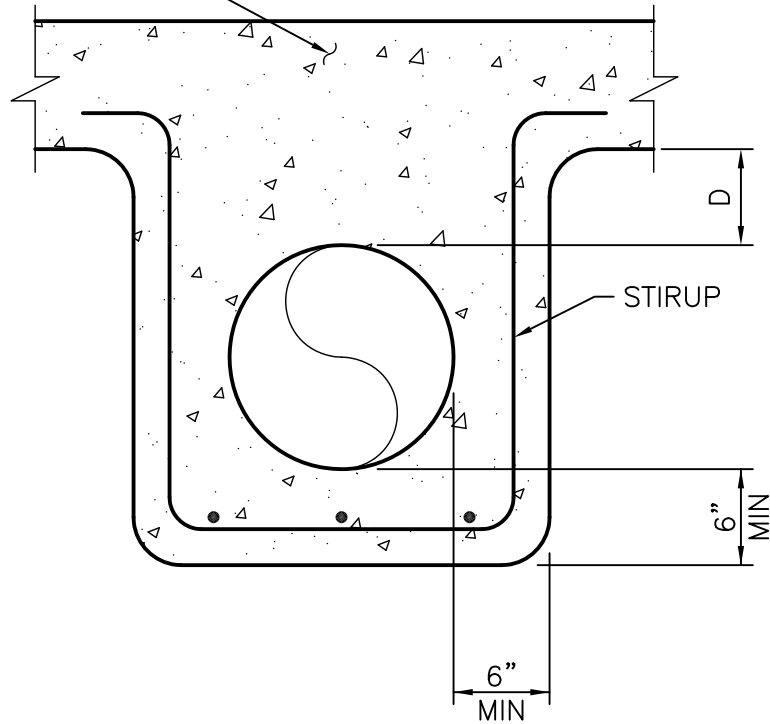
PROVIDE ENCASEMENT FOR ALL UNDERSLAB PIPING
AS SHOWN ABOVE.

UNDERSLAB PIPE ENCASEMENT TYPE 1

NTS

40 05 00-01

SLAB THICKNESS
& REINFORCING
VARIES



PIPE ENCASEMENT REINFORCING TABLE		
PIPE SIZE	STIRUPS	BOTTOM BARS
4"-14"	#3@12	3#4
16"-20"	#3@12	4#4
24"-30"	#4@12	4#4
36"-48"	#4@8	5#4

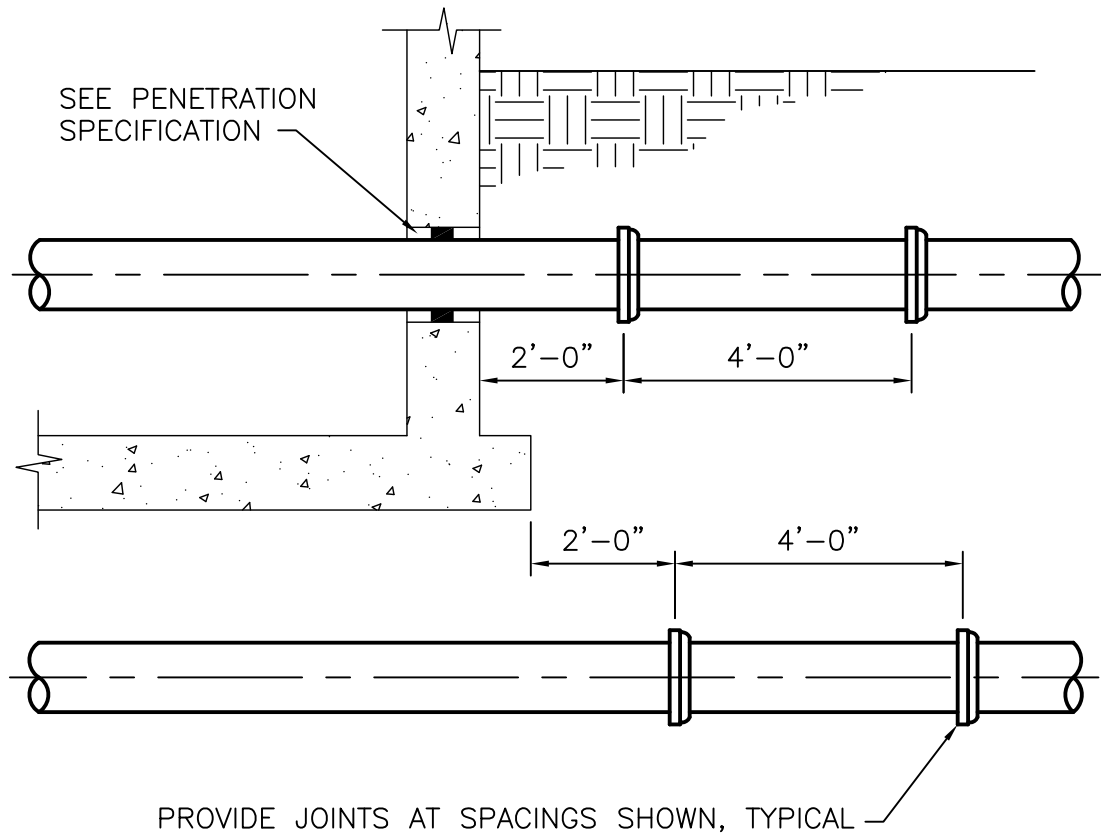
NOTE:

1. FOR ALL UNDERSLAB PIPE ENCASEMENT WHEN $D < 4'-0"$.

UNDERSLAB PIPE ENCASEMENT TYPE 2

NTS

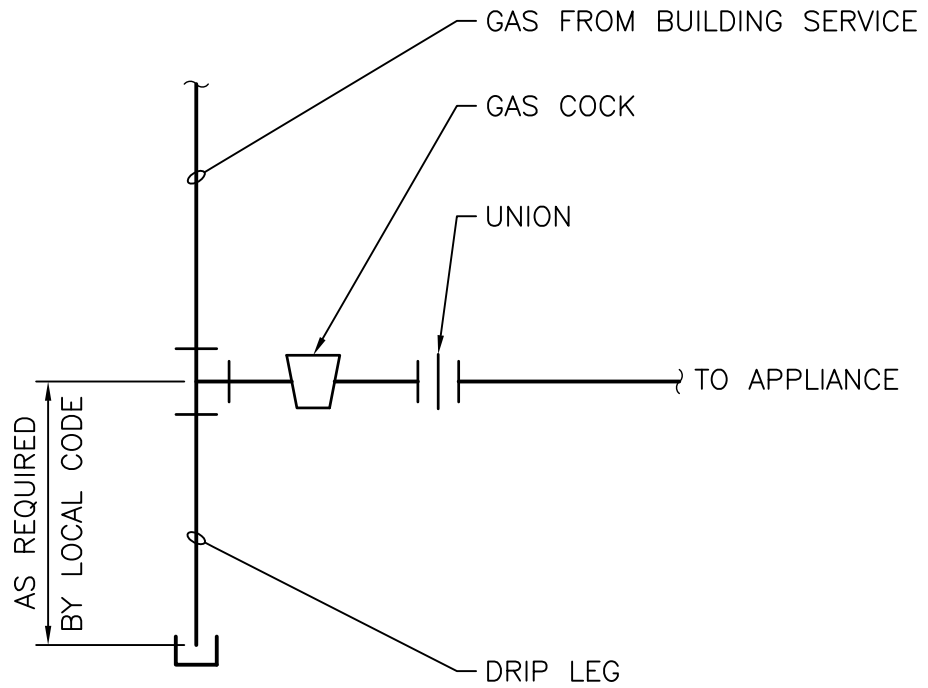
40 05 00-02



LOCATION OF FLEXIBLE CONNECTIONS

NTS

40 05 00-03



NOTE:

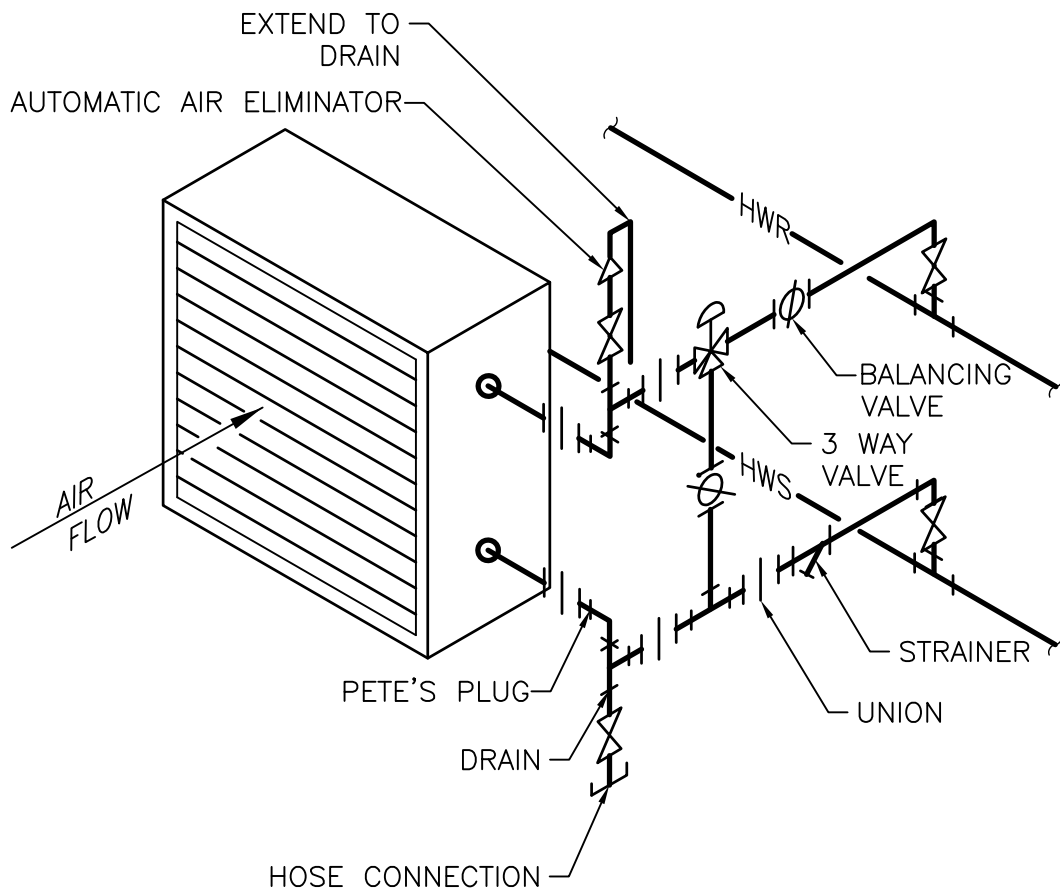
1. PROVIDE FLEXIBLE CONNECTOR TO APPLIANCE PER LOCAL CODE.

GAS APPLIANCE CONNECTION

NTS

40 05 00-04



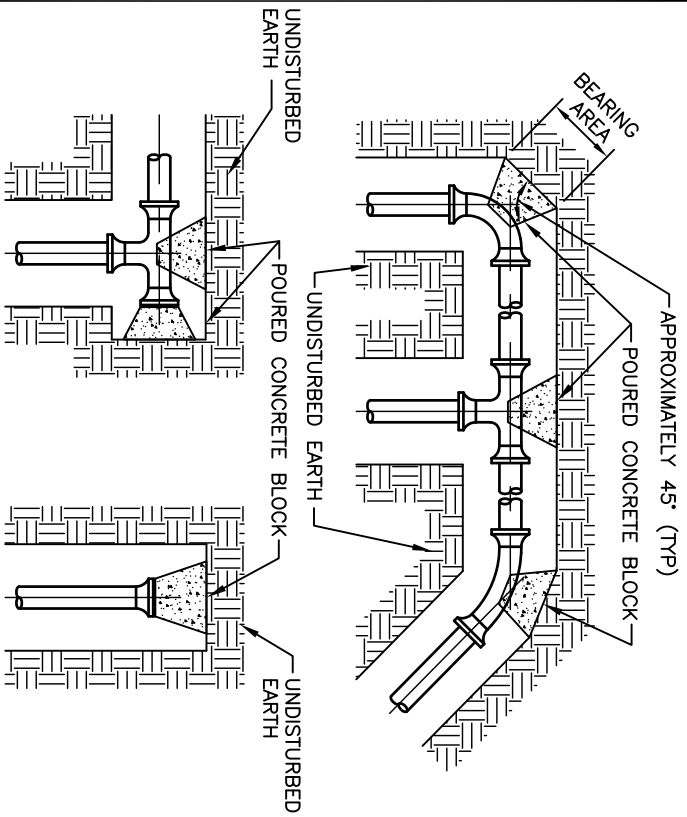


UNIT HEATER

NTS

40 05 00-05





FITTING SIZES	BEARING AREA OF BLOCK IN SQ. FT.				
	TEE & END	90° BEND	45° BEND	22-1/2° BEND	11-1/4° BEND
4"	1.0	1.4	1.0	-	-
6"	2.1	3.0	1.6	1.0	-
8"	3.8	5.3	2.9	1.5	1.0
10"	5.9	8.4	4.6	2.4	1.2
12"	8.5	12.0	6.6	3.4	1.7
14"	11.5	16.3	8.8	4.5	2.3
16"	15.0	21.3	11.6	6.0	3.0
18"*	19.0	27.0	14.6	7.6	3.8
20"*	23.5	33.3	18.1	9.4	4.7
24"*	34.0	48.0	26.2	13.6	6.8
30"*	53.0	75.0	40.6	20.7	10.4
36"*	76.3	107.9	58.3	29.8	15.0

NOTES:

1. PLACE 4 MIL POLYETHYLENE BETWEEN CONCRETE AND FITTING. CONSTRUCT BLOCK SUCH THAT CONCRETE DOES NOT INTERFERE WITH THE ADJACENT PIPE JOINT.
2. THE HEIGHT (h) OF THE BLOCK SHALL BE EQUAL TO OR LESS THAN 1/2 THE TOTAL DEPTH FROM FINISHED GRADE TO THE BOTTOM THE BLOCK BUT NOT LESS THAN THE PIPE DIAMETER.
3. THE HORIZONTAL DIMENSION OF THE BEARING AREA SHALL BE BETWEEN 1 AND 2 TIMES THE VERTICAL DIMENSION.
4. THRUST BLOCK ORIENTATION SHALL BE SUCH THAT THE CENTER OF THE FITTING CORRESPONDS WITH THE CENTER OF THE THRUST BLOCK.
5. CONCRETE SHALL HAVE A MINIMUM COMPRESSIVE STRENGTH OF 4000 PSI @ 28 DAYS.
6. LISTED AREAS ARE BASED ON TEST PRESSURE OF 100 P.S.I. AND AN ALLOWABLE SOIL BEARING STRESS OF 2,000 LBS PER SQUARE FOOT. TO COMPUTE BEARING AREAS FOR DIFFERENT TEST PRESSURE, USE THE FOLLOWING EQUATION: BEARING AREA = (TEST PRESSURE/100) x (TABLE VALUE).

THRUST BLOCK DETAIL

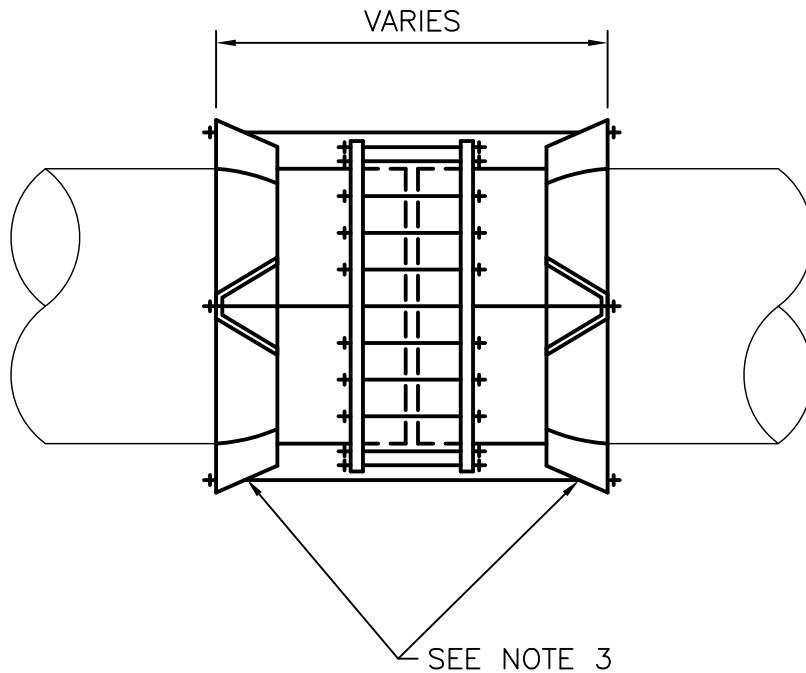
NTS

EDITOR NOTE:

1. * RESTRAINED JOINTS RECOMMENDED FOR PIPE 18 IN AND LARGER.
2. BEARING AREA CALCULATED IN ACCORDANCE WITH DIPRA "THRUST RESTRAINT DESIGN FOR DUCTILE IRON PIPE".

40 05 00-06





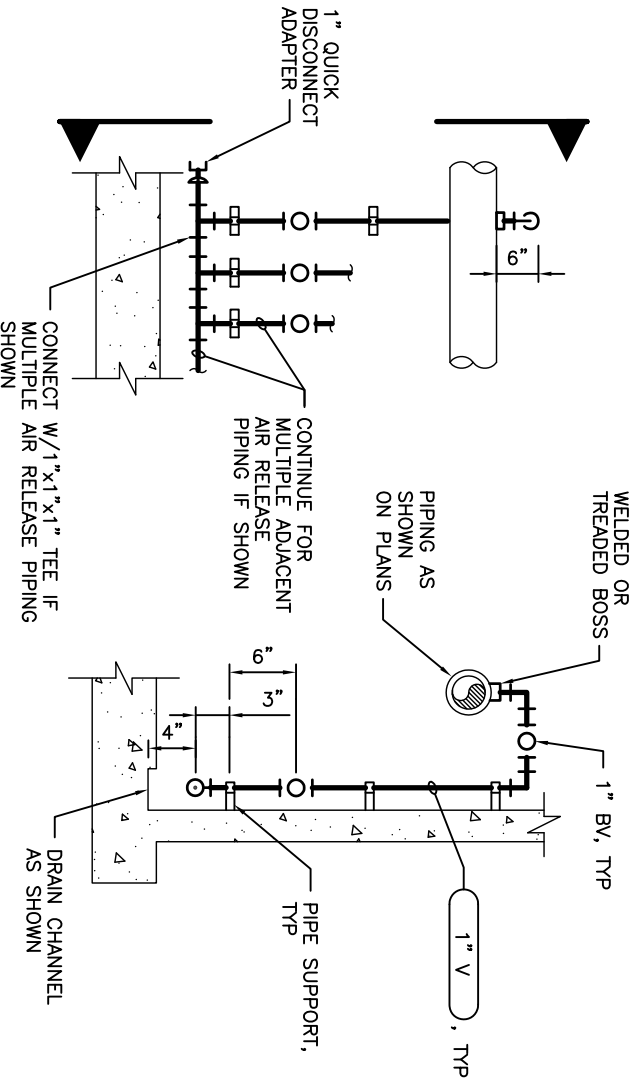
NOTES:

1. PROVIDE COUPLING WHERE NOTED ON DRAWINGS.
2. DESIGN HARNESS IN ACCORDANCE WITH AWWA M-11 MANUAL STEEL PIPE.
3. LUGS FOR PIPE < 14" AND HARNESS RINGS FOR PIPE \geq 14"

HARNESSED MECHANICAL COUPLING

NTS

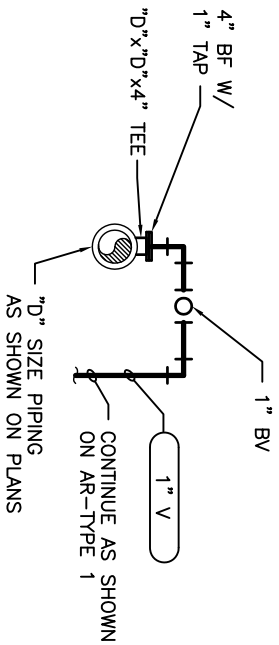
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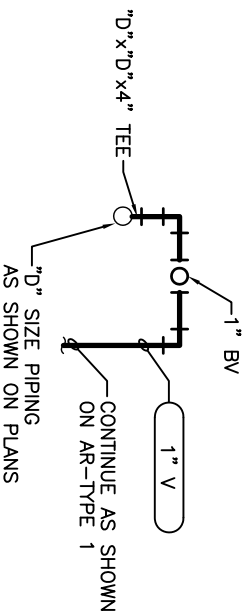
ELEVATION

SECTION

AR-TYPE 1



AR-TYPE 2

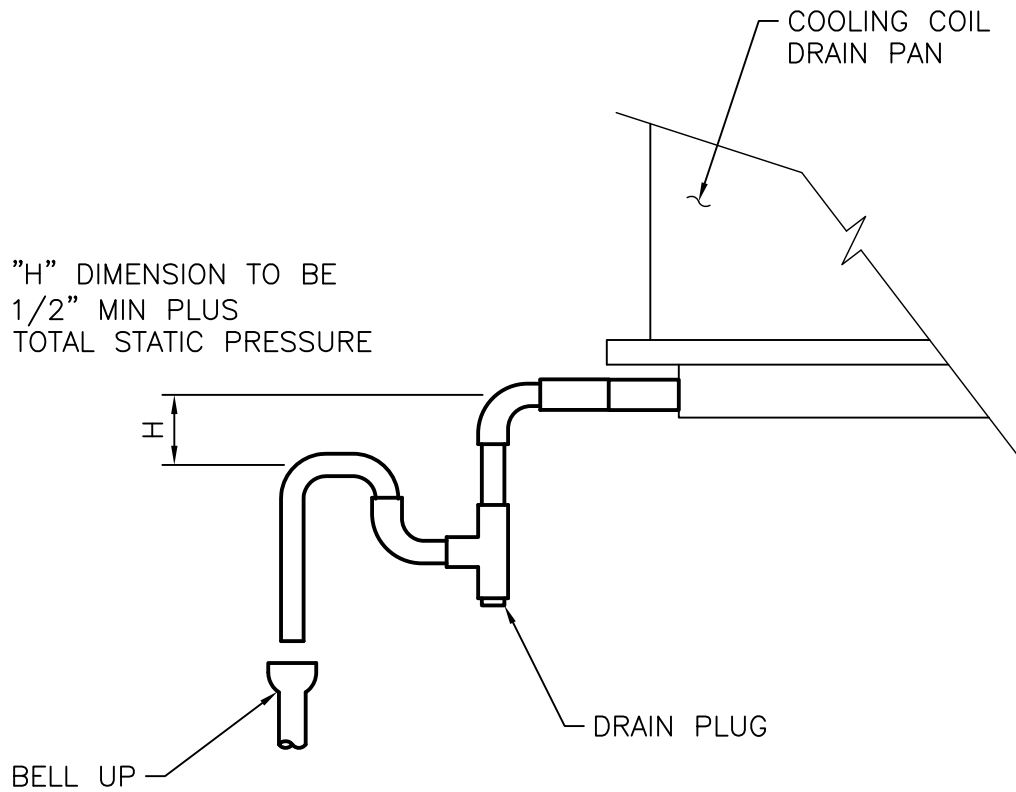


AR-TYPE 3

AIR RELEASE VALVES

NTS

40 05 00-08

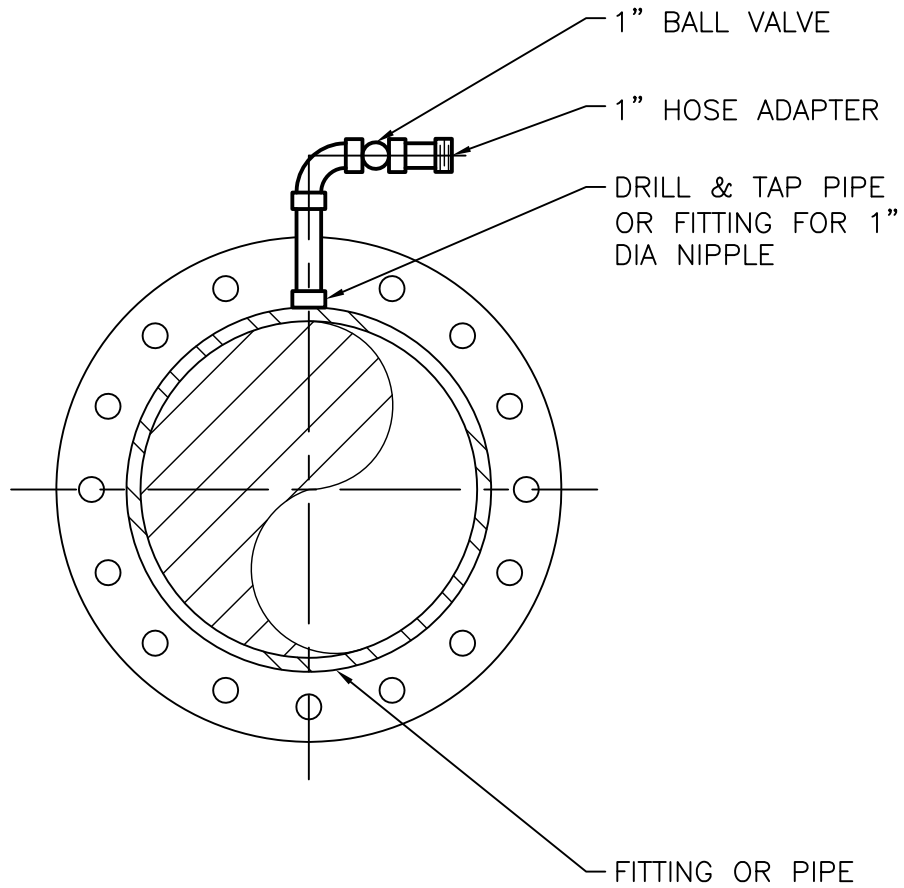


COOLING COIL DRAIN TRAP

NTS

40 05 00-09





FLUSHING CONNECTION FC-1

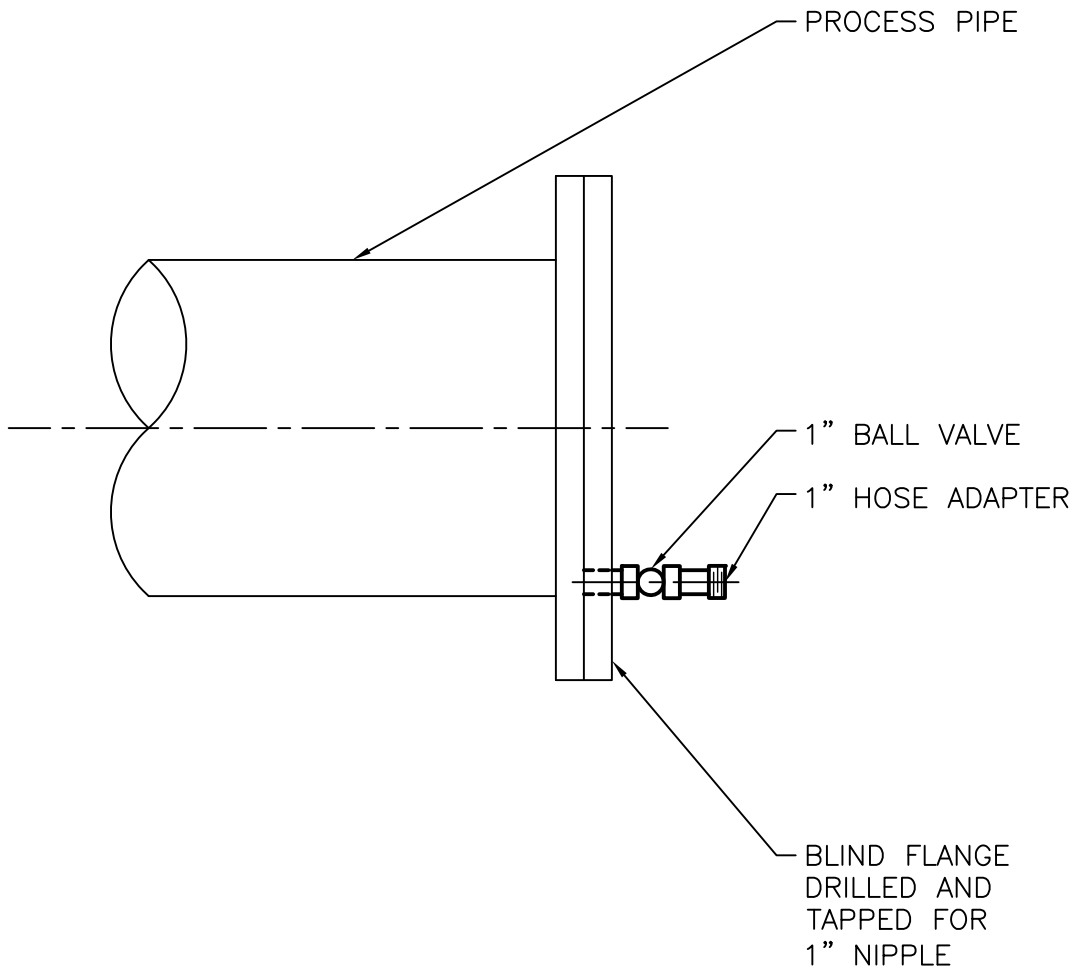
40 05 00-10

NTS

EDITOR NOTE:

USE TAPPING SADDLE OR WELDED BOSS FOR PIPE LESS THAN 6"
DIAMETER OR WHEN REQUIRED BY PIPE WALL THICKNESS.



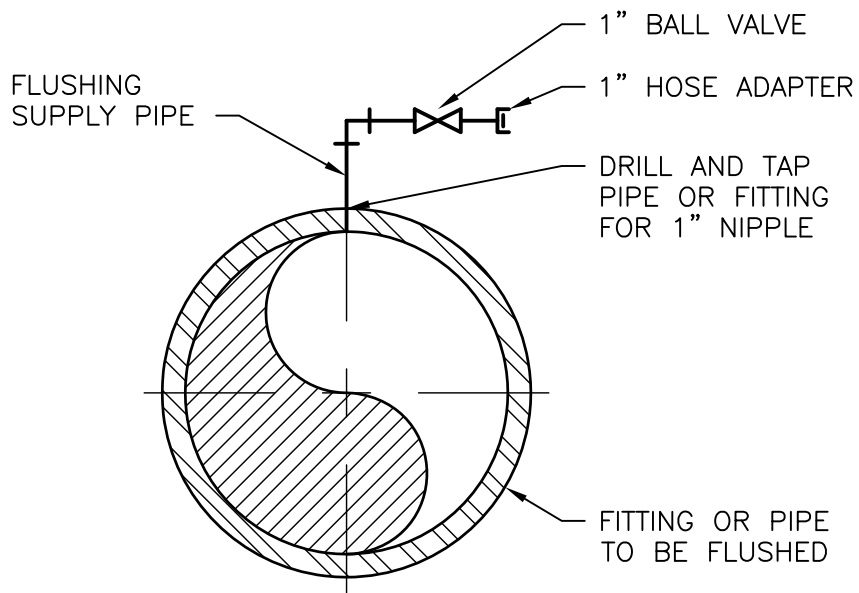


FLUSHING CONNECTION FC-2

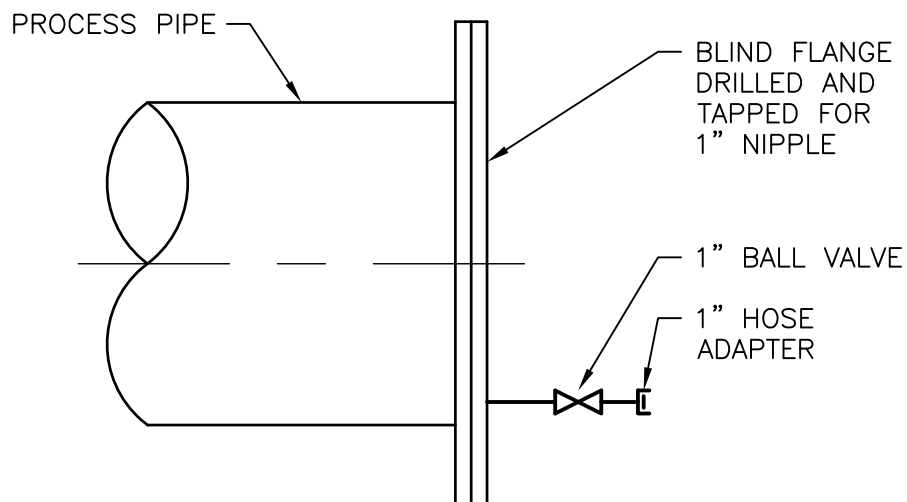
NTS

40 05 00-11





FC-1



FC-2

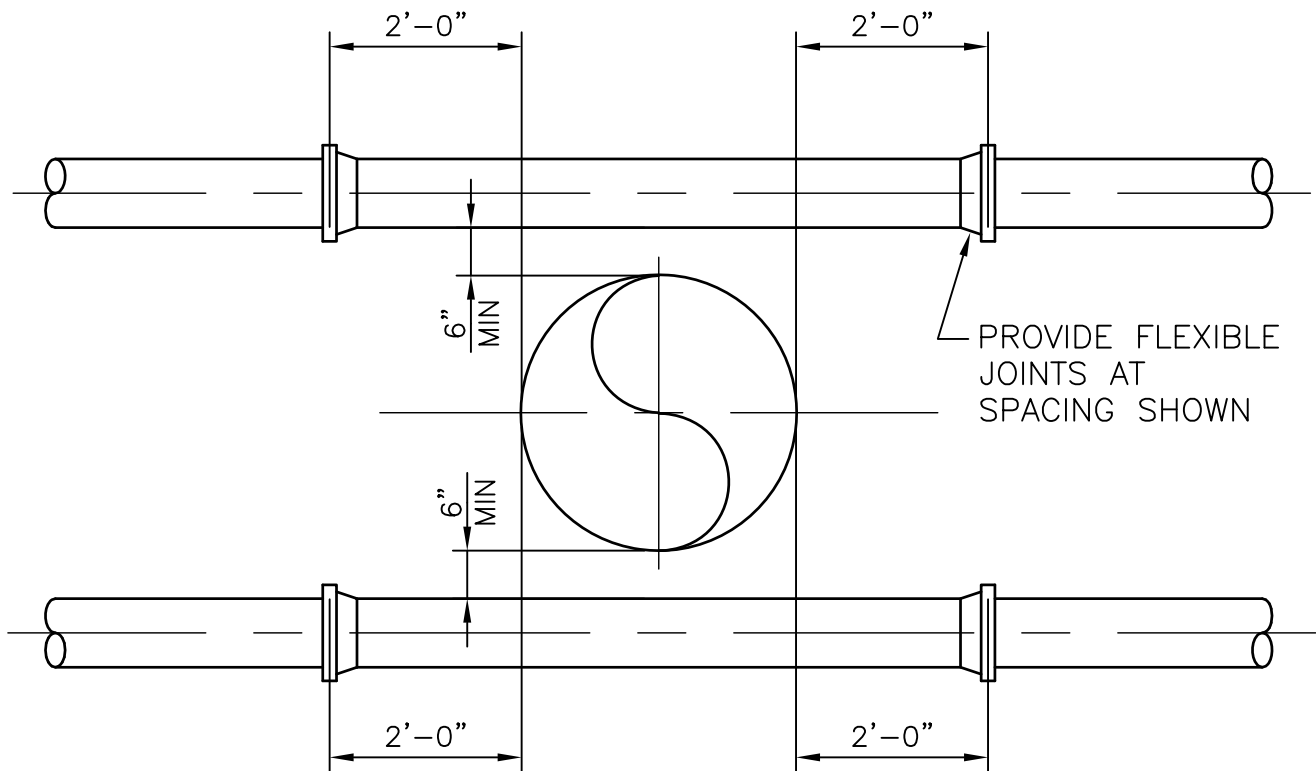
NOTES:

1. USE TAPPING SADDLE OR WELDED BOSS FOR PIPE LESS THAN 6" DIAMETER OR WHEN REQUIRED BY PIPE WALL THICKNESS. USE TAPPING SADDLE ON ALL NON-METALLIC PIPE.
2. FLUSHING SUPPLY PIPE GALVANIZED STEEL, SCHEDULE 40.

HOSE FLUSHING CONNECTION

NTS

40 05 00-12



NOTE:

1. NOT APPLICABLE TO WATER AND SEWER LINE CROSSINGS – SEE 10-STATE STANDARDS.

TYPICAL PIPE JOINT LOCATIONS AT PIPELINE CROSSINGS

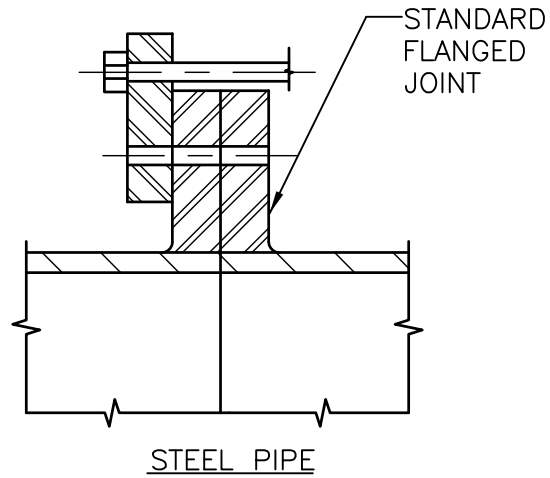
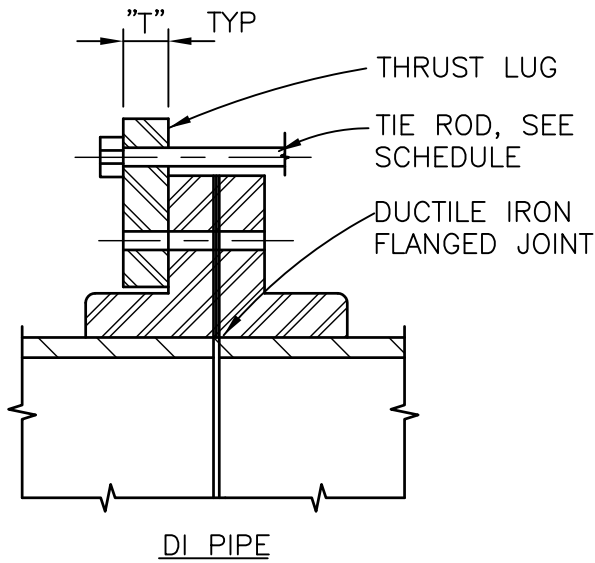
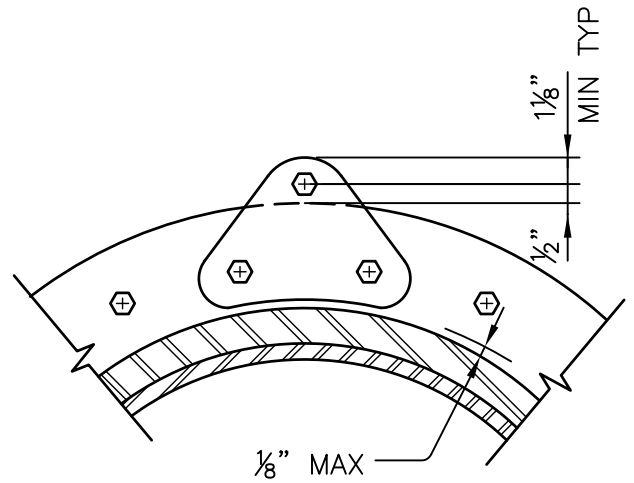
NTS

40 05 00-13

PIPE DIA (IN)	TIE ROD DIA (IN)	"T" THICKNESS (IN)	MINIMUM LUG DIA (IN)
4 - 6	5/8	1/2	
8 - 12	5/8	1/2	
14 - 18	5/8	7/8	
20 - 24	5/8	1 1/4	

NOTE:

1. MAXIMUM PIPE PRESSURE = 50 PSI
2. GRIND ALL EDGES SMOOTH



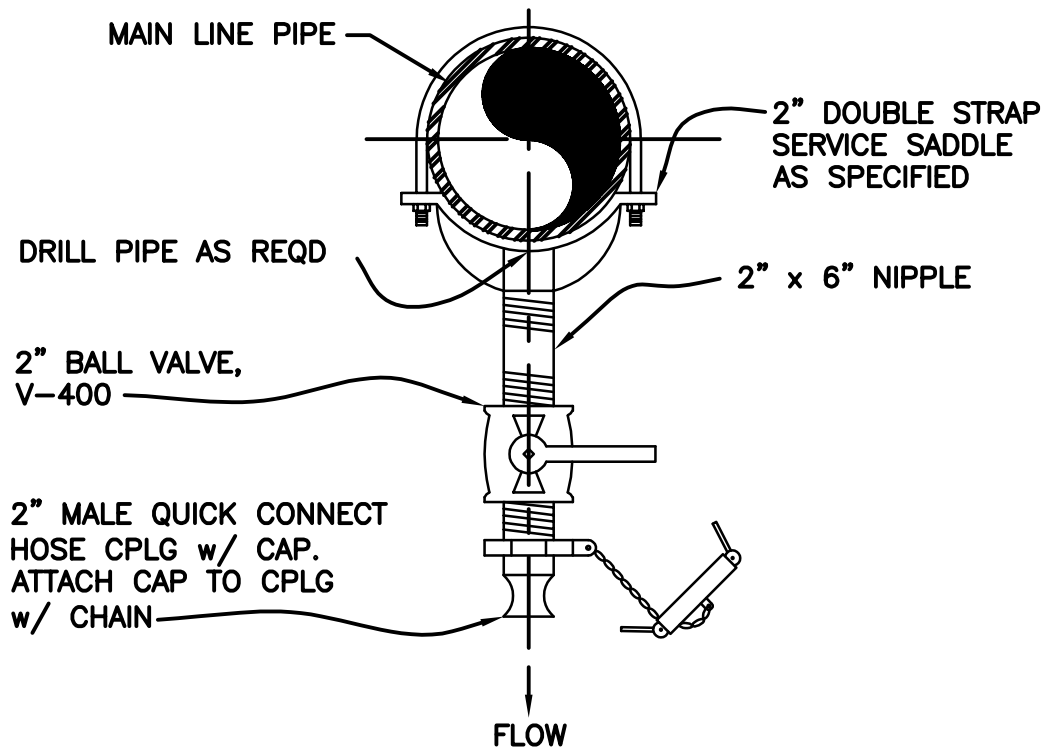
SECTIONS

THRUST TIE FOR FLEXIBLE COUPLING

NTS

40 05 00-14



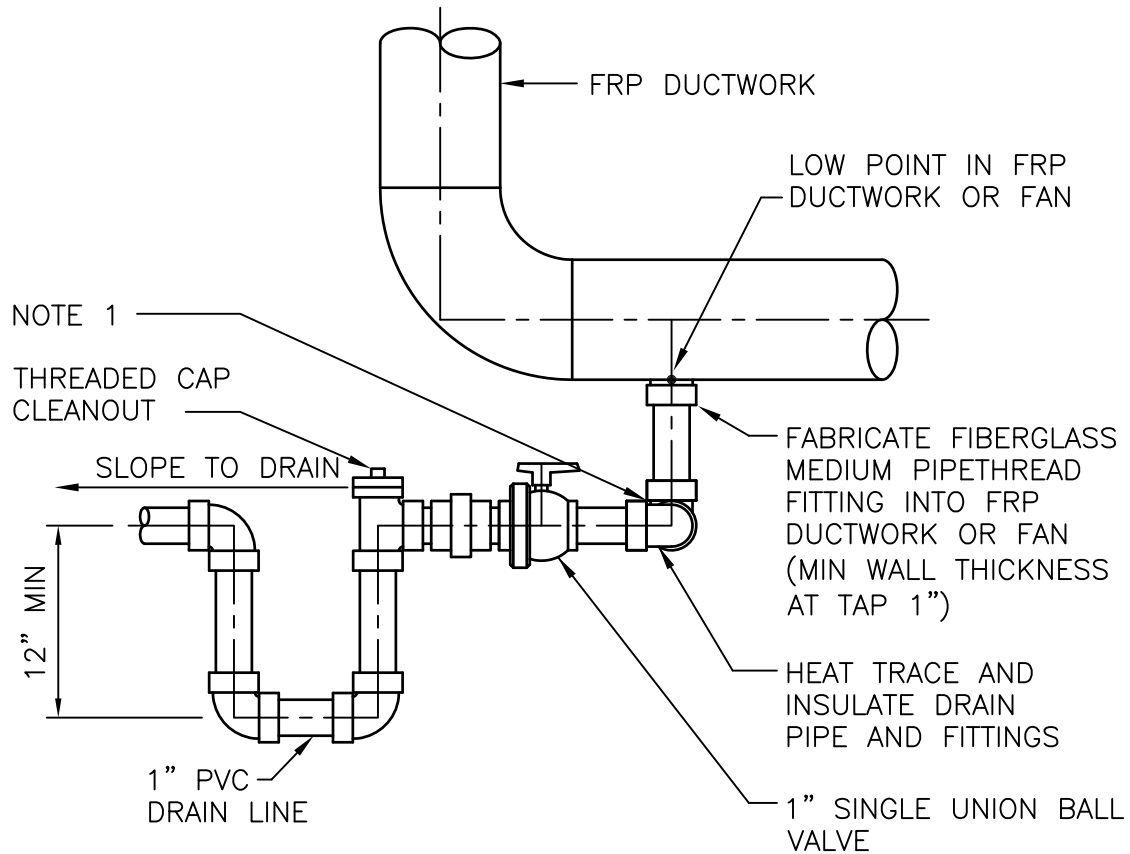


NOTE:
 FOR LINE SIZE 2" AND SMALLER, FITTINGS
 AND VALVE SHALL BE SAME SIZE AS LINE

LINE DRAIN VALVE INSTALLATION

NTS

40 05 00-15



NOTES:

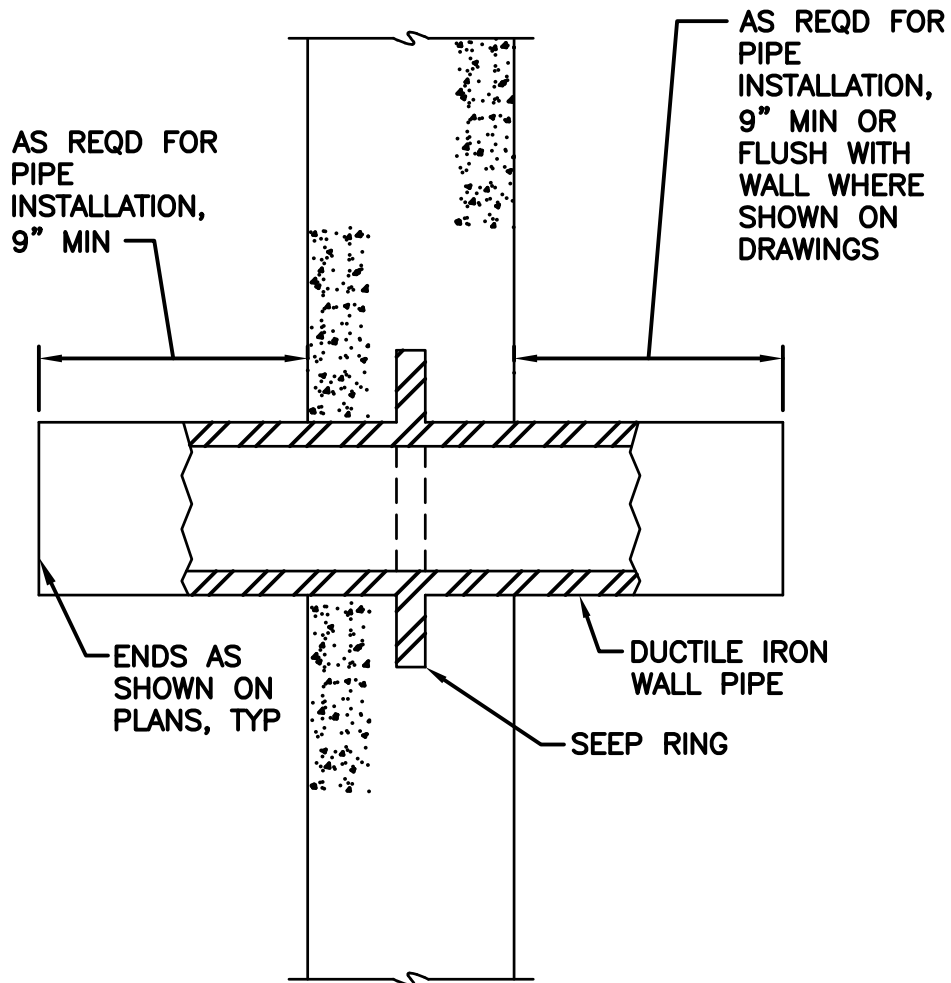
1. DRAIN PIPING SHALL BE LOCATED TO SIDE OF EQUIP OR DUCT FOR EASE OF ACCESS

FRP DRAIN

NTS

40 05 00-16





NOTE:

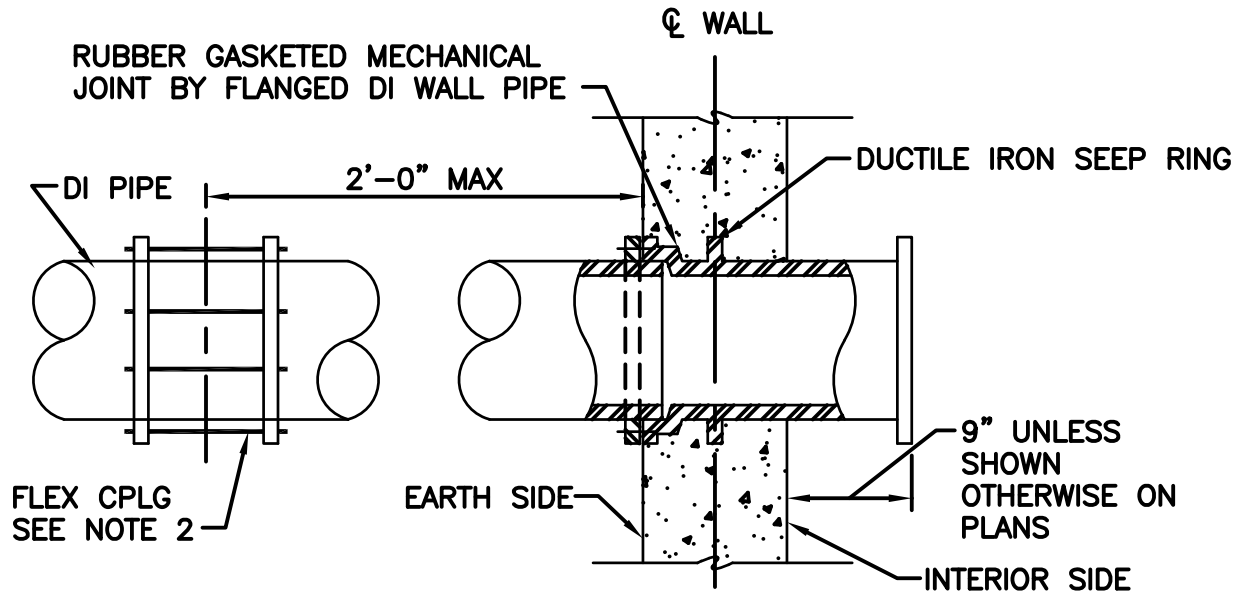
COAT & LINE PIPE w/ SPECIFIED COATING AND/OR CEMENT SYSTEMS PRIOR TO CONC PLACEMENT. DO NOT ALLOW PIPE OR SEEP RING TO CONTACT WALL REINFORCING STEEL.

DUCTILE IRON WALL PIPE

NTS

40 05 00-17





NOTES:

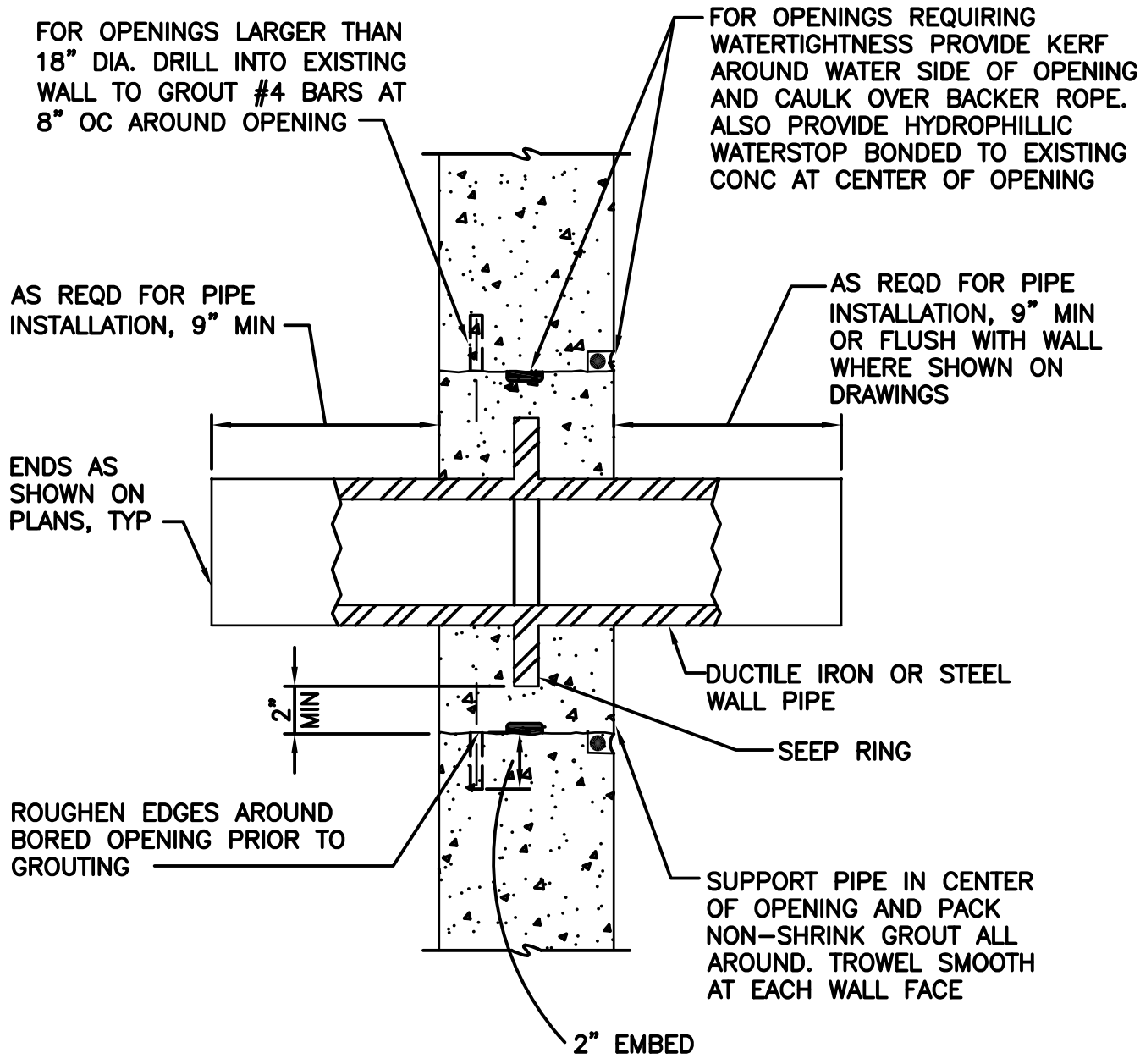
1. COAT & LINE WALL PIPE w/ SPECIFIED PAINT AND/OR CEMENT SYSTEMS PRIOR TO CONC PLACEMENT.
2. PROVIDE TWO FLEX CPLGS AS SPECIFIED, SECOND CPLG TO BE 2'-0" FROM FIRST CPLG.

WALL PIPE

NTS

40 05 00-18





NOTE:

COAT & LINE PIPE W/ SPECIFIED COATING AND/OR CEMENT SYSTEMS PRIOR TO GROUT PLACEMENT. DO NOT ALLOW PIPE OR SEEP RING TO CONTACT EXIST. WALL OPENING OR REINF. STEEL. ALSO, APPLY EPOXY BONDING AGENT TO OPENING SURFACE PRIOR TO GROUTING.

DUCTILE IRON OR STEEL WALL PIPE IN EXISTING WALL

40 05 00-19

NTS

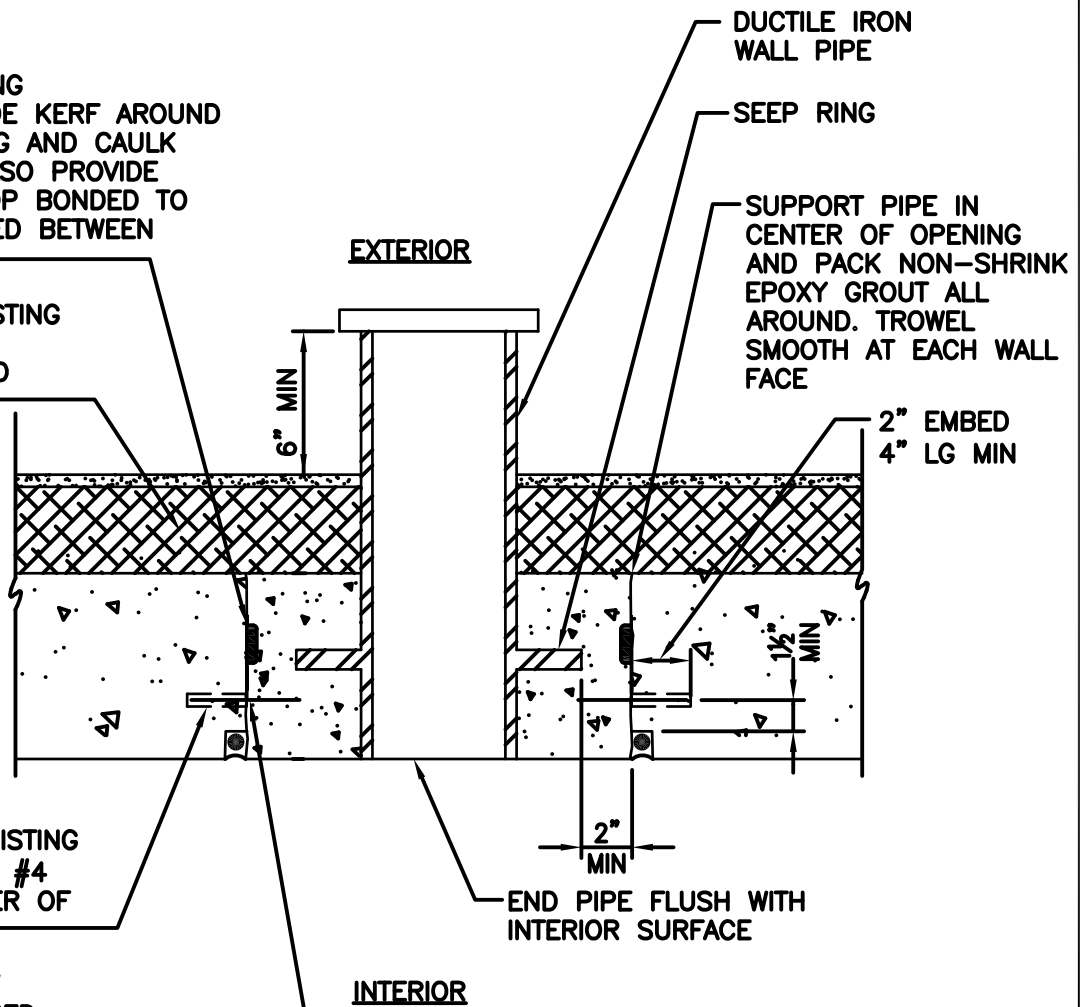


FOR OPENINGS REQUIRING WATERTIGHTNESS PROVIDE KERF AROUND WATER SIDE OF OPENING AND CAULK OVER BACKER ROPE. ALSO PROVIDE HYDROPHILIC WATERSTOP BONDED TO EXISTING CONC CENTERED BETWEEN REBAR & TOP EDGE

RE-INSTALL/REPAIR EXISTING INSULATION & BUILT-UP ROOFING. FLASH AROUND PIPE PENETRATION

DRILL RADIALLY INTO EXISTING CEILING TO GROUT 6 - #4 BARS AROUND PERIMETER OF OPENING

ROUGHEN EDGES TO $\frac{1}{4}$ " AMPLITUDE AROUND BORED OPENING PRIOR TO GROUTING



DUCTILE IRON WALL PIPE

SEEP RING

SUPPORT PIPE IN CENTER OF OPENING AND PACK NON-SHRINK EPOXY GROUT ALL AROUND. TROWEL SMOOTH AT EACH WALL FACE

2" EMBED
4" LG MIN

6" MIN

1 1/2" MIN

2" MIN

END PIPE FLUSH WITH INTERIOR SURFACE

INTERIOR

NOTE:

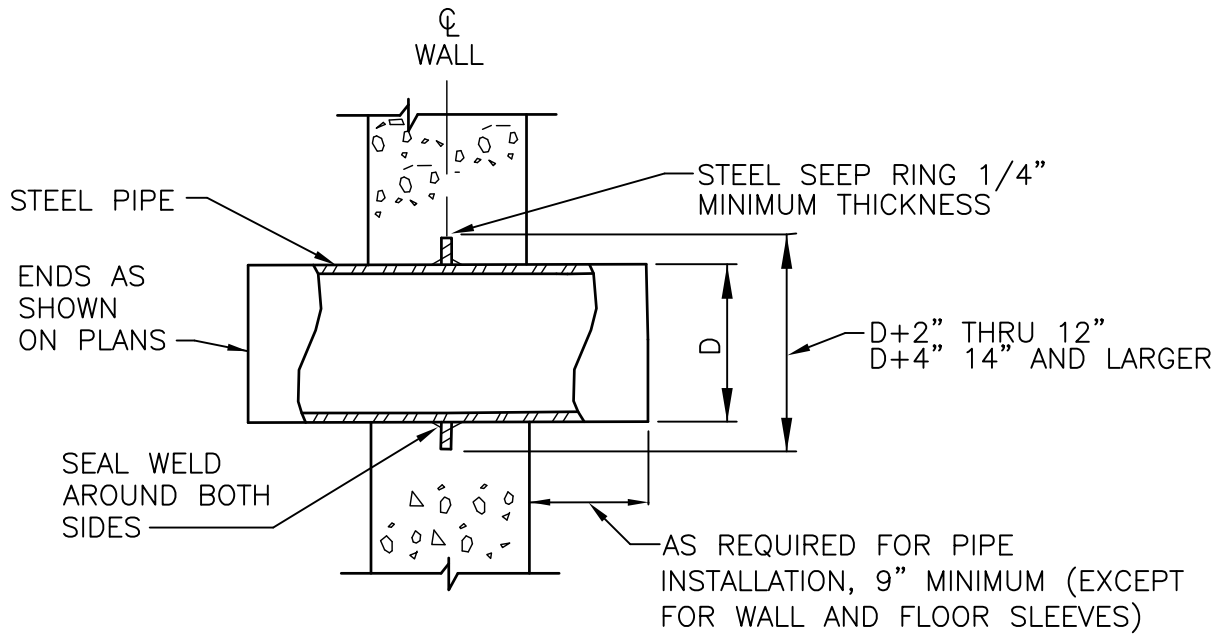
COAT & LINE PIPE W/ SPECIFIED COATING AND/OR CEMENT SYSTEMS PRIOR TO GROUT PLACEMENT. DO NOT ALLOW PIPE OR SEEP RING TO CONTACT EXIST. WALL OPENING OR REINF STEEL. ALSO, APPLY EPOXY BONDING AGENT TO OPENING SURFACE PRIOR TO GROUTING.

DUCTILE IRON WALL PIPE IN EXISTING CONCRETE CEILING

NTS

40 05 00-20





NOTE:

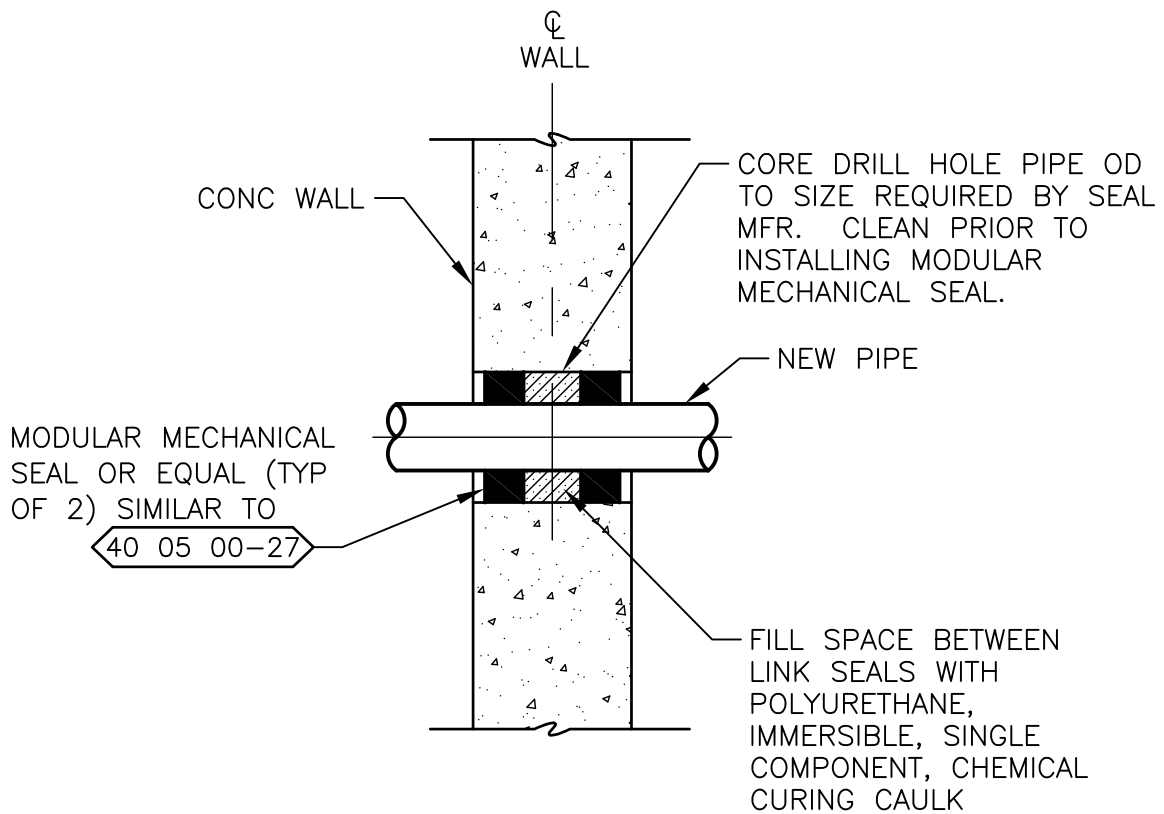
HOT DIP GALV AFTER FABRICATION WHERE NOTED. LINE AND COAT WALL PIPE w/ SPECIFIED PAINT SYSTEM PRIOR TO CONCRETE PLACEMENT.

STEEL WALL PIPE

NTS

40 05 00-21

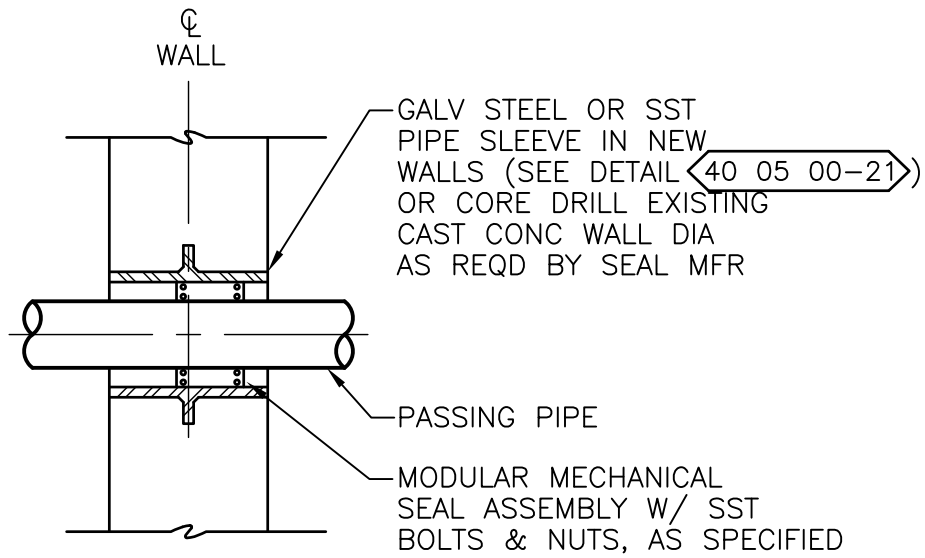




WALL PENETRATION SEAL

NTS

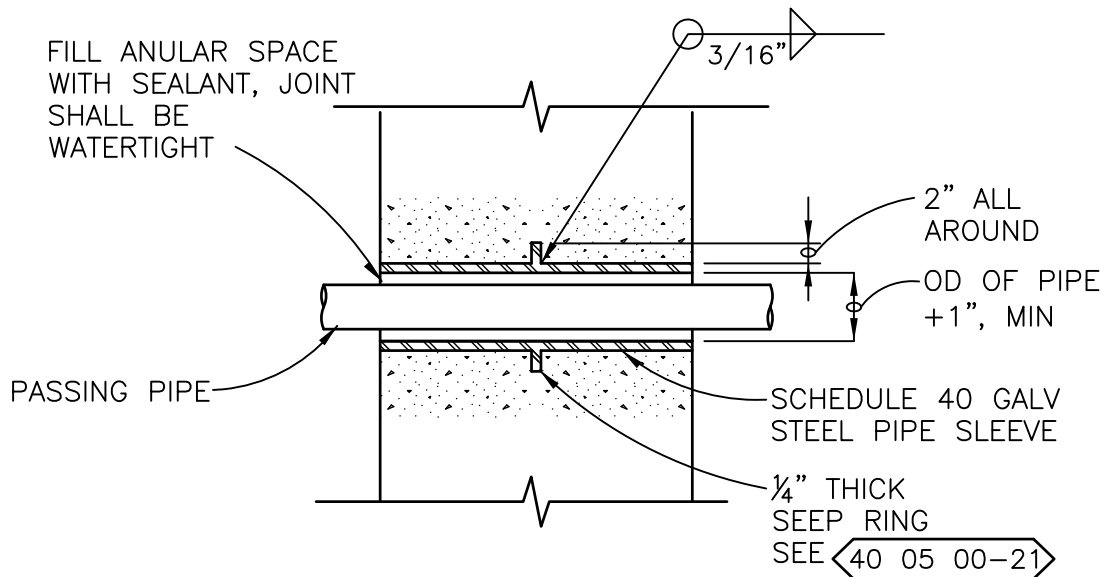
40 05 00-22



TYPE 'A' WALL PENETRATION SEAL

NTS

40 05 00-23



NOTE:

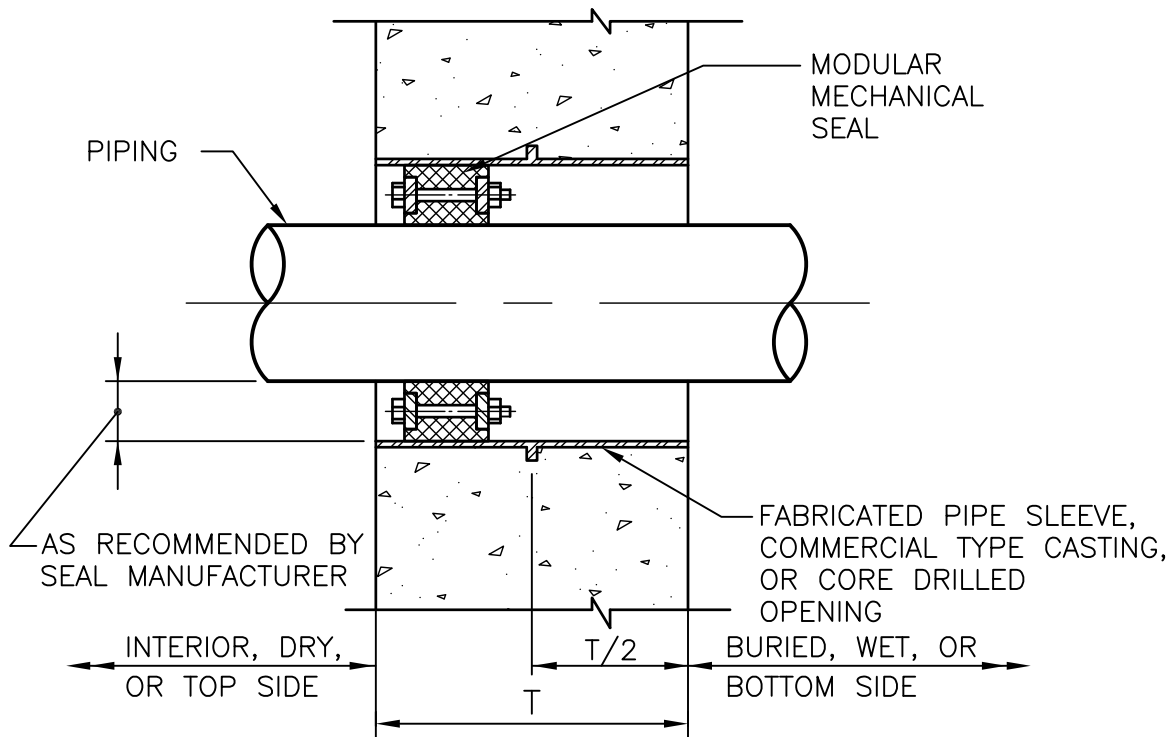
DO NOT USE WHERE SUBJECT TO HYDROSTATIC PRESSURE.
 COAT & LINE SLEEVE & SEEP RING AS SPECIFIED.

TYPE 'B' PIPE SLEEVE

NTS

40 05 00-24





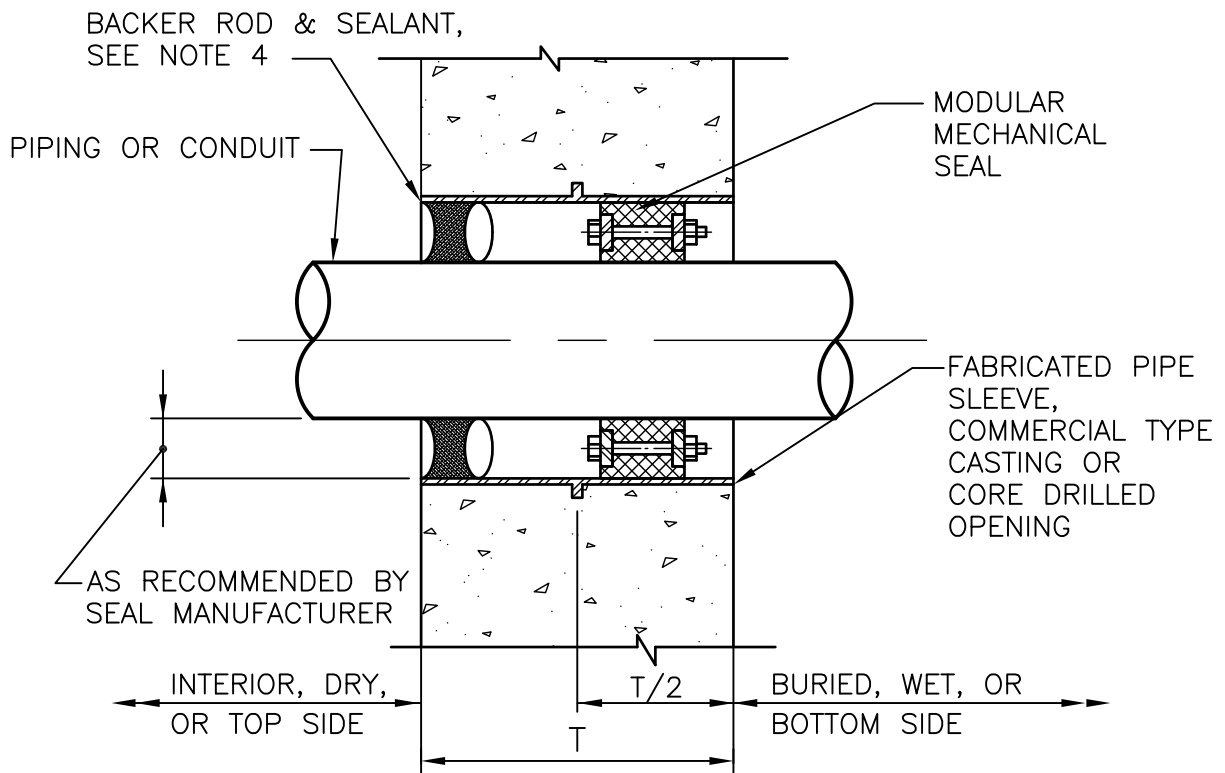
NOTES:

1. BOLT HEADS ON ACCESSIBLE SIDE OF PENETRATION
2. PROVIDE DOUBLE ROW OF SEALS FOR PIPES 16" DIAMETER AND LARGER IF CONCRETE THICKNESS PERMITS
3. ONE SEAL FOR WALLS LESS THAN 8" THICK, TWO FOR WALLS 8" THICK AND LARGER

MODULAR MECHANICAL SEAL

NTS

40 05 00-26



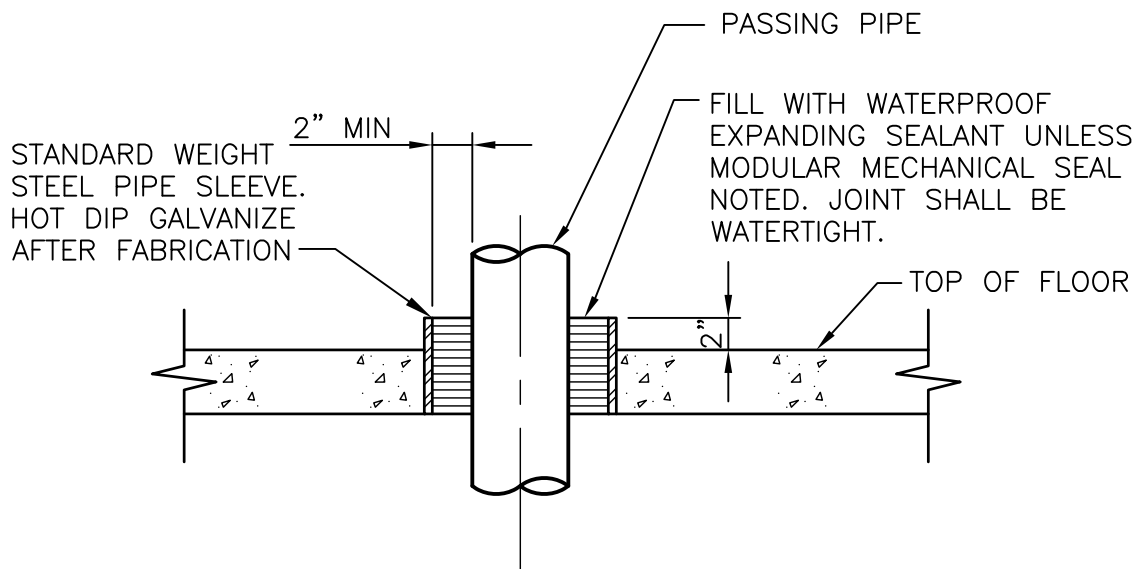
NOTES:

1. BOLT HEADS ON ACCESSIBLE SIDE OF PENETRATION
2. PROVIDE DOUBLE ROW OF SEALS FOR PIPES 16" DIAMETER AND LARGER IF CONCRETE THICKNESS PERMITS
3. ONE SEAL FOR WALLS LESS THAN 8" THICK, TWO FOR WALLS 8" THICK AND LARGER
4. INSTALL BACKER ROD AND SEALANT ONLY ON TOP SIDE OF SLABS OR AT FINISHED WALLS.

MODULAR MECHANICAL SEAL

NTS

40 05 00-27

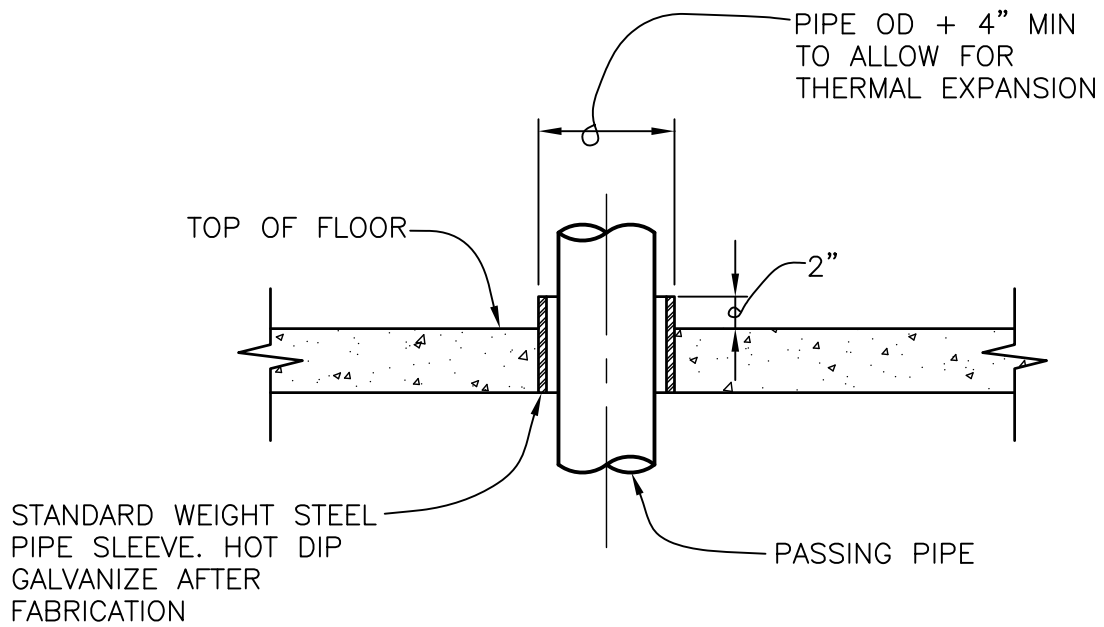


FLOOR SLEEVE

NTS

40 05 00-28





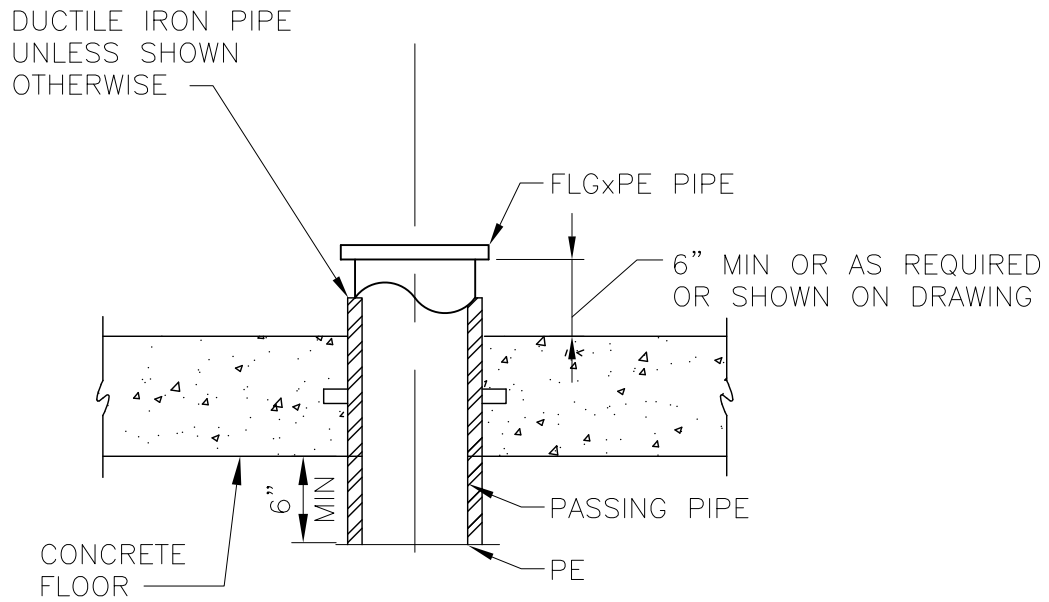
NOTE:

COAT FLOOR SLEEVE WITH SPECIFIED PAINT
SYSTEM BEFORE CONCRETE PLACEMENT.

FLOOR SLEEVE

NTS

40 05 00-29



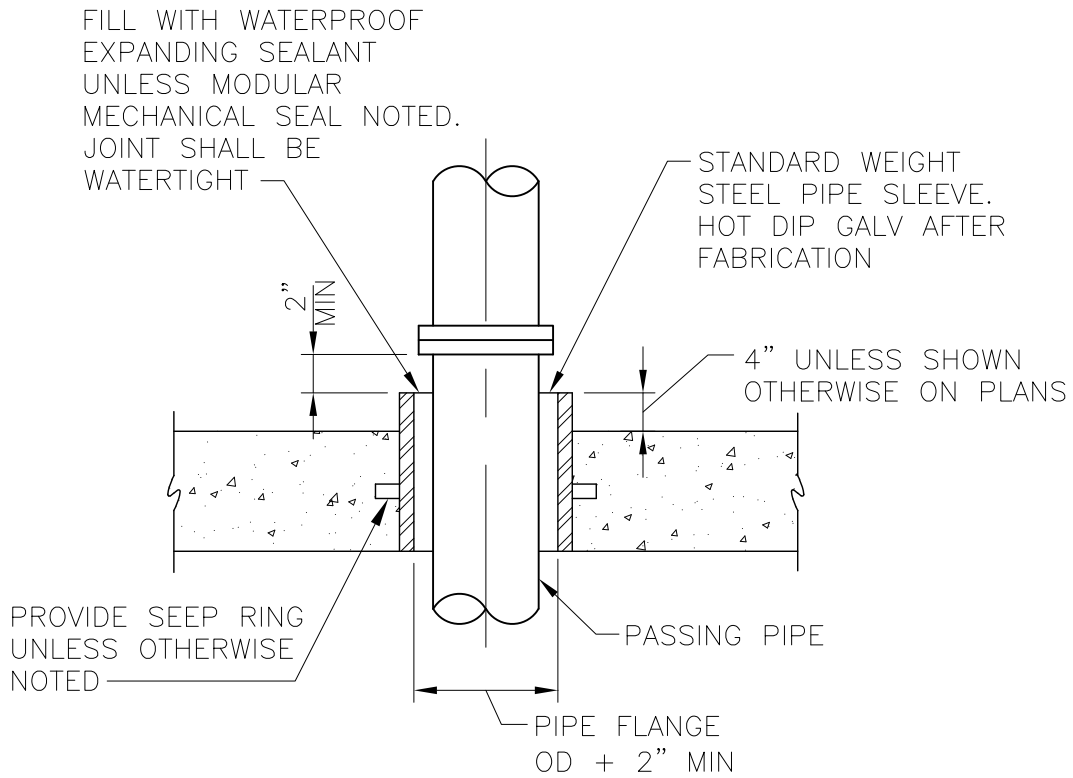
NOTE:

1. COAT FLOOR PIPE AS SPECIFIED PRIOR TO PLACEMENT.
2. MOUNT SUCH THAT FLANGE IS LEVEL.

FLOOR PIPE DETAIL

NTS

40 05 00-30



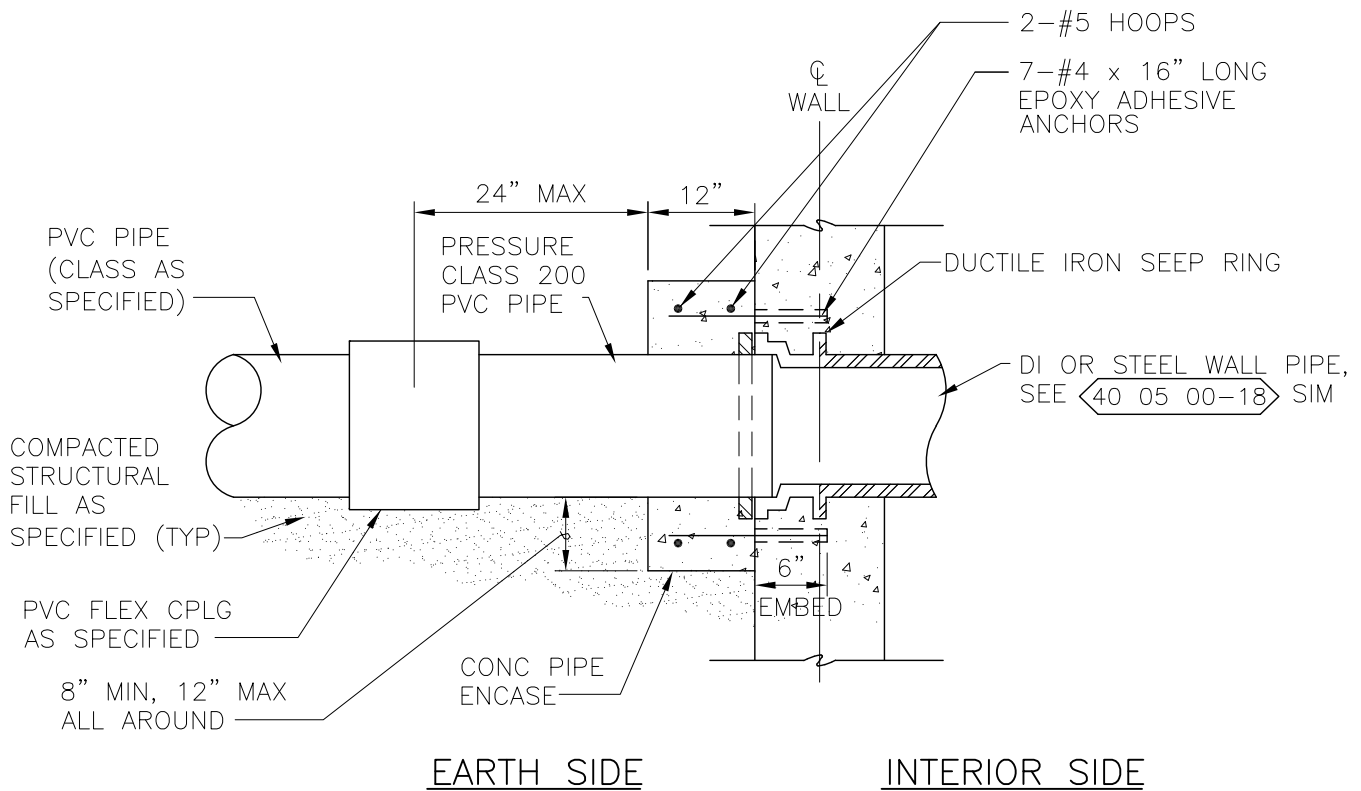
NOTE:

COAT & LINE FLOOR SLEEVE W/ SPECIFIED PAINT SYSTEM BEFORE CONCRETE PLACEMENT

FLOOR SLEEVE

NTS

40 05 00-31



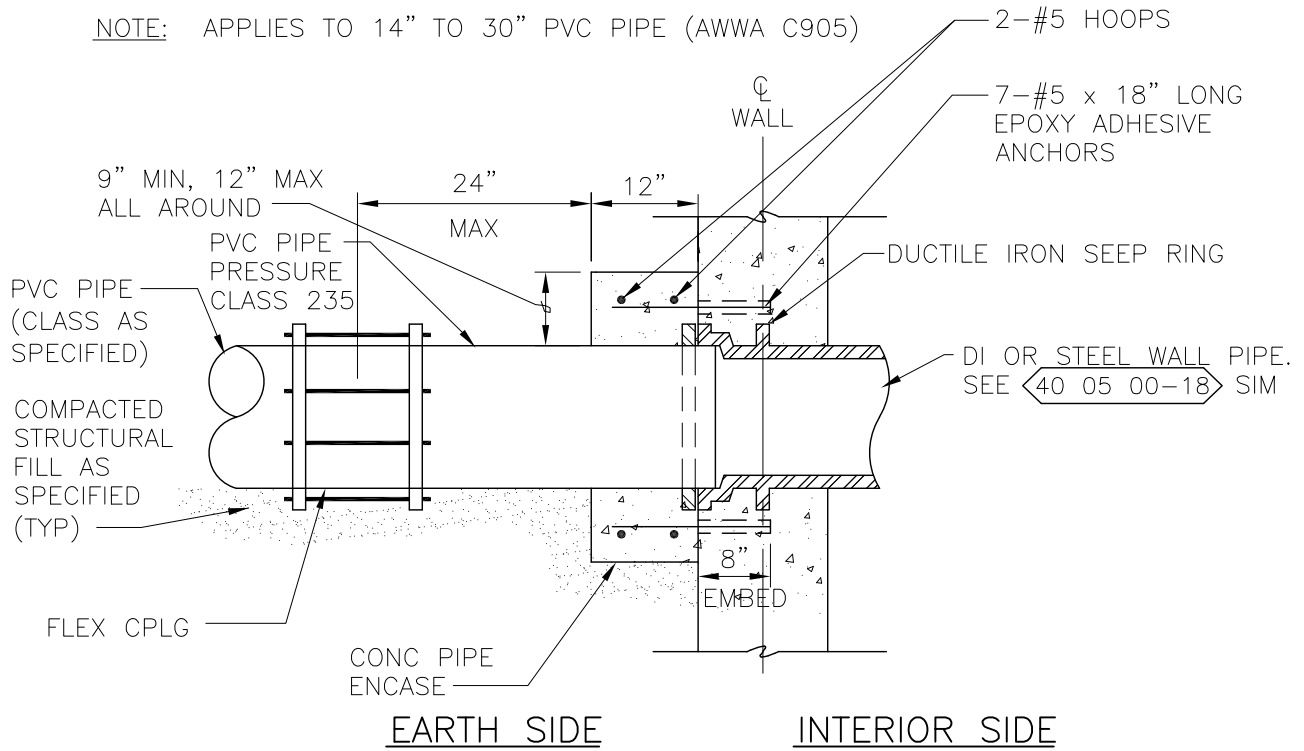
NOTE:

APPLIES TO 12" AND SMALLER PVC PIPE (AWWA C900)

WALL PIPE – SMALL
DIAMETER PVC PIPE

NTS

40 05 00-32



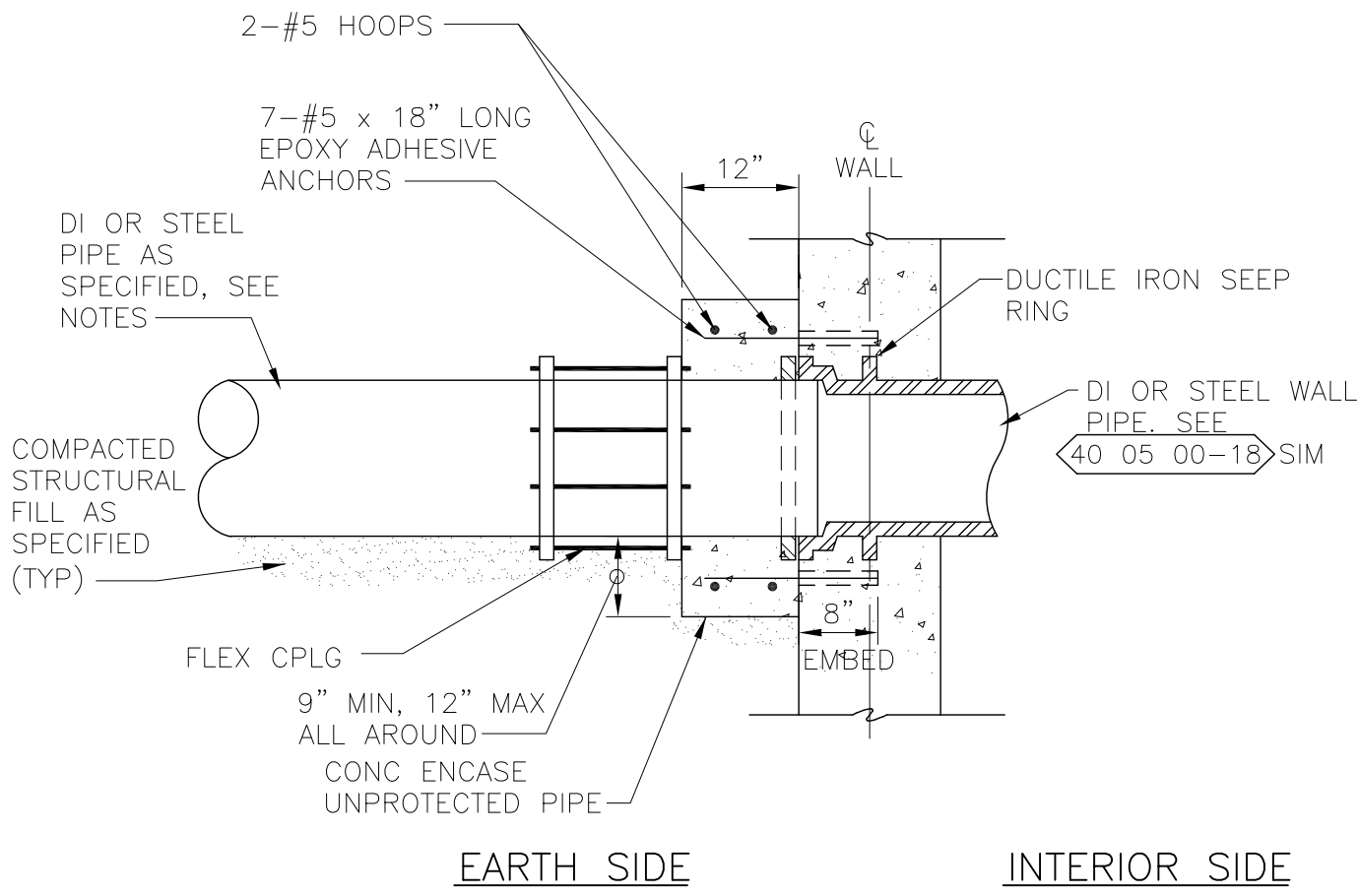
NOTE:

1. AT CONTRACTOR'S OPTION, THE FLEXIBLE COUPLING MAY BE COATED WITH MASTIC AND HEAT SHRINK WRAPPED INSTEAD OF PROVIDING GALVANIC ANODES FOR CORROSION PROTECTION.

WALL PIPE — LARGE DIAMETER PVC PIPE

NTS

40 05 00-33



NOTES:

1. AT A MINIMUM, ALL BURIED DUCTILE IRON OR STEEL PIPE SHALL BE JOINT BONDED AS SPECIFIED.
2. PROVIDE TEST STATIONS AT EACH END OF PROTECTED PIPE. SEE PLANS.
3. POLYWRAP ALL BURIED DUCTILE IRON PIPE AND TAPE WRAP ALL BURIED STEEL PIPE AS SPECIFIED.

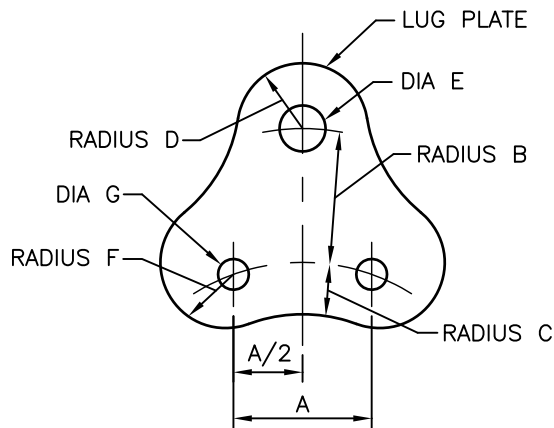
**WALL PIPE – LARGE DIAMETER
DUCTILE IRON OR STEEL PIPE**

NTS

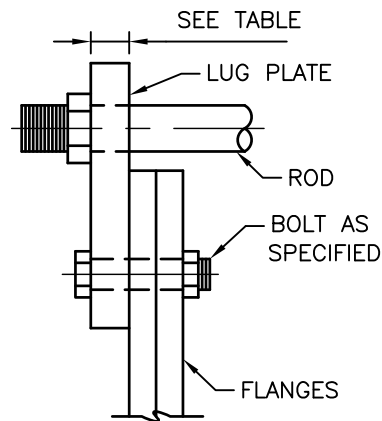
40 05 00-34



FLANGE LUG TIE ROD SCHEDULE												
TIE ROD DIA OR BOLT SIZE	5/8	3/4	7/8	1	1 1/8	1 1/4	1 1/2	1 3/4	2	1 3/4	2 3/4	
DIA G OR F	3/4	7/8	1	1 1/8	1 1/4	1 3/8	1 1/2	1 3/4	2	2 1/4	2 1/2	3
RADIUS D OR F	7/8	1	1 1/8	1 1/4	1 3/8	1 1/2	1 3/4	2	1 3/4	2 3/8	2 1/2	
TEST PRESSURE (PSI)			25	50	100	150	225	375				
PIPE DIA	MIN PLATE THICKNESS	TIE ROD DIA	MIN NUMBER REQUIRED									
3	1/2	5/8	2	2	2	2	2	2	2	2	2	2
4	1/2	5/8	2	2	2	2	2	2	2	2	2	3
6	5/8	5/8	2	2	2	2	2	2	2	3	3	3
8	5/8	3/4	2	2	2	2	2	2	2	3	3	4
10	7/8	7/8	2	2	2	2	2	2	2	3	3	4
12	7/8	1	2	2	2	2	2	2	2	3	3	5
14	7/8	1 1/8	2	2	2	2	2	2	2	3	3	4
16	7/8	1 1/8	2	2	2	2	2	2	2	3	3	4
18	7/8	1 1/8	2	2	2	2	2	2	2	3	3	4
20	7/8	1 1/8	2	2	2	2	2	2	2	3	3	4
22	7/8	1 1/4	2	2	2	2	2	2	2	3	3	4
24	1 1/8	1 1/4	2	2	2	2	2	2	2	3	3	4
30	1 1/8	1 1/2	2	2	2	2	2	2	2	3	3	4
36	1 3/8	1 3/4	2	2	2	2	2	2	2	3	3	4
42	1 3/8	1 3/4	2	2	2	2	2	2	2	3	3	4
48	1 3/8	1 3/4	2	2	2	2	2	2	2	3	3	4



FRONT VIEW



SIDE VIEW

NOTES:

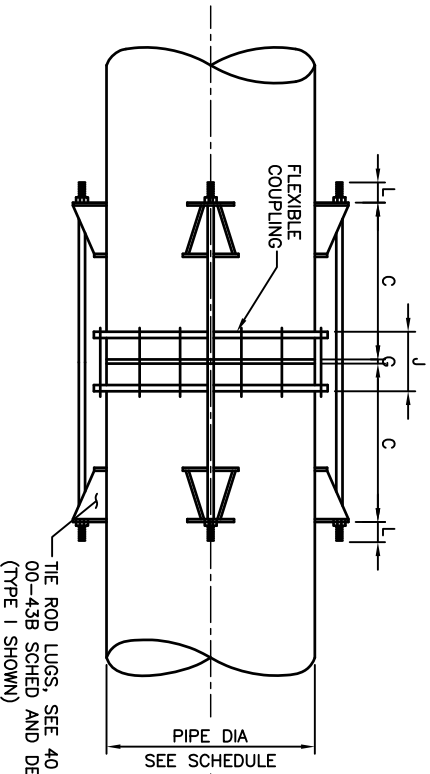
1. ALL DIMENSIONS ARE IN INCHES.
2. DIMENSION "A" AS REQD BY FLANGE SPECIFIED.
3. RADIUS "C" = 1/2 x (BOLT CIRCLE) + F.
4. RADIUS "B" = 1/2 x (FLANGE OD) + D.
5. INSTALL TIE ROD ASSEMBLIES SUCH THAT ALL RODS ARE EQUALLY SPACED AROUND FLANGE. ON PIPING 20" & LARGER, RODS MAY BE GROUPED IN PAIRS BUT GROUPS MUST BE EQUALLY SPACED AROUND FLANGE. THE TOTAL NUMBER OF THE RODS SHALL BE INCREASED ABOVE THAT TABULATED AS NECESSARY TO MEET SPACING REQUIREMENTS.

FLANGE LUG

NTS

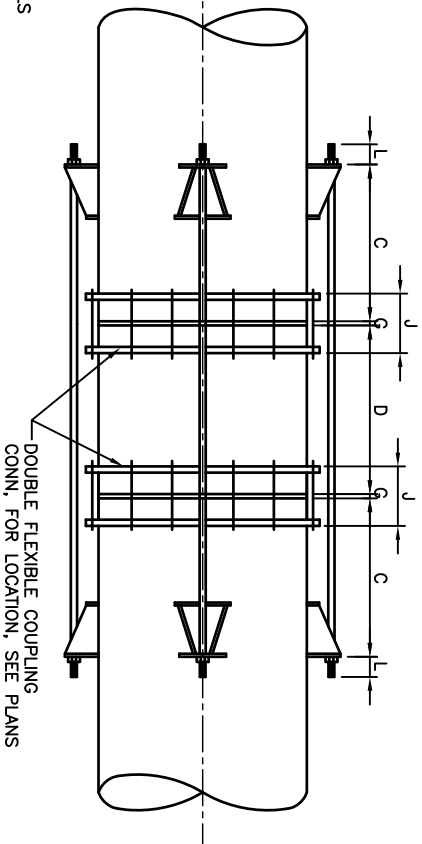
40 05 00-35





- NOTES:
1. THE MIDDLE RING LENGTH OF THE FLEXIBLE COUPLING SHALL BE AS SPECIFIED.
 2. THE CONTRACTOR SHALL DETERMINE THE LENGTH "J" (COUPLING BOLT LENGTH) FROM MANUFACTURER'S CATALOGS USING THE SPECIFIED MIDDLE RING LENGTH.
 3. "G" = MANUFACTURER'S RECOMMENDED SPACE BETWEEN ENDS OF PIPE.
 4. "C" = $J+Z+1$ INCH, (ROUND THIS VALUE UP TO NEXT EVEN INCH), MINIMUM. (FOR Z DIMENSIONS, SEE 40 05 00-43B LUG SCHEDULE)
 5. THE ROD LENGTH = $2L+2C+G$.

**TYPICAL THRUST TIE DETAIL FOR STEEL
PIPE-SINGLE COUPLING**



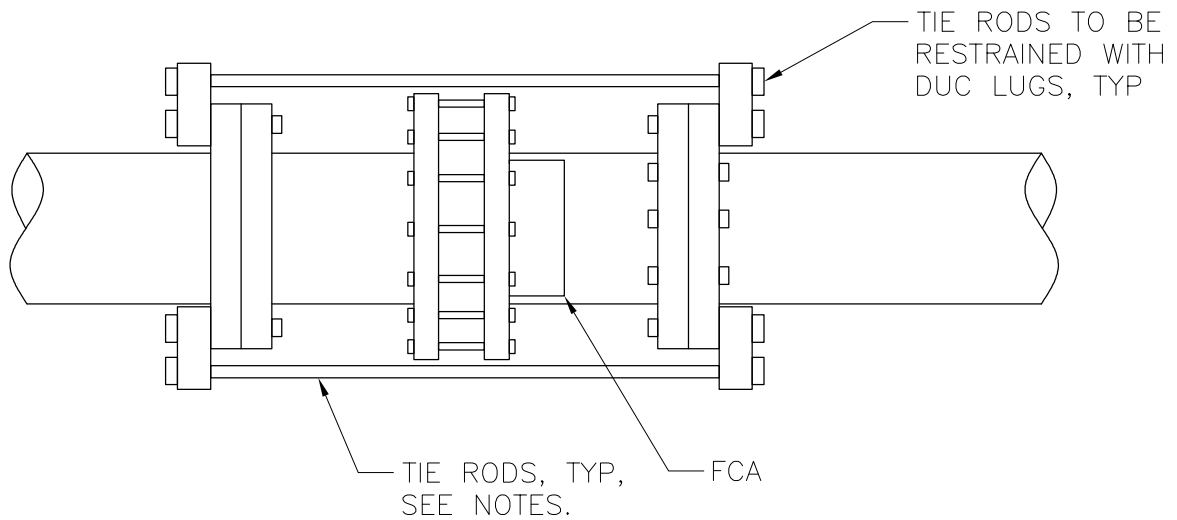
- NOTES:
1. THE MIDDLE RING LENGTH OF THE FLEXIBLE COUPLING SHALL BE AS SPECIFIED.
 2. THE CONTRACTOR SHALL DETERMINE THE LENGTH "J" (COUPLING BOLT LENGTH) FROM MANUFACTURER'S CATALOGS USING THE SPECIFIED MIDDLE RING LENGTH.
 3. "G" = MANUFACTURER'S RECOMMENDED SPACE BETWEEN ENDS OF PIPE.
 4. "C" = $J+Z+1$ INCH, (ROUND THIS VALUE UP TO NEXT EVEN INCH), MINIMUM. (FOR Z DIMENSIONS, SEE 40 05 00-43B LUG SCHEDULE)
 5. "D" = $2C+6$ INCHES.
 6. THE ROD LENGTH = $2L+2C+2G+D$.
 7. SIMILAR TO TYPICAL THRUST TIE DETAIL EXCEPT AS NOTED.

**TYPICAL THRUST TIE DETAIL FOR STEEL
PIPE-DUAL COUPLINGS**

**TYPICAL THRUST TIE DETAILS FOR STEEL
PIPE-SINGLE & DUAL COUPLINGS**

NTS

40 05 00-43A



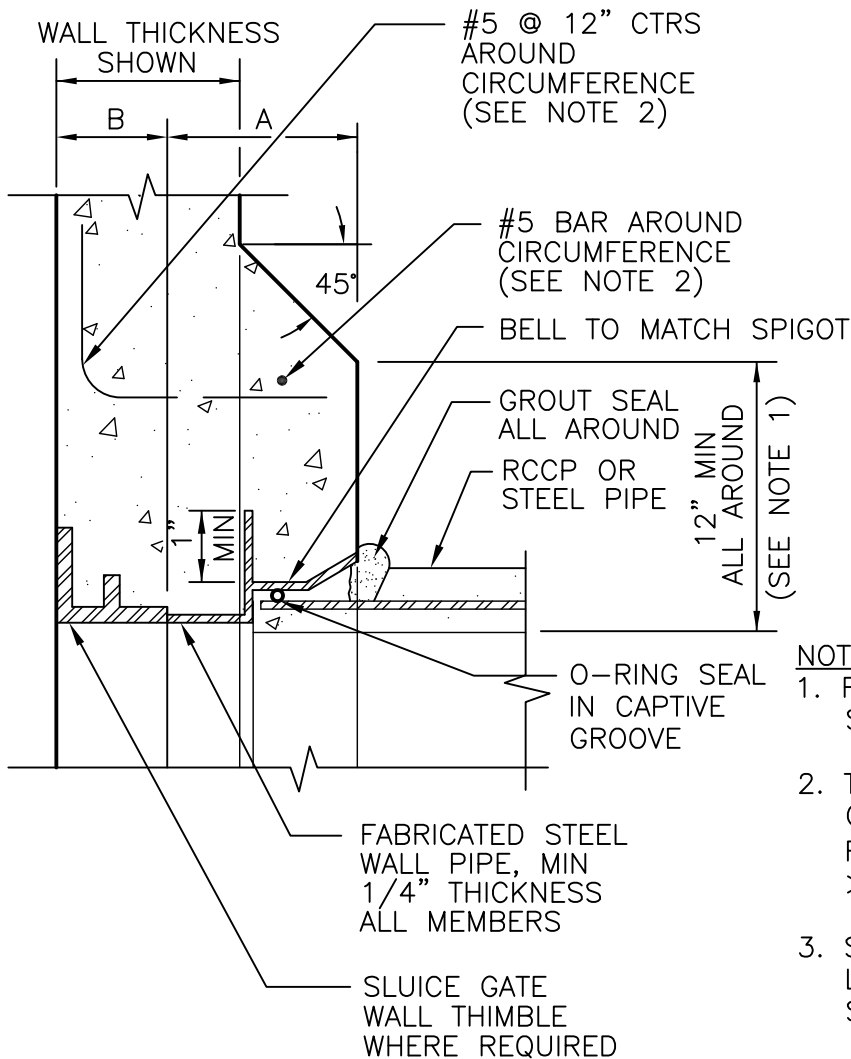
NOTES:

1. DUC LUG AND FLANGES TO BE DUCTILE IRON PER AWWA C153. TIE-ROD SHALL BE COR-TEN PER AWWA C600.
2. TIE RODS TO BE 5/8-IN DIA. AND A MINIMUM OF 2 TIE RODS REQUIRED FOR PIPE LESS THAN 12-INCH DIAMETER.

RESTRAINED FLANGED COUPLING ADAPTER (FCA)

NTS

40 05 00-43B



FITTING SCHEDULE		
PIPE DIAMETER	MINIMUM WALL FITTING LENGTH	MINIMUM WALL THIMBLE
	A	B
16"-36"	8"	8"
42"-54"	9"	8"
60"	10"	8"
96"	12"	NA

NOTES:

1. FOR REINF OF PENETRATION SEE STRUCTURAL DRAWINGS.
2. THICKENED WALL SECTION AND CIRCUMFERENTIAL REBAR NOT REQ'D WHEN WALL THICKNESS > A PLUS B.
3. SEE SECTION 15060 FOR JOINT LENGTH REQUIREMENTS AT STRUCTURES

NOTES

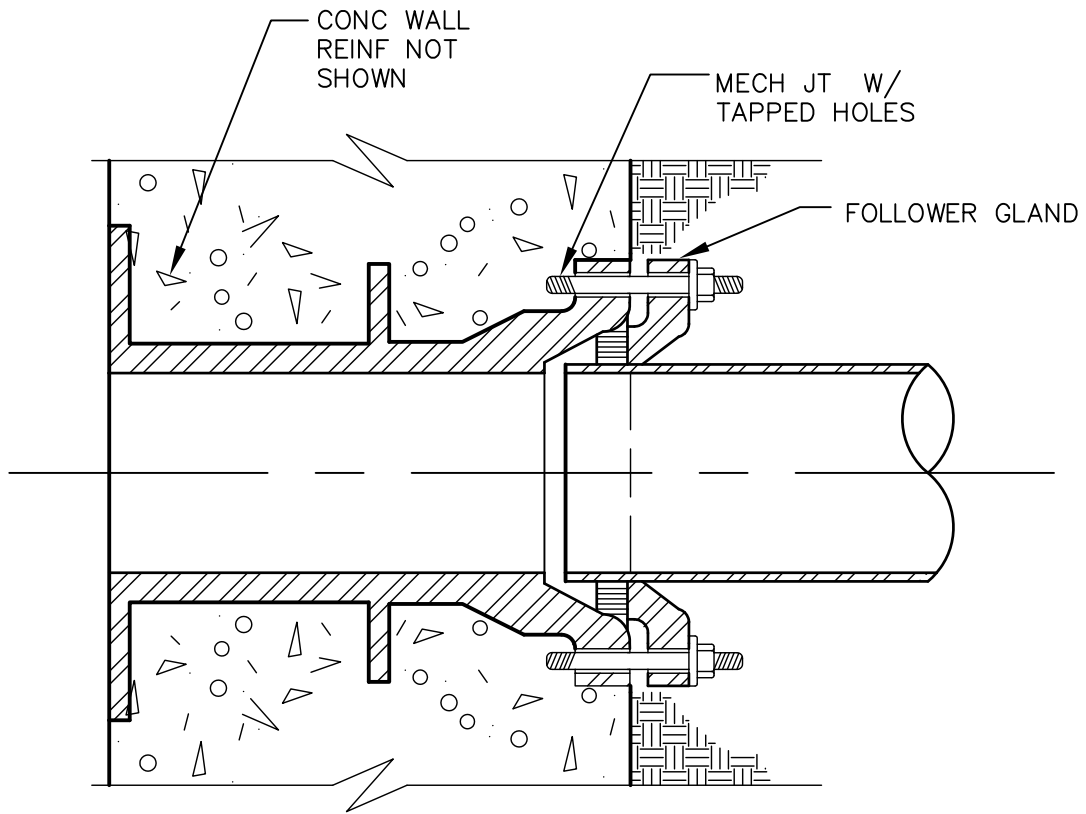
1. FOR REINF OF PENETRATION SEE
2. ADDITIONAL WALL THICKNESS "A" AS REQ'D BY SLEEVE INSULATOR/SUPPORT AND MODULAR MECHANICAL SEAL SYSTEM MFR
3. ADDITIONAL CIRCUMFERENTIAL REBAR NOT REQ'D WHEN A=0
4. SEE SECTION 15060 FOR JOINT LENGTH REQUIREMENTS AT STRUCTURES
5. TEMPORARILY FULLY SUPPORT AND CENTER PIPE PRIOR TO INSTALLATION OF SLEEVE INSULATOR/SUPPORT AND MODULAR MECHANICAL SEAL SYSTEM

PCCP/STEEL WALL THIMBLE CONNECTION

NTS

40 05 00-51





BURIED DIP WALL CONNECTION

NTS

40 05 00-52

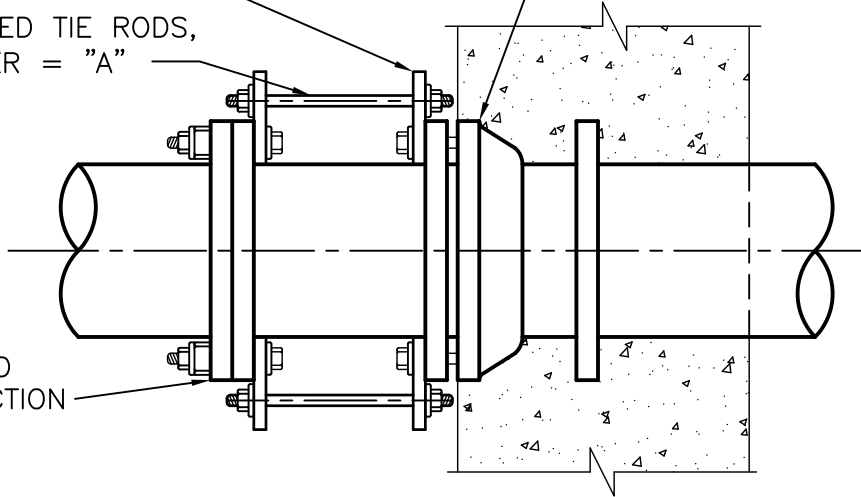


FABRICATED GUSSET PLATE
FOR ALIGNING MJ & FLG
BOLT HOLES, TWO BOLTS PER PLATE
THICKNESS = "D"

THREADED TIE RODS,
DIAMETER = "A"

MECHANICAL JOINT WALL
PIPE WITH TAPPED HOLES

FLANGED
CONNECTION



PIPE SIZE	"D"	"A"	MAX PRESSURE	
			2-RODS	3-RODS
2	3/8	5/8	200	—
2 1/2	3/8	5/8	200	—
3	3/8	5/8	200	—
4	3/8	5/8	200	—
5	3/8	5/8	200	—
6	1/2	5/8	140	200
8	1/2	3/4	140	190
10	3/4	7/8	140	190
12	3/4	1	140	190
14	3/4	1	85	130
16	3/4	1 1/8	65	110
18	3/4	1 1/8	65	110
20	3/4	1 1/8	65	110
24	1	1 1/4	65	100

NOTE:

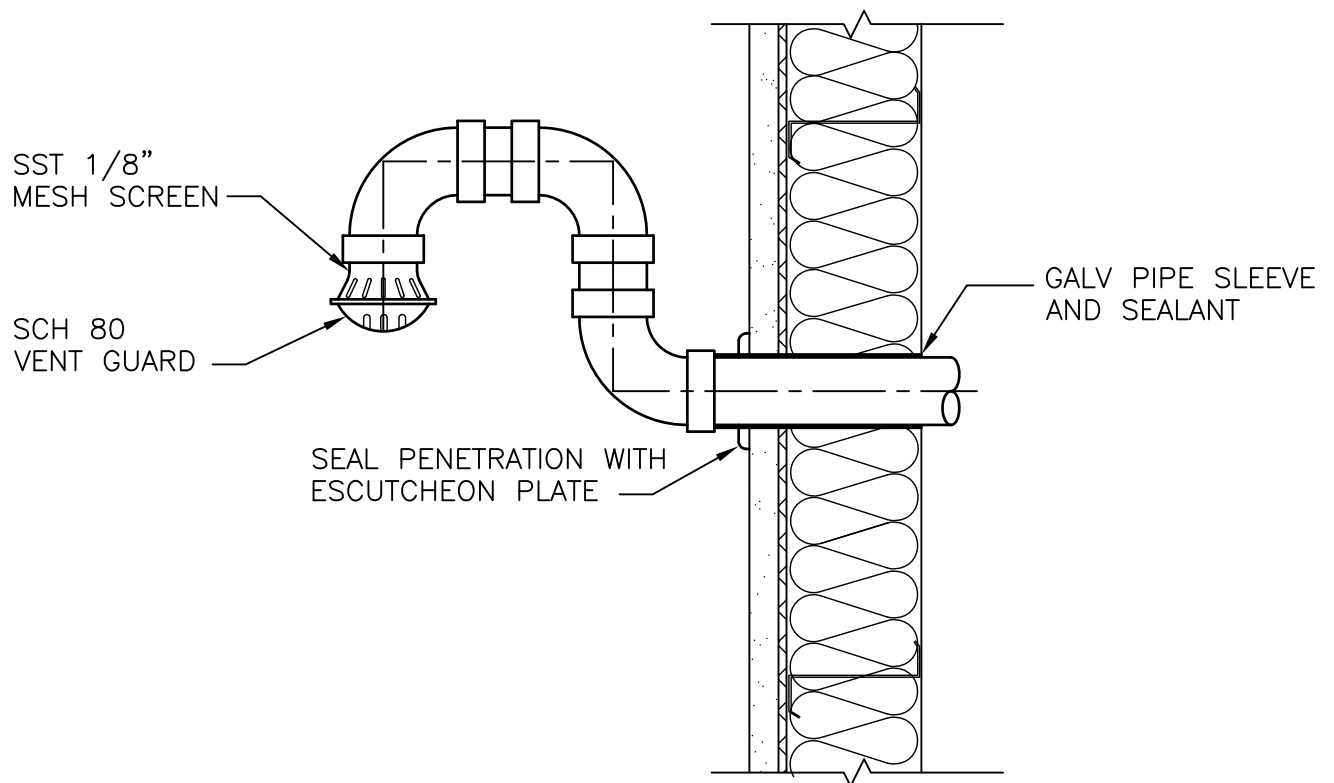
1. USE WHEN SPACE IS LIMITED AND YOU CANNOT INSTALL A DOUBLE MECHANICAL JOINT.

RESTRAINED MECHANICAL JOINT TO FLANGED JOINT

NTS

40 05 00-53



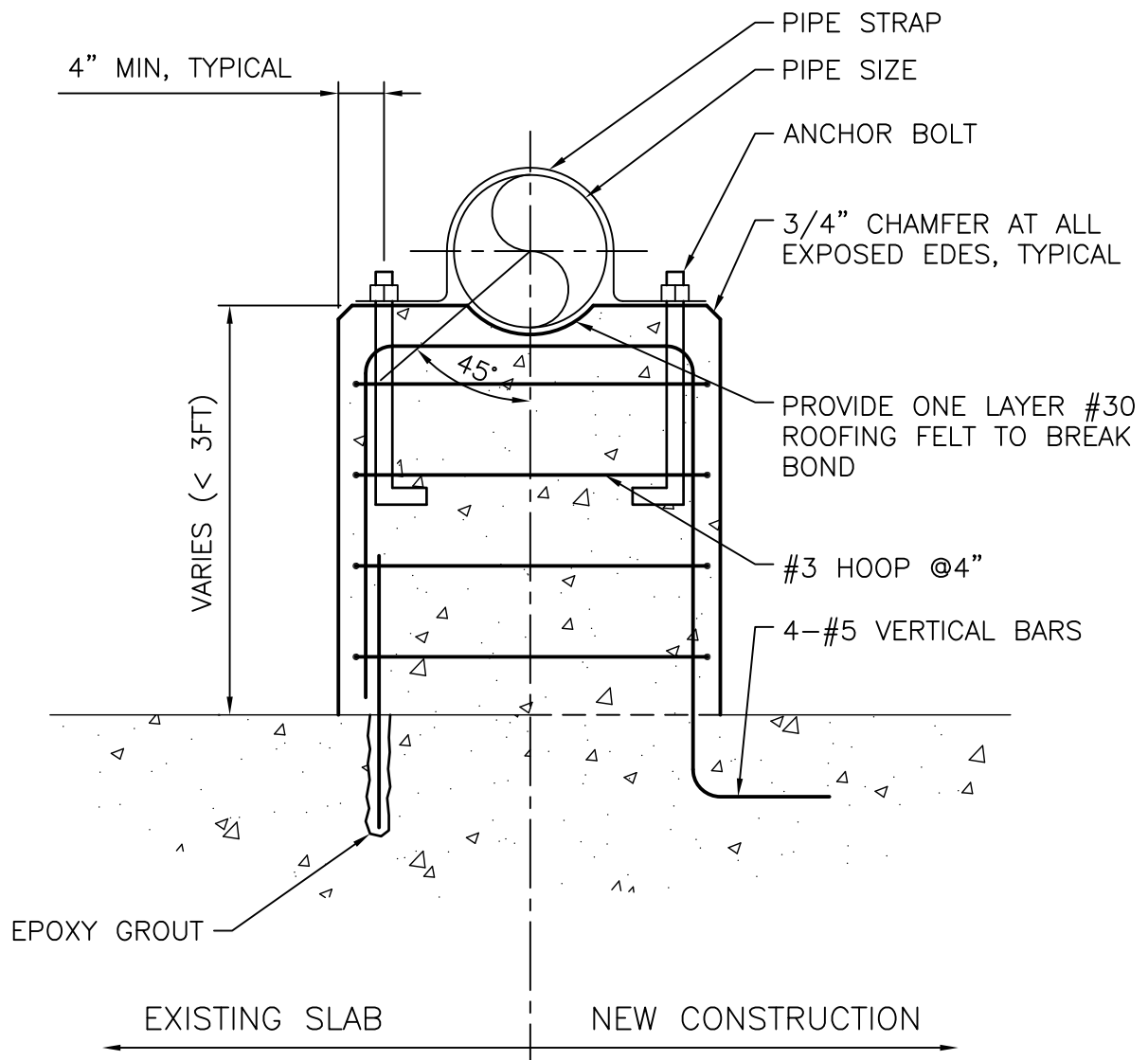


VENT PIPE THRU WALL

NTS

40 05 00-55



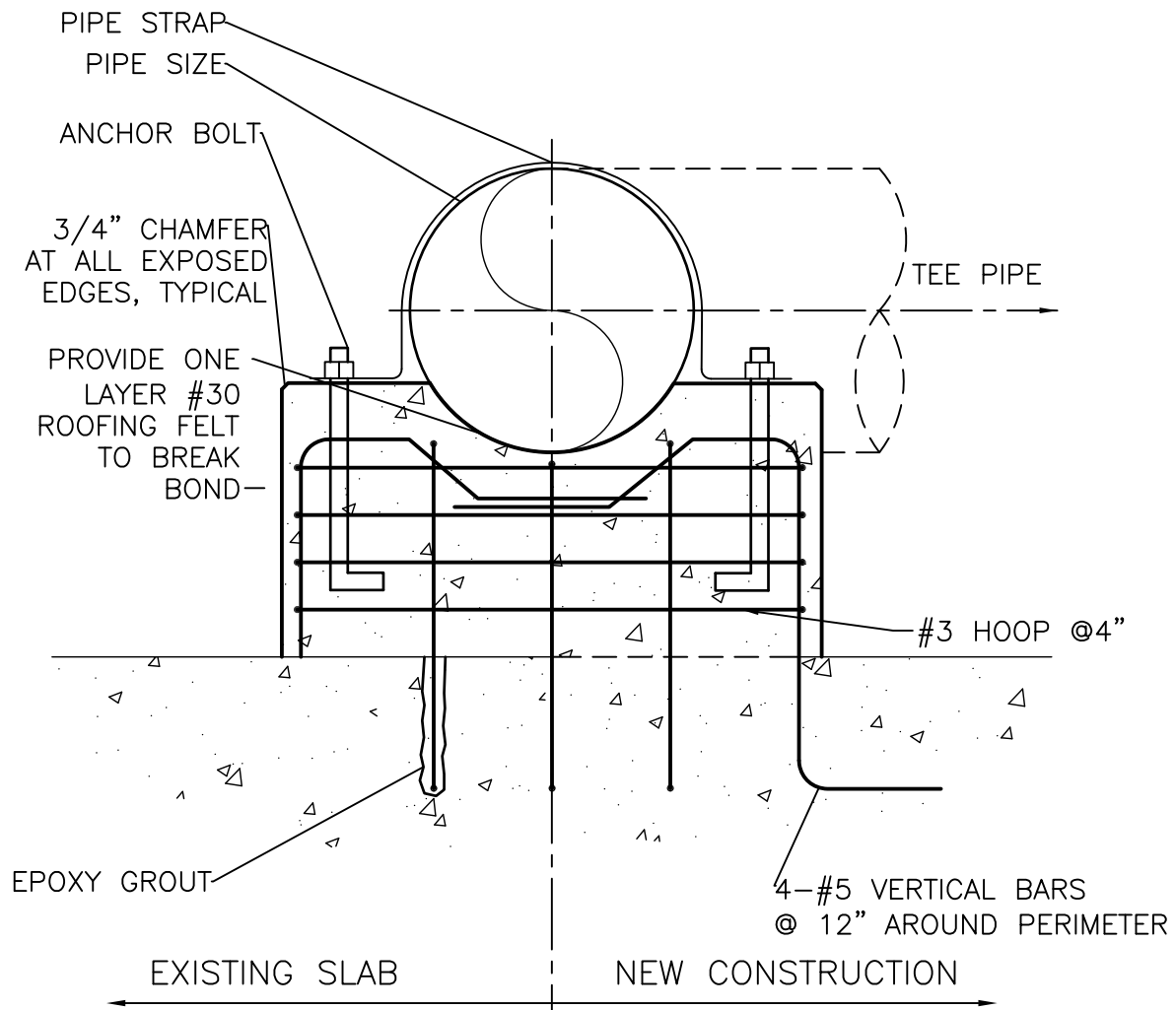


PIPE SIZE, DIA	PIPE STRAP	ANCHOR BOLTS, DIA	PEDESTAL THICKNESS
6"-12"	1/4"x2"	1/2"	12"
14"-24"	3/8"x2 1/2"	5/8"	16"
30"-48"	1/2"x3"	3/4"	24"

CONCRETE PEDESTAL SUPPORT

NTS

40 05 07-01



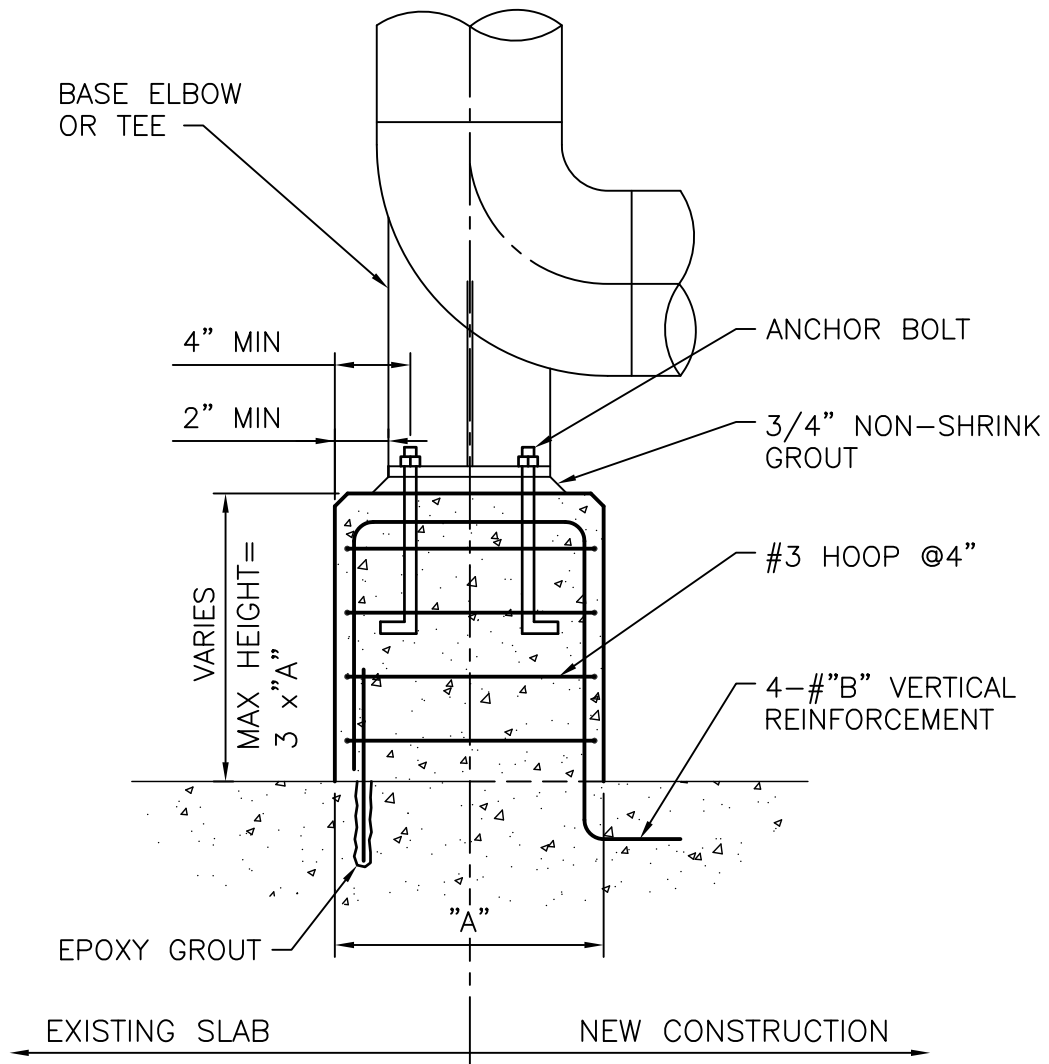
MAIN PIPE SIZE, DIA	PEDESTAL THICKNESS
14"–24"	36"
30"–48"	60"

CONCRETE PEDESTAL HEAVY SUPPORT

NTS

40 05 07-01A





PIPE SIZE, DIA	ANCHOR BOLTS, DIA	PEDESTAL DIMENSION "A"	"B" VERTICAL REINFORCEMENT
TO 6"	1/2"	12"	#5
TO 16"	3/4"	16"	#7
TO 30"	3/4"	20"	#8
36"	7/8"	36"	6-#8

NOTE:

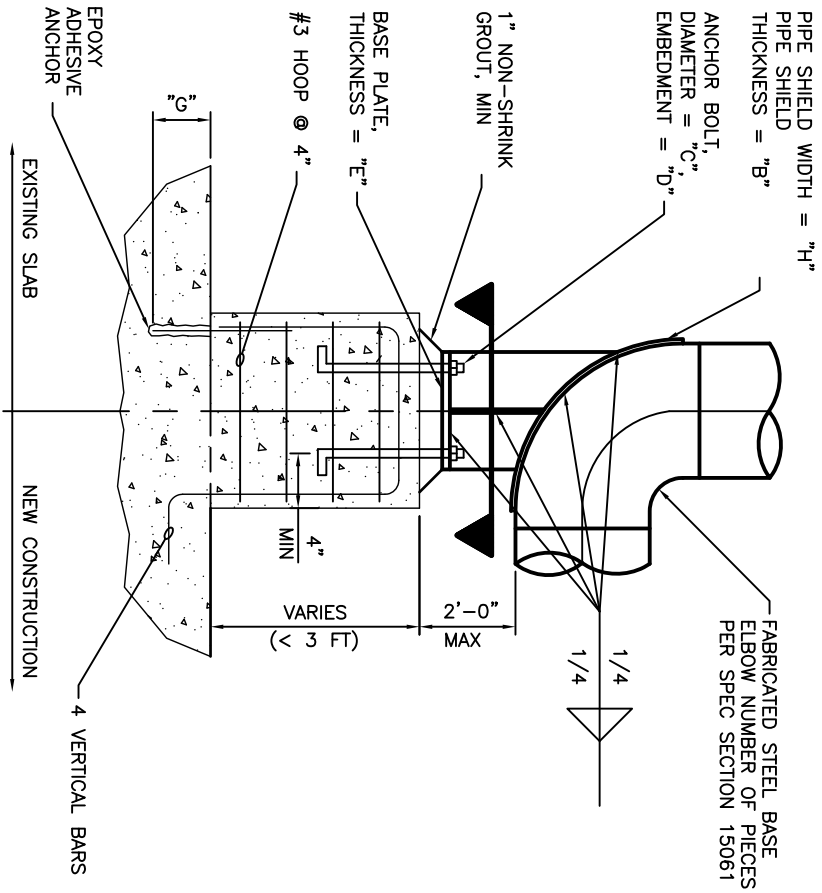
1. USE FOR DUCTILE IRON OR CAST IRON ONLY.

BASE ELBOW PEDESTAL

NTS

40 05 07-02



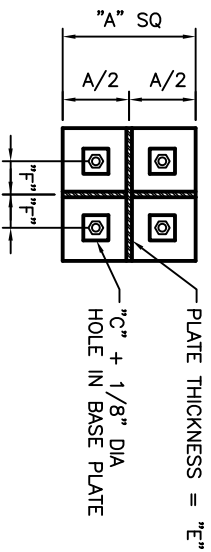


NOTE:
 1. VALUES ARE BASED ON MAXIMUM UNSUPPORTED LENGTH OF 10'-0".

FABRICATED STEEL BASE ELBOW

NTS

PIPE SIZE	A	B	C	D	E	F	G	H
8"	6"	5/16"	1/2"	8"	1/2"	2"	5"	2"
10"	6"			8"		2"		2 1/2"
12"	8"		5/8"	10"	5/8"	2 7/8"		3"
14"	10"					3 7/8"		3 1/2"
16"	10"	3/8"				3 7/8"	7 1/2"	4"
18"	12"			12"		4 7/8"		4 1/2"
20"	14"					5 7/8"		5"
24"	16"	1/2"	3/4"		3/4"	6 3/4"		6"
30"	20"	1/2"		14"		8 3/4"	10"	7 1/2"
36"	24"	5/8"				10 3/4"		9"
42"	28"	3/4"		16"		12 3/4"		10 1/2"
48"	30"	7/8"	1"		1"	13"		12"
54"	30"	7/8"		18"		13"		13 1/2"
60"	36"	1"				16"		15"



SECTION

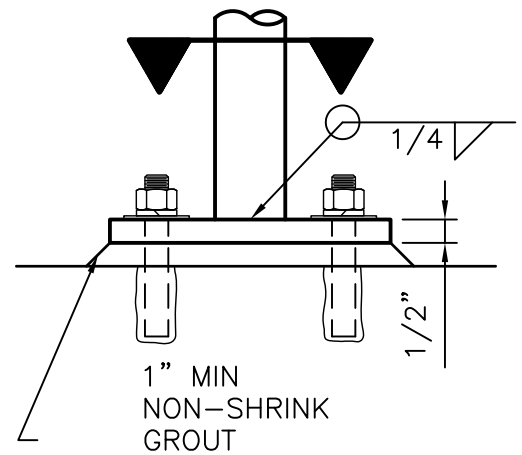
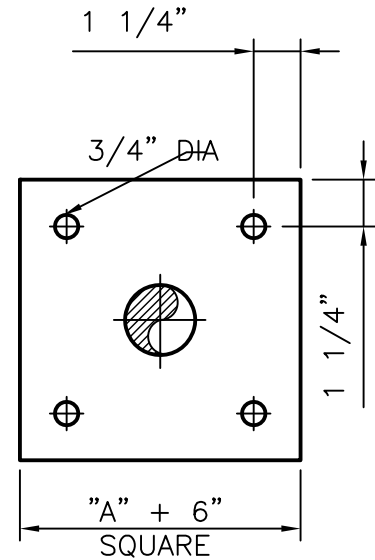
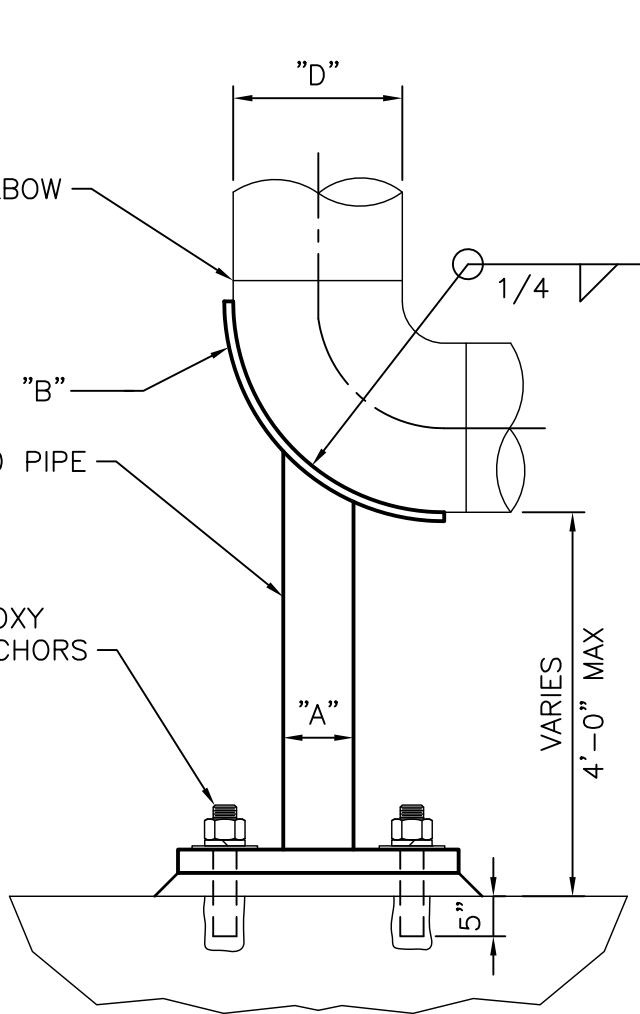
90° STEEL ELBOW

PIPE SHIELD
WIDTH = "H"

PIPE SHIELD
THICKNESS = "B"

SCHEDULE 40 PIPE

5/8" DIA EPOXY
ADHESIVE ANCHORS



BASE PLATE DETAIL

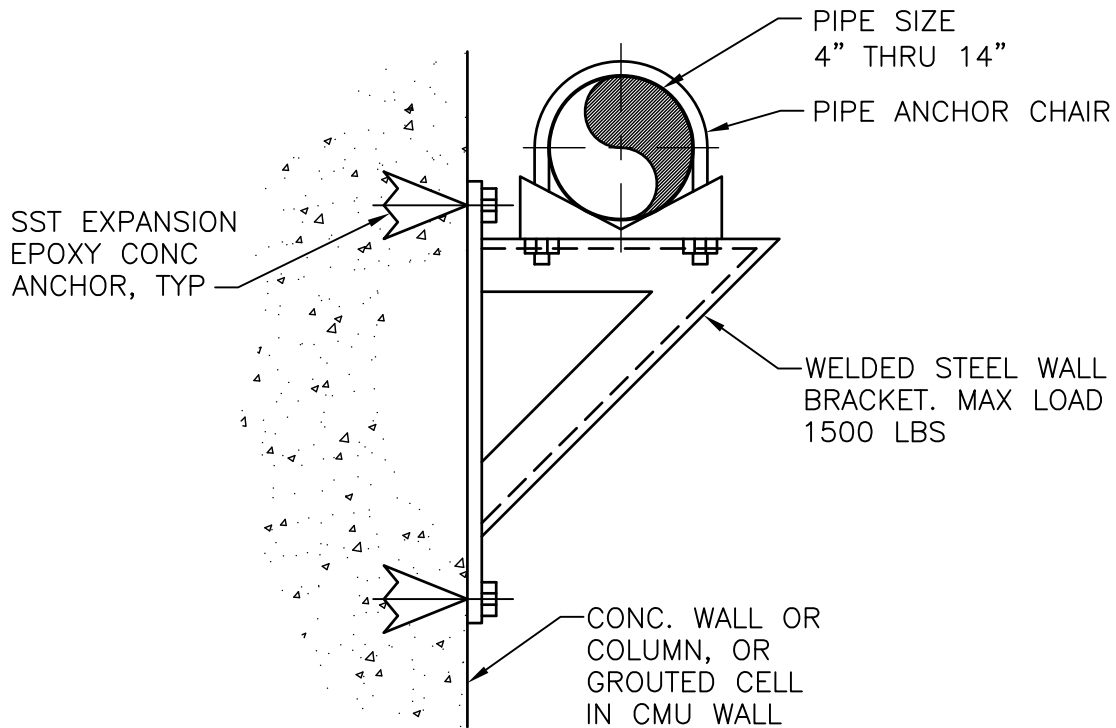
PIPE SIZE			
"A"	"B"	"D"	"H"
2"	-	4"	-
3"	-	6"	-
4"	5/16"	8"	2"
4"	5/16"	10"	2 1/2"
6"	5/16"	12"	3"

STEEL ELBOW SUPPORT

NTS

40 05 07-02B





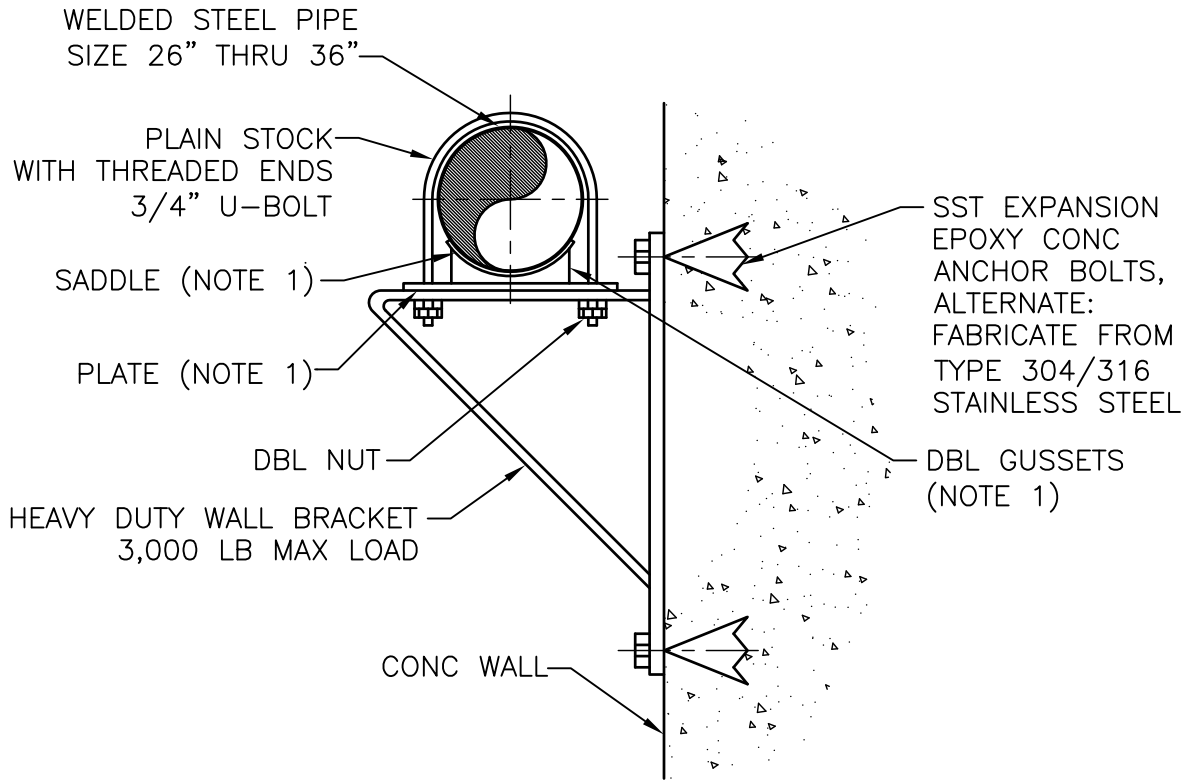
NOTE:

HOT DIP GALVANIZE AFTER FABRICATION
OR USE PAINT SYSTEM NO. 31 FOR
SUBMERGED APPLICATIONS PER SECTION
09905.

MEDIUM PIPE SUPPORT

NTS

40 05 07-05



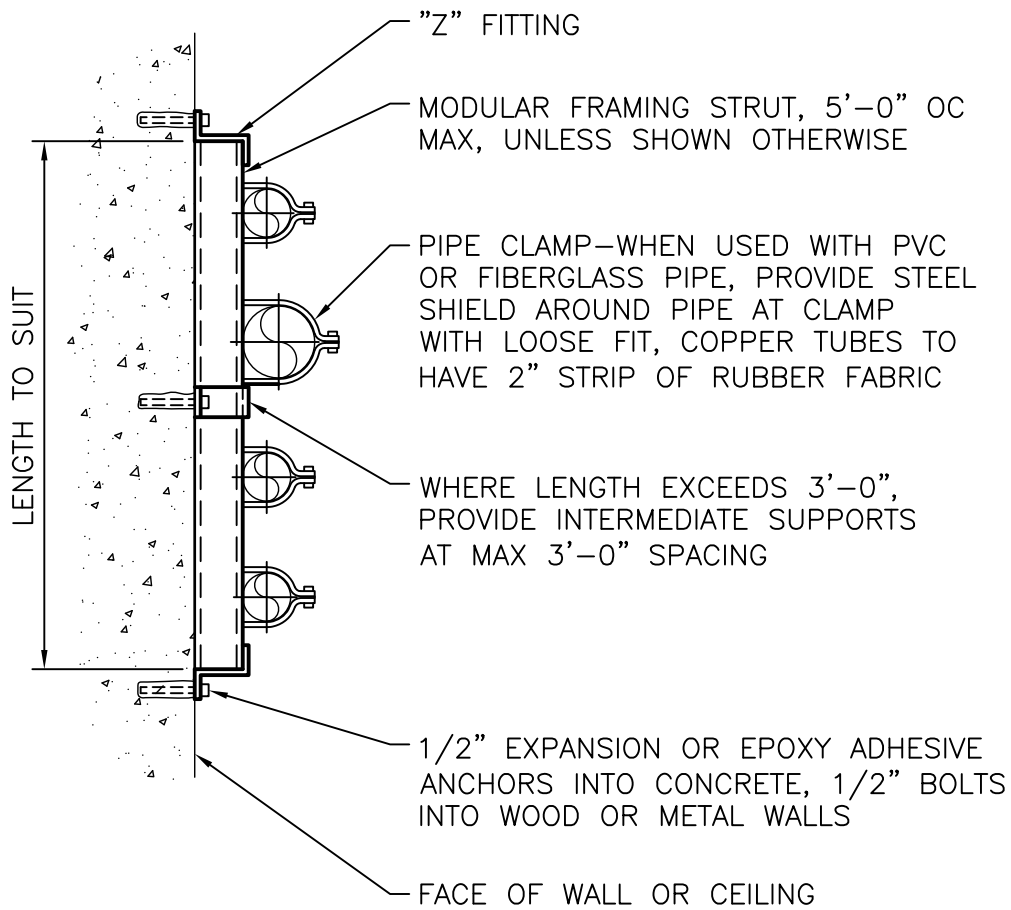
NOTE:

1. FABRICATE FROM STL, 3/8" MIN THICKNESS.
2. HOT DIP GALVANIZE AFTER FABRICATION, U-BOLT & NUTS, PIPE SADDLE ASSEMBLY & WALL BRACKET.
3. HOT DIP GALVANIZE AFTER FABRICATION OR USE PAINT SYSTEM NO. 31 FOR SUBMERGED APPLICATIONS, PER SECTION 09905.

HEAVY DUTY PIPE SUPPORT

NTS

40 05 07-07



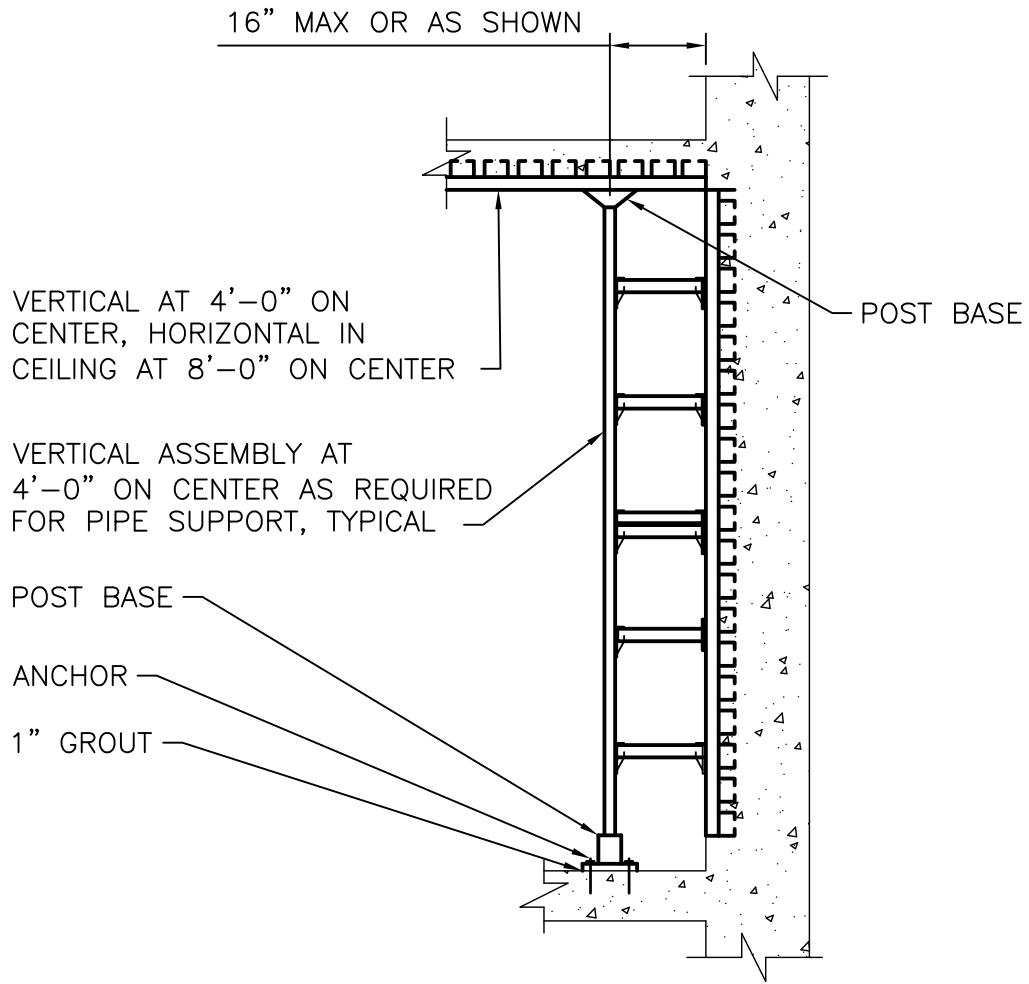
NOTES:

1. UP TO 8" DIAMETER PIPES ONLY.
2. MAXIMUM OF 3-6" PIPES.

SURFACE MOUNT MODULAR STRUT

NTS

40 05 07-08



CIP MODULAR FRAME

NTS

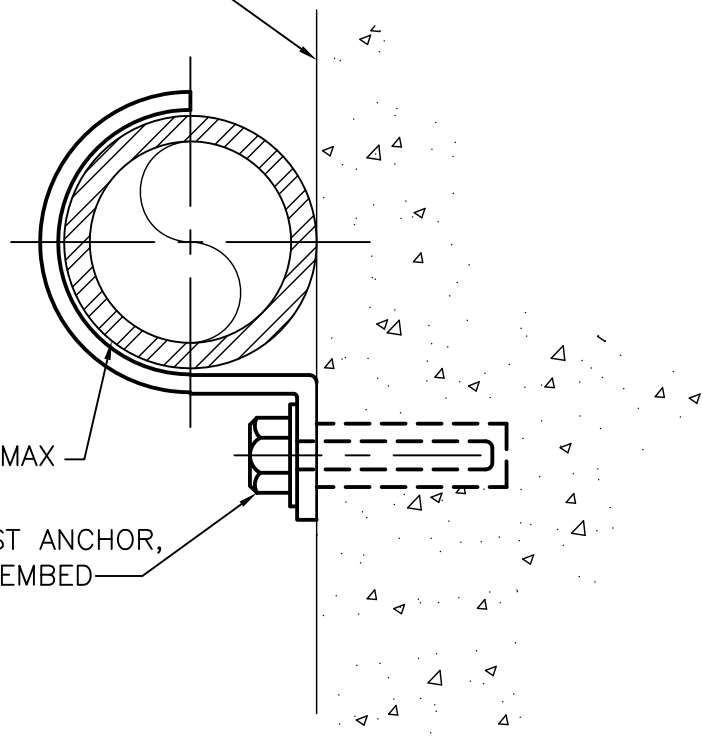
40 05 07-09



CONCRETE OR
MASONRY WALL

1" DIA, MAX

3/8" SST ANCHOR,
MIN 3" EMBED

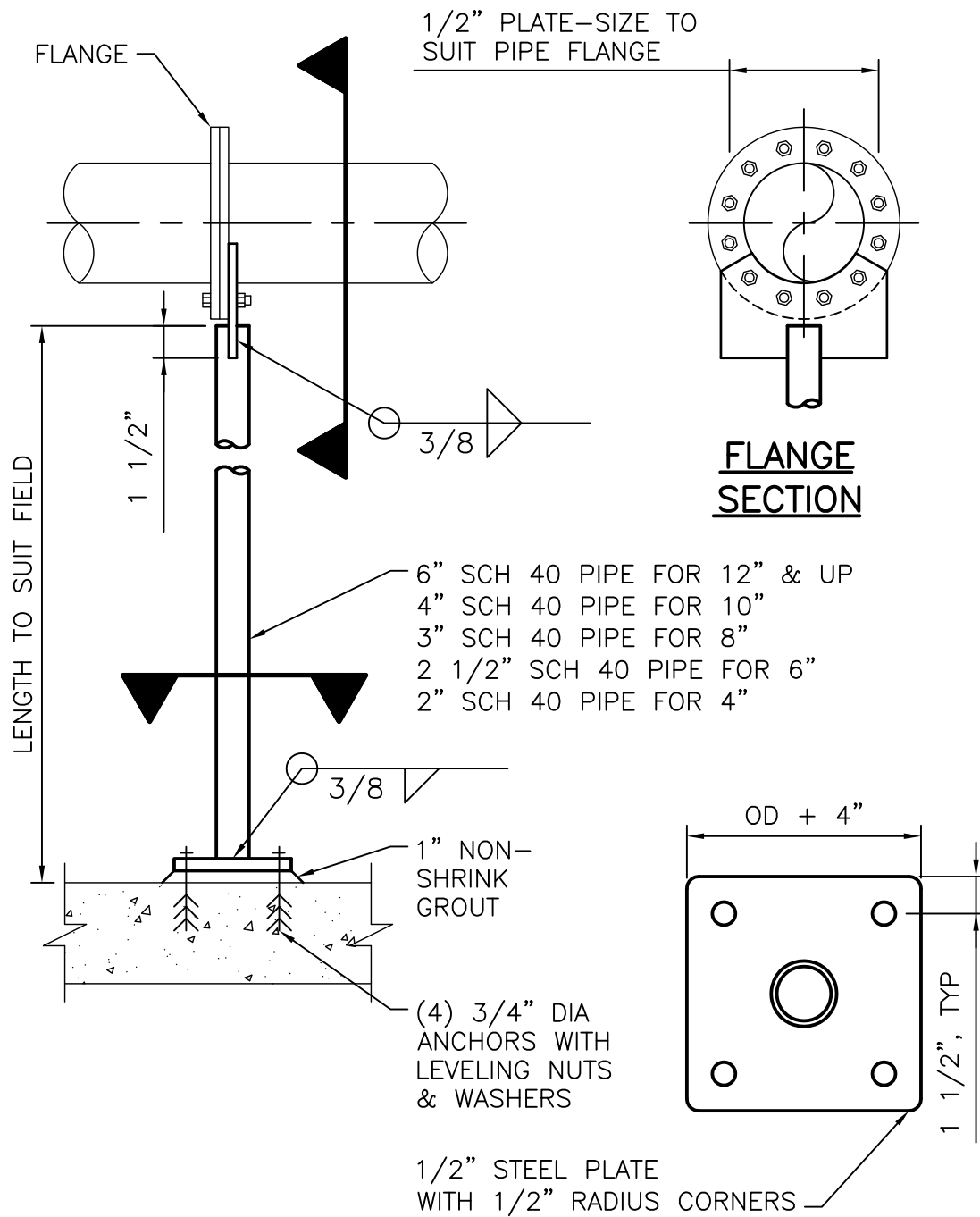


ONE HOLE CLAMP

NTS

40 05 07-10





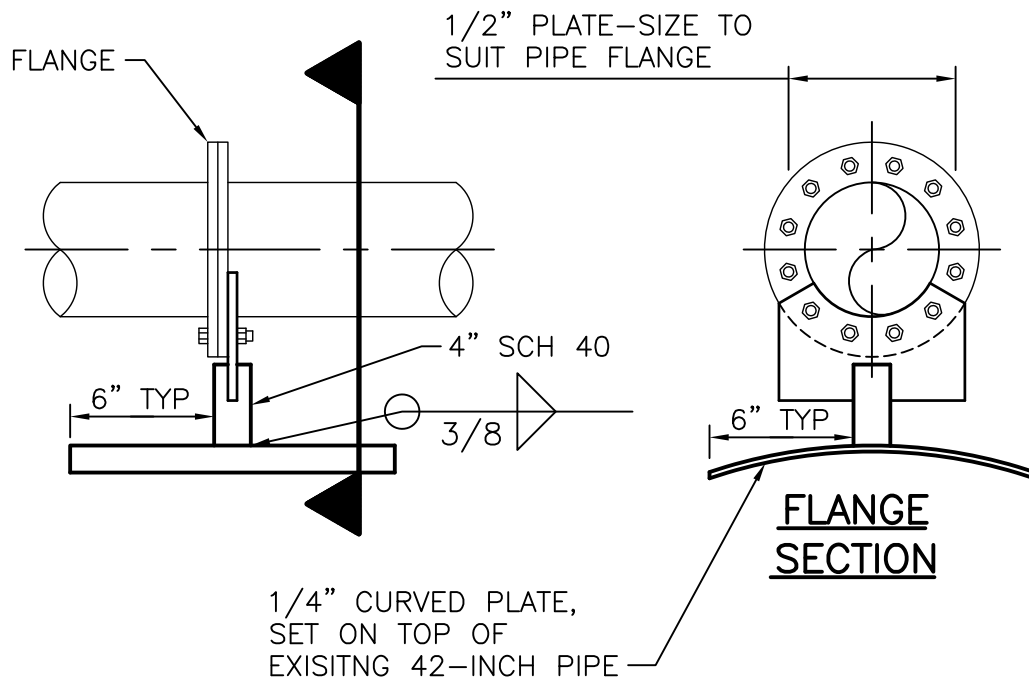
NOTE:

1. NOT INTENDED FOR THRUST RESTRAINT.
2. MATERIAL FOR ALL COMPONENTS SHALL BE HOT DIPPED GALVANIZED AFTER FABRICATION UNLESS NOTED OTHERWISE, REFERENCE SPECIFICATION SECTION 40 05 07.

FLANGED PIPE SUPPORT

NTS

40 05 07-11



NOTE:

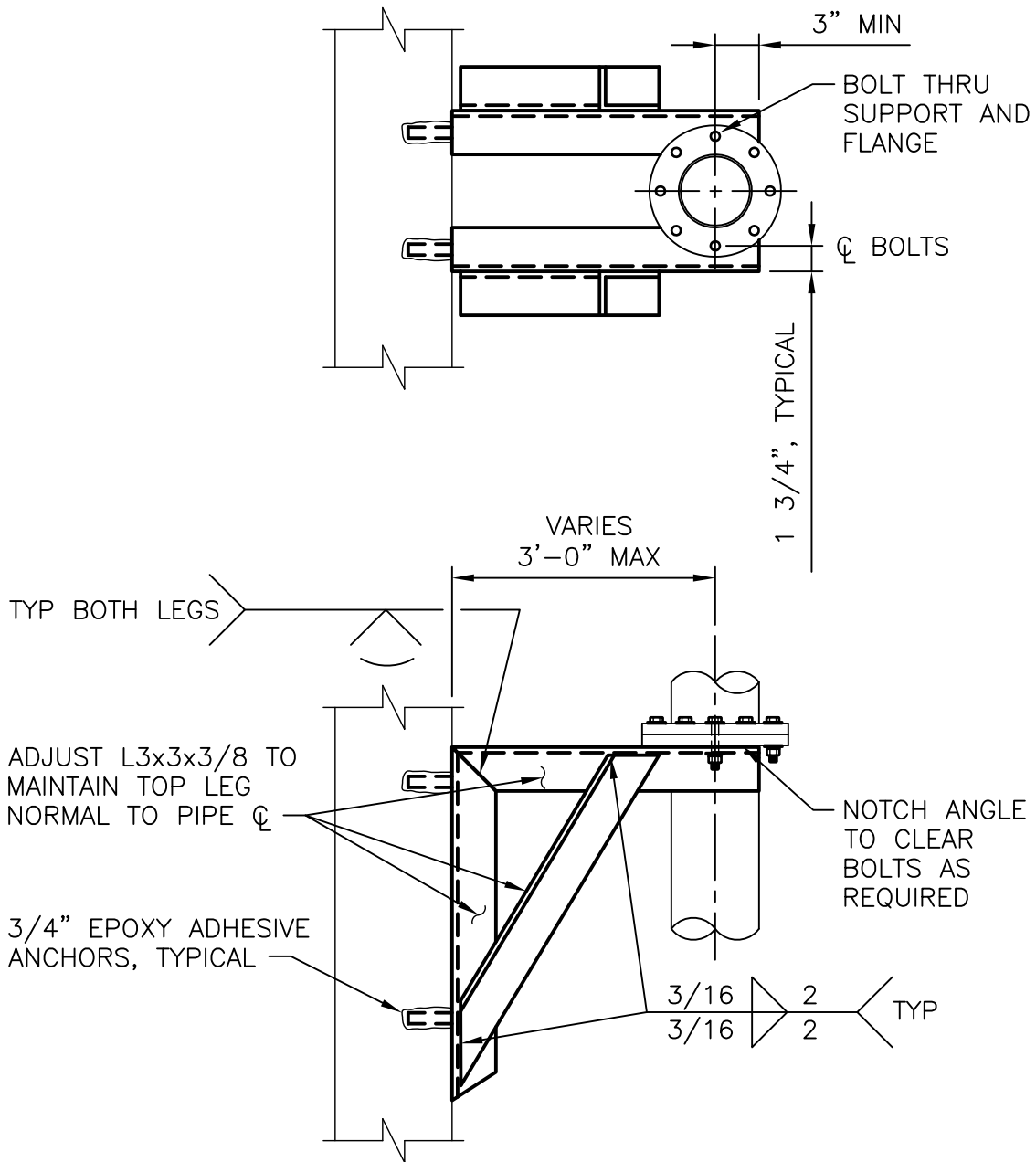
1. NOT INTENDED FOR THRUST RESTRAINT.
2. MATERIAL FOR ALL COMPONENTS SHALL BE HOT DIPPED GALVANIZED AFTER FABRICATION UNLESS NOTED OTHERWISE, REFERENCE SPECIFICATION SECTION 40 05 07.

FLANGED PIPE SUPPORT

NTS

40 05 07-11





RISER PIPE SUPPORT

NTS

40 05 07-12

$\frac{3}{8}$ " SST NUTS &
STUD TYPE
EXPANSION EPOXY
ANCHORS

CONCRETE WALL OR
GROUTED CELL IN
CMU WALLS

SPACER BLOCK
AS REQD

PIPE SIZE 4" MAX FOR
VERTICAL PIPES, 2" MAX
FOR HORIZONTAL PIPES

SHORT CLIP

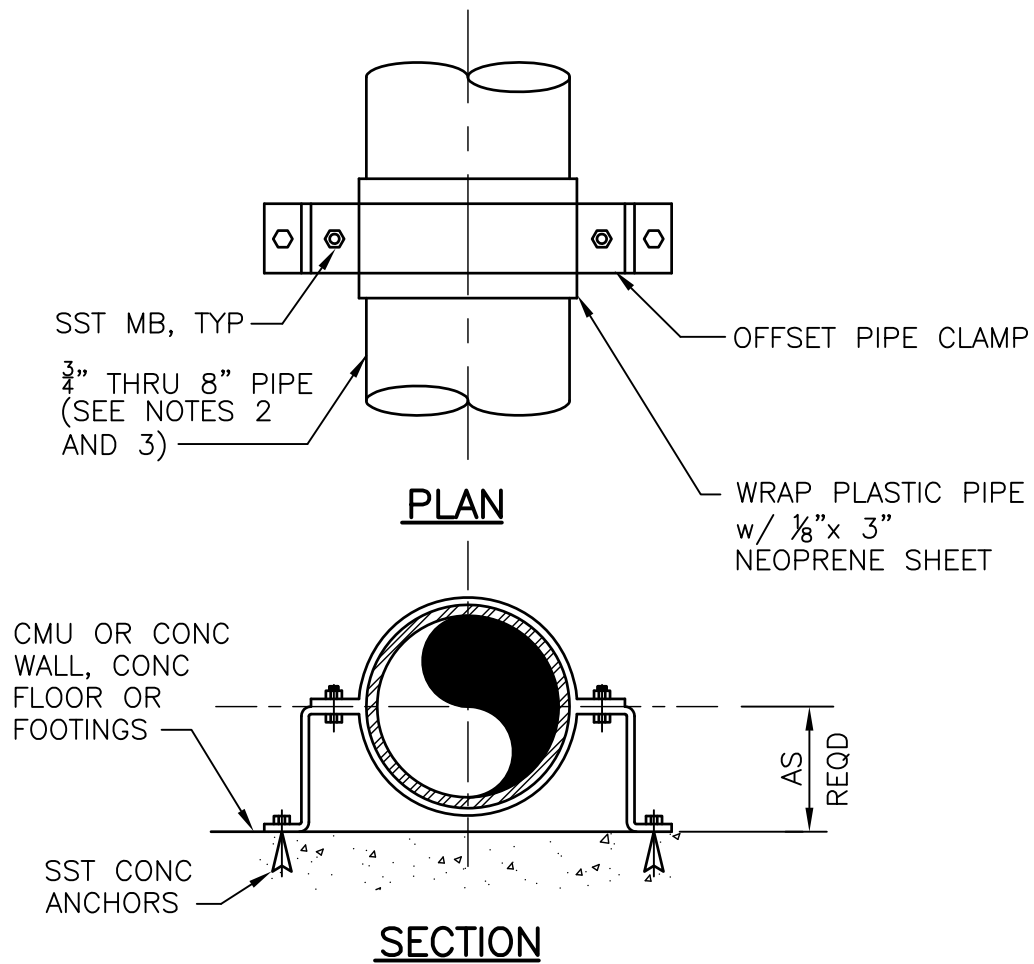
NOTE:

USE SST HARDWARE UNLESS OTHERWISE NOTED ON
DRAWINGS.

PIPE SUPPORT DETAIL

NTS

40 05 07-13



NOTES:

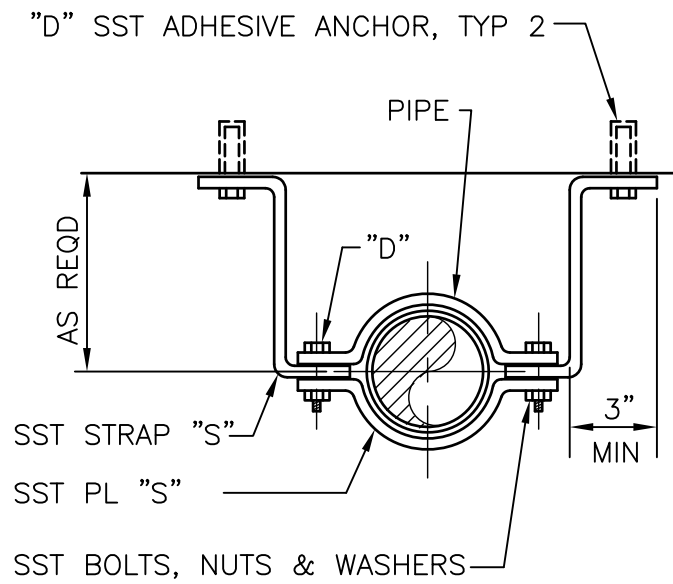
1. USE SST MATERIALS UNLESS OTHERWISE NOTED ON THE DRAWINGS.
2. NOT SUITABLE FOR PIPING OVER 3" DIAMETER THAT IS HORIZONTALLY MOUNTED ON VERTICAL WALLS OR CEILINGS.
3. FOR PIPES LARGER THAN 3" DIAMETER, USE ONLY FOR HORIZ PIPING MOUNTED TO FLOORS.

PIPE SUPPORT DETAIL

NTS

40 05 07-14





PIPE SIZE	"D"	"S"
≤ 2-1/2"	3/8"	1/4"x1"
3"-4"	5/8"	1/4"x1-1/2"
6"-8"	3/4"	3/8"x2"
10"-14"	7/8"	5/8"x2"

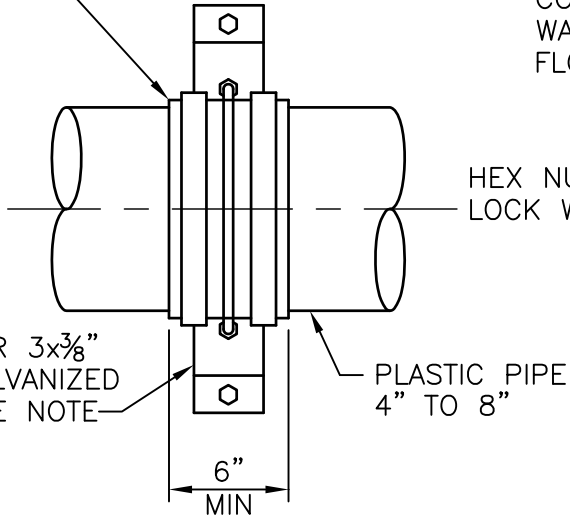
OFFSET PIPE SUPPORT

NTS

40 05 07-15



18 GA GALV
SHEET SLEEVE
STRAPPED
AROUND PIPE
w/ SST HOSE
CLAMPS SEE
NOTE



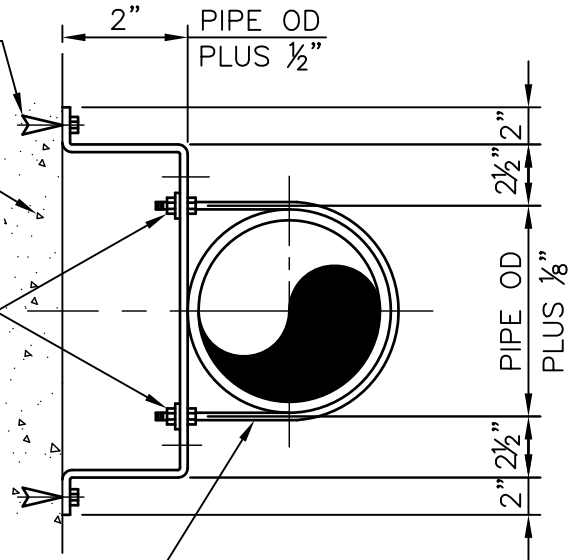
PLAN

$\frac{3}{8}$ " SST EPOXY
ANCHORS, TYP

CONC
WALL OR
FLOOR

HEX NUT w/
LOCK WASHER

$\frac{1}{4}$ " U-BOLT
GALVANIZED
SEE NOTE



SECTION

NOTE:

USE SST MATERIALS UNLESS OTHERWISE
NOTED ON THE DRAWINGS

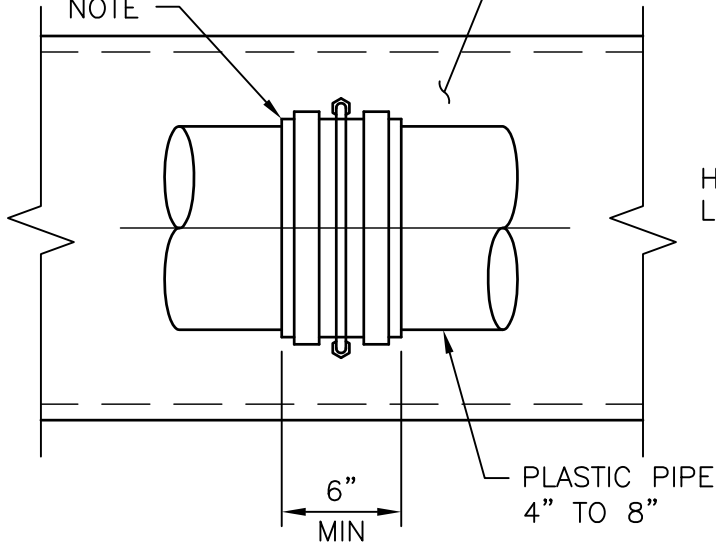
PLASTIC PIPE SUPPORT

NTS

40 05 07-16

18 GA GALV
SHEET SLEEVE
STRAPPED
AROUND PIPE
w/ SST HOSE
CLAMPS SEE
NOTE

CHANNEL SECTION

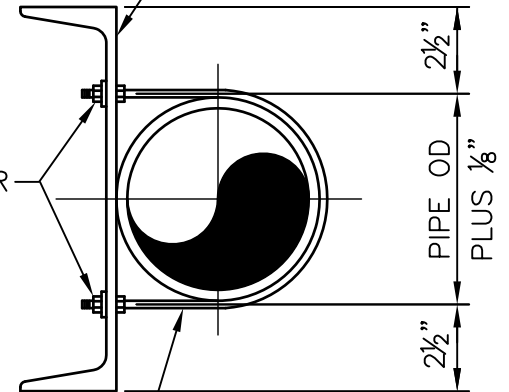


PLAN

HEX NUT w/
LOCK WASHER

CHANNEL SECTION

1/4" U-BOLT
GALVANIZED
SEE NOTE



SECTION

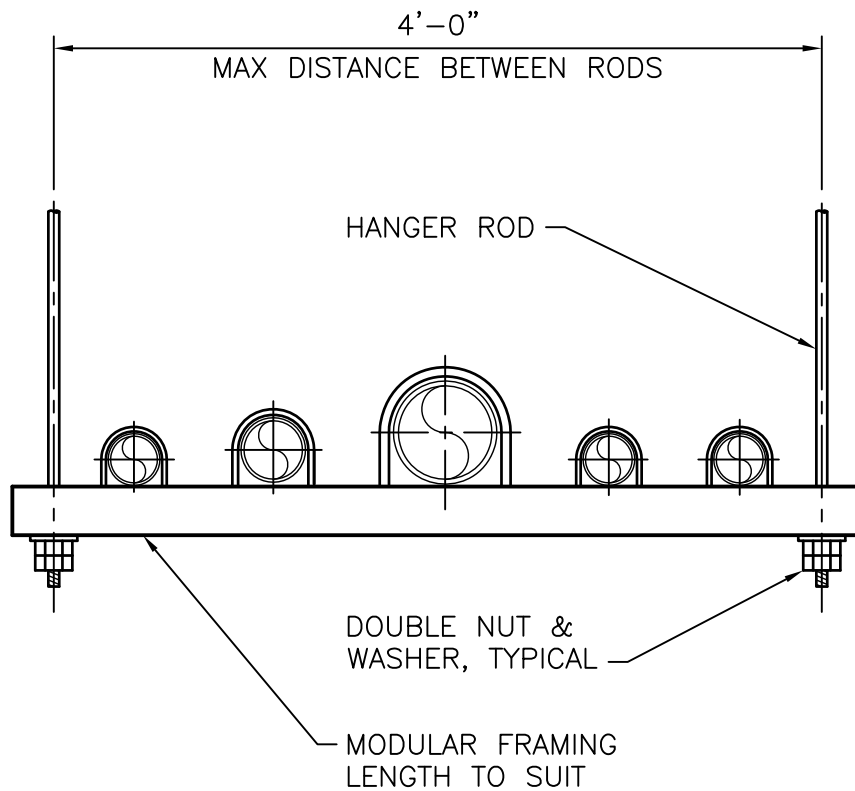
NOTE:

USE SST MATERIALS UNLESS OTHERWISE
NOTED ON THE DRAWINGS

PLASTIC PIPE SUPPORT CHANNEL CONNECTION

NTS

40 05 07-16A

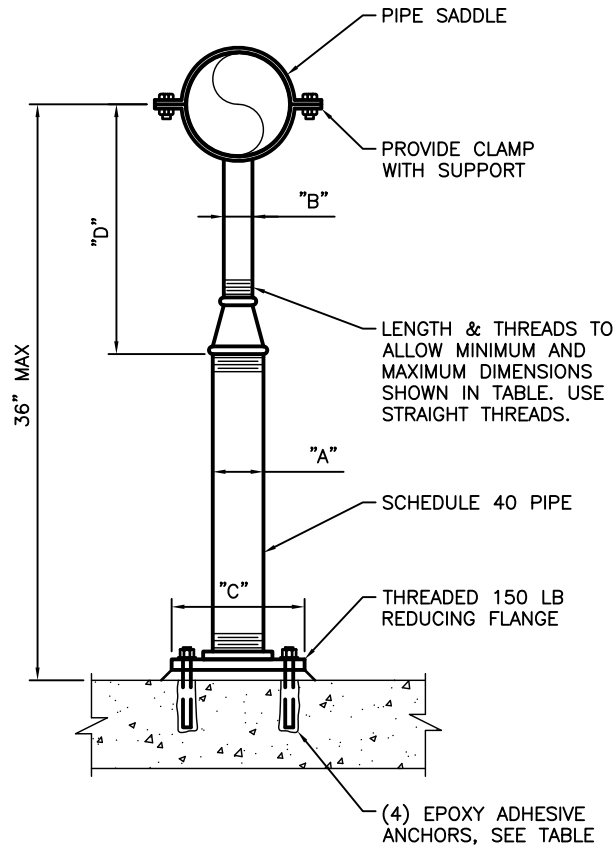


MODULAR TRAPEZE HANGER

NTS

40 05 07-17



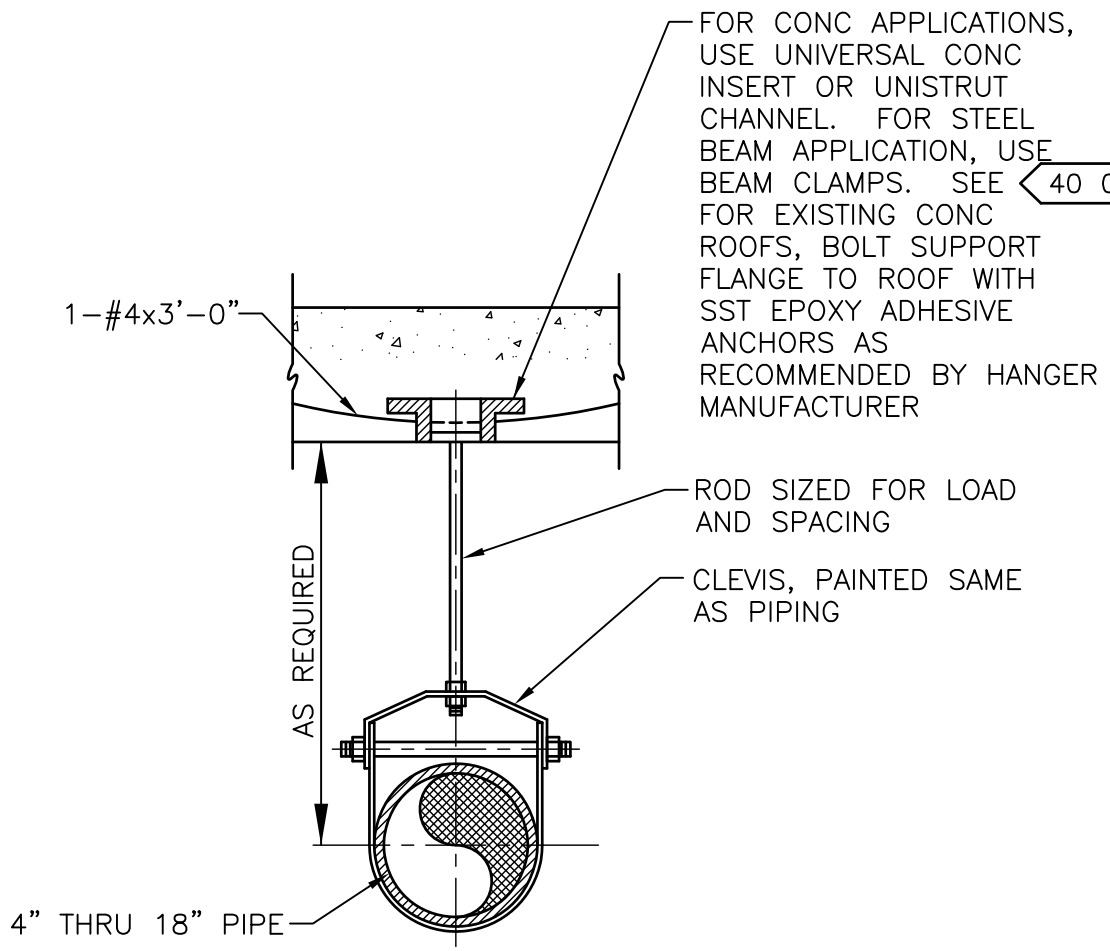


FLOOR PIPE SUPPORT SCHEDULE DIMENSIONS IN INCHES							
PIPE SIZE	"A"	"B"	"C"	"D"		ANCHORS	
				MINIMUM	MAXIMUM	DIA	EMBED
≤ 2 1/2	2 1/2	1 1/2	9	8	13	5/8	5
3	2 1/2	1 1/2	9	8 1/2	13 1/2	5/8	5
3 1/2	2 1/2	1 1/2	9	8 1/2	13 1/2	5/8	5
4	3	2 1/2	9	9 1/2	14	5/8	5
6	3	2 1/2	9	10 1/2	15 1/2	5/8	5
8	3	2 1/2	9	11 1/2	16 1/2	5/8	5
10	3	2 1/2	9	13 1/2	18 1/2	5/8	5
12	3	2 1/2	9	15	19 1/2	5/8	5
14	4	3	11	16 1/2	20 1/2	3/4	6 5/8
16	4	3	11	17 1/2	22 1/2	3/4	6 5/8
18	6	3 1/2	13 1/2	19 1/2	24	3/4	6 5/8
20	6	3 1/2	13 1/2	21	25 1/2	3/4	6 5/8
24	6	4	13 1/2	23 1/2	28 1/2	3/4	6 5/8
30	6	4	13 1/2	27	31 1/2	3/4	6 5/8
32	6	4	13 1/2	28 1/2	32 1/2	3/4	6 5/8
36	6	4	13 1/2	30 1/2	34 1/2	3/4	6 5/8

FLOOR PIPE SUPPORT

NTS

40 05 07-18



NOTE:

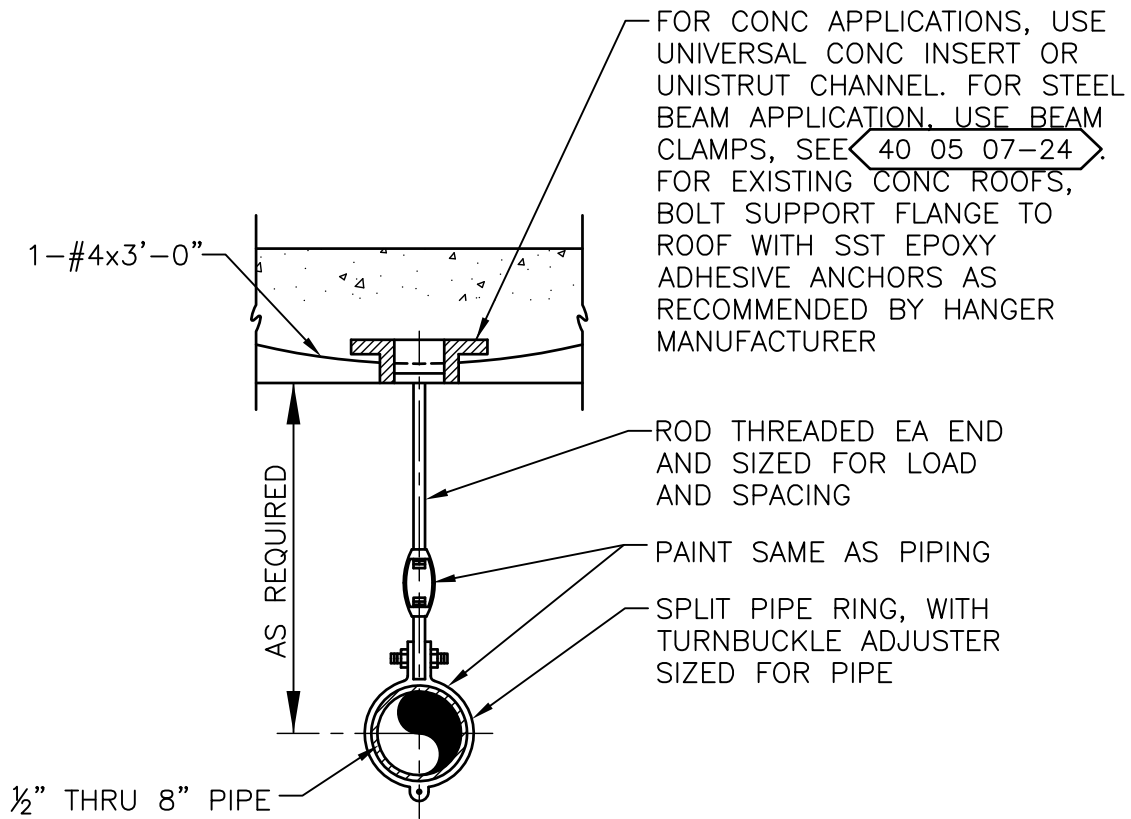
1. FOR INSULATED PIPES, USE GRINNELL FIG 167 OR ELCEN FIG 219 INSULATION PROTECTION SHIELD.
2. TOTAL LOADING ON EACH CONC. INSERT OR OTHER TYPE HANGER ROD ANCHOR SHALL NOT EXCEED MFR'S RECOMMENDED LOADINGS.

PIPE HANGER DETAIL

NTS

40 05 07-20





NOTES:

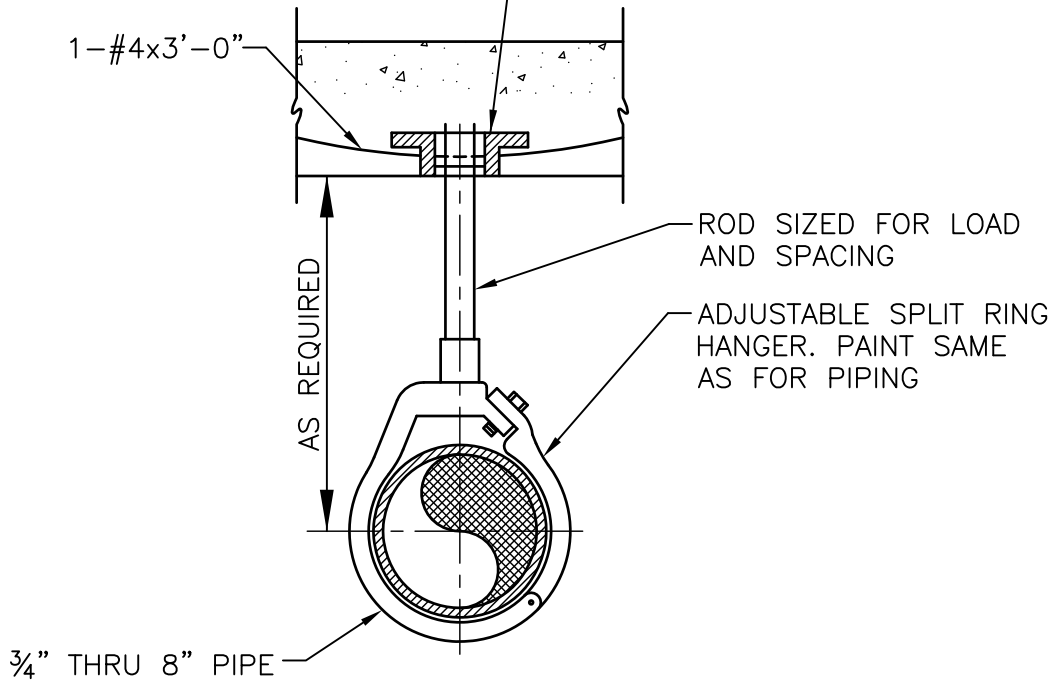
1. TOTAL LOADING ON EACH CONC. INSERT OR OTHER TYPE HANGER ROD ANCHOR SHALL NOT EXCEED MFR.'S RECOMMENDED LOADINGS.
2. USE ALL SST COMPONENTS UNLESS OTHERWISE NOTED ON THE DRAWINGS.

PIPE HANGER DETAIL

NTS

40 05 07-21

FOR CONC APPLICATIONS, USE UNIVERSAL CONC INSERT OR UNISTRUT CHANNEL.
 FOR STEEL BEAM APPLICATION, USE BEAM CLAMPS, SEE 40 05 07-24. FOR
 EXISTING CONC ROOFS, BOLT SUPPORT FLANGE TO ROOF WITH SST EPOXY
 ADHESIVE ANCHORS AS RECOMMENDED BY
 HANGER MANUFACTURER

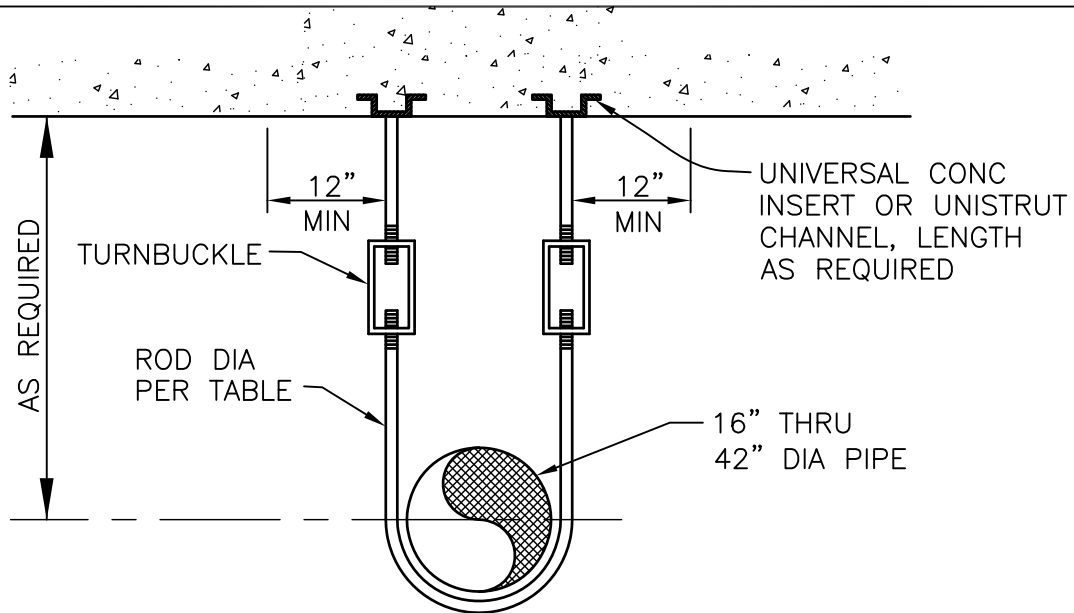


NOTE:
 TOTAL LOADING ON EACH CONC INSERT OR OTHER
 TYPE HANGER ROD ANCHOR SHALL NOT EXCEED
 MFR'S RECOMMENDED LOADINGS.

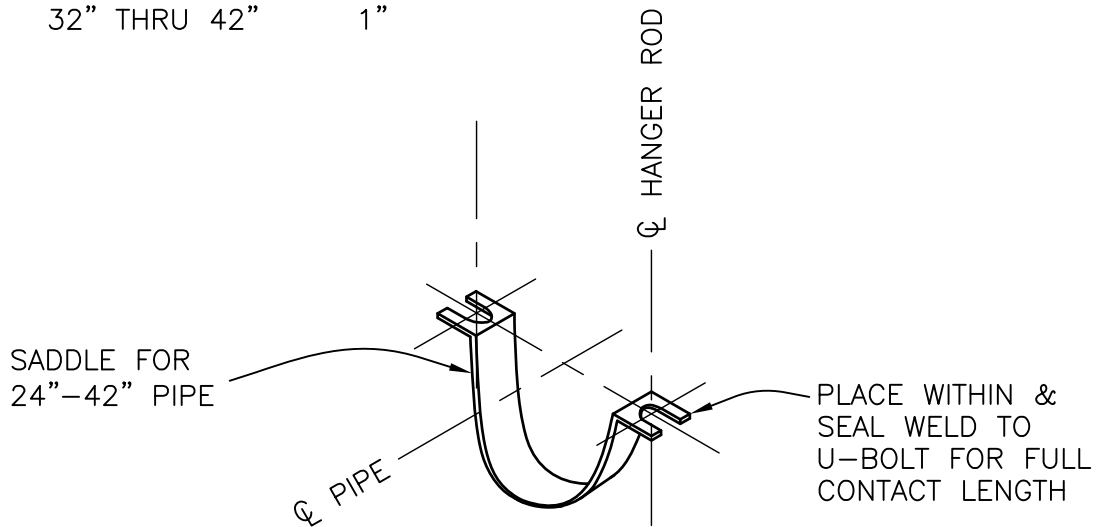
PIPE HANGER DETAIL

NTS

40 05 07-22



PIPE DIA	ROD DIA
16" AND 18"	1/2"
20" THRU 24"	5/8"
26" THRU 30"	3/4"
32" THRU 42"	1"



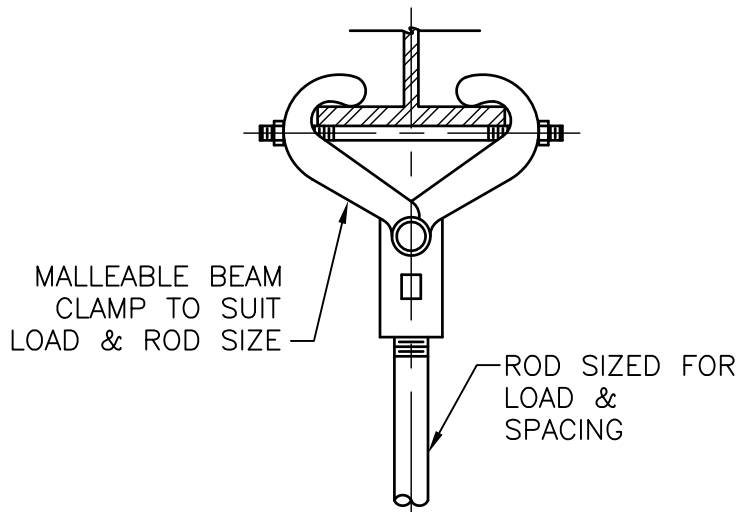
NOTES:

1. HANGERS FOR PIPES 24" & LARGER SHALL BE EQUIPPED WITH 1/4"x4" STEEL PLATE SADDLE (SEE DETAIL).
2. HOT DIP GALV AFTER FABRICATION.
3. SPACE HANGERS 12'-0" OC MAXIMUM.

PIPE HANGER DETAIL

NTS

40 05 07-23



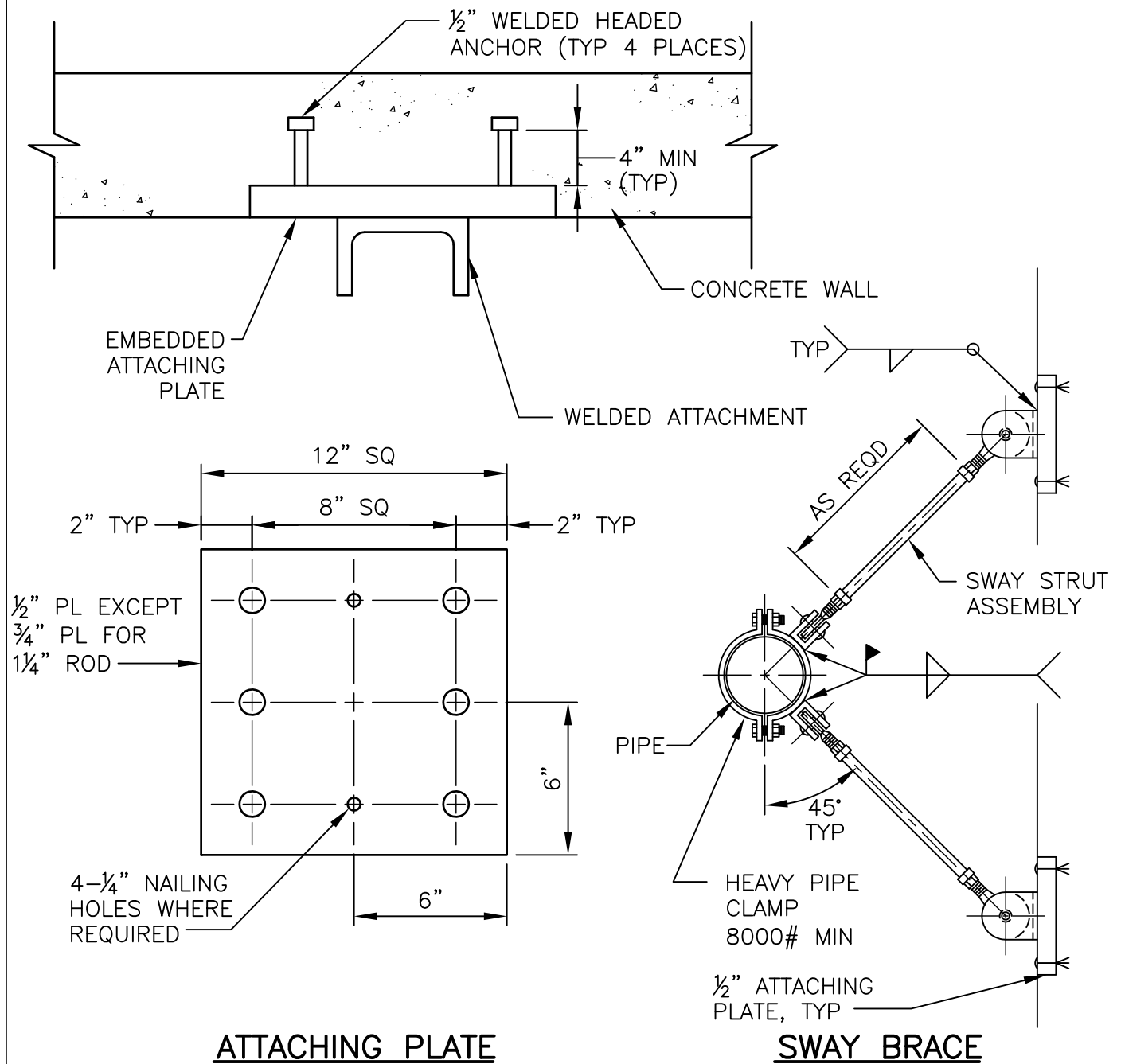
NOTE:

TOTAL LOADING OF EACH BEAM CLAMP
SHALL NOT EXCEED MFR RECOMMENDED
LOADINGS.

BEAM CLAMP

NTS

40 05 07-24



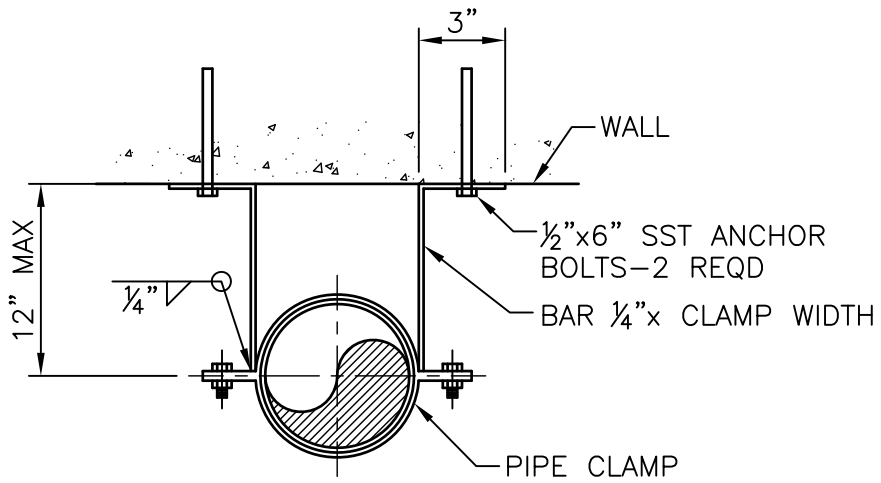
NOTE:
 USE ALL SST MATERIALS IN WET OR
 SUBMERGED SERVICES, UNLESS
 OTHERWISE NOTED ON THE
 DRAWINGS.

TYPE 'A' SWAY BRACE ASSEMBLY

NTS

40 05 07-25



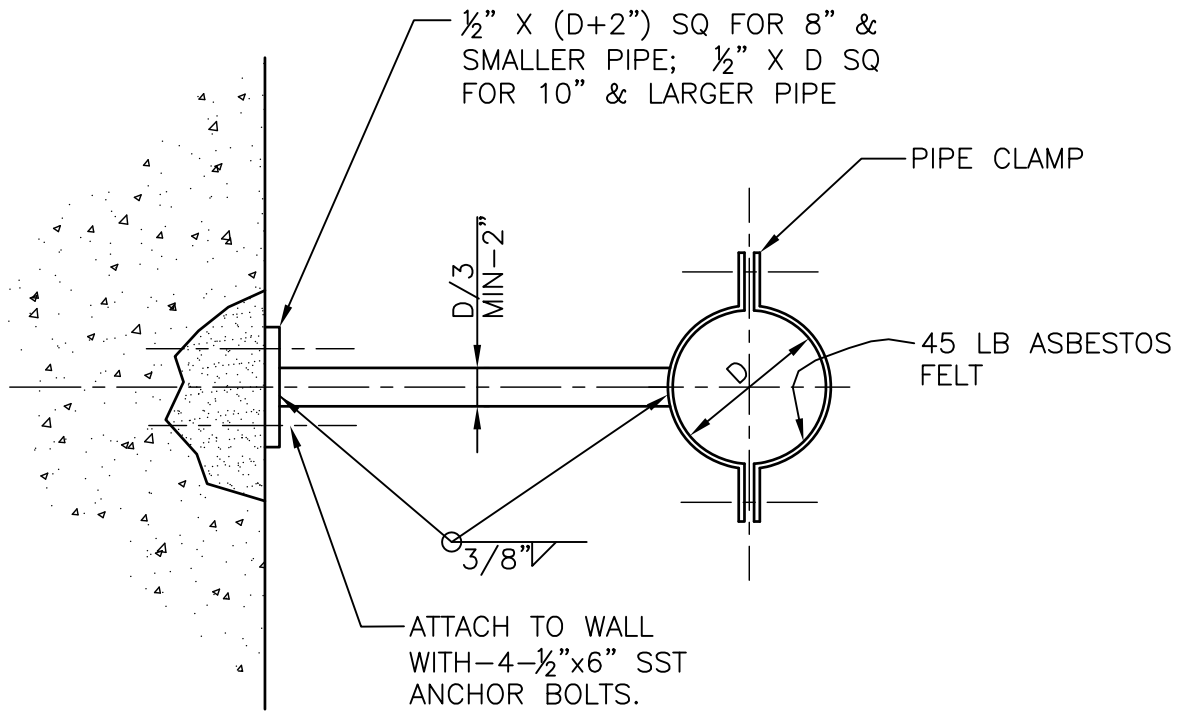


NOTE:
HOT DIP GALV. AFTER FABRICATION.

TYPE 'B' PIPE SWAY BRACE

NTS

40 05 07-26



PLAN

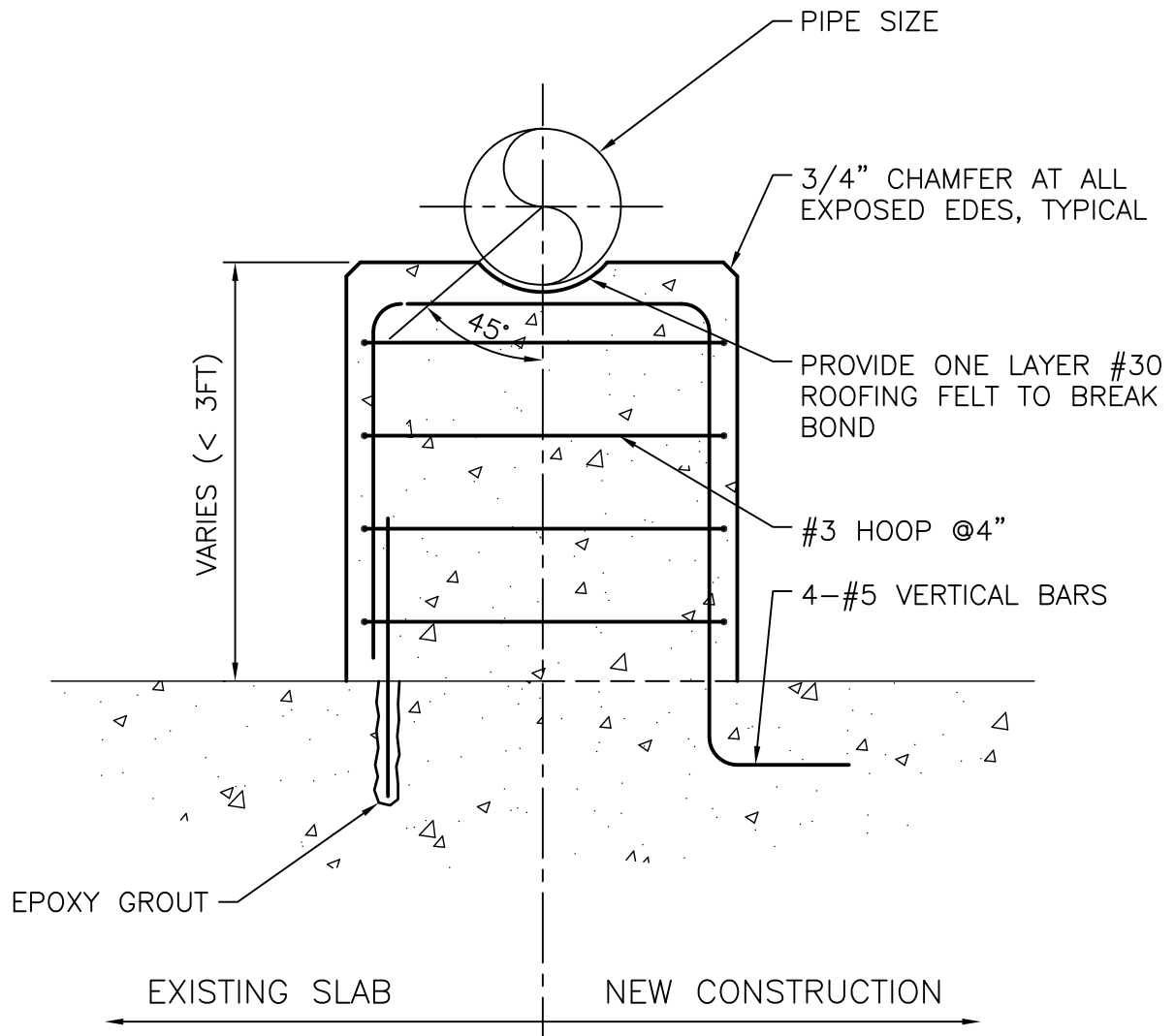
NOTE:

HOT DIP GALV. AFTER FABRICATION.

TYPE 'C' PIPE SWAY BRACE

NTS

40 05 07-27

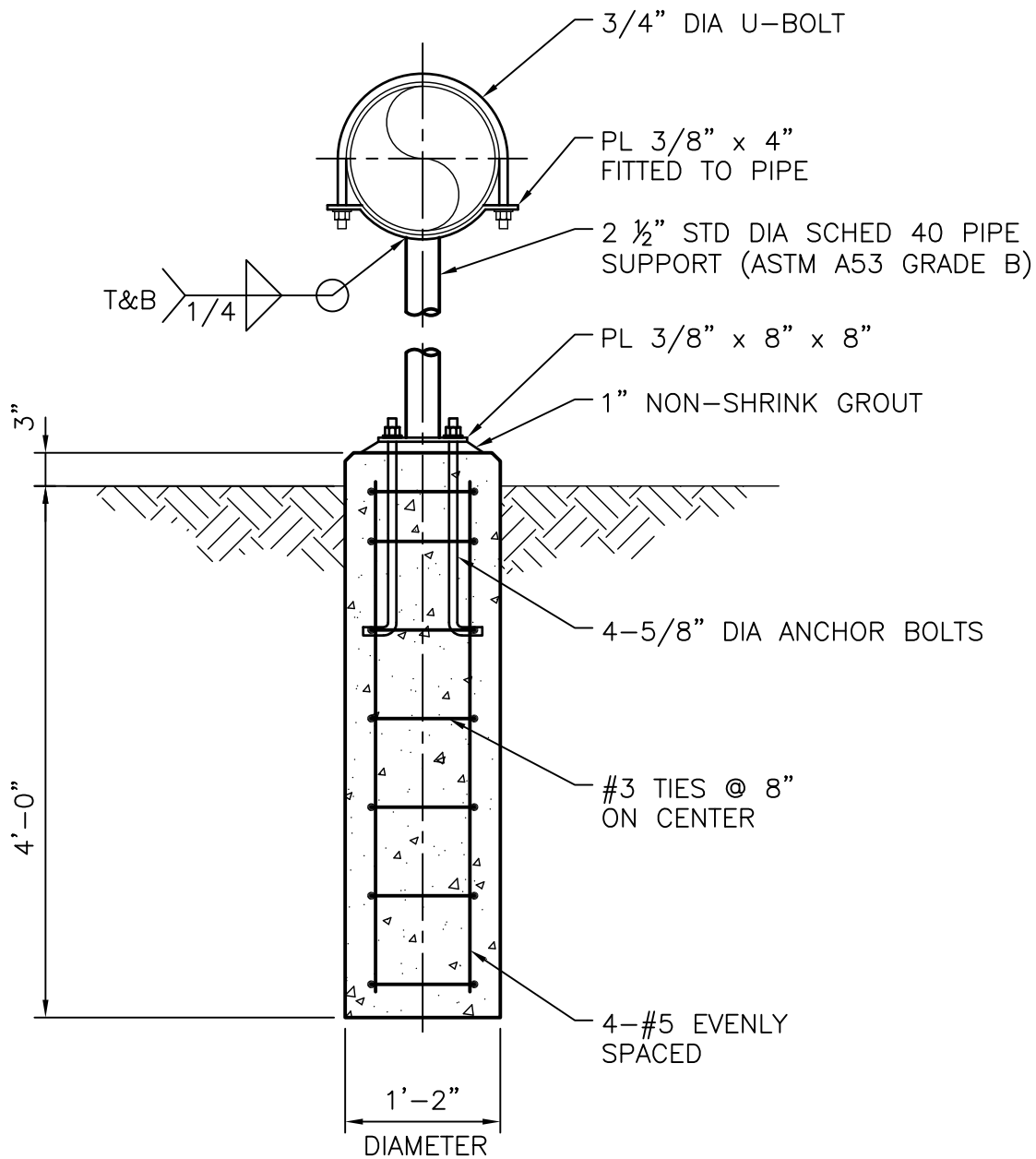


PIPE SIZE, DIA	PEDESTAL THICKNESS
≤ 24"	6"
24"–42"	10"
≥ 42"	12"

CONCRETE PIPE SUPPORT

NTS

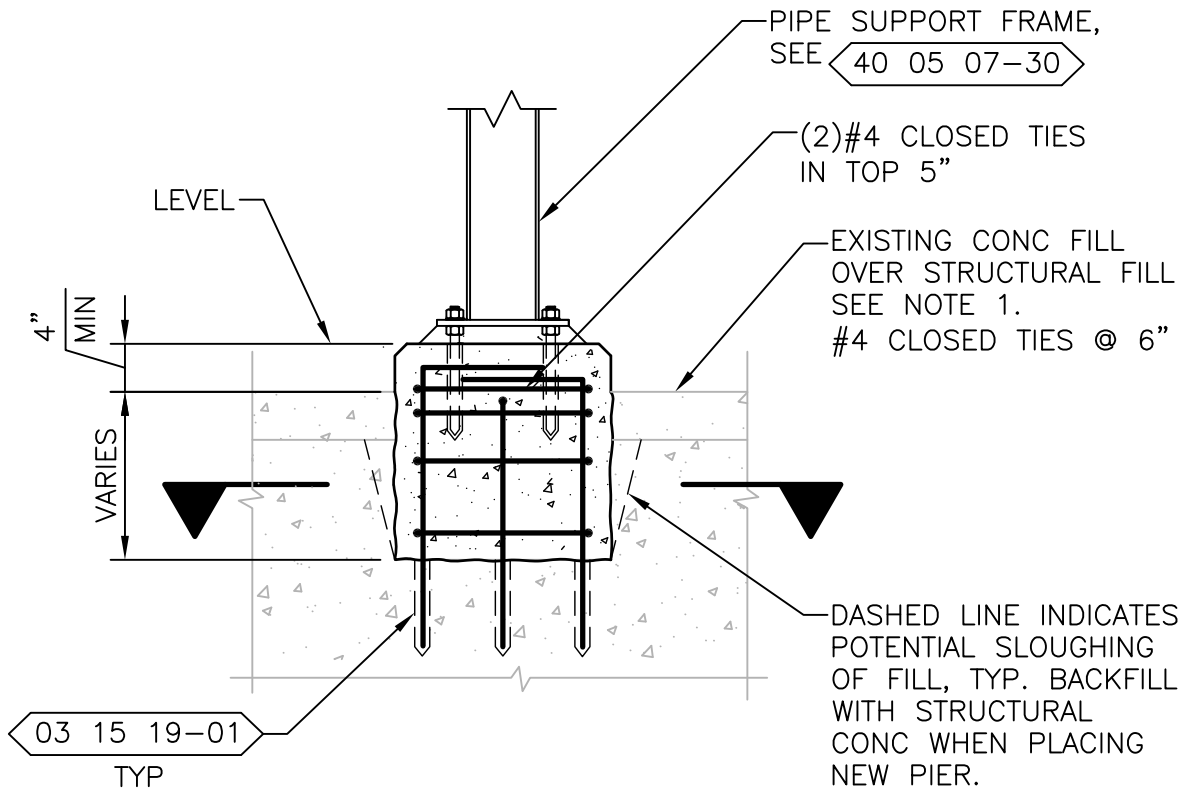
40 05 07-28



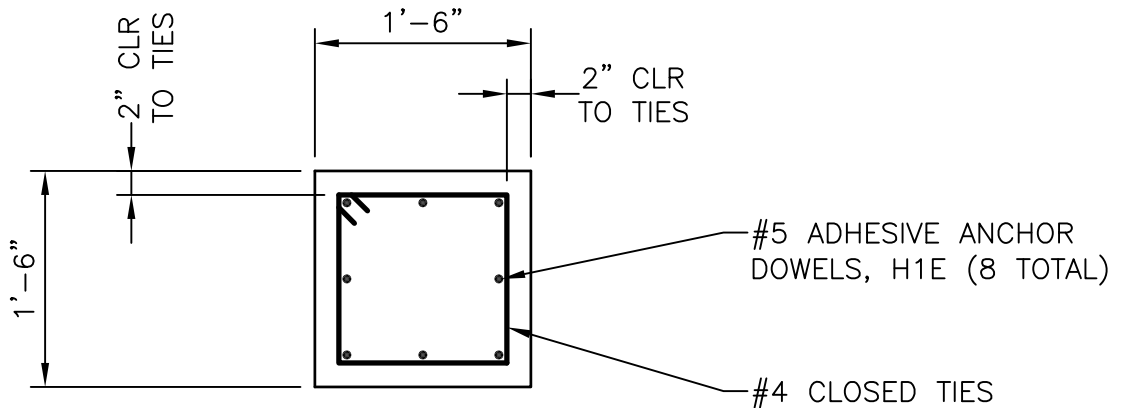
6" AIR DUCT SUPPORT

NTS

40 05 07-30



ELEVATION



SECTION

NOTES:

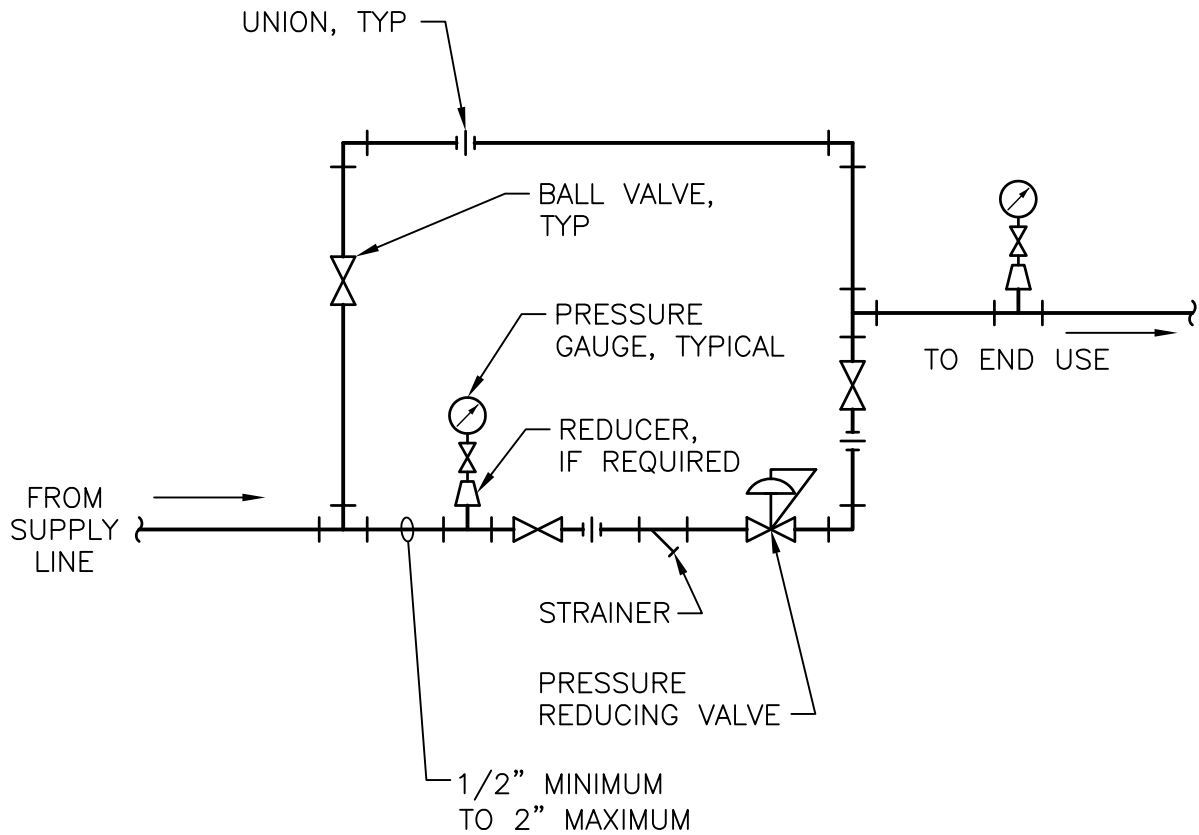
1. DETAILS OF EXISTING CONCRETE SLAB ARE TAKEN FROM AS-BUILT DRAWINGS "AERATION BASIN MODIFICATIONS AND BLOWER FACILITIES ADDITION" DATED 1996 BY HDR. AS-BUILT DRAWINGS INDICATE THAT CONTRACTOR HAD OPTION OF FURNISHING ALL CONCRETE FILL FOR FLOOR SLOPING IN LIEU OF STRUCTURAL FILL WITH 4" CONCRETE SLAB. THE CONDITION SHOWN ON THIS DETAIL ASSUMES THAT THE CONCRETE FILL WAS PLACED AS SHOWN ON THE AS-BUILT DRAWINGS.

**PIPE SUPPORT TYPE B
CONCRETE PIER**

NTS

40 05 07-30A





DESIGNER NOTES:

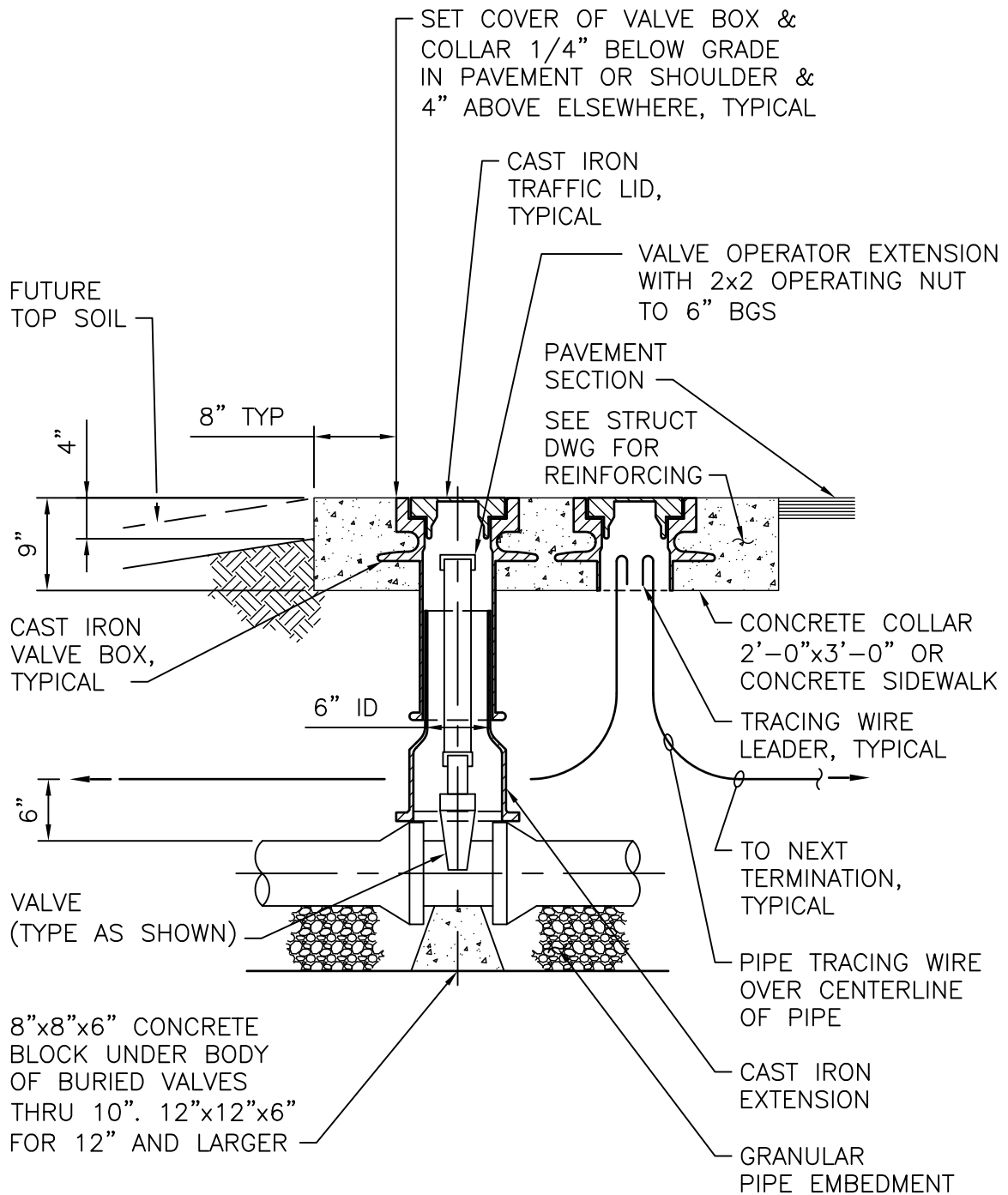
1. SIZE PIPING FOR DOWNSTREAM USE (SIZE AND PRESSURE).

PRESSURE REDUCING STATION (PRS)

NTS

40 05 51-02

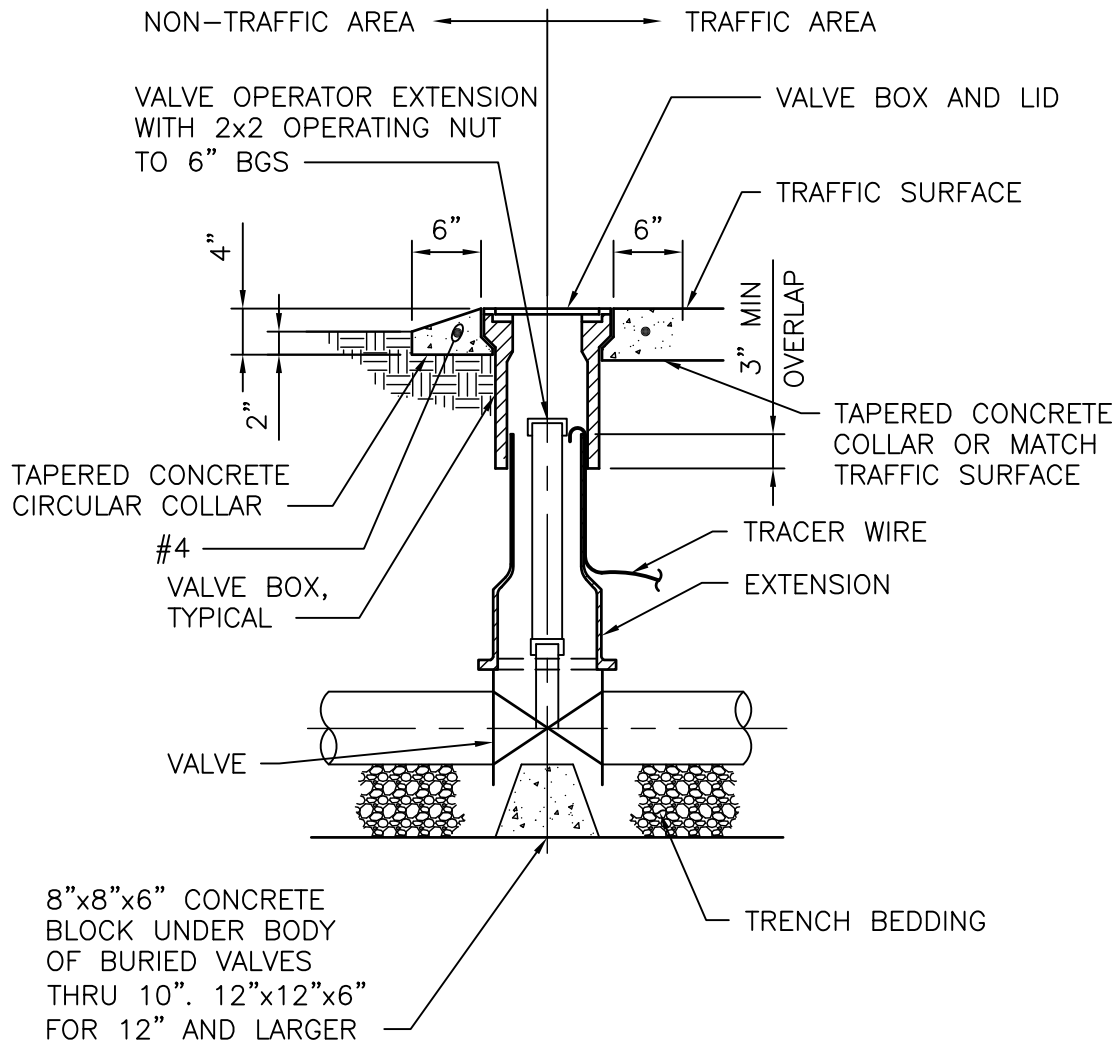




BURIED VALVE BOX

NTS

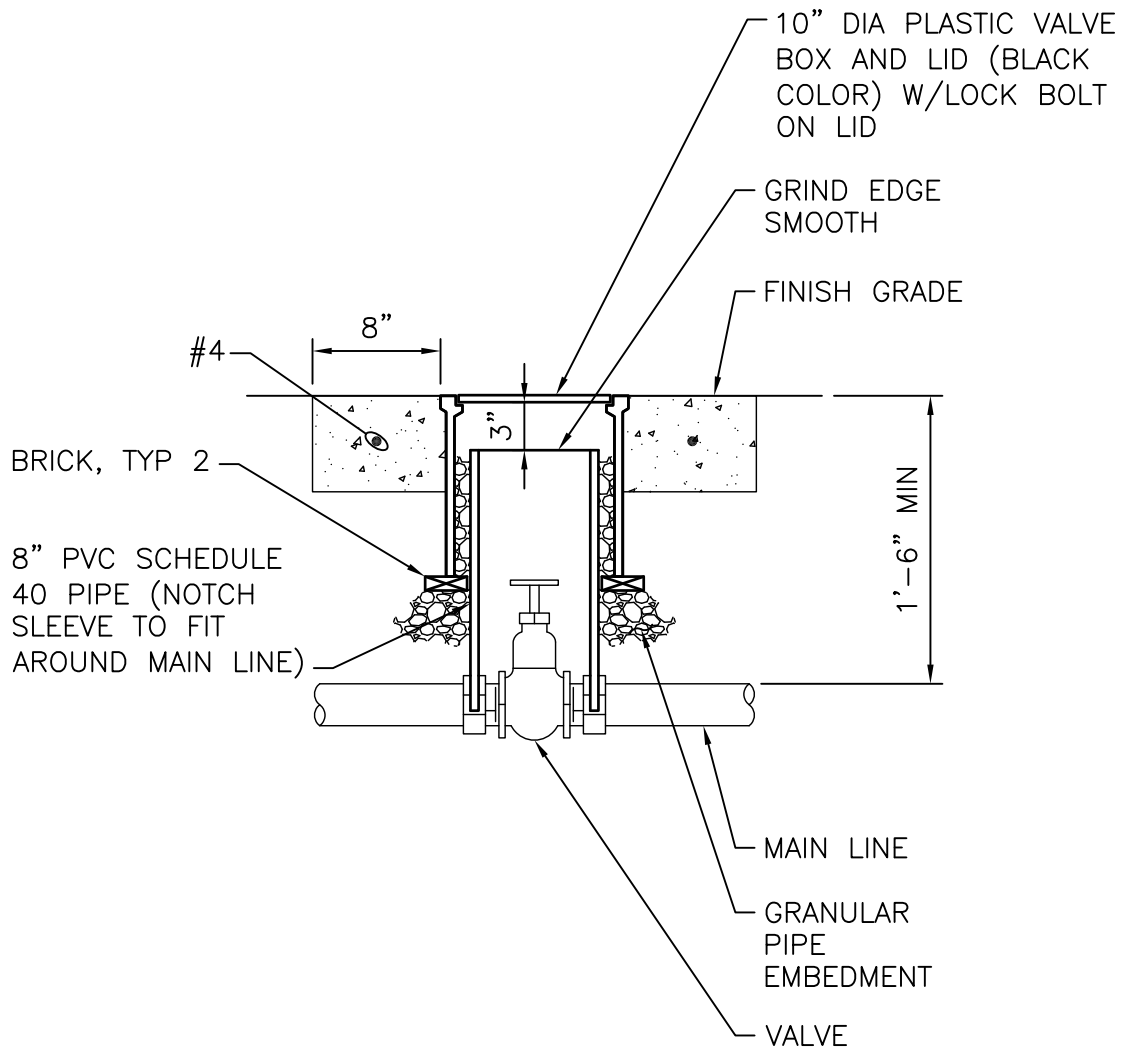
40 05 51-04



BURIED VALVE BOX WITH TRACER WIRE

NTS

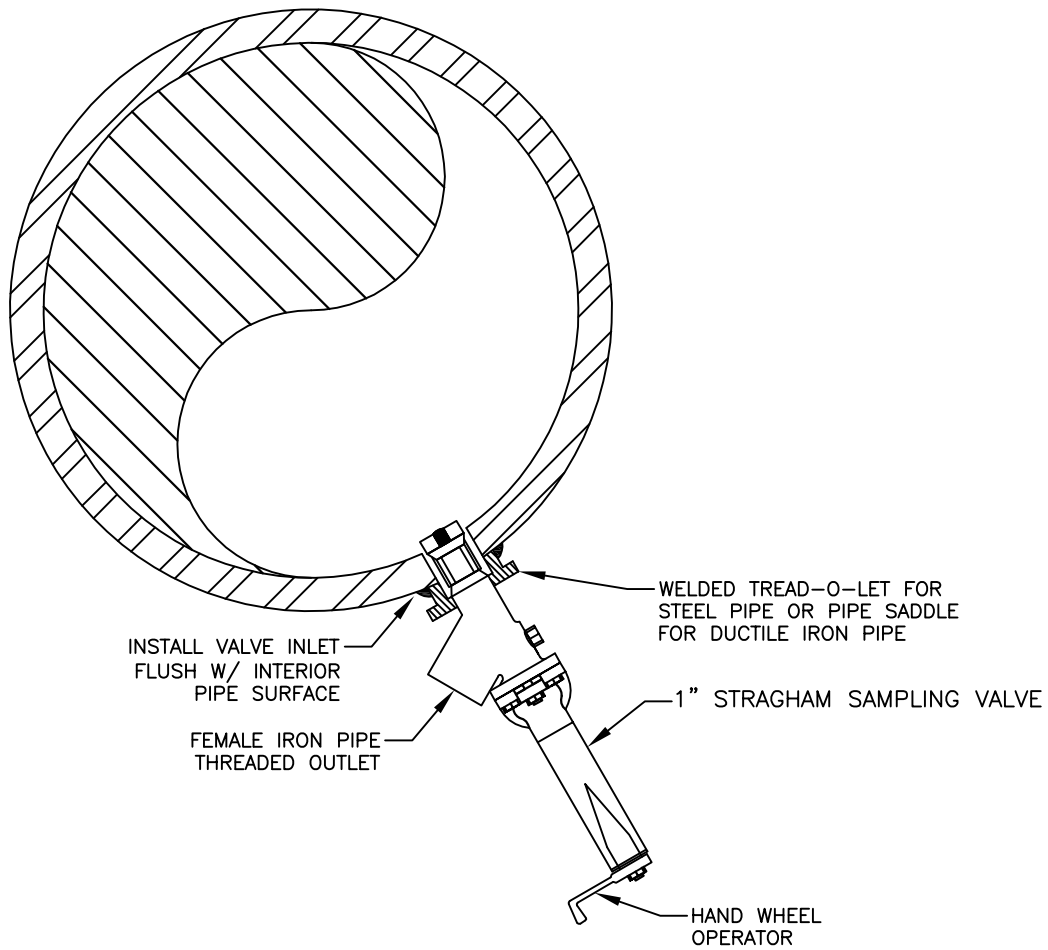
40 05 51-05



2-1/2" OR SMALLER VALVE BOX

NTS

40 05 51-06



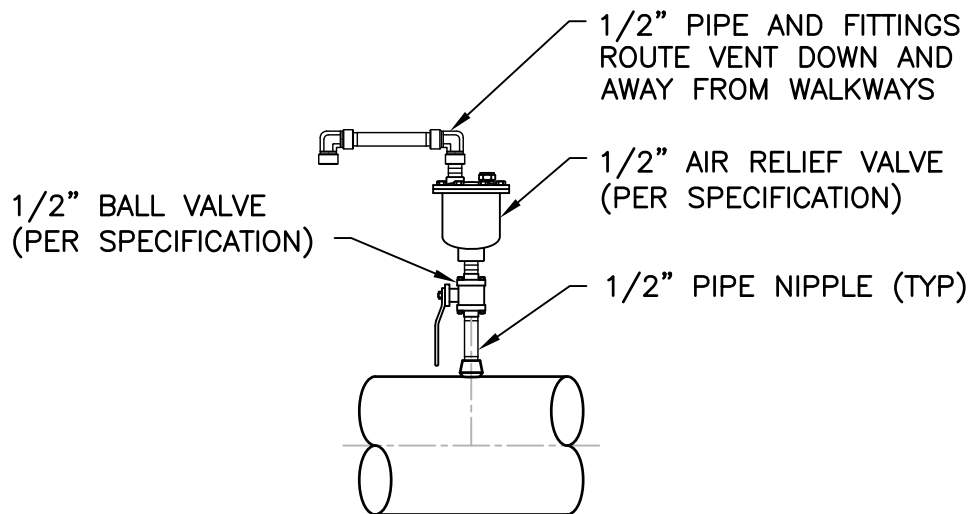
NOTES:

1. APPLY ANTI-GALLING COMPOUND TO SST PIPE THREADS.
2. LOCATE VALVE FOR CONVENIENT OPERATION WITH OWNER'S REPRESENTATIVE APPROVAL ONLY.

SAMPLE VALVE

NTS

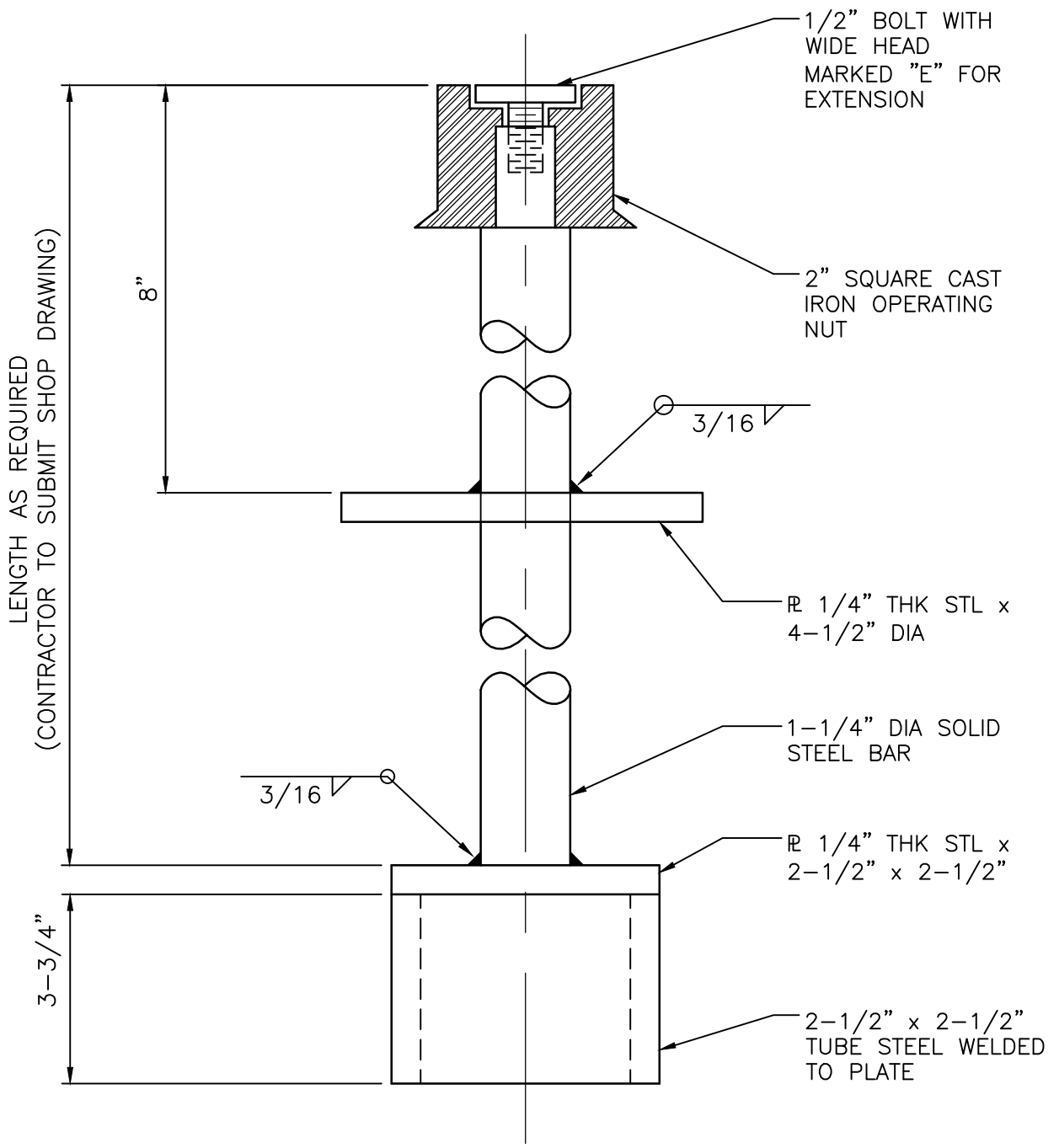
40 05 51-07



AIR RELIEF VALVE INSTALLATION

NTS

40 05 52-04



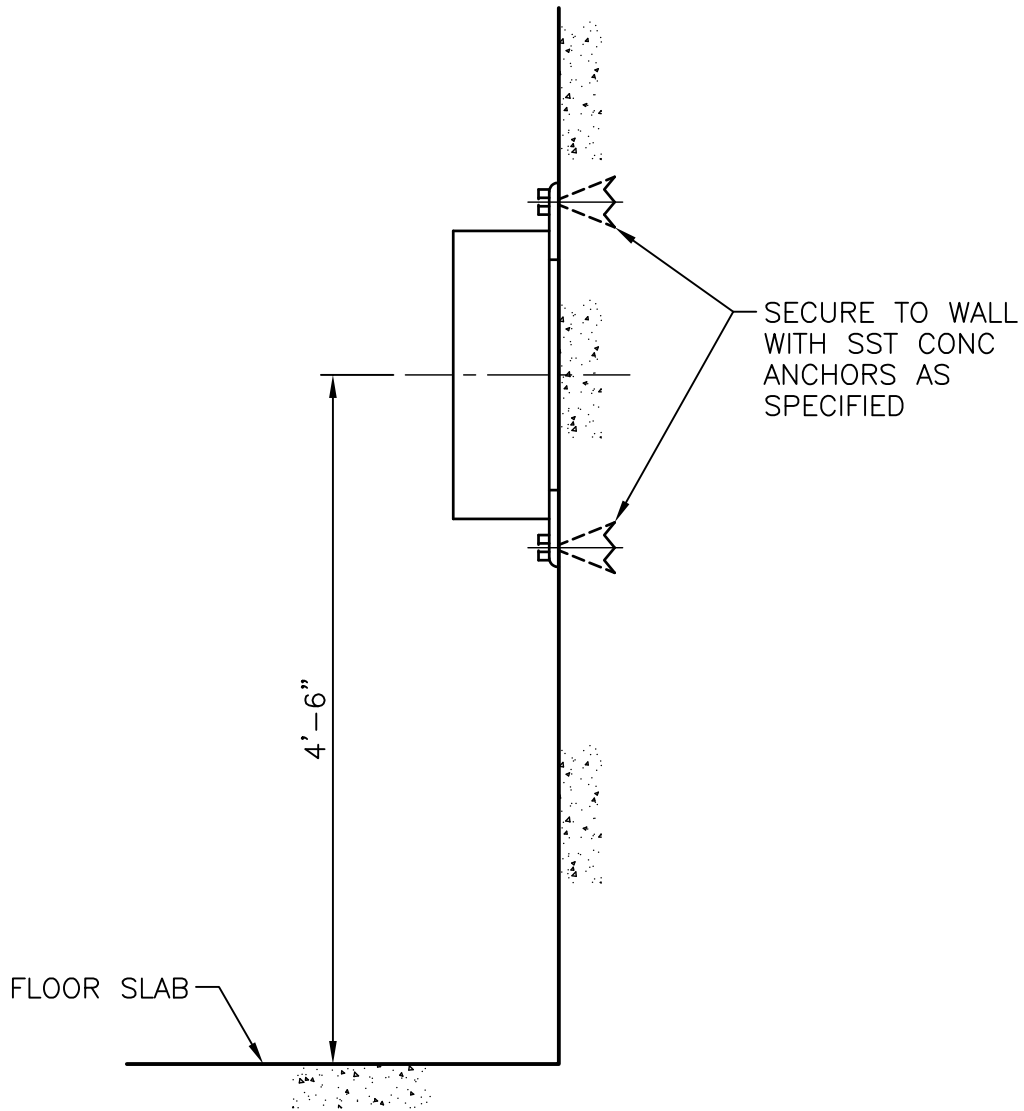
NOTE:
 USE STANDARD DETAIL 40 05 07 -15, OFFSET PIPE SUPPORT,
 FOR STEM EXTENSION SUPPORT OFF WALL AS NECESSARY.

VALVE STEM EXTENSION

NTS

40 05 59-08



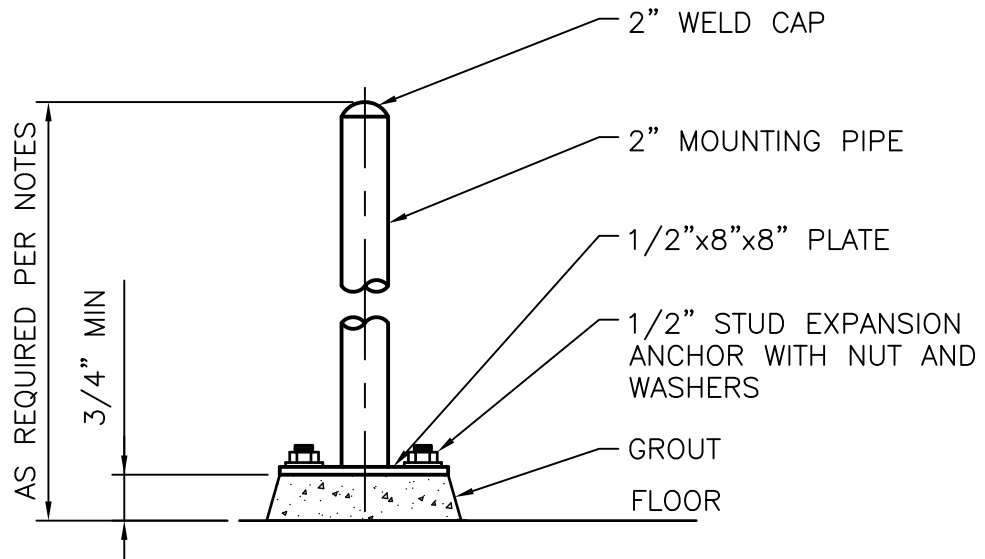


WALL MOUNTED INSTRUMENT INSTALLATION

NTS

40 91 10-01





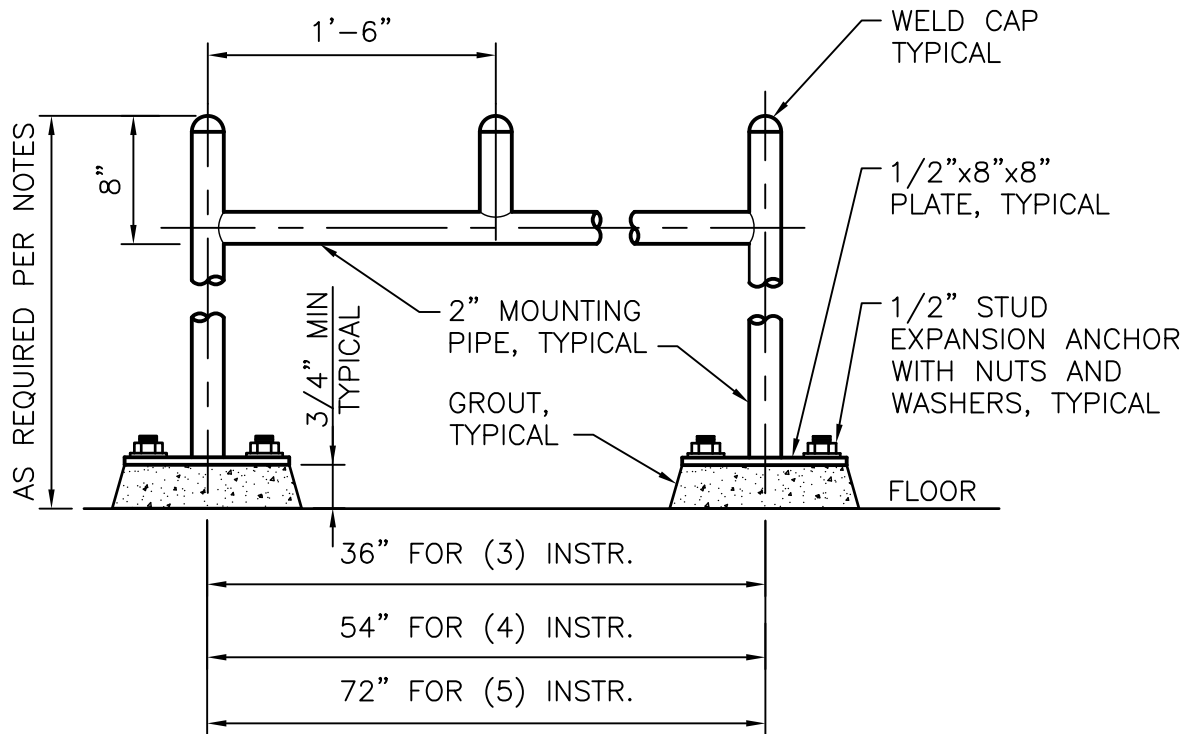
NOTES:

1. MOUNT BLIND INSTRUMENTS 52" ABOVE FLOOR.
2. MOUNT INDICATING INSTRUMENTS SO THAT CENTER LINE OF INDICATOR IS 60" ABOVE FLOOR.

FLOOR MOUNTED PIPE STAND FOR ONE INSTRUMENT

NTS

40 91 10-02



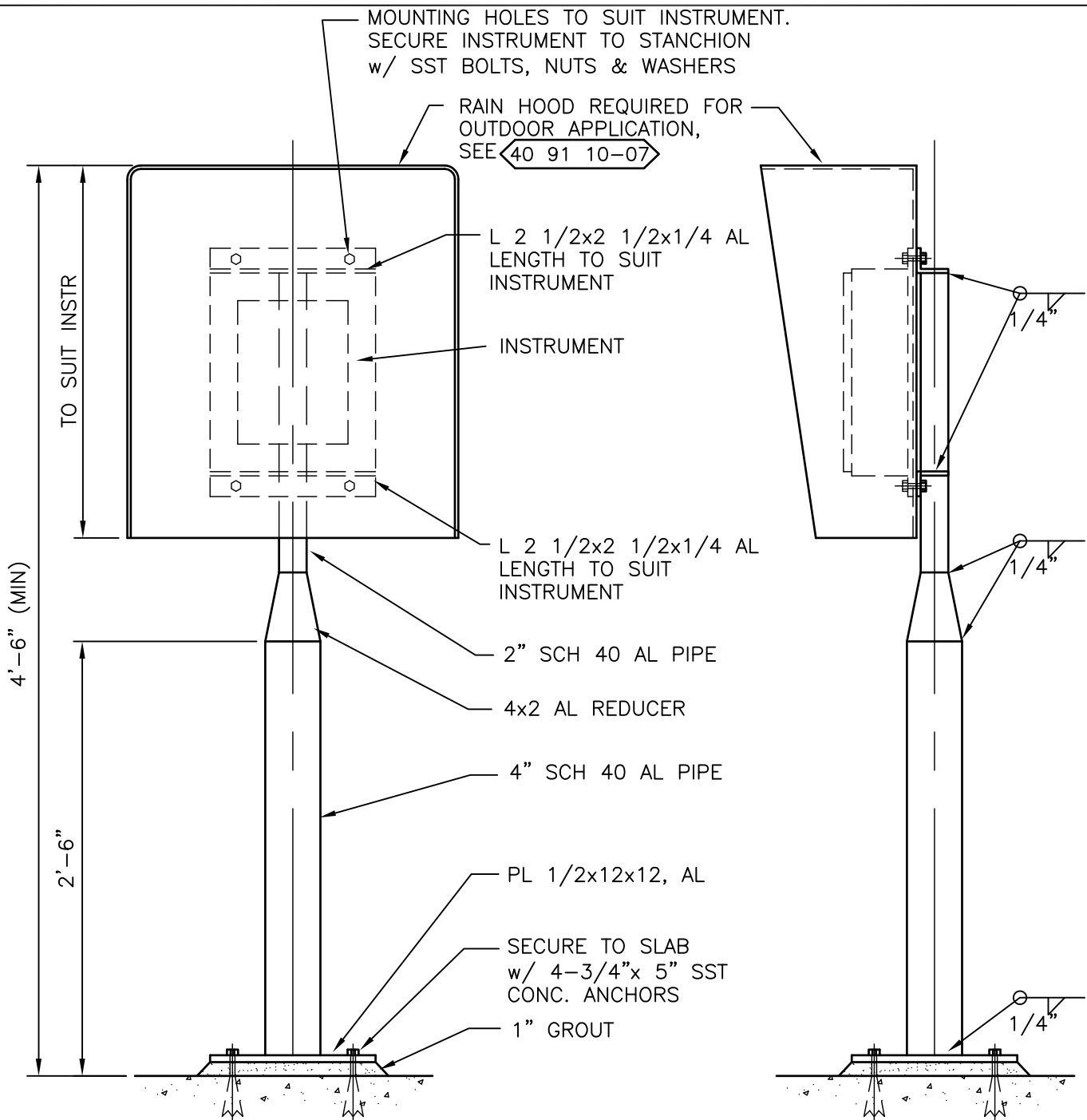
NOTES:

1. MOUNT BLIND INSTRUMENTS 52" ABOVE FLOOR.
2. MOUNT INDICATING INSTRUMENTS SO THAT CENTERLINE OF INDICATOR IS 60" ABOVE FLOOR.

FLOOR MOUNTED PIPE STAND FOR MULTIPLE INSTRUMENTS

NTS

40 91 10-03



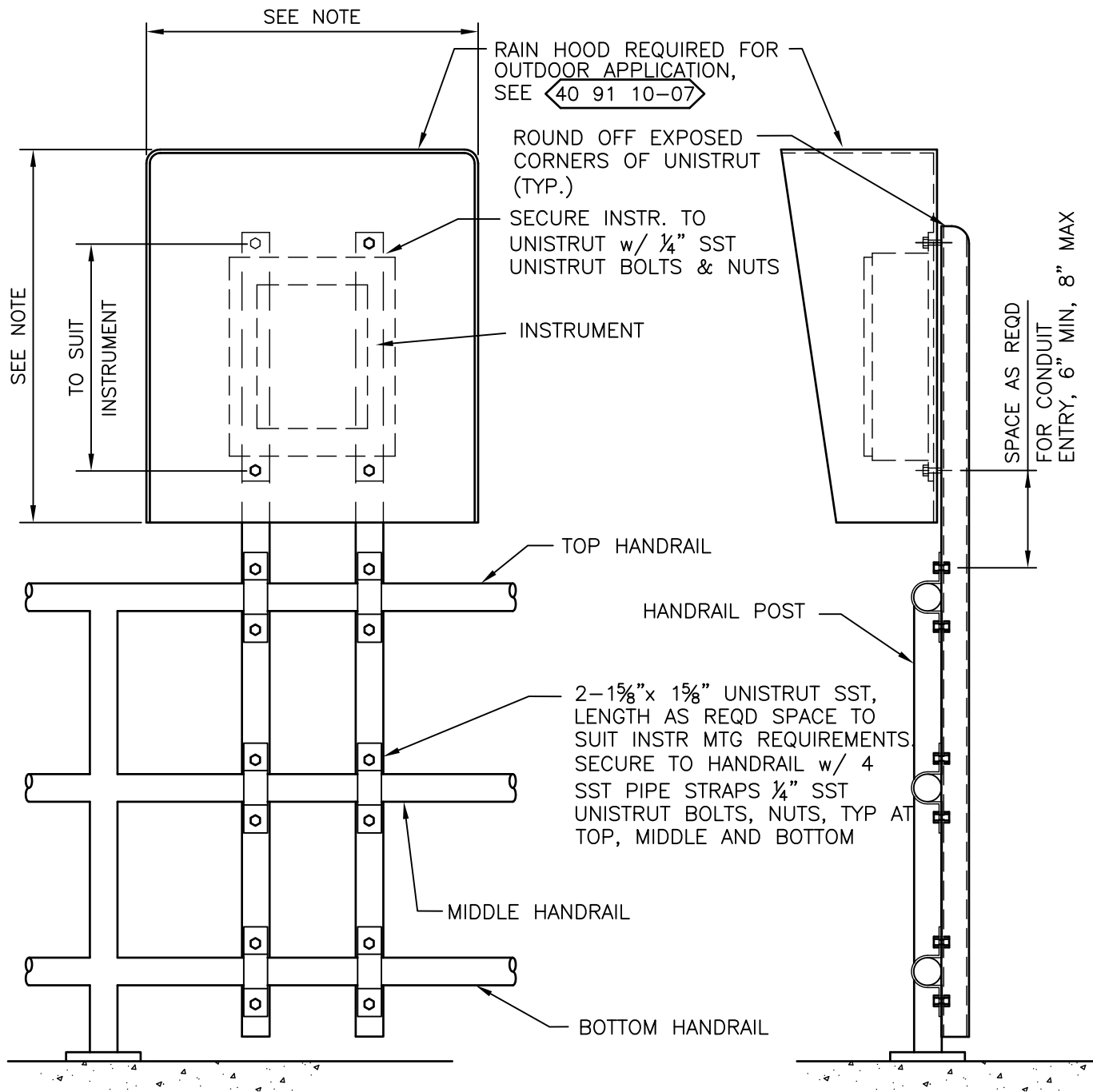
NOTE:

1. ROUND OFF ALL EXPOSED EDGES AND CORNERS.
2. PAINT ALUMINUM IN CONTACT WITH CONCRETE ACCORDING TO SPECIFICATIONS FOR PAINTING.

STANCHION SUPPORT FOR CASE MOUNTED INSTRUMENTS

40 91 10-04

NTS



NOTE:

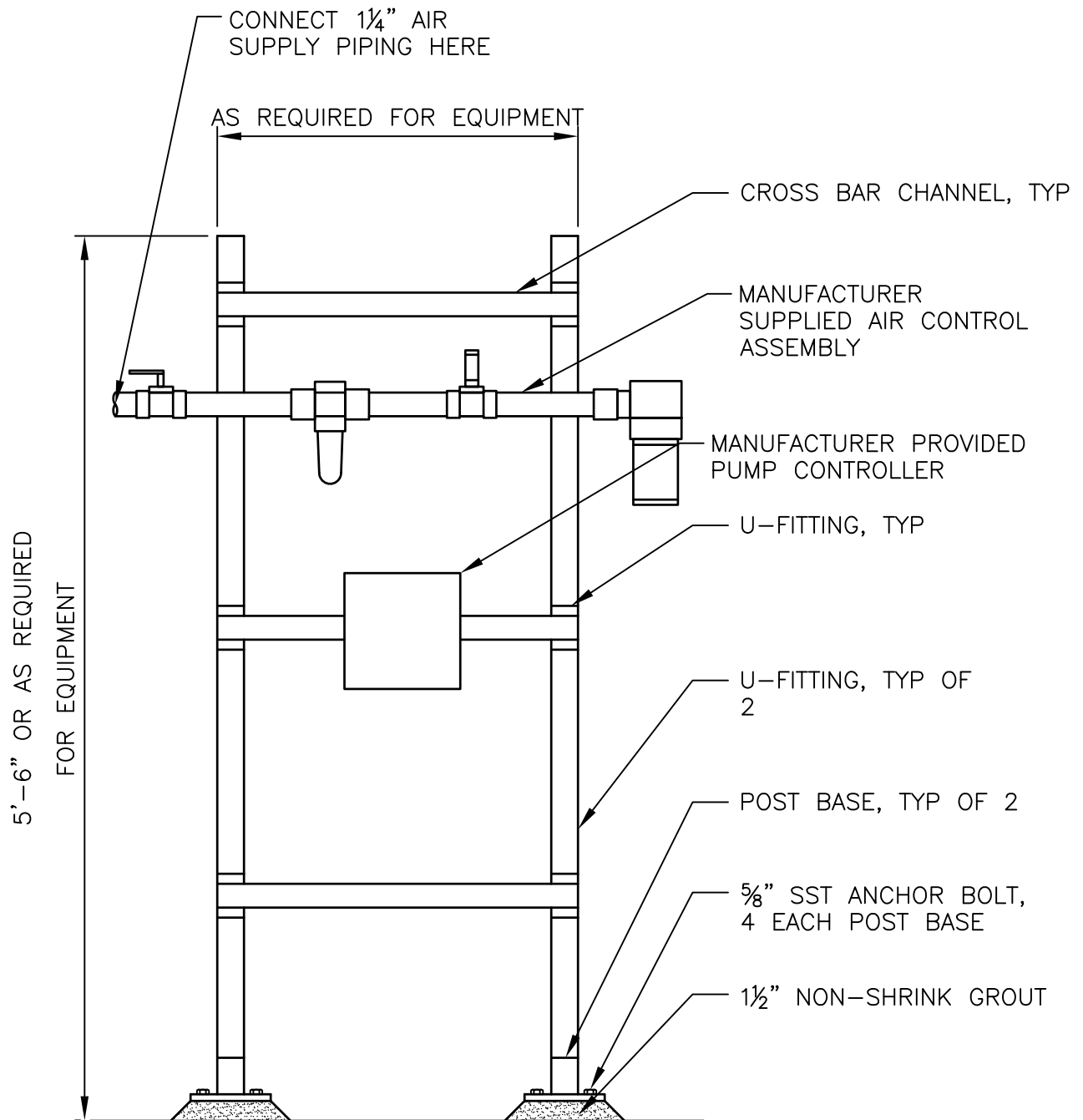
RAINHOOD AND INSTRUMENTS SHALL ONLY BE MOUNTED TO HANDRAIL IF THE RAINHOOD DIMENSIONS DO NOT EXCEED 1'-6" BY 1'-6". FOR LARGER INSTALLATIONS, SEE 40 91 10-04

TYP HANDRAIL MOUNTING FOR CASE MOUNTED INSTRUMENTS

40 91 10-05

NTS



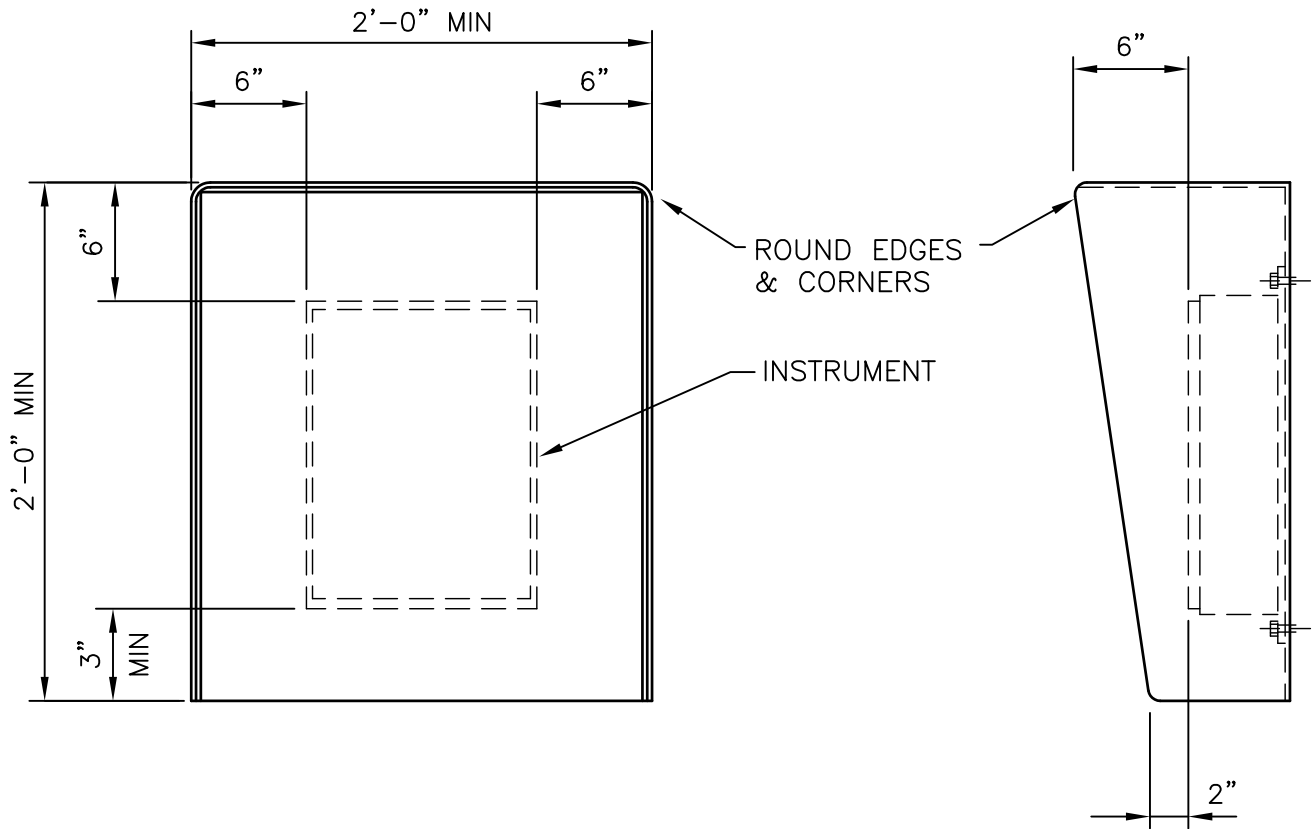
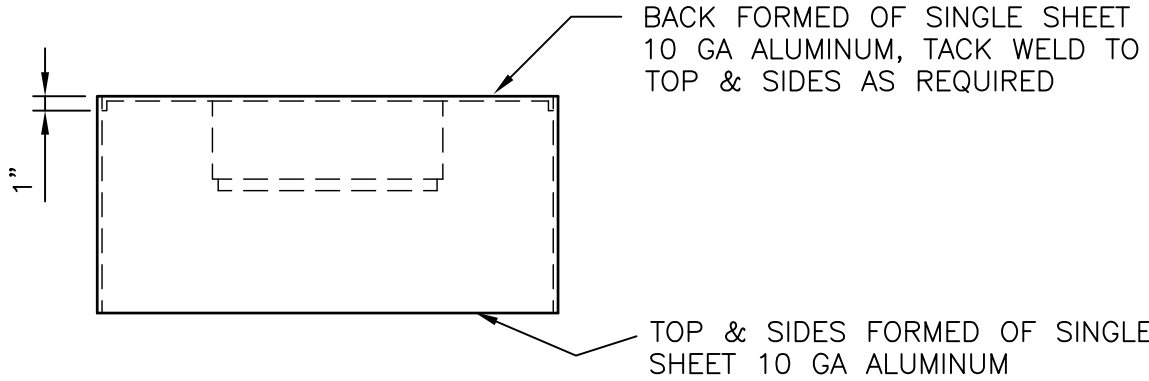


NOTE:
 PIPING SUPPORTS AND HARDWARE SHALL BE UNISTRUT, KINLINE, OR APPROVED EQUAL. UNISTRUT PRODUCT NUMBERS ARE SHOWN.

EQUIPMENT SUPPORT

NTS

40 91 10-06



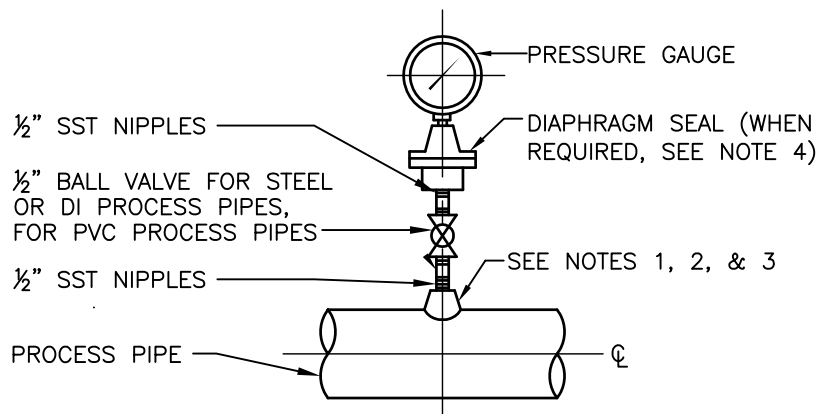
NOTES:

1. ALL EXPOSED EDGES TO BE GROUND SMOOTH AND BURR FREE.
2. MOUNT RAIN HOOD BETWEEN INSTRUMENT AND MOUNTING BRACKET. DRILL HOLES IN RAIN HOOD AS PER MOUNTING HOLES FOR INSTRUMENT, SEE 40 91 10-04 & 40 91 10-05 EXCEPT AS NOTED.

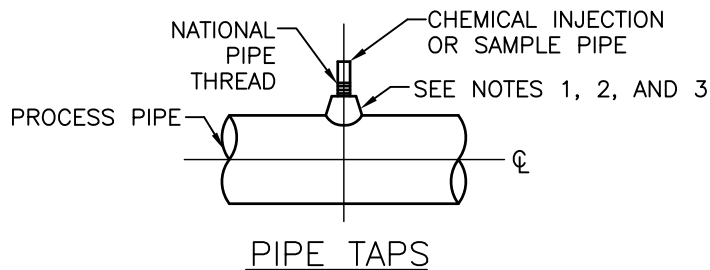
RAIN HOOD INSTALLATION

NTS

40 91 10-07



DIAPHRAGM PRESSURE GAUGE



PIPE TAPS

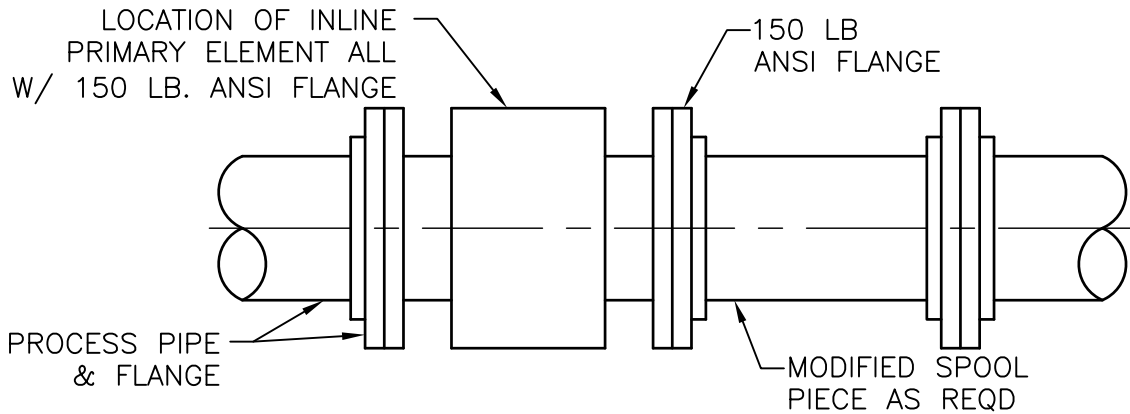
NOTES:

1. FOR STEEL, GALVANIZED STEEL AND PVC 2½" AND SMALLER USE A BUSHING IN A TEE.
2. FOR DUCTILE IRON, ALL SIZES, USE PIPE SADDLE WITH BUSHING.
3. FOR STEEL AND STAINLESS STEEL PIPES 3" AND LARGER, AND PRESSURE VESSELS, USE THRED-O-LET AS SHOWN.
4. USE DIAPHRAGM SEAL ON ALL SERVICES EXCEPT AIR, POTABLE WATER, & NONPOTABLE WATER. USE IN-LINE DIAPHRAGM FOR SLUDGE SERVICES. SEE STANDARD DETAIL 13442-31.
5. PROVIDE SNUBBER FOR POSITIVE DISPLACEMENT PUMP APPLICATIONS.

PRESSURE GAUGE/PRESSURE SWITCH APPLICATIONS

NOT TO SCALE

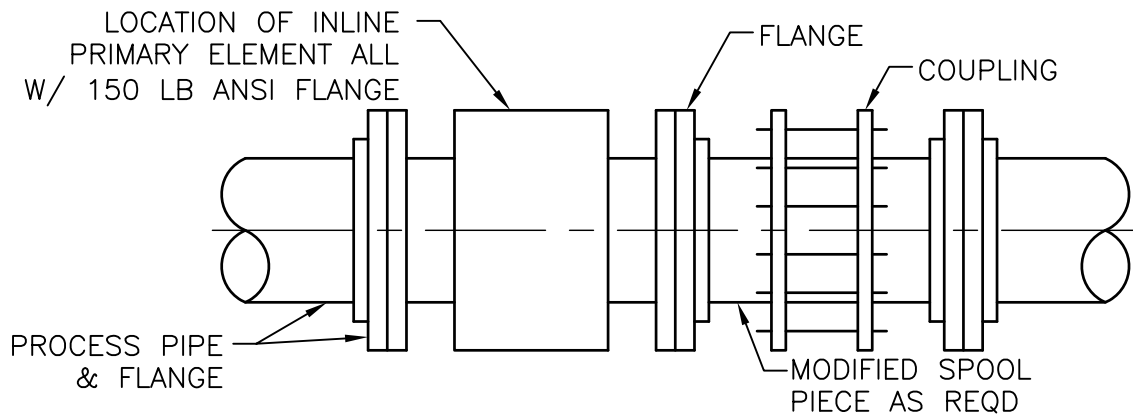
40 91 10-16



NOTE:

FOR EXISTING PIPING, REMOVE & CUT EXISTING SPOOL PIECE TO PROPER LENGTH & INSTALL PRIMARY ELEMENT AS SHOWN. CEMENT WELD NEW 150 LB ANSI FLANGE & REINSTALL MODIFIED SPOOL PIECE.

PVC & CPVC PIPE



NOTE:

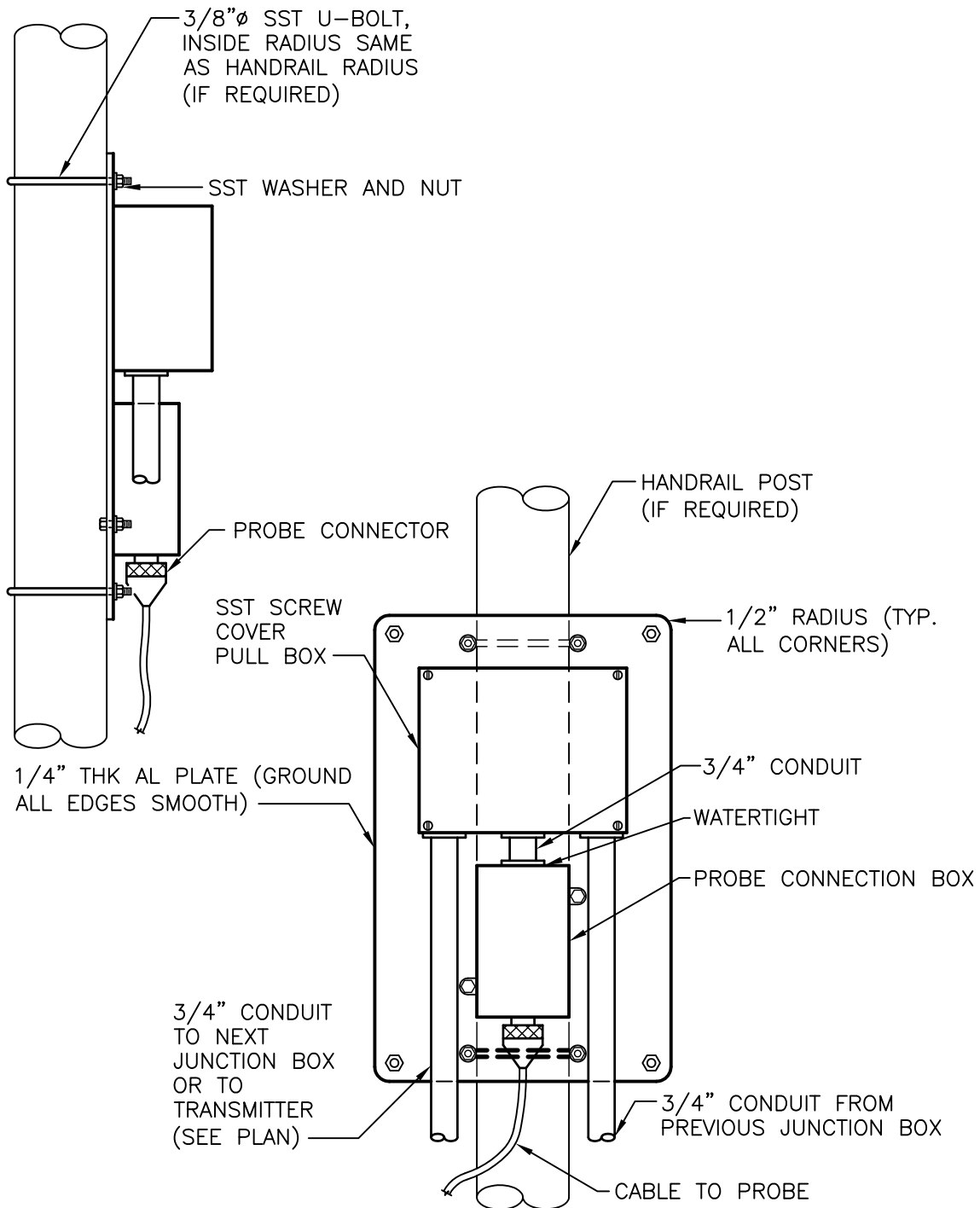
FOR EXISTING PIPING, REMOVE EXISTING SPOOL PIECE & COUPLING, INSTALL PRIMARY ELEMENT AS SHOWN. CUT EXISTING SPOOL PIECE TO PROPER LENGTH & REINSTALL MODIFIED SPOOL PIECE.

DI, STEEL & SST PIPE

**INLINE PRIMARY ELEMENT
INSTALLATION**

NTS

40 91 10-17



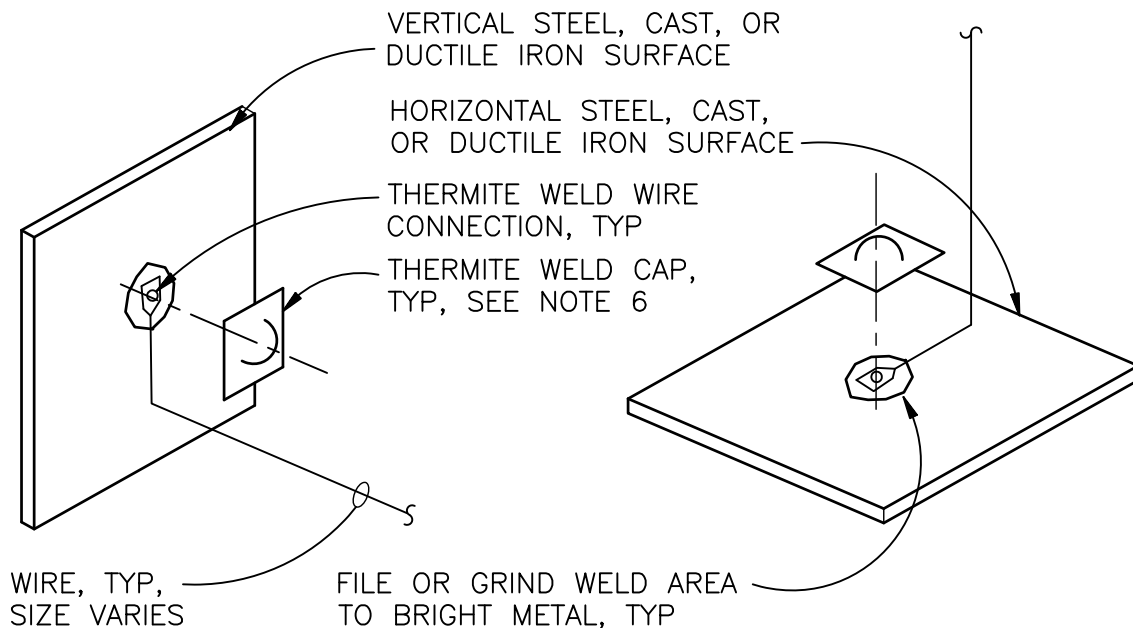
NOTES:

1. INSTALL ASSEMBLY ON HANDRAIL VERTICAL MEMBER CLOSEST TO THE PROBE OR ON WALL.

TRANSMITTER/JUNCTION BOX MOUNTING DETAIL

NTS

40 91 10-20



NOTES:

1. COPPER SLEEVE REQUIRED FOR THERMITE WELDING OF #10 AWG AND SMALLER WIRE.
2. USE COPPER SLEEVE FOR THERMITE WELDING OF #4 AND #2 AWG JOINT BONDING WIRES.
3. WELDER AND CARTRIDGE SIZE VARIES ACCORDING TO SURFACE SHAPE, MATERIAL, AND HORIZONTAL OR VERTICAL SURFACE. CONSULT WELDER MANUFACTURER FOR RECOMMENDED WELDER AND CARTRIDGE.
4. FOR MULTIPLE WIRE CONNECTIONS TO PIPE SEPARATE THERMITE WELD WIRE CONNECTIONS BY ONE PIPE DIAMETER MINIMUM, 2'-0" MAXIMUM.
5. USE 15 GRAM MAXIMUM SIZE WELD CARTRIDGES FOR CONNECTIONS TO PETROLEUM AND NATURAL GAS PIPELINES OR STRUCTURES. WIRE CONNECTIONS SHALL BE AS SPECIFIED AND APPROVED BY THE OWNER.
6. COAT COMPLETED THERMITE WELD CONNECTIONS WITH ROYSTON HANDYCAP !! AND 747 PRIMER.
7. COLOR CODE WIRES ACCORDING TO WIRE COLOR CODE 40 91 10-25 .

WIRE CONNECTION FOR VERTICAL & HORIZONTAL SURFACES

NTS

40 91 10-23

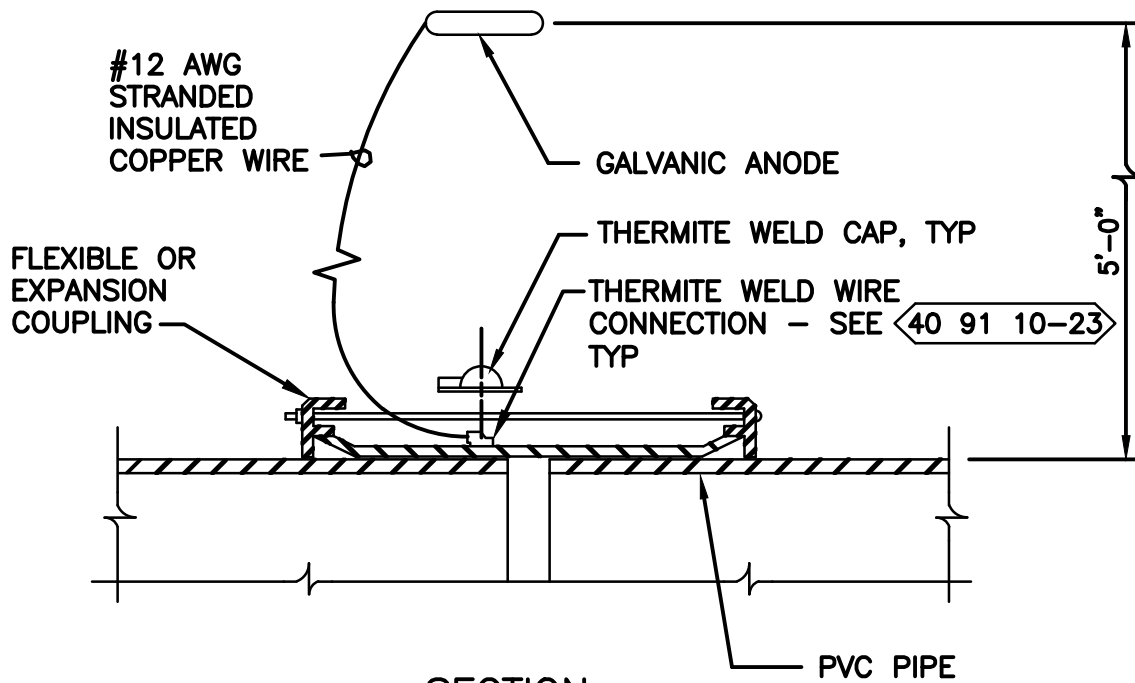
1. PIPELINE TEST WIRES:
WATER OR WASTEWATER – BLUE
FOREIGN PIPELINES – WHITE OR AS REQUESTED BY
FOREIGN PIPELINE COMPANY
2. UNPROTECTED PIPELINE – BLACK
3. CASINGS – ORANGE
4. ANODE LEADS – BLACK
5. REFERENCE ELECTRODE WIRES – YELLOW

WIRE COLOR CODE

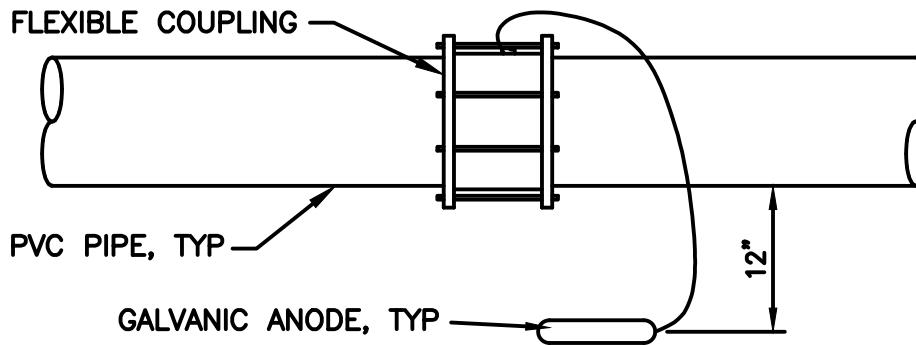
NTS

40 91 10-25





SECTION



ELEVATION

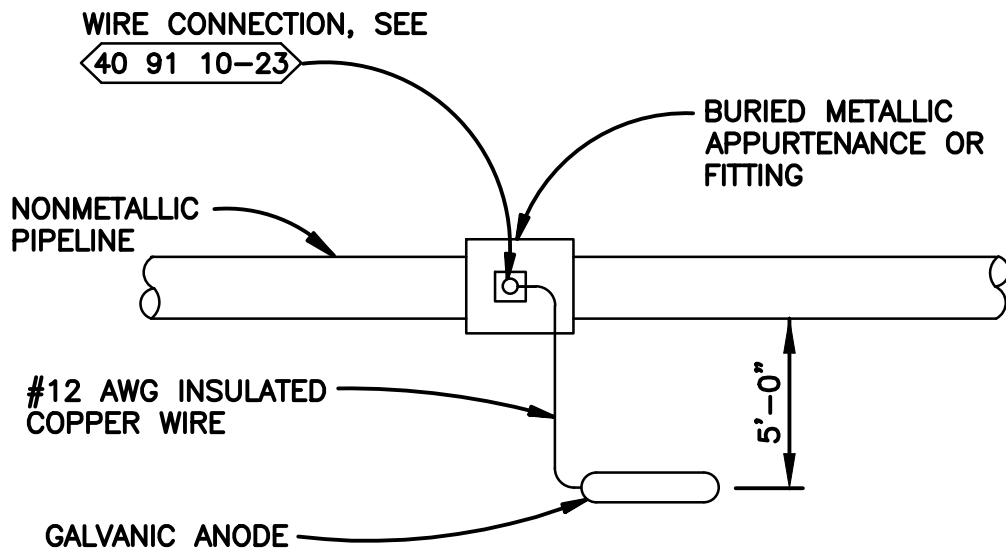
NOTE:

PROVIDE NUMBER OF ANODES AS SHOWN OR SPECIFIED. MINIMUM SHALL BE 1 ANODE FOR 16" AND SMALLER PIPE, 2 ANODES FOR PIPES 18" THRU 30", AND 3 ANODES FOR PIPES LARGER THAN 30".

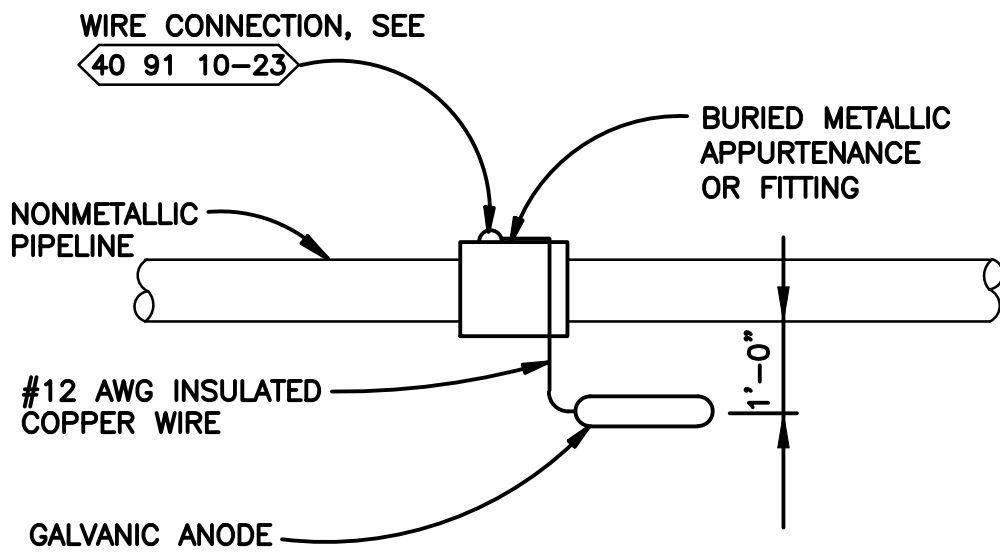
**FLEXIBLE COUPLING WITH
CORROSION PROTECTION**

NTS

40 91 10-27



PLAN

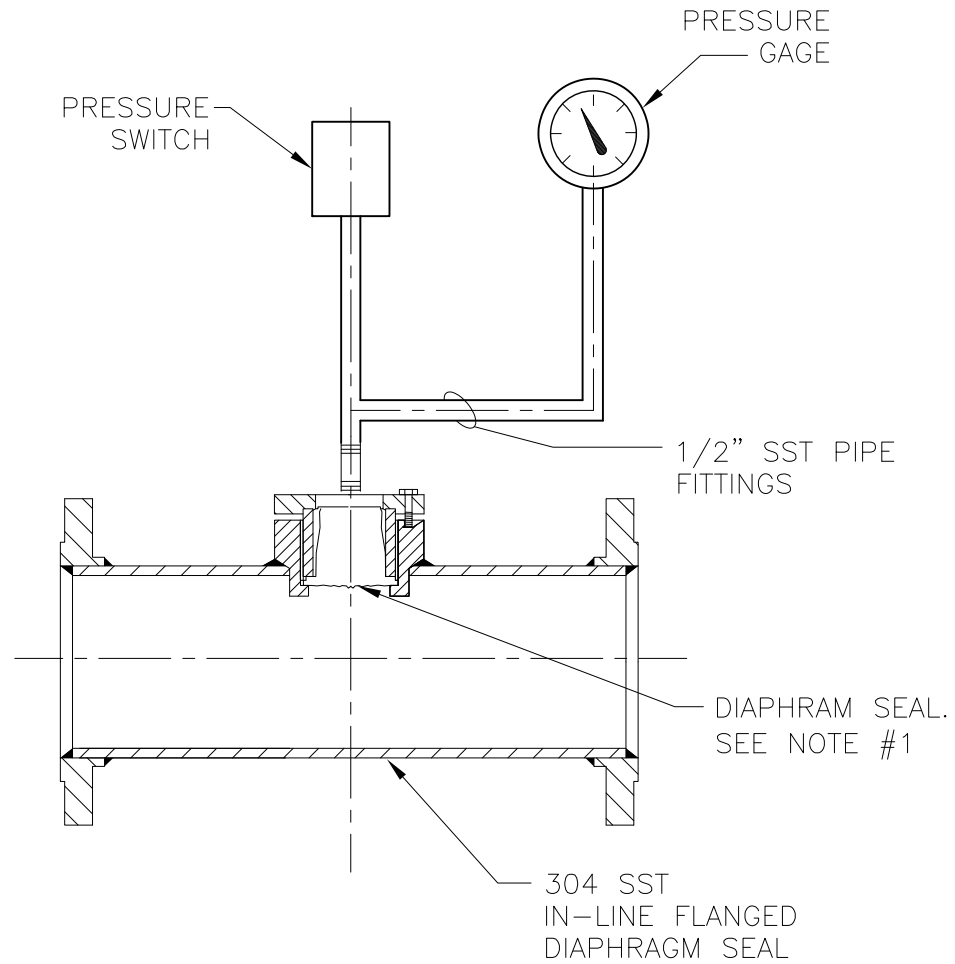


ELEVATION

GALVANIC ANODE INSTALLATION AT BURIED METALLIC FITTINGS

NTS

40 91 10-28



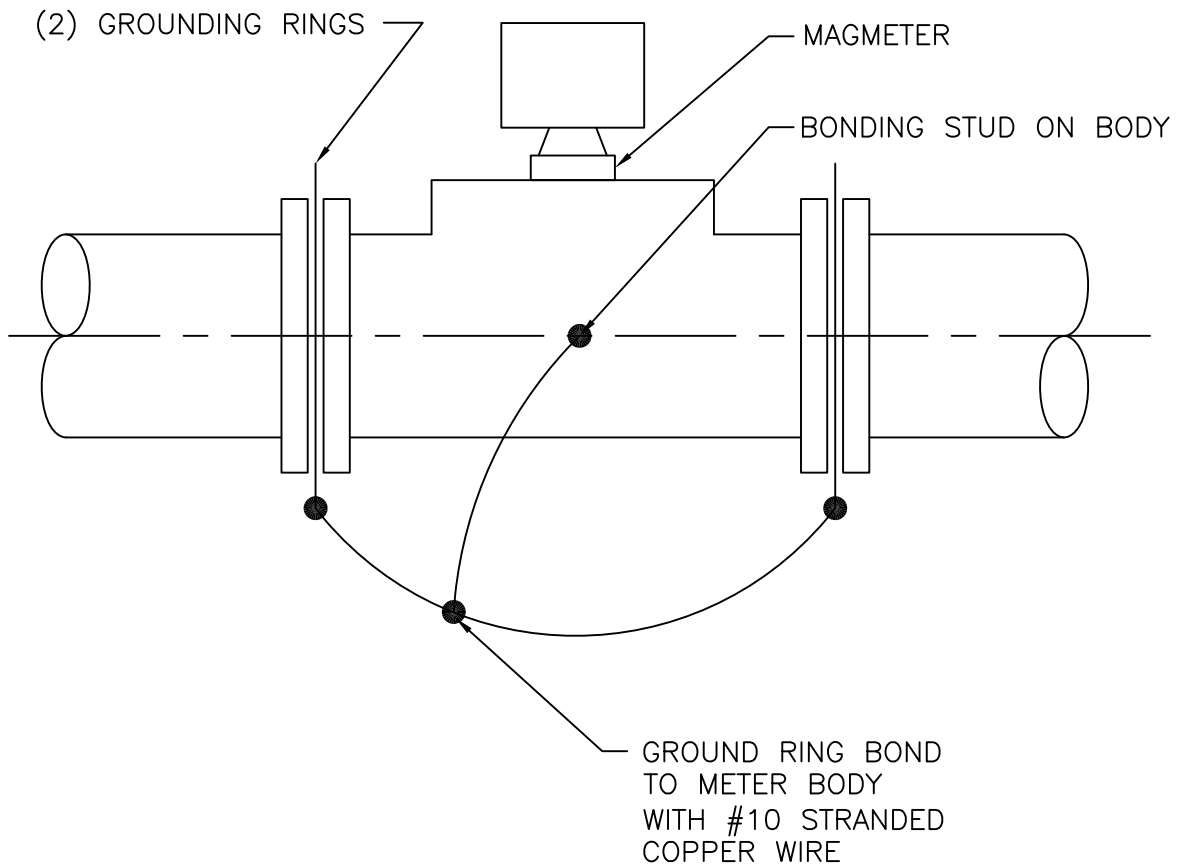
NOTES

1. IN-LINE FLANGED DIAPHRAGM SEAL UNITS TO BE FACTORY ASSEMBLED.
2. MODIFY ORIENTATION OF INSTRUMENT WHERE INSTALLED ON VERTICAL PIPE.

SLUDGE/SCUM
PRESSURE GAGE/SWITCH

NTS

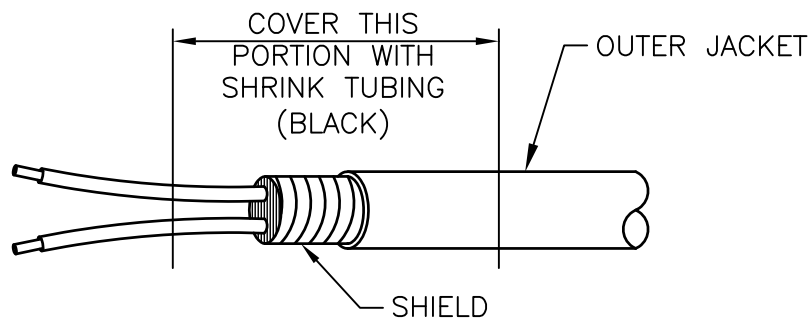
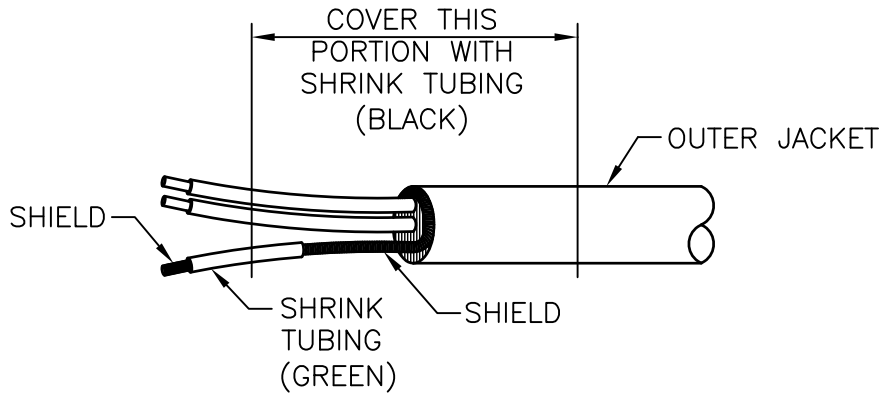
40 91 10-31



MAGNETIC FLOW METER GROUNDING RING BONDING DETAIL

NTS

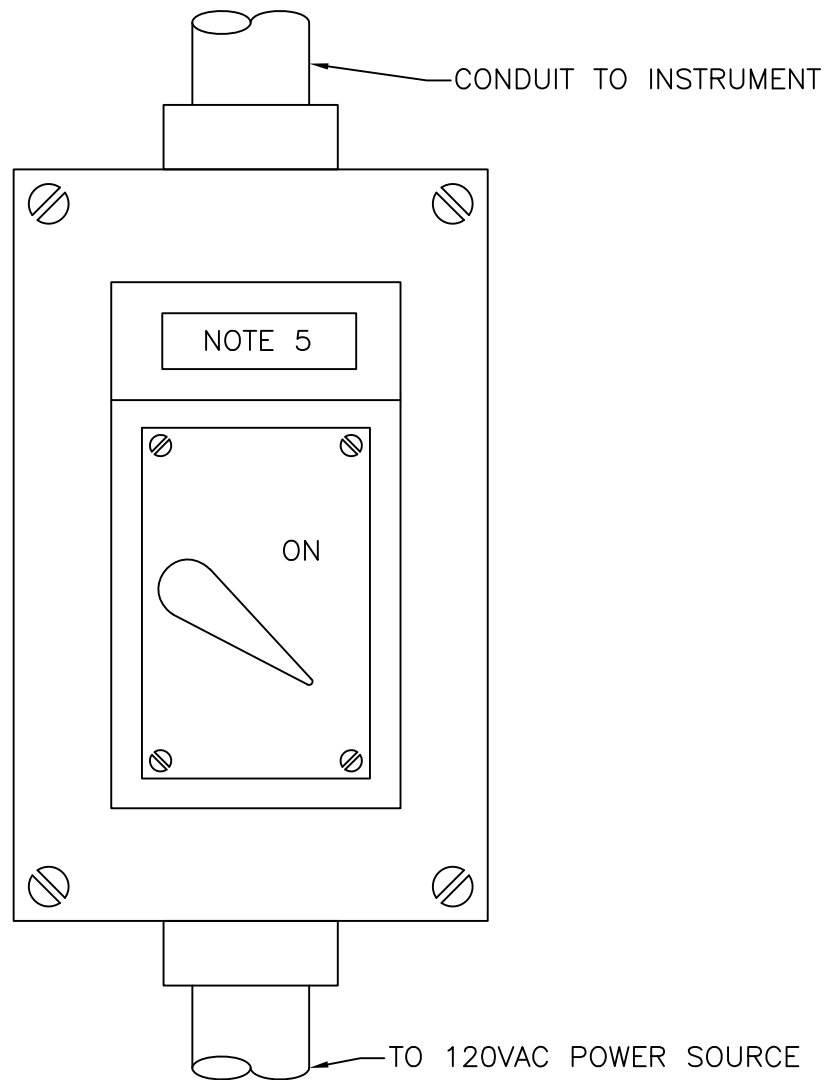
40 91 10-33



SHIELDED CONTROL CABLE TERMINATION DRESSING

NTS

40 91 10-34



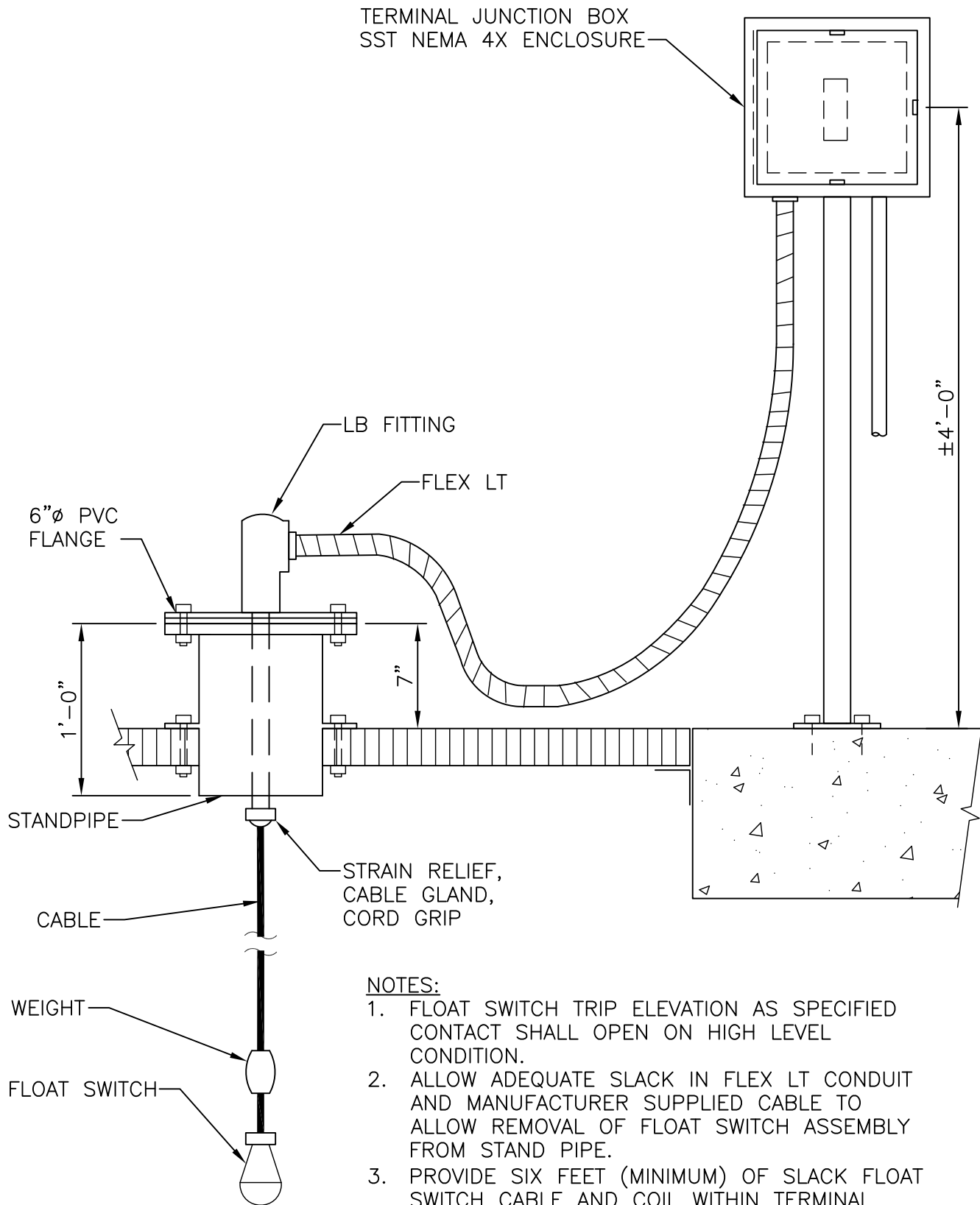
NOTES:

1. SINGLE-PHASE, MANUAL SWITCH REQUIRED FOR EACH AC POWERED FIELD INSTRUMENT
2. OPERATING HANDLE PAD-LOCKABLE IN OFF POSITION
3. CAST ALUMINUM NEMA 4, WATERPROOF ENCLOSURE
4. CUTLER-HAMMER TYPE MS, OR EQUAL
5. NAME PLATE ATTACHED SECURELY. ENGRAVED WITH INSTRUMENT TAG NUMBER AND DESCRIPTION
6. ENCLOSURES AND COMPONENTS TO BE NEMA 7, NEMA 9 RATED WHERE INSTALLED IN HAZARDOUS RATED LOCATIONS. REFERENCE ELECTRICAL PLAN SHEETS FOR AREA RATINGS.

SINGLE PHASE CONTROL STATION

NTS

40 91 10-35



TERMINAL JUNCTION BOX
SST NEMA 4X ENCLOSURE

6"Ø PVC
FLANGE

LB FITTING

FLEX LT

±4'-0"

1'-0"

7"

STANDPIPE

STRAIN RELIEF,
CABLE GLAND,
CORD GRIP

CABLE

WEIGHT

FLOAT SWITCH

NOTES:

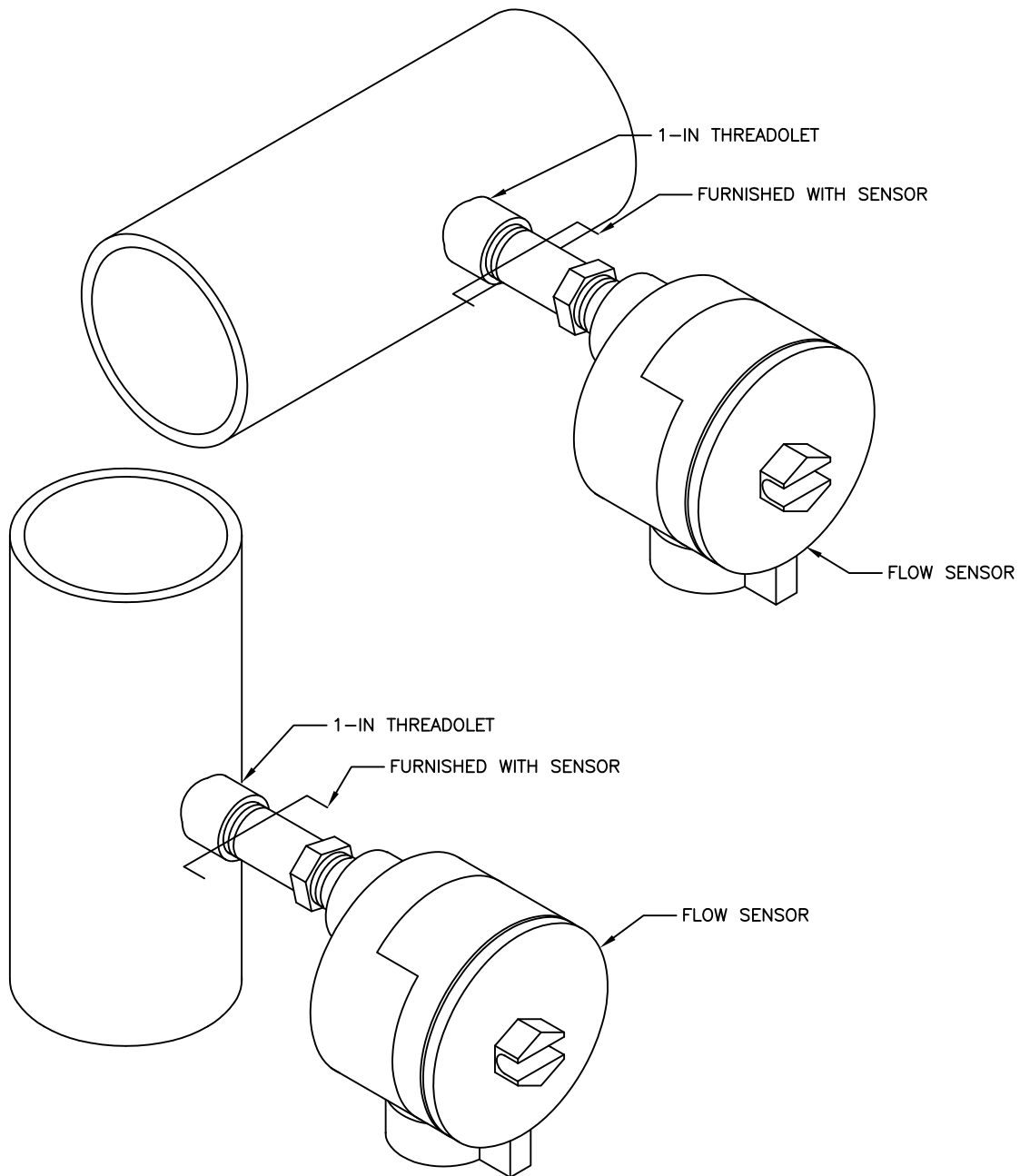
1. FLOAT SWITCH TRIP ELEVATION AS SPECIFIED CONTACT SHALL OPEN ON HIGH LEVEL CONDITION.
2. ALLOW ADEQUATE SLACK IN FLEX LT CONDUIT AND MANUFACTURER SUPPLIED CABLE TO ALLOW REMOVAL OF FLOAT SWITCH ASSEMBLY FROM STAND PIPE.
3. PROVIDE SIX FEET (MINIMUM) OF SLACK FLOAT SWITCH CABLE AND COIL WITHIN TERMINAL JUNCTION BOX.

SUSPENDED FLOAT SWITCH

NTS

40 91 10-37





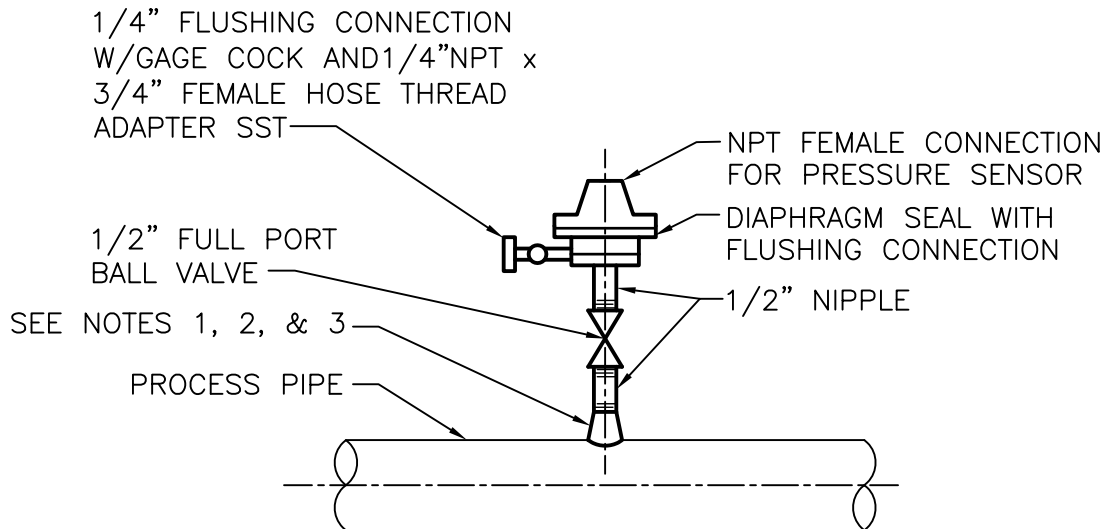
NOTES:

1. THREADOLET TO BE MOUNTED ON THE HORIZONTAL CENTERLINE OF THE PIPE
2. SWITCH "FLAT-UP AND LEVEL" INDICATOR SHALL BE ADHERED TO.
3. ALL CONDUIT RUNS MUST BE SUPPORTED AT LEAST EVERY 10 FEET AND WITHIN 2 FEET OF EACH END. ALL MOUNTING BRACKETS ARE TO BE ANCHORED SECURELY TO AN I-BEAM, WALL , OR STAND.

THERMAL MASS FLOW SENSOR

NTS

40 91 10-47



NOTES:

1. FOR STL, GSP, AND PVC 2 1/2" AND SMALLER, USE A BUSHING IN A TEE.
2. FOR DI AND FRP ALL SIZES, USE PIPE SADDLE W/ BUSHING.
3. FOR STL, AND SST PIPES 3" AND LARGER, AND PRESSURE VESSELS, USE THREAD-O-LET, OR EQUAL AS SHOWN.
4. DIAPHRAGM SEAL AND PRESSURE INSTRUMENT SHALL BE FACTORY ASSEMBLED.

DIAPHRAGM SEAL

NTS

40 91 10-54



APPENDIX B

Geotechnical Report prepared by
Shannon & Wilson, Inc.

December 10, 2020

SUBMITTED TO:
HDR Engineering, Inc.
835 North Post Street,
Suite 101
Spokane, WA 99202

BY:
Shannon & Wilson
400 N. 34th Street, Suite 100
Seattle, WA 98103

(206) 632-8020
www.shannonwilson.com

GEOTECHNICAL DATA REPORT
Wenatchee Digester #4
WENATCHEE, WASHINGTON

Submitted To: HDR Engineering, Inc.
835 North Post Street, Suite 101
Spokane, WA 99202
Attn: Mr. Andrew Staples

Subject: GEOTECHNICAL DATA REPORT, WENATCHEE DIGESTER #4,
WENATCHEE, WASHINGTON

Shannon & Wilson prepared this report and participated in this project as a subconsultant to HDR Engineering Inc.. Our scope of services was specified in the Subconsultant Agreement with HDR dated May 10, 2019. This report presents the geotechnical data collected for the project and was prepared by the undersigned.

We appreciate the opportunity to be of service to you on this project. If you have questions concerning this report, or we may be of further service, please contact us.

Sincerely,

SHANNON & WILSON



12/11/2020

David C. Ward, PE, LEG
Vice President

DCW/dcw

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2 Site and Project Description.....1

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4 Geotechnical Laboratory Testing2

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- Appendix A: Subsurface Explorations
- Appendix B: Geotechnical Laboratory Testing
- Appendix C: Existing Exploration Log
- Important Information

1 INTRODUCTION

This geotechnical data report presents the results of our geotechnical explorations for the Wenatchee Digester No. 4 project. Included in this report are a site and project description and a discussion of the completed subsurface geotechnical explorations and geotechnical laboratory testing.

2 SITE AND PROJECT DESCRIPTION

The project site is at the City of Wenatchee Wastewater Treatment Plant located adjacent to Riverfront Park on the western bank of the Columbia River in Wenatchee, Washington (Figure 1). The ground is slightly sloping to the northeast and is primarily covered in non-native grass and landscaping bark. The ground surface elevation at the proposed site of the new digester is about 640 feet (North American Vertical Datum of 1988). The riverfront site was a landfill from 1930 to 1958 and possibly as late as 1972 (Washington State Department of Ecology). The ground surface in the northeast corner of the site is hummocky; due possibly as a result of differential settlement associated with the former landfill.

The purpose of the project is to design and construct a fourth anaerobic digester tank, designated as Digester #4 and a new mechanical building. The proposed digester tank and mechanical building will be located in the northwest corner of the wastewater treatment plant site, south of Riverside Drive and east of N Worthen Street.

3 SUBSURFACE EXPLORATION PROGRAM

Six geotechnical borings, designated WD4-1 through WD4-6, were drilled and sampled at the site. The locations of the borings are shown in the Site and Exploration Plan (Figure 2).

Two observation wells were installed during the subsurface exploration program. One observation well was installed in boring WD4-2 and the other in boring WD4-6. A description of the methodology and procedures used for drilling and sampling the boring is provided in Appendix A, Subsurface Explorations. The boring logs are presented in Appendix A as Figures A-2 to A-7 and a soil description and log key is included as Figure A-1.

Seven existing boring logs near the current proposed Digest #4 and mechanical building location were provided by City of Wenatchee. These boring logs were for exploration

programs completed by others in 1989 and 2010. The approximate locations of these borings are shown in Figure 2 and the boring logs are included in Appendix C. Two other boring logs, also from the 1989 exploration program but drilled to the south of the project site and therefore not shown in Figure 2, are also included in Appendix C.

4 GEOTECHNICAL LABORATORY TESTING

Geotechnical laboratory tests were performed on selected samples retrieved from the borings to assist with classifying the soil and to provide data for our engineering analyses. The geotechnical laboratory testing was performed in our laboratory in Seattle, Washington, and included visual classification, water content determinations, Atterberg Limits determinations, and particle-size analysis. A description of the methodology and testing procedures for these tests is discussed in Appendix B, Geotechnical Laboratory Testing.

There was one sample submitted to Norton Corrosion in Woodinville, Washington, for corrosion testing. This sample was tested for pH, resistivity, sulfides, chlorides, and redox potential. The test results are presented in Appendix B.

5 GEOLOGY AND SUBSURFACE CONDITIONS

The geology and subsurface conditions at the site were evaluated based on conditions encountered in the borings and a review of available geologic maps. The following sections present a description of the site geology and the subsurface conditions encountered in the borings.

5.1 Site Geology

The geology in the project area is presented in the Geologic Map of the Wenatchee Quadrangle (1:100,000), by Tabor and others (1982, U.S. Geological Survey [USGS] Map I-1311). Bedrock of the Chumstick Formation, a mid-Eocene (45 million years old) sandstone, shale, and conglomerate sedimentary deposit, and of the Wenatchee Formation, an early Oligocene (34 million years old) sandstone and shale sedimentary deposit, are mapped on the hillslopes west of Wenatchee. Rock outcrops of the Chumstick Formation have also been mapped approximately seven blocks south of the project site.

Large catastrophic floods that originated from ice-dammed lakes to the north inundated the Columbia River valley at Wenatchee at least five times between 18,000 and 13,000 years ago. These floods deposited large point bars, dunes, and ripples composed of cobbles and boulders in a sand and gravel matrix along the river valley walls and bed. Also, during this

period, large lakes were created in this portion of the Columbia River valley by landslides that formed dams across the river. Sand and silt were deposited on the bed and shore of these lakes. In addition, large landslides occurred on the valley walls as they were undercut by the floods.

These catastrophic flood lake deposits currently form a veneer of silty sand, gravel, cobbles, and boulders that overlie the bedrock in the project vicinity. These flood deposits have subsequently been overlain by younger river deposits of silt, sand, and gravel as well as windblown deposits of sand and silt.

The soil types observed in the borings at the project site include the following:

- **Fill:** Fill deposits are placed by humans and can be both engineered and nonengineered. The deposits consist of various compositions of clay, silt, sand, and gravel and may contain other materials, including debris, cobbles, and boulders. Typically, engineered fill is dense or stiff and nonengineered fill is very loose to medium dense or very soft to stiff.
- **Alluvium:** Sand and gravel deposits of the Columbia River. These soils are typically very loose to very dense, clean to silty sand; sand with gravel; and gravel with sand and cobbles. These deposits may be interbedded with peat or lacustrine deposits. Wood or logs and boulders may be present.

The weathered bedrock observed in the project borings at the site is generally comprised of siltstone.

5.2 Site Subsurface Conditions

The borings were performed to evaluate geotechnical conditions at the location of the proposed digester tank. Our observations are specific to the location and depths noted on the logs and may not be applicable to all areas of the site. No amount of borings or testing can precisely predict the characteristics, quality, or distribution of subsurface and site conditions. Potential variation includes, but is not limited to:

- The conditions between and below explorations may be different.
- The passage of time or intervening causes (natural and manmade) may result in changes to site and subsurface conditions.
- Groundwater levels and flow directions may fluctuate due to seasonal or recharge source variations.
- Groundwater flow between different aquifers can occur. No soil or rock layer should be assumed to be continuous and/or watertight.

If conditions different from those described herein are encountered during the construction phase, we should review our descriptions of the subsurface conditions and reconsider our conclusions and recommendations.

The project borings generally encountered 12 to 27 feet of very loose to dense fill, with the fill near the proposed Digester #4 site ranging in thickness from 14 to 14.5 feet in WD4-1 and WD4-2 to about 21 feet in existing boring B-6 (2010). The fill is likely associated with the silty sand cap for a landfill that operated at the site from 1930 to 1958 and possibly as late as 1972 (Washington State Department of Ecology). Borings WD4-4 to WD4-6 all had trace amount of solid waste that included plastics, metal, and wood treated with creosote. The fill is locally underlain by up to 15 feet of dense to very dense alluvium deposits ranging between sandy silt and silty sand. Weathered bedrock near the proposed Digester #4 location was encountered at depths ranging from 21 to 23 feet below ground surface.

Existing borings B-2 (1989) through B-6 (1989) were reportedly terminated at depths ranging from 1.5 to 9 feet because of hard drilling, observed or inferred obstructions, and auger refusal. The term auger refusal is commonly used to denote the inability to advance the borehole using hollow-stem auger drilling methods.

5.3 Groundwater

Groundwater levels were recorded in borings WD4-2 and WD4-6 on June 18, 2019. The water level recorded in WD4-2 was about 17 feet bgs (elevation 623 feet) and the water level recorded in WD4-6 was about 19 feet bgs (elevation 620 feet). The groundwater data from the existing boring logs B-1 (1989), B-12 (1989) and B-13 (1989) suggests a similar range of groundwater elevations ranging from about 618 to 620 feet. The magnitude of seasonal groundwater fluctuation is not known.

6 CLOSURE

We cannot assume responsibility or liability for the adequacy of our recommendations without our being retained to observe geotechnical construction activities. Our involvement will help with developing alternative recommendations if the conditions observed during construction are different from those assumed in this report. Our support services should include review of the geotechnical submittals, observation of earthwork and excavation, and as-needed support to clarify related issues.

This report should not be used without our approval if any of the following occurs:

- Conditions change due to natural forces or human activity under, at, or adjacent to the site.

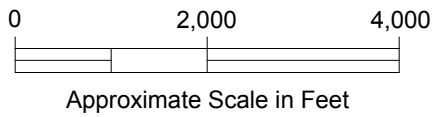
- Assumptions stated in this report have changed.
- Project details change or new information becomes available such that our analyses, conclusions, and recommendation may be affected.
- If the site ownership or land use has changed.
- More than ten years has passed since the date of this report.

If any of these occur, we should be retained to review the applicability of our recommendations. Shannon and Wilson has prepared the document, "Important Information About Your Geotechnical /Environmental Report," to assist you and others in understanding the use and limitations of our reports.

7 REFERENCES

Tabor, R.W.; Waitt, R.B.; Frizzell, V.A.; Swanson, D.A.; Byerly, G.R.; and Bentley, R.D., 1982, Geologic Map of the Wenatchee Quadrangle, Central Washington: U.S. Geological Survey Miscellaneous Investigations Series Map I-1311, scale 1:100,000.

Washington State Department of Ecology, Wenatchee City Worthen St. Landfill: Available: <https://apps.ecology.wa.gov/gsp/Sitepage.aspx?csid=4085>



NOTE

Bing Map Image adapted from aerial imagery provided by Autodesk Live Maps and Microsoft Bing Maps reprinted with permission from Microsoft Corporation.

Waste Water Treatment Plant Digester No. 4
Wenatchee, Washington

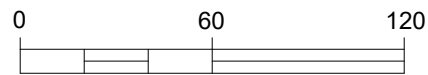
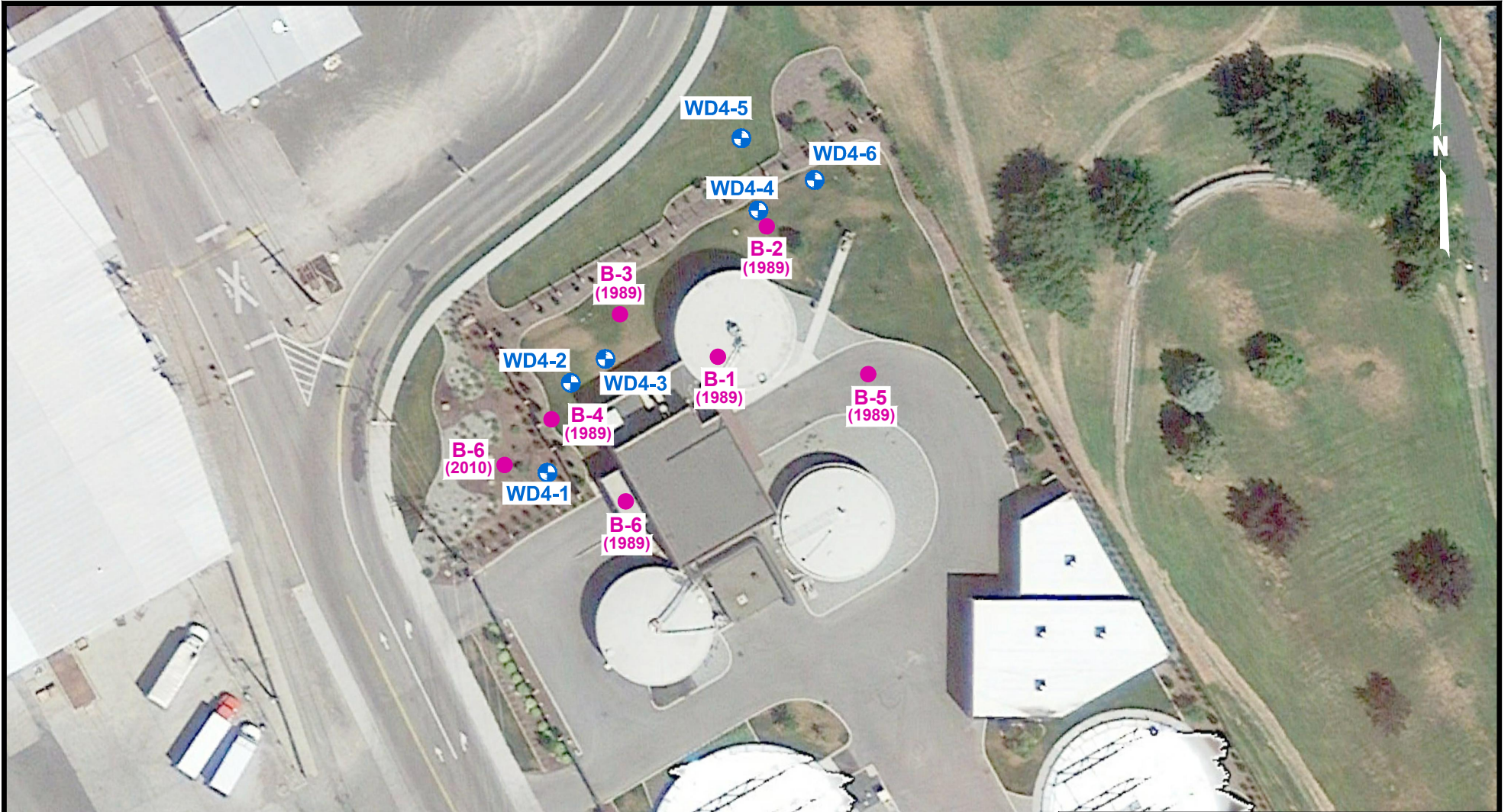
VICINITY MAP

July 2019

102083-003



FIG. 1



Scale in Feet

LEGEND

WD4-1

Boring Designation and Approximate Location (2019)

B-6
(2010)

Existing Boring Designation, Date, and Approximate Location (By Others)

Waste Water Treatment Plant Digester No. 4
Wenatchee, Washington

SITE AND EXPLORATION PLAN

July 2019

102083-003

SHANNON & WILSON, INC.
GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS

FIG. 2

FIG. 2

Appendix A

Subsurface Explorations

APPENDIX A: SUBSURFACE EXPLORATIONS

Appendix A

Subsurface Explorations

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A.2 Drilling Procedures..... A-1

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- Figure A-2: Log of Boring WD4-1
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- Figure A-5: Log of Boring WD4-4
- Figure A-6: Log of Boring WD4-5
- Figure A-7: Log of Boring WD4-6

APPENDIX A: SUBSURFACE EXPLORATIONS

A.1 GENERAL

We performed subsurface explorations for this project consisting of drilling and sampling six soil borings. The approximate location of these borings is shown in Figure 2. General locations were marked by RH2 Engineering for utility locates. The exact location of the borings was determined at the site by a field representative from Shannon & Wilson, Inc.

A.2 DRILLING PROCEDURES

Six borings, designated WD4-1 through WD4-6, were drilled from May 28 to 30, 2019. Holt Services, Inc. of Puyallup, Washington, under contract to Shannon & Wilson, drilled the borings using a CME 85 truck-mounted, hollow-stem auger (HSA) drill. The borings were advanced to 41.5 feet, with the exception of boring WD4-5, which terminated at 26.5 feet. HSA drilling consists of a continuous-flight auger equipped with a 4.25-inch-diameter hollow stem. Samples obtained by removing the center rod and plug and lowering a split-spoon sampler through the hollow stem. The soil cuttings were placed into 55-gallon drums and left at the wastewater treatment plant for Wenatchee Public Works to dispose of.

A.3 SOIL SAMPLING

A Shannon & Wilson field representative was present to observe drilling, collect samples for subsequent laboratory testing, and prepare a descriptive field log of the boring. Sampling was performed in conjunction with Standard Penetration Tests (SPTs). All samples retrieved were classified onsite by our field representative, placed in airtight containers, and transported to the Shannon & Wilson laboratory in Seattle for further classification and testing. Each soil sample was classified according to the Unified Soil Classification System (USCS), which is presented in the Soil Description and Log Key (Figure A-1). Sample classification was based on ASTM D2487, Standard Test Method for Classification of Soil for Engineering Purpose, and ASTM D2488, Standard Recommended Practice for Description of Soils (Visual-Manual Procedure).

SPTs were performed in accordance with ASTM Designation: D1586, Test Method for Penetration Test and Split-Barrel Sampling of Soils. The SPT consists of driving a 2-inch outside diameter, 1.375-inch inside diameter, split-spoon sampler 18 inches into the bottom of the borehole with a 140-pound hammer falling 30 inches. The number of blows required to achieve the last two 6-inch increments of sampler penetration is termed the Standard Penetration Resistance (N-Value) or blow count. This value is an indicator of relative density or consistency of the soils. Whenever 50 or more blows are required to cause

6 inches of penetration, the hammer is stopped, and the number of blows and corresponding penetration is recorded. Samples recovered from the split-spoon sampler are disturbed but are generally considered representative of the soils encountered. The results of the SPT's are plotted on the boring logs in this Appendix.

A.4 BORING LOG

The boring logs for each hole are presented in this Appendix (Figures A-2 through A-7). A boring log is a written record of the subsurface conditions encountered. It describes the geologic units (layers) encountered in the borings and the USCS symbol of each geologic layer. It also includes the natural water content (where tested) and the blow count. Other information shown in the bore logs includes groundwater level observations, approximate surface elevation, types and depths of sampling, and the results of the grain size analysis and Atterberg Limits testing.

Shannon & Wilson, Inc. (S&W), uses a soil identification system modified from the Unified Soil Classification System (USCS). Elements of the USCS and other definitions are provided on this and the following pages. Soil descriptions are based on visual-manual procedures (ASTM D2488) and laboratory testing procedures (ASTM D2487), if performed.

S&W INORGANIC SOIL CONSTITUENT DEFINITIONS

CONSTITUENT ²	FINE-GRAINED SOILS (50% or more fines) ¹	COARSE-GRAINED SOILS (less than 50% fines) ¹
Major	Silt, Lean Clay, Elastic Silt,³ or Fat Clay	Sand or Gravel⁴
Modifying (Secondary) Precedes major constituent	30% or more coarse-grained: Sandy or Gravelly⁴	More than 12% fine-grained: Silty or Clayey³
Minor Follows major constituent	15% to 30% coarse-grained: with Sand or with Gravel⁴ 30% or more total coarse-grained and lesser coarse-grained constituent is 15% or more: with Sand or with Gravel⁵	5% to 12% fine-grained: with Silt or with Clay³ 15% or more of a second coarse-grained constituent: with Sand or with Gravel⁵

¹All percentages are by weight of total specimen passing a 3-inch sieve.
²The order of terms is: *Modifying Major with Minor*.
³Determined based on behavior.
⁴Determined based on which constituent comprises a larger percentage.
⁵Whichever is the lesser constituent.

MOISTURE CONTENT TERMS

Dry	Absence of moisture, dusty, dry to the touch
Moist	Damp but no visible water
Wet	Visible free water, from below water table

STANDARD PENETRATION TEST (SPT) SPECIFICATIONS

Hammer:	140 pounds with a 30-inch free fall. Rope on 6- to 10-inch-diam. cathead 2-1/4 rope turns, > 100 rpm
	NOTE: If automatic hammers are used, blow counts shown on boring logs should be adjusted to account for efficiency of hammer.
Sampler:	10 to 30 inches long Shoe I.D. = 1.375 inches Barrel I.D. = 1.5 inches Barrel O.D. = 2 inches
N-Value:	Sum blow counts for second and third 6-inch increments. Refusal: 50 blows for 6 inches or less; 10 blows for 0 inches.
	NOTE: Penetration resistances (N-values) shown on boring logs are as recorded in the field and have not been corrected for hammer efficiency, overburden, or other factors.











PARTICLE SIZE DEFINITIONS

DESCRIPTION	SIEVE NUMBER AND/OR APPROXIMATE SIZE
FINES	< #200 (0.075 mm = 0.003 in.)
SAND Fine Medium Coarse	#200 to #40 (0.075 to 0.4 mm; 0.003 to 0.02 in.) #40 to #10 (0.4 to 2 mm; 0.02 to 0.08 in.) #10 to #4 (2 to 4.75 mm; 0.08 to 0.187 in.)
GRAVEL Fine Coarse	#4 to 3/4 in. (4.75 to 19 mm; 0.187 to 0.75 in.) 3/4 to 3 in. (19 to 76 mm)
COBBLES	3 to 12 in. (76 to 305 mm)
BOULDERS	> 12 in. (305 mm)

RELATIVE DENSITY / CONSISTENCY

COHESIONLESS SOILS		COHESIVE SOILS	
N, SPT, BLOWS/FT.	RELATIVE DENSITY	N, SPT, BLOWS/FT.	RELATIVE CONSISTENCY
< 4	Very loose	< 2	Very soft
4 - 10	Loose	2 - 4	Soft
10 - 30	Medium dense	4 - 8	Medium stiff
30 - 50	Dense	8 - 15	Stiff
> 50	Very dense	15 - 30	Very stiff
		> 30	Hard

WELL AND BACKFILL SYMBOLS

	Bentonite Cement Grout		Surface Cement Seal
	Bentonite Grout		Asphalt or Cap
	Bentonite Chips		Slough
	Silica Sand		Inclinometer or Non-perforated Casing
	Perforated or Screened Casing		Vibrating Wire Piezometer

PERCENTAGES TERMS^{1,2}

Trace	< 5%
Few	5 to 10%
Little	15 to 25%
Some	30 to 45%
Mostly	50 to 100%

¹Gravel, sand, and fines estimated by mass. Other constituents, such as organics, cobbles, and boulders, estimated by volume.

²Reprinted, with permission, from ASTM D2488 - 09a Standard Practice for Description and Identification of Soils (Visual-Manual Procedure), copyright ASTM International, 100 Barr Harbor Drive, West Conshohocken, PA 19428. A copy of the complete standard may be obtained from ASTM International, www.astm.org.

Wenatchee Digester #4
Wenatchee, WA

SOIL DESCRIPTION AND LOG KEY
















July 2019

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FIG. A-1
Sheet 1 of 3

UNIFIED SOIL CLASSIFICATION SYSTEM (USCS)
 (Modified From USACE Tech Memo 3-357, ASTM D2487, and ASTM D2488)

MAJOR DIVISIONS		GROUP/GRAPHIC SYMBOL	TYPICAL IDENTIFICATIONS	
COARSE-GRAINED SOILS <i>(more than 50% retained on No. 200 sieve)</i>	Gravels <i>(more than 50% of coarse fraction retained on No. 4 sieve)</i>	Gravel <i>(less than 5% fines)</i>	GW 	Well-Graded Gravel; Well-Graded Gravel with Sand
			GP 	Poorly Graded Gravel; Poorly Graded Gravel with Sand
		Silty or Clayey Gravel <i>(more than 12% fines)</i>	GM 	Silty Gravel; Silty Gravel with Sand
			GC 	Clayey Gravel; Clayey Gravel with Sand
	Sands <i>(50% or more of coarse fraction passes the No. 4 sieve)</i>	Sand <i>(less than 5% fines)</i>	SW 	Well-Graded Sand; Well-Graded Sand with Gravel
			SP 	Poorly Graded Sand; Poorly Graded Sand with Gravel
		Silty or Clayey Sand <i>(more than 12% fines)</i>	SM 	Silty Sand; Silty Sand with Gravel
			SC 	Clayey Sand; Clayey Sand with Gravel
FINE-GRAINED SOILS <i>(50% or more passes the No. 200 sieve)</i>	Silt and Clays <i>(liquid limit less than 50)</i>	Inorganic	ML 	Silt; Silt with Sand or Gravel; Sandy or Gravelly Silt
			CL 	Lean Clay; Lean Clay with Sand or Gravel; Sandy or Gravelly Lean Clay
		Organic	OL 	Organic Silt or Clay; Organic Silt or Clay with Sand or Gravel; Sandy or Gravelly Organic Silt or Clay
	Silt and Clays <i>(liquid limit 50 or more)</i>	Inorganic	MH 	Elastic Silt; Elastic Silt with Sand or Gravel; Sandy or Gravelly Elastic Silt
			CH 	Fat Clay; Fat Clay with Sand or Gravel; Sandy or Gravelly Fat Clay
		Organic	OH 	Organic Silt or Clay; Organic Silt or Clay with Sand or Gravel; Sandy or Gravelly Organic Silt or Clay
HIGHLY-ORGANIC SOILS	Primarily organic matter, dark in color, and organic odor	PT 	Peat or other highly organic soils (see ASTM D4427)	

NOTE: No. 4 size = 4.75 mm = 0.187 in.; No. 200 size = 0.075 mm = 0.003 in.

NOTES

- Dual symbols (*symbols separated by a hyphen, i.e., SP-SM, Sand with Silt*) are used for soils with between 5% and 12% fines or when the liquid limit and plasticity index values plot in the CL-ML area of the plasticity chart. Graphics shown on the logs for these soil types are a combination of the two graphic symbols (e.g., SP and SM).
- Borderline symbols (*symbols separated by a slash, i.e., CL/ML, Lean Clay to Silt; SP-SM/SM, Sand with Silt to Silty Sand*) indicate that the soil properties are close to the defining boundary between two groups.

Wenatchee Digester #4
Wenatchee, WA

**SOIL DESCRIPTION
AND LOG KEY**

July 2019

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SHANNON & WILSON, INC.
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FIG. A-1
Sheet 2 of 3

GRADATION TERMS

Poorly Graded	Narrow range of grain sizes present or, within the range of grain sizes present, one or more sizes are missing (Gap Graded). Meets criteria in ASTM D2487, if tested.
Well-Graded	Full range and even distribution of grain sizes present. Meets criteria in ASTM D2487, if tested.

CEMENTATION TERMS¹

Weak	Crumbles or breaks with handling or slight finger pressure.
Moderate	Crumbles or breaks with considerable finger pressure.
Strong	Will not crumble or break with finger pressure.

PLASTICITY²

DESCRIPTION	VISUAL-MANUAL CRITERIA	APPROX. PLASTICITY INDEX RANGE
Nonplastic	A 1/8-in. thread cannot be rolled at any water content.	< 4
Low	A thread can barely be rolled and a lump cannot be formed when drier than the plastic limit.	4 to 10
Medium	A thread is easy to roll and not much time is required to reach the plastic limit. The thread cannot be rerolled after reaching the plastic limit. A lump crumbles when drier than the plastic limit.	10 to 20
High	It takes considerable time rolling and kneading to reach the plastic limit. A thread can be rerolled several times after reaching the plastic limit. A lump can be formed without crumbling when drier than the plastic limit.	> 20

ADDITIONAL TERMS

Mottled	Irregular patches of different colors.
Bioturbated	Soil disturbance or mixing by plants or animals.
Diamict	Nonsorted sediment; sand and gravel in silt and/or clay matrix.
Cuttings	Material brought to surface by drilling.
Slough	Material that caved from sides of borehole.
Sheared	Disturbed texture, mix of strengths.

PARTICLE ANGULARITY AND SHAPE TERMS¹

Angular	Sharp edges and unpolished planar surfaces.
Subangular	Similar to angular, but with rounded edges.
Subrounded	Nearly planar sides with well-rounded edges.
Rounded	Smoothly curved sides with no edges.
Flat	Width/thickness ratio > 3.
Elongated	Length/width ratio > 3.

ACRONYMS AND ABBREVIATIONS

ATD	At Time of Drilling
Diam.	Diameter
Elev.	Elevation
ft.	Feet
FeO	Iron Oxide
gal.	Gallons
Horiz.	Horizontal
HSA	Hollow Stem Auger
I.D.	Inside Diameter
in.	Inches
lbs.	Pounds
MgO	Magnesium Oxide
mm	Millimeter
MnO	Manganese Oxide
NA	Not Applicable or Not Available
NP	Nonplastic
O.D.	Outside Diameter
OW	Observation Well
pcf	Pounds per Cubic Foot
PID	Photo-Ionization Detector
PMT	Pressuremeter Test
ppm	Parts per Million
psi	Pounds per Square Inch
PVC	Polyvinyl Chloride
rpm	Rotations per Minute
SPT	Standard Penetration Test
USCS	Unified Soil Classification System
q _u	Unconfined Compressive Strength
VWP	Vibrating Wire Piezometer
Vert.	Vertical
WOH	Weight of Hammer
WOR	Weight of Rods
Wt.	Weight

STRUCTURE TERMS¹

Interbedded	Alternating layers of varying material or color with layers at least 1/4-inch thick; singular: bed.
Laminated	Alternating layers of varying material or color with layers less than 1/4-inch thick; singular: lamination.
Fissured	Breaks along definite planes or fractures with little resistance.
Slickensided	Fracture planes appear polished or glossy; sometimes striated.
Blocky	Cohesive soil that can be broken down into small angular lumps that resist further breakdown.
Lensed	Inclusion of small pockets of different soils, such as small lenses of sand scattered through a mass of clay.
Homogeneous	Same color and appearance throughout.

Wenatchee Digester #4
Wenatchee, WA

SOIL DESCRIPTION AND LOG KEY

July 2019

102083-002

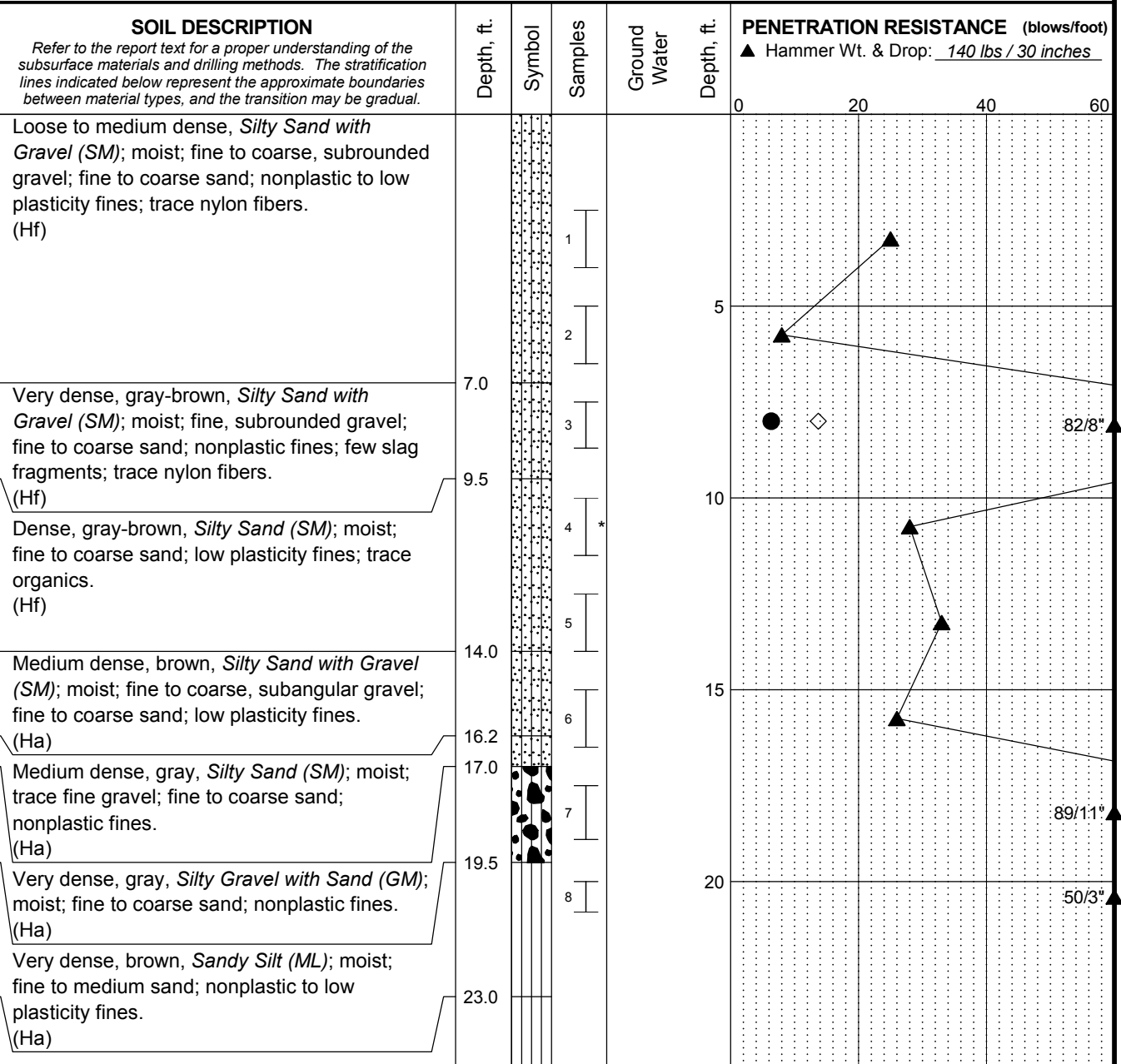
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Geotechnical and Environmental Consultants

FIG. A-1
Sheet 3 of 3

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²Adapted, with permission, from ASTM D2488 - 09a Standard Practice for Description and Identification of Soils (Visual-Manual Procedure), copyright ASTM International, 100 Barr Harbor Drive, West Conshohocken, PA 19428. A copy of the complete standard may be obtained from ASTM International, www.astm.org.

Total Depth: <u>40.1 ft.</u>	Northing: <u>157,204 ft.</u>	Drilling Method: <u>Hollow Stem Auger</u>	Hole Diam.: <u>8 in.</u>
Top Elevation: <u>639.4 ft.</u>	Easting: <u>1,769,784 ft.</u>	Drilling Company: <u>Holt Services</u>	Rod Diam.: <u>mw</u>
Vert. Datum: <u>NAVD88</u>	Station: <u>-</u>	Drill Rig Equipment: <u>CME 85</u>	Hammer Type: <u>Automatic</u>
Horiz. Datum: <u>NAD83</u>	Offset: <u>-</u>	Other Comments: _____	



Log: ECS Rev: EAS Typ: EAS
 MASTER LOG E 102083.GPJ SHAN_WIL_GDT_7/23/19

CONTINUED NEXT SHEET
LEGEND

- * Sample Not Recovered
- ⌊ 2.0" O.D. Split Spoon Sample

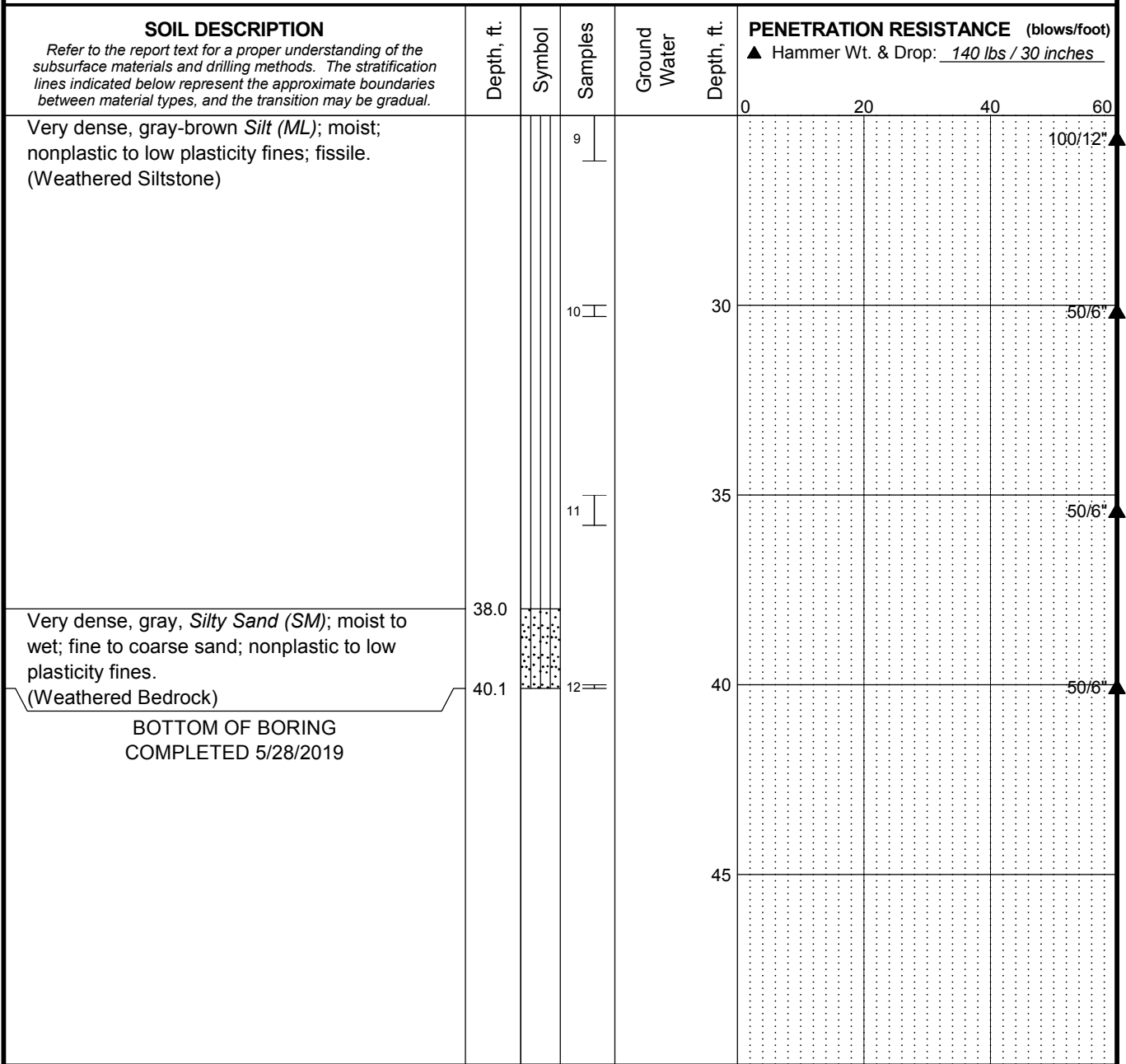
- ◇ % Fines (<0.075mm)
- % Water Content

NOTES

- Refer to KEY for explanation of symbols, codes, abbreviations and definitions.
- Groundwater level, if indicated above, is for the date specified and may vary.
- USCS designation is based on visual-manual classification and selected lab testing.

Wenatchee Digester #4 Wenatchee, WA	
LOG OF BORING WD4-1	
July 2019	102083-002
SHANNON & WILSON, INC. Geotechnical and Environmental Consultants	FIG. A-2 Sheet 1 of 2

Total Depth: 40.1 ft. Northing: 157,204 ft. Drilling Method: Hollow Stem Auger Hole Diam.: 8 in.
 Top Elevation: 639.4 ft. Easting: 1,769,784 ft. Drilling Company: Holt Services Rod Diam.: mw
 Vert. Datum: NAVD88 Station: - Drill Rig Equipment: CME 85 Hammer Type: Automatic
 Horiz. Datum: NAD83 Offset: - Other Comments: _____



LEGEND

- * Sample Not Recovered
- ┆ 2.0" O.D. Split Spoon Sample

- ◇ % Fines (<0.075mm)
- % Water Content

NOTES

1. Refer to KEY for explanation of symbols, codes, abbreviations and definitions.
2. Groundwater level, if indicated above, is for the date specified and may vary.
3. USCS designation is based on visual-manual classification and selected lab testing.

Wenatchee Digester #4
Wenatchee, WA

LOG OF BORING WD4-1

July 2019

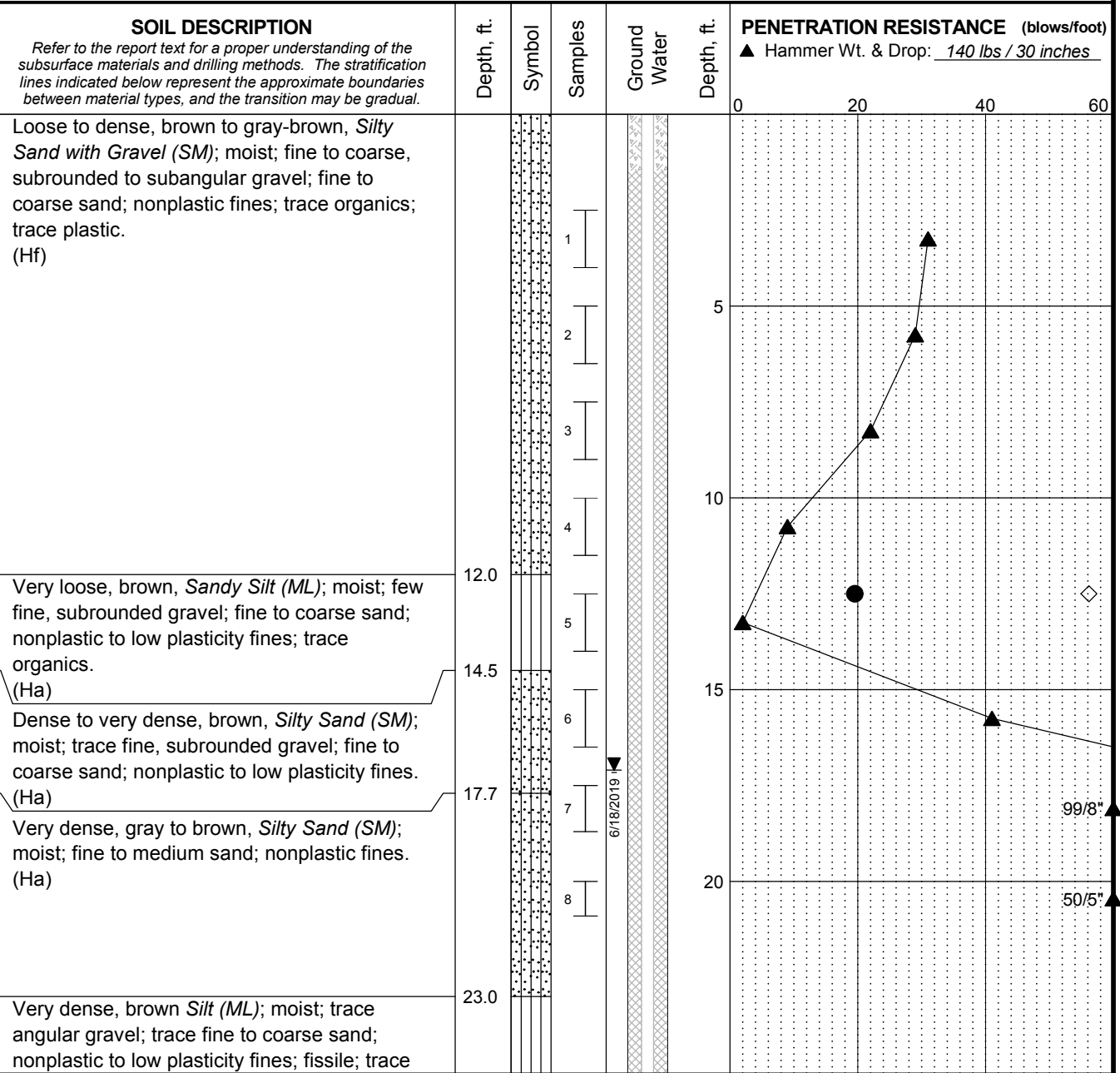
102083-002

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

FIG. A-2
Sheet 2 of 2

Log: ECS Rev: EAS Typ: EAS MASTER LOG E 102083.GPJ SHAN_WIL_GDT 7/23/19

Total Depth: 40.1 ft. Northing: 157,134 ft. Drilling Method: Hollow Stem Auger Hole Diam.: 8 in.
 Top Elevation: 640.3 ft. Easting: 1,769,707 ft. Drilling Company: Holt Services Rod Diam.: mw
 Vert. Datum: NAVD88 Station: - Drill Rig Equipment: CME 85 Hammer Type: Automatic
 Horiz. Datum: NAD83 Offset: - Other Comments: _____



Log: ECS Rev: EAS Typ: EAS MASTER LOG E 102083.GPJ SHAN_WIL_GDT_7/23/19

CONTINUED NEXT SHEET

LEGEND

- * Sample Not Recovered
- ┆ 2.0" O.D. Split Spoon Sample
- [Symbol] Well Screen and Sand Filter
- [Symbol] Bentonite-Cement Grout
- [Symbol] Bentonite Chips/Pellets
- [Symbol] Bentonite Grout
- ▼ Ground Water Level in Well

- ◇ % Fines (<0.075mm)
- % Water Content
- Plastic Limit
- Liquid Limit
- Natural Water Content

NOTES

- Refer to KEY for explanation of symbols, codes, abbreviations and definitions.
- Groundwater level, if indicated above, is for the date specified and may vary.
- USCS designation is based on visual-manual classification and selected lab testing.

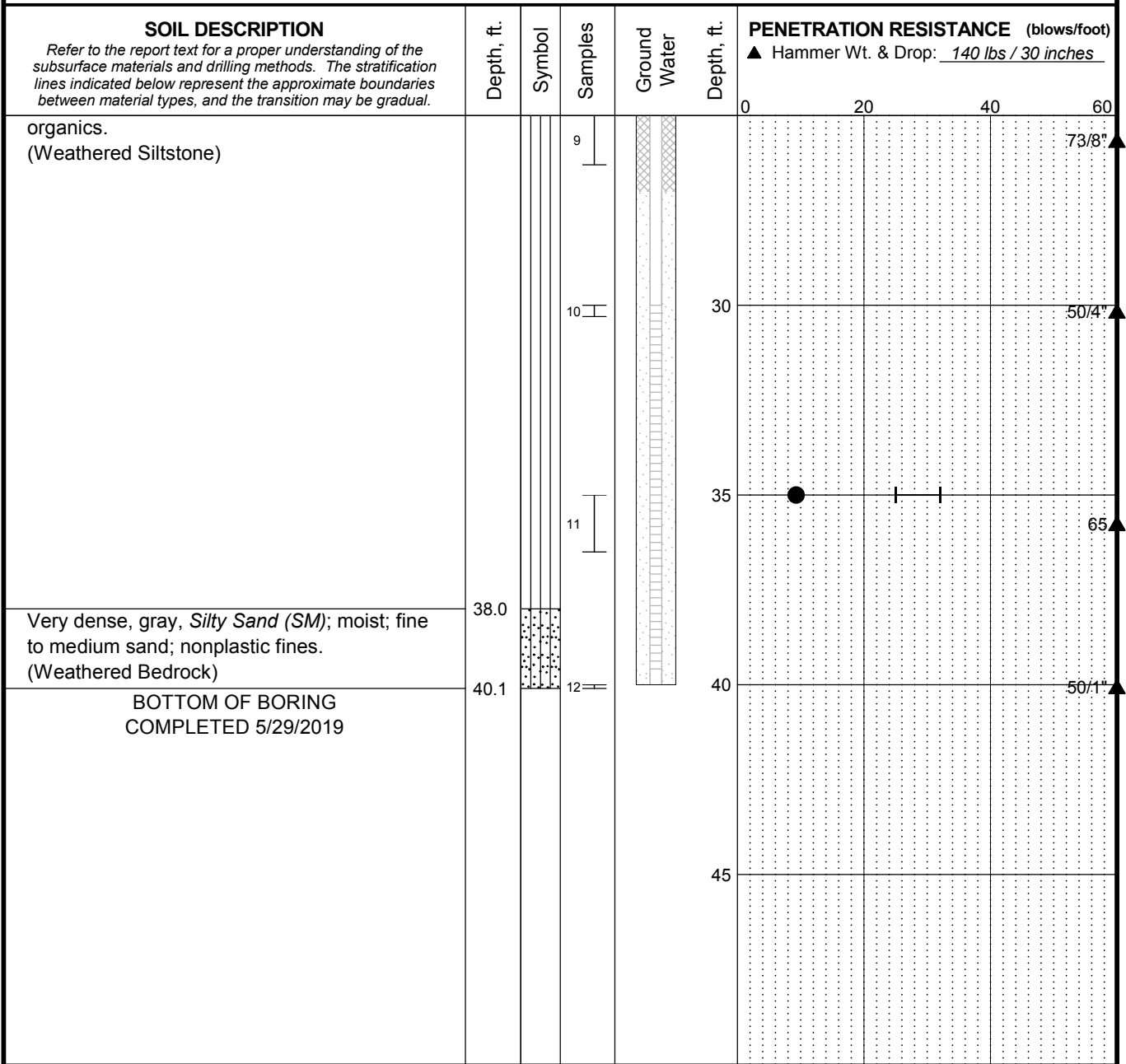
Wenatchee Digester #4
Wenatchee, WA

LOG OF BORING WD4-2

July 2019 102083-002

SHANNON & WILSON, INC. **FIG. A-3**
 Geotechnical and Environmental Consultants Sheet 1 of 2

Total Depth: 40.1 ft. Northing: 157,134 ft. Drilling Method: Hollow Stem Auger Hole Diam.: 8 in.
 Top Elevation: 640.3 ft. Easting: 1,769,707 ft. Drilling Company: Holt Services Rod Diam.: mw
 Vert. Datum: NAVD88 Station: - Drill Rig Equipment: CME 85 Hammer Type: Automatic
 Horiz. Datum: NAD83 Offset: - Other Comments: _____



Log: ECS Rev: EAS Typ: EAS
MASTER LOG E 102083.GPJ SHAN_WIL_GDT 7/23/19

- * Sample Not Recovered
- ┆ 2.0" O.D. Split Spoon Sample

LEGEND

- Well Screen and Sand Filter
- Bentonite-Cement Grout
- Bentonite Chips/Pellets
- Bentonite Grout
- Ground Water Level in Well

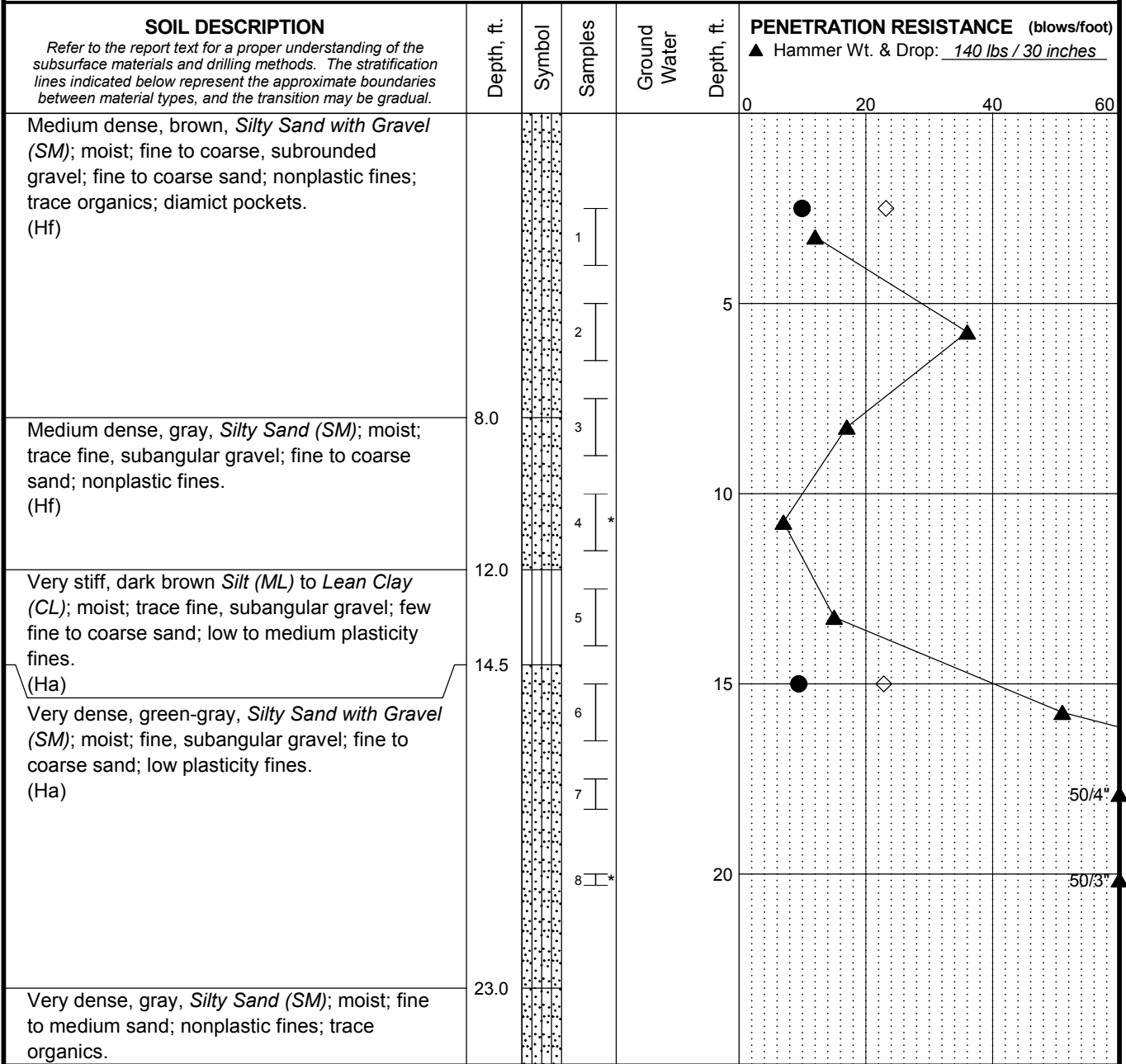
- ◇ % Fines (<0.075mm)
- % Water Content
- Liquid Limit
- Natural Water Content

NOTES

1. Refer to KEY for explanation of symbols, codes, abbreviations and definitions.
2. Groundwater level, if indicated above, is for the date specified and may vary.
3. USCS designation is based on visual-manual classification and selected lab testing.

Wenatchee Digester #4 Wenatchee, WA	
LOG OF BORING WD4-2	
July 2019	102083-002
SHANNON & WILSON, INC. Geotechnical and Environmental Consultants	FIG. A-3 Sheet 2 of 2

Total Depth: <u>40.2 ft.</u>	Northing: <u>157,144 ft.</u>	Drilling Method: <u>Hollow Stem Auger</u>	Hole Diam.: <u>8 in.</u>
Top Elevation: <u>640.1 ft.</u>	Easting: <u>1,769,721 ft.</u>	Drilling Company: <u>Holt Services</u>	Rod Diam.: <u>mw</u>
Vert. Datum: <u>NAVD88</u>	Station: <u>-</u>	Drill Rig Equipment: <u>CME 85</u>	Hammer Type: <u>Automatic</u>
Horiz. Datum: <u>NAD83</u>	Offset: <u>-</u>	Other Comments: _____	



CONTINUED NEXT SHEET
LEGEND

* Sample Not Recovered
 I 2.0" O.D. Split Spoon Sample

◇ % Fines (<0.075mm)
 ● % Water Content

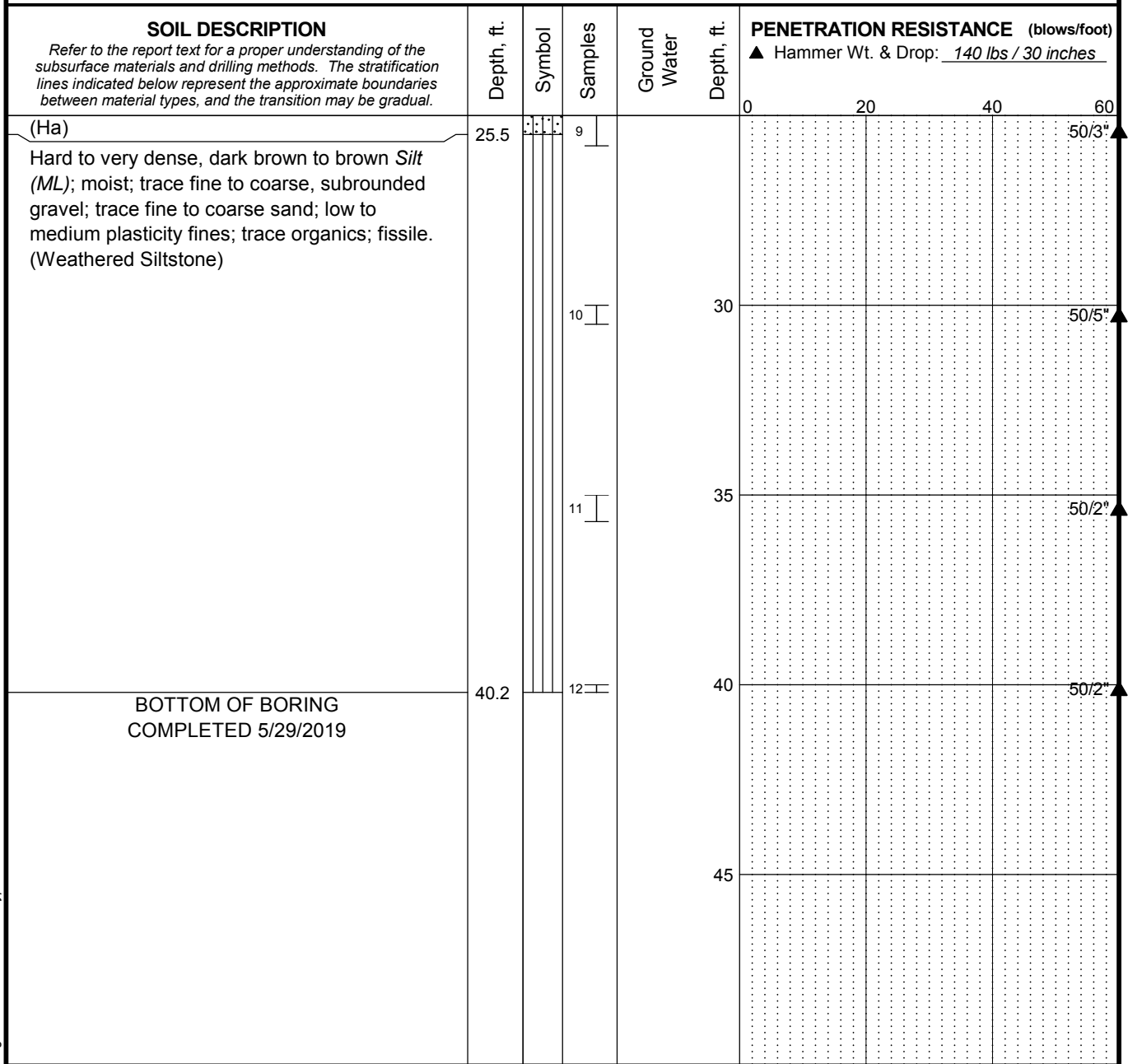
NOTES

1. Refer to KEY for explanation of symbols, codes, abbreviations and definitions.
2. Groundwater level, if indicated above, is for the date specified and may vary.
3. USCS designation is based on visual-manual classification and selected lab testing.

Wenatchee Digester #4 Wenatchee, WA	
LOG OF BORING WD4-3	
July 2019	102083-002
SHANNON & WILSON, INC. Geotechnical and Environmental Consultants	FIG. A-4 Sheet 1 of 2

Log: ECS Rev: EAS Typ: EAS
 MASTER LOG E 102083.GPJ SHAN_WIL_GDT_7/23/19

Total Depth: 40.2 ft. Northing: 157,144 ft. Drilling Method: Hollow Stem Auger Hole Diam.: 8 in.
 Top Elevation: 640.1 ft. Easting: 1,769,721 ft. Drilling Company: Holt Services Rod Diam.: mw
 Vert. Datum: NAVD88 Station: - Drill Rig Equipment: CME 85 Hammer Type: Automatic
 Horiz. Datum: NAD83 Offset: - Other Comments: _____



Log: ECS Rev: EAS Typ: EAS
MASTER LOG_E_102083.GPJ_SHAN_WIL_GDT_7/23/19

LEGEND

- * Sample Not Recovered
- ┆ 2.0" O.D. Split Spoon Sample

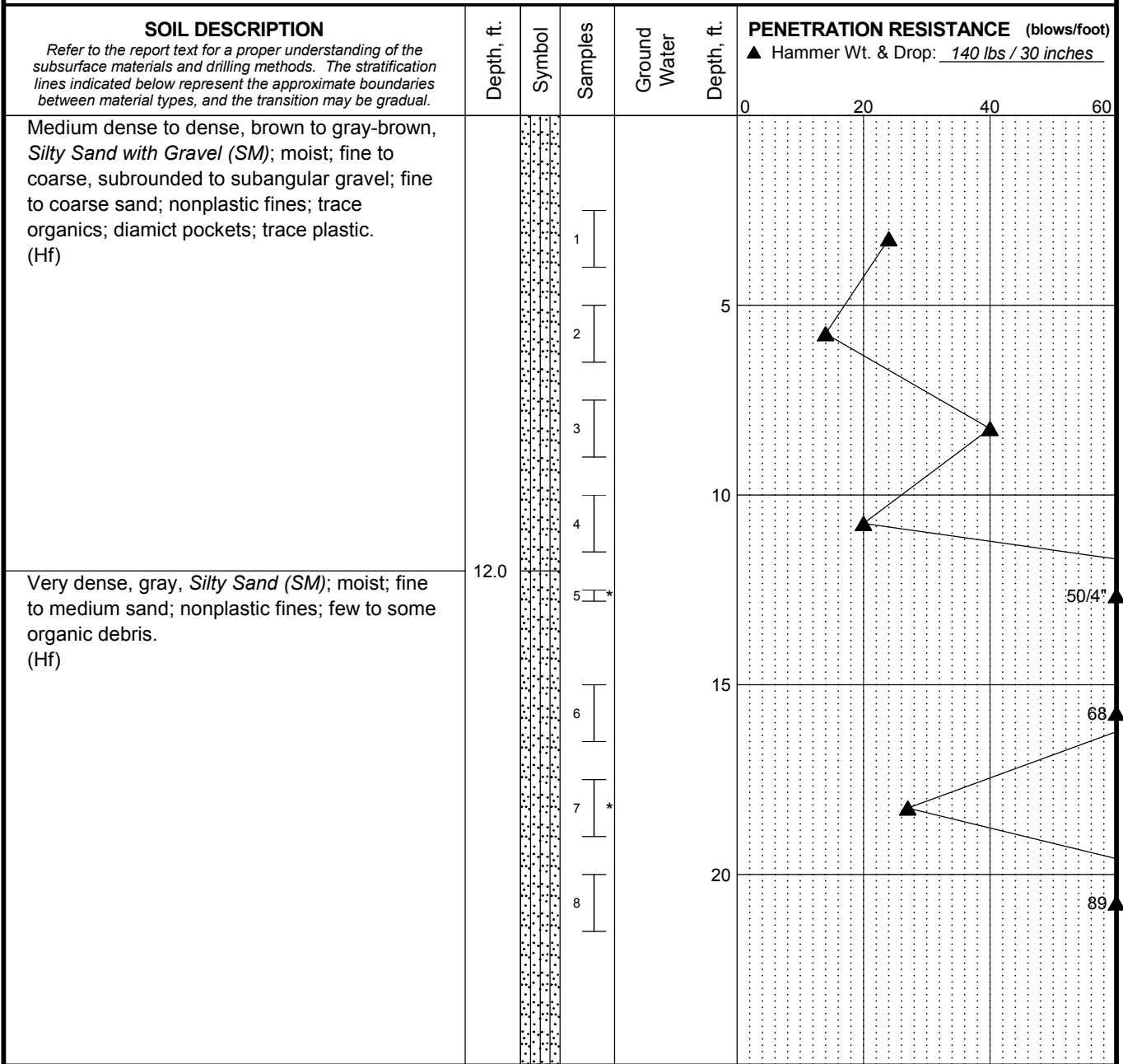
- ◇ % Fines (<0.075mm)
- % Water Content

NOTES

1. Refer to KEY for explanation of symbols, codes, abbreviations and definitions.
2. Groundwater level, if indicated above, is for the date specified and may vary.
3. USCS designation is based on visual-manual classification and selected lab testing.

Wenatchee Digester #4 Wenatchee, WA	
LOG OF BORING WD4-3	
July 2019	102083-002
SHANNON & WILSON, INC. Geotechnical and Environmental Consultants	FIG. A-4 Sheet 2 of 2

Total Depth: 40.1 ft. Northing: 157,097 ft. Drilling Method: Hollow Stem Auger Hole Diam.: 8 in.
 Top Elevation: 639.4 ft. Easting: 1,769,698 ft. Drilling Company: Holt Services Rod Diam.: mw
 Vert. Datum: NAVD88 Station: - Drill Rig Equipment: CME 85 Hammer Type: Automatic
 Horiz. Datum: NAD83 Offset: - Other Comments:



CONTINUED NEXT SHEET

LEGEND

- * Sample Not Recovered
- ⊥ 2.0" O.D. Split Spoon Sample

- ◇ % Fines (<0.075mm)
- % Water Content

NOTES

1. Refer to KEY for explanation of symbols, codes, abbreviations and definitions.
2. Groundwater level, if indicated above, is for the date specified and may vary.
3. USCS designation is based on visual-manual classification and selected lab testing.

Wenatchee Digester #4
Wenatchee, WA

LOG OF BORING WD4-4

July 2019

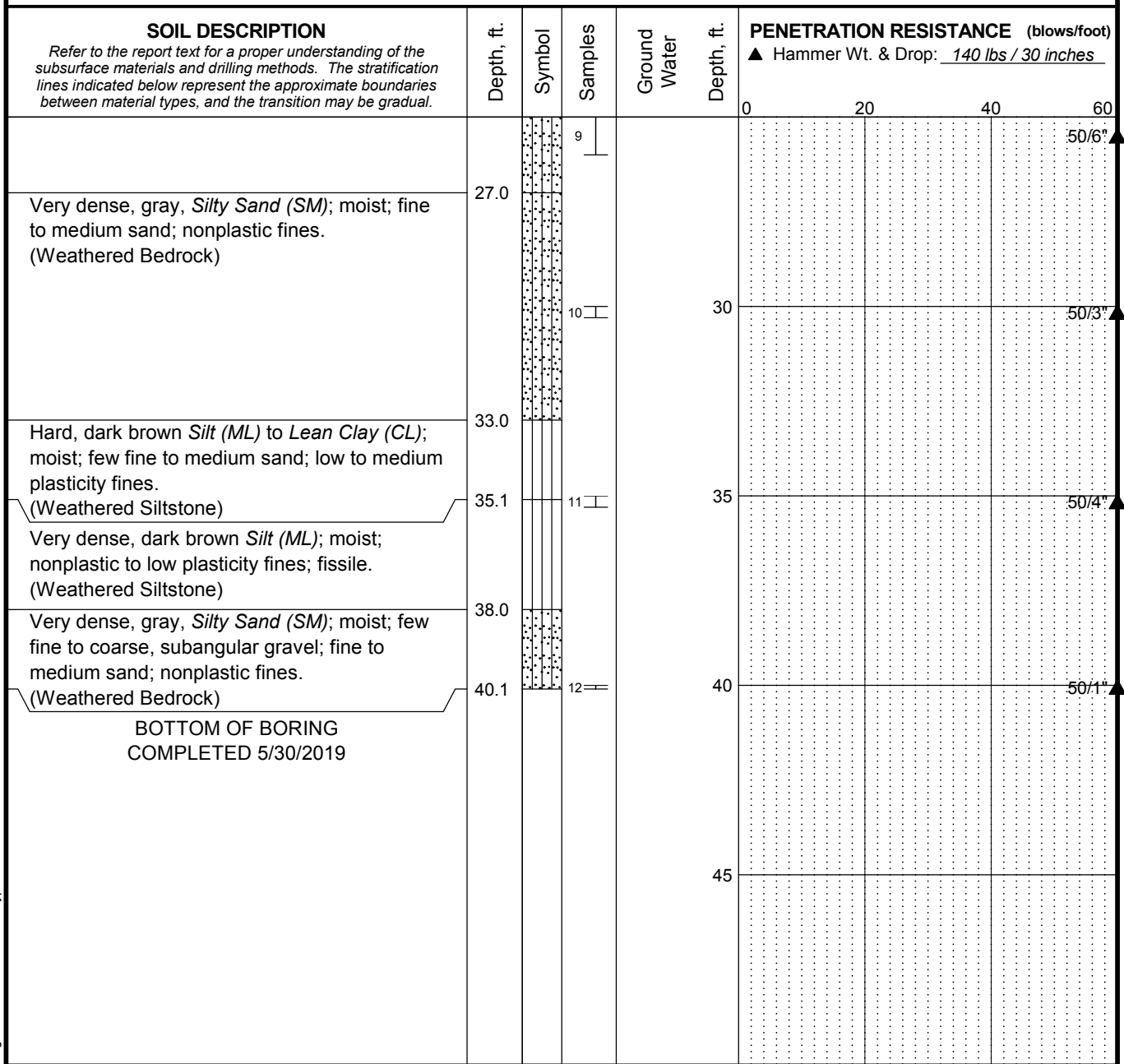
102083-002

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

FIG. A-5
Sheet 1 of 2

MASTER LOG E 102083.GPJ SHAN_WIL_GDT_7/23/19 Log: ECS Rev: EAS Typ: EAS

Total Depth: 40.1 ft. Northing: 157,097 ft. Drilling Method: Hollow Stem Auger Hole Diam.: 8 in.
 Top Elevation: 639.4 ft. Easting: 1,769,698 ft. Drilling Company: Holt Services Rod Diam.: mw
 Vert. Datum: NAVD88 Station: - Drill Rig Equipment: CME 85 Hammer Type: Automatic
 Horiz. Datum: NAD83 Offset: - Other Comments: _____



Log: ECS Rev: EAS Typ: EAS MASTER LOG E 102083.GPJ SHAN_WIL_GDT_7/23/19

LEGEND
 * Sample Not Recovered
 I 2.0" O.D. Split Spoon Sample

◇ % Fines (<0.075mm)
 ● % Water Content

NOTES
 1. Refer to KEY for explanation of symbols, codes, abbreviations and definitions.
 2. Groundwater level, if indicated above, is for the date specified and may vary.
 3. USCS designation is based on visual-manual classification and selected lab testing.

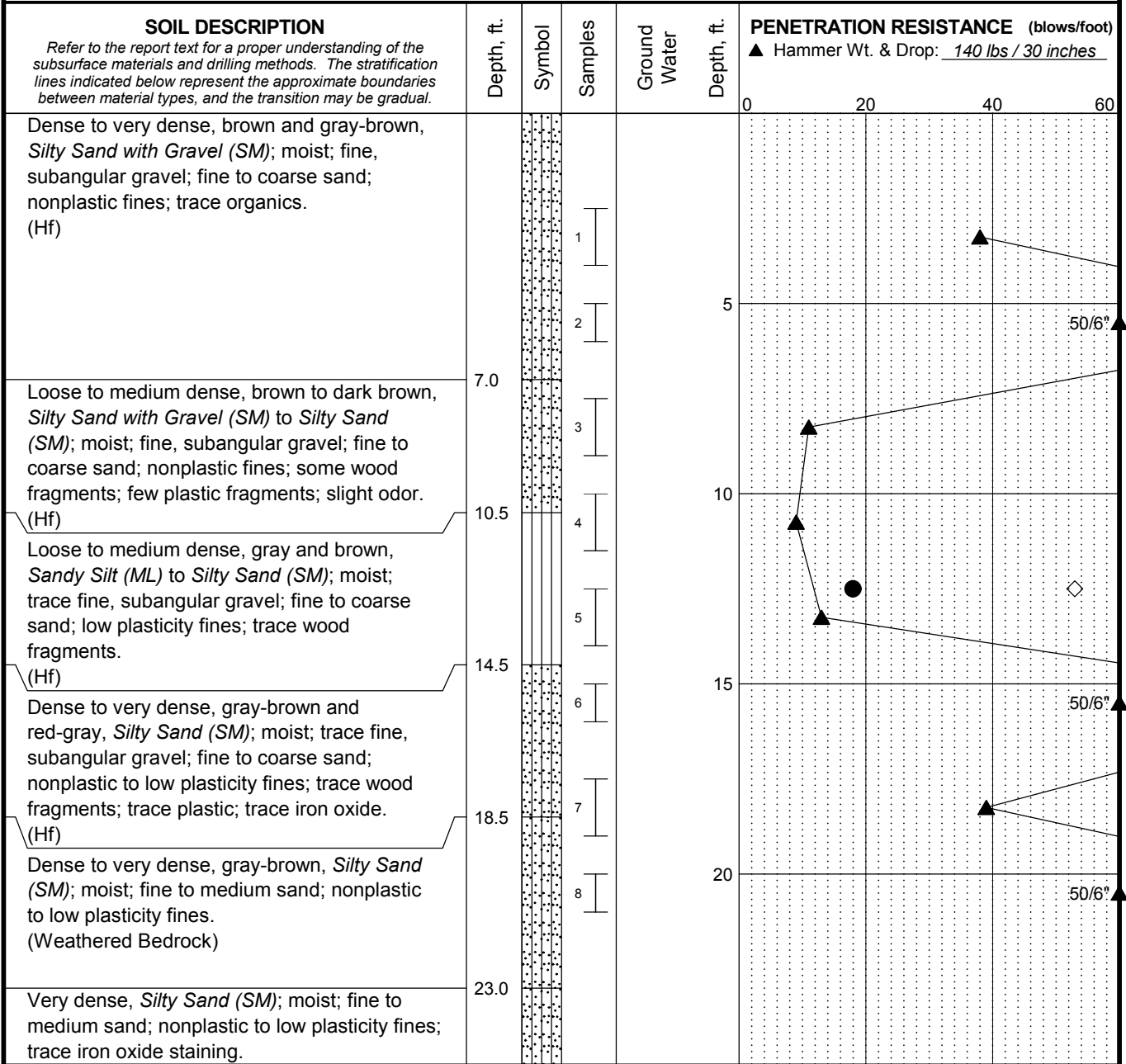
Wenatchee Digester #4
Wenatchee, WA

LOG OF BORING WD4-4

July 2019 102083-002

SHANNON & WILSON, INC. **FIG. A-5**
 Geotechnical and Environmental Consultants Sheet 2 of 2

Total Depth: <u>25.6 ft.</u>	Northing: <u>157,234 ft.</u>	Drilling Method: <u>Hollow Stem Auger</u>	Hole Diam.: <u>8 in.</u>
Top Elevation: <u>637.2 ft.</u>	Easting: <u>1,769,777 ft.</u>	Drilling Company: <u>Holt Services</u>	Rod Diam.: <u>mw</u>
Vert. Datum: <u>NAVD88</u>	Station: <u>-</u>	Drill Rig Equipment: <u>CME 85</u>	Hammer Type: <u>Automatic</u>
Horiz. Datum: <u>NAD83</u>	Offset: <u>-</u>	Other Comments: _____	



CONTINUED NEXT SHEET
LEGEND

- * Sample Not Recovered
- ┆ 2.0" O.D. Split Spoon Sample

- ◇ % Fines (<0.075mm)
- % Water Content

NOTES

1. Refer to KEY for explanation of symbols, codes, abbreviations and definitions.
2. Groundwater level, if indicated above, is for the date specified and may vary.
3. USCS designation is based on visual-manual classification and selected lab testing.

Wenatchee Digester #4 Wenatchee, WA	
LOG OF BORING WD4-5	
July 2019	102083-002
SHANNON & WILSON, INC. Geotechnical and Environmental Consultants	FIG. A-6 Sheet 1 of 2

Log: ECS Rev: EAS Typ: EAS MASTER LOG E 102083.GPJ SHAN_WIL_GDT_7/23/19

Total Depth: 25.6 ft. Northing: 157,234 ft. Drilling Method: Hollow Stem Auger Hole Diam.: 8 in.
 Top Elevation: 637.2 ft. Easting: 1,769,777 ft. Drilling Company: Holt Services Rod Diam.: mw
 Vert. Datum: NAVD88 Station: - Drill Rig Equipment: CME 85 Hammer Type: Automatic
 Horiz. Datum: NAD83 Offset: - Other Comments: _____

SOIL DESCRIPTION <i>Refer to the report text for a proper understanding of the subsurface materials and drilling methods. The stratification lines indicated below represent the approximate boundaries between material types, and the transition may be gradual.</i>	Depth, ft.	Symbol	Samples	Ground Water	Depth, ft.	PENETRATION RESISTANCE (blows/foot)			
						▲ Hammer Wt. & Drop: <u>140 lbs / 30 inches</u>			
(Weathered Bedrock)	25.6	⋮	9		0	20	40	60	50/6"
BOTTOM OF BORING COMPLETED 5/28/2019									

Log: ECS Rev: EAS Typ: EAS MASTER_LOG_E_102083.GPJ_SHAN_WIL_GDT_7/23/19

LEGEND

- * Sample Not Recovered
- ⊥ 2.0" O.D. Split Spoon Sample

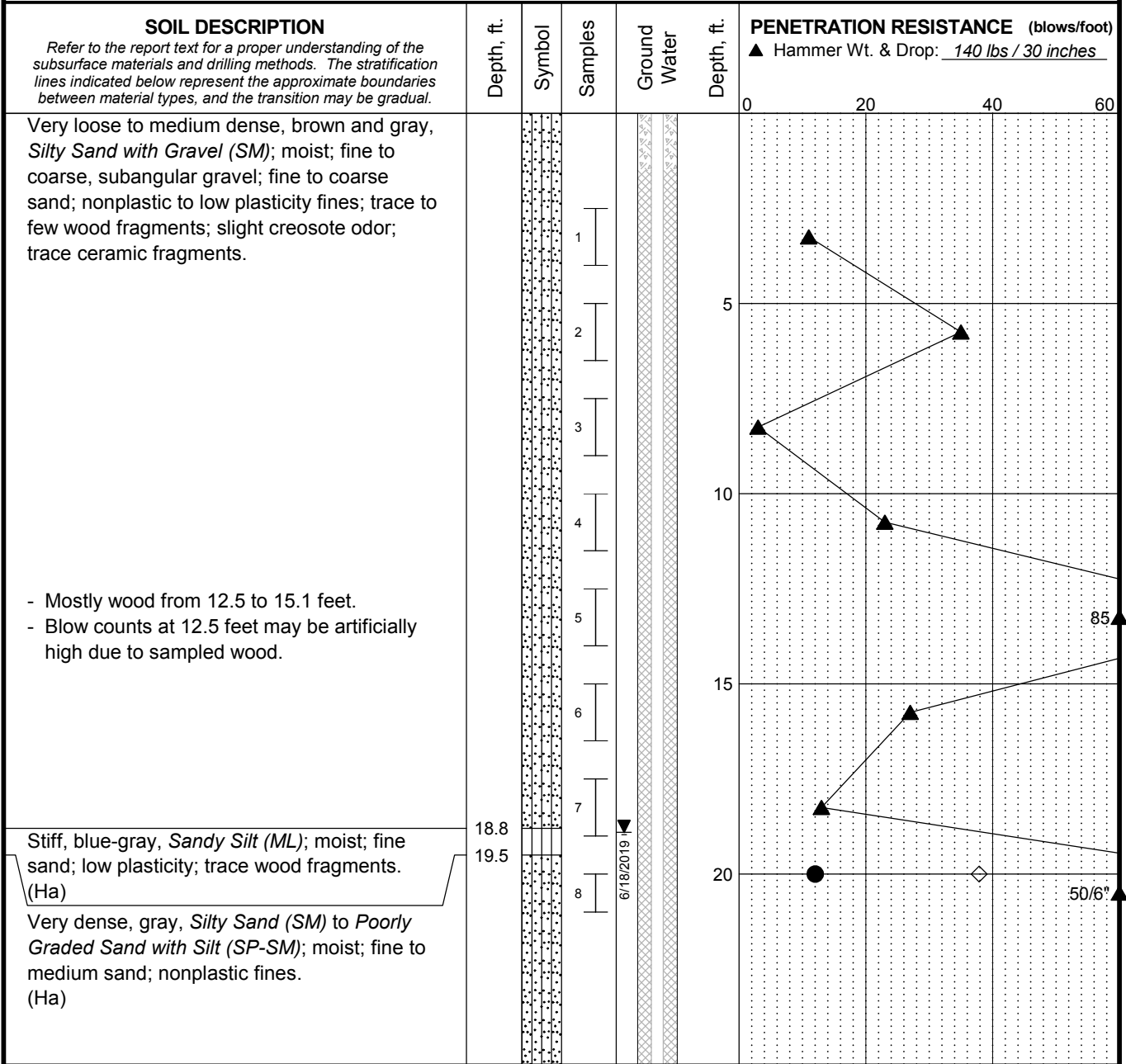
- ◇ % Fines (<0.075mm)
- % Water Content

NOTES

1. Refer to KEY for explanation of symbols, codes, abbreviations and definitions.
2. Groundwater level, if indicated above, is for the date specified and may vary.
3. USCS designation is based on visual-manual classification and selected lab testing.









Wenatchee Digester #4 Wenatchee, WA	
LOG OF BORING WD4-5	
July 2019	102083-002
SHANNON & WILSON, INC. Geotechnical and Environmental Consultants	FIG. A-6 Sheet 2 of 2

Total Depth: <u>40.2 ft.</u>	Northing: <u>157,217 ft.</u>	Drilling Method: <u>Hollow Stem Auger</u>	Hole Diam.: <u>8 in.</u>
Top Elevation: <u>639.1 ft.</u>	Easting: <u>1,769,807 ft.</u>	Drilling Company: <u>Holt Services</u>	Rod Diam.: <u>mw</u>
Vert. Datum: <u>NAVD88</u>	Station: <u>-</u>	Drill Rig Equipment: <u>CME 85</u>	Hammer Type: <u>Automatic</u>
Horiz. Datum: <u>NAD83</u>	Offset: <u>-</u>	Other Comments: <u></u>	



CONTINUED NEXT SHEET

LEGEND

- | | | |
|--|---|--|
| * Sample Not Recovered |  Well Screen and Sand Filter |  % Fines (<0.075mm) |
|  2.0" O.D. Split Spoon Sample |  Bentonite-Cement Grout |  % Water Content |
| |  Bentonite Chips/Pellets | |
| |  Bentonite Grout | |
| |  Ground Water Level in Well | |

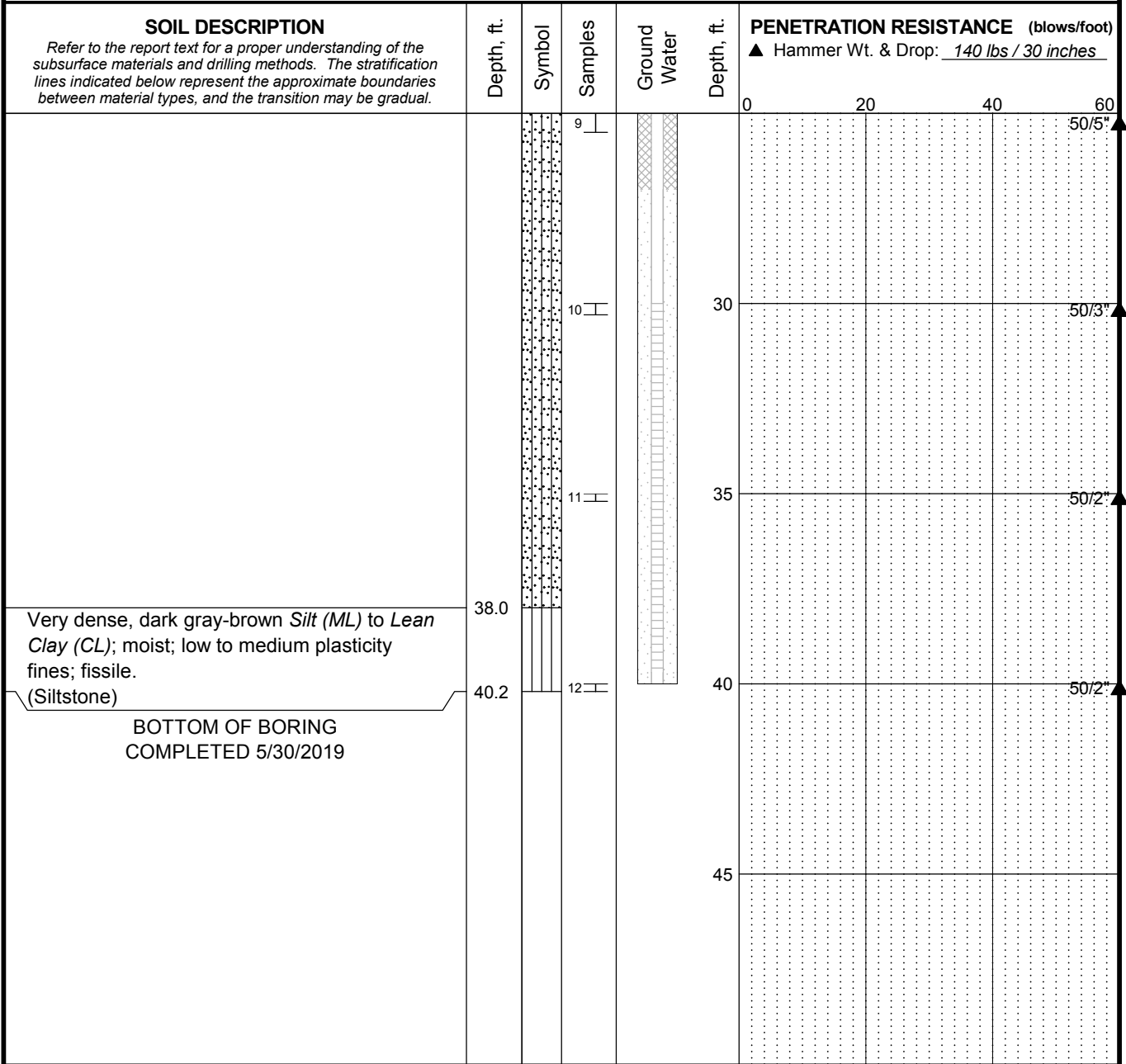
NOTES

1. Refer to KEY for explanation of symbols, codes, abbreviations and definitions.
2. Groundwater level, if indicated above, is for the date specified and may vary.
3. USCS designation is based on visual-manual classification and selected lab testing.








Wenatchee Digester #4 Wenatchee, WA	
LOG OF BORING WD4-6	
July 2019	102083-002
SHANNON & WILSON, INC. Geotechnical and Environmental Consultants	FIG. A-7 Sheet 1 of 2

Log: ECS Rev: EAS Typ: EAS
 MASTER LOG E 102083.GPJ SHAN_WIL_GDT_7/23/19

Total Depth: 40.2 ft. Northing: 157,217 ft. Drilling Method: Hollow Stem Auger Hole Diam.: 8 in.
 Top Elevation: 639.1 ft. Easting: 1,769,807 ft. Drilling Company: Holt Services Rod Diam.: mw
 Vert. Datum: NAVD88 Station: - Drill Rig Equipment: CME 85 Hammer Type: Automatic
 Horiz. Datum: NAD83 Offset: - Other Comments: _____



Log: ECS Rev: EAS Typ: EAS MASTER LOG E 102083.GPJ SHAN_WIL_GDT 7/23/19

- LEGEND**
- * Sample Not Recovered
 - ┆ 2.0" O.D. Split Spoon Sample
 -  Well Screen and Sand Filter
 -  Bentonite-Cement Grout
 -  Bentonite Chips/Pellets
 -  Bentonite Grout
 -  Ground Water Level in Well
 -  % Fines (<0.075mm)
 -  % Water Content

- NOTES**
- Refer to KEY for explanation of symbols, codes, abbreviations and definitions.
 - Groundwater level, if indicated above, is for the date specified and may vary.
 - USCS designation is based on visual-manual classification and selected lab testing.

Wenatchee Digester #4
Wenatchee, WA

LOG OF BORING WD4-6

July 2019 102083-002

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

FIG. A-7
Sheet 2 of 2

Appendix B

Geotechnical Laboratory Testing

APPENDIX B: GEOTECHNICAL LABORATORY TESTING

Appendix B

Geotechnical Laboratory Testing

CONTENTS

B.1 General..... B-1

B.2 Natural Water Contents B-1

B.3 Grain Size Analysis..... B-1

B.4 Atterberg Limits B-1

B.5 Ductile Iron Pipe Research Association (DIPRA) Corrosion Testing B-2

Enclosures

Grain Size Distribution Plots

Plasticity Chart

B.1 GENERAL

Laboratory tests were performed on selected soil samples retrieved from the geotechnical borings. The laboratory testing program included tests to classify the soils and to provide data for engineering studies.

Soil samples recovered from the borings were visually reclassified in our laboratory using a system based on ASTM Designation: D2487, Standard Test Method for Classification of Soil for Engineering Purposes, and ASTM Designation: D2488, Standard Recommended Practice for Description of Soils (Visual-Manual Procedure). This visual classification method allows for convenient and consistent comparison of soils from widespread geographic areas. Using this method, the soils are classified using the Unified Soils Classification System. The individual sample classification have been incorporated into the boring logs presented in Appendix A.

B.2 NATURAL WATER CONTENTS

The natural water content of select soil samples recovered from the field exploration was determined in general accordance with ASTM Designation: D2216, Standard Method of Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass. Comparison of Water content of a soil with its index properties can be useful in characterizing soil unit weight, consistency, compressibility, and strength. Water content, where tested, is plotted on each of the boring logs presented in Appendix A.

B.3 GRAIN SIZE ANALYSIS

A grain size analysis was performed on one sample in accordance with ASTM Designation: D422, Standard Method for Particle-Size Analysis of Soils or D1140, Standard Test Methods for Amount of Material in Soils Finer than No. 200 (75-microgram) Sieve.

The percent passing the No. 200 sieve was used to assist with the liquefaction analysis. The result of the grain size analysis along with the natural water content is shown in the enclosed Grain Size Distribution Plots.

B.4 ATTERBERG LIMITS

Atterberg Limits were determined on select samples in accordance with ASTM Designation: D4318, Standard Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.

The Atterberg Limits include Liquid Limit (LL), Plastic Limit (PL), and Plasticity Index (PI=LL-PL). They are generally used to assist in classification of soil, to indicate soil consistency (when compared with natural water content), and to provide correlation to soil properties including compressibility and strength and to assist with the liquefaction analysis.

The results of the Atterberg Limits determinations are shown on the boring log in Appendix A and in the enclosed plasticity chart.

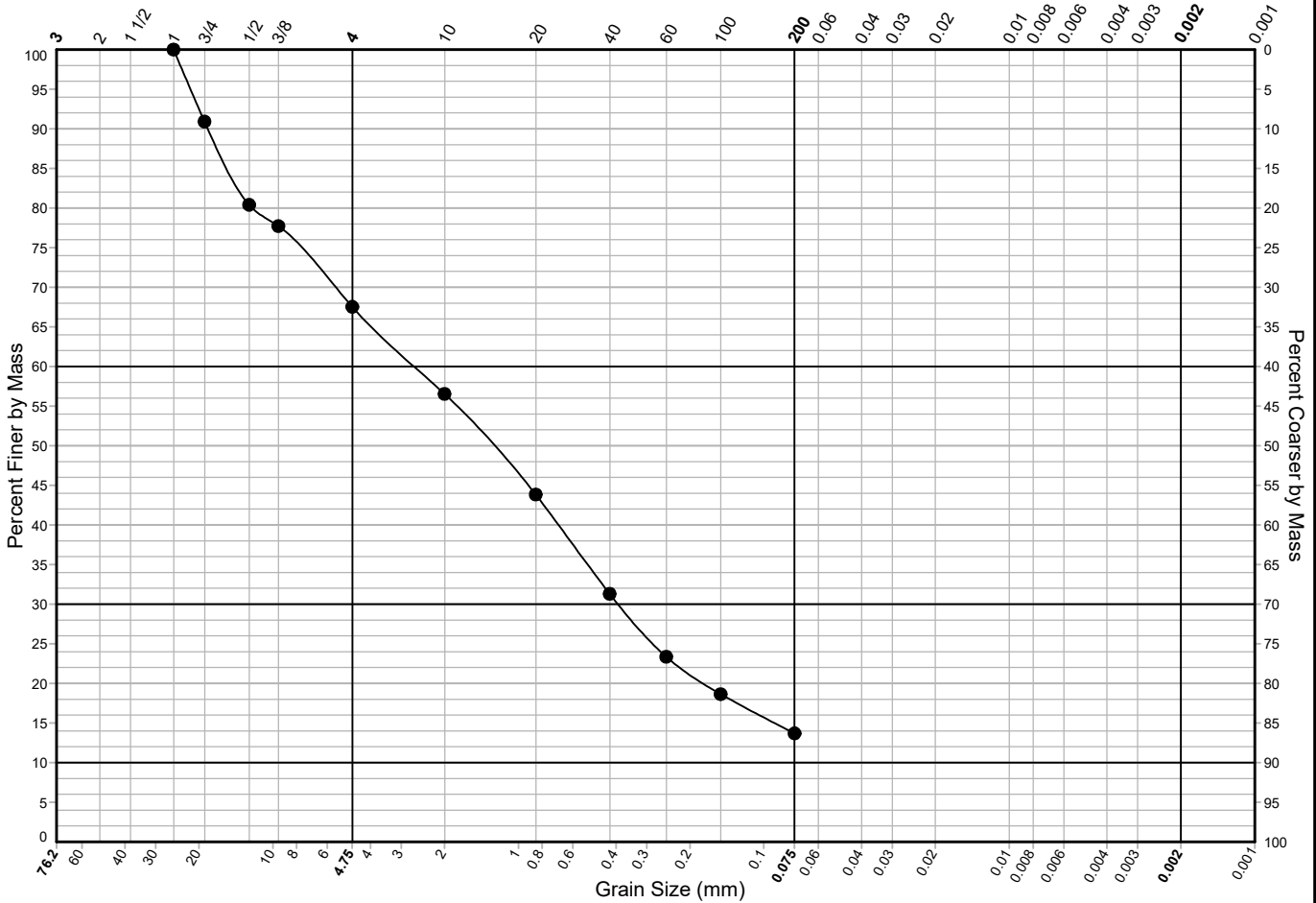
B.5 DUCTILE IRON PIPE RESEARCH ASSOCIATION (DIPRA) CORROSION TESTING

Chemical analytical testing for corrosivity was completed by Norton Corrosion in Woodinville, Washington, in general accordance with the DIPRA 10-point Soil Evaluation. The evaluation includes measurement of resistivity, pH, redox potential, sulfides, and moisture to rate the soil corrosion potential. The DIPRA results are enclosed in this appendix.

Wenatchee Digester #4
Wenatchee, WA

BORING WD4-1

Gravel		Sand			Fines	
Coarse	Fine	Coarse	Medium	Fine	Silt & Clay-Size	
Mesh Opening in Inches		Mesh Openings per Inch, U.S. Standard			Grain Size in Millimeters	



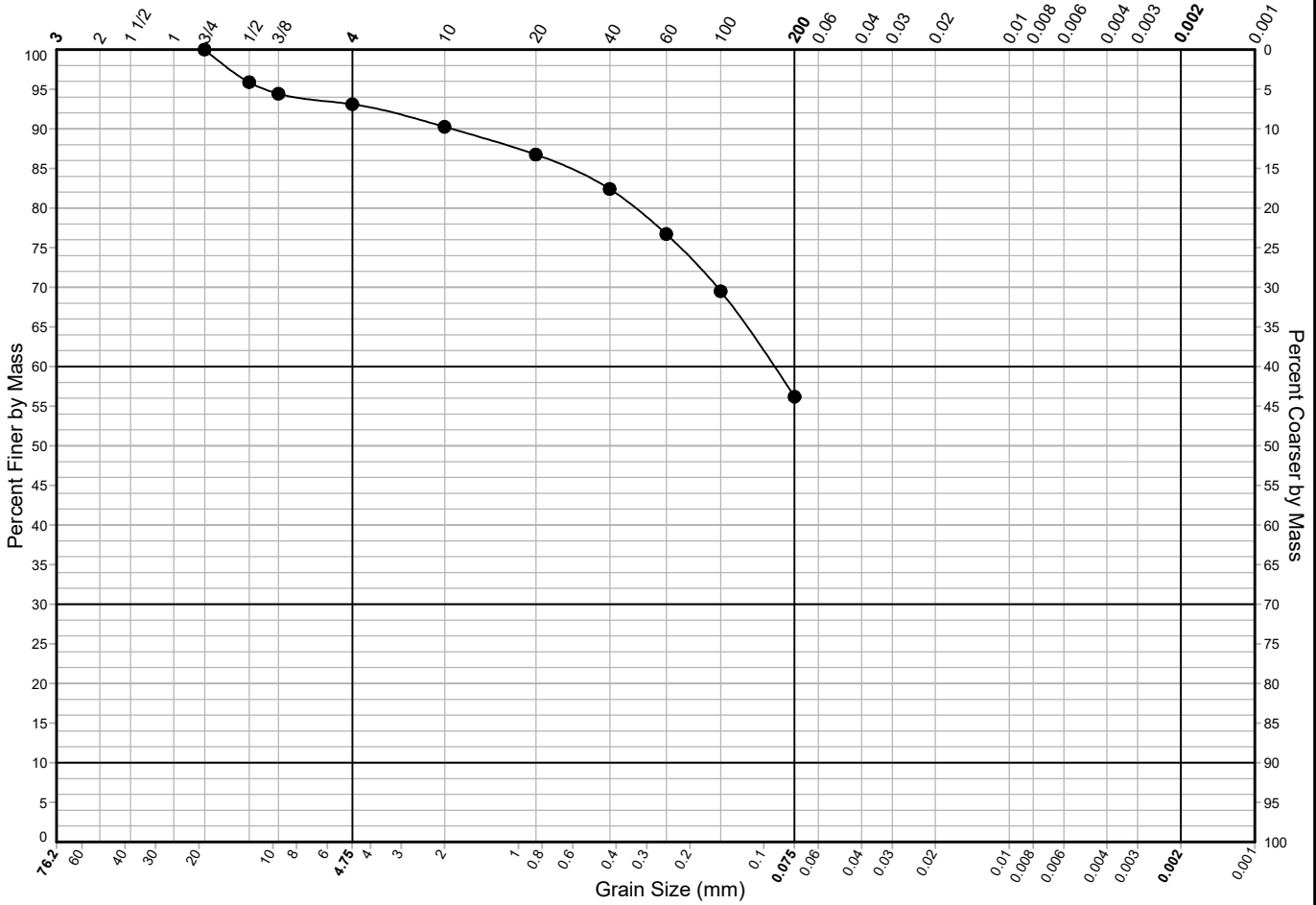
Sample Identification	Depth (ft)	USCS Group Symbol	USCS Group Name	Gravel %	Sand %	Fines %	< 20µm %	< 2µm %	WC %	Tested By	Review By	ASTM Std.
● WD4-1, S-3b	8.0	SM	Silty Sand with Gravel	32	54	14			6.4	MXC	JFL	C136

* Test specimen did not meet minimum mass recommendations.

Wenatchee Digester #4
Wenatchee, WA

BORING WD4-2

Gravel		Sand			Fines	
Coarse	Fine	Coarse	Medium	Fine	Silt & Clay-Size	
Mesh Opening in Inches		Mesh Openings per Inch, U.S. Standard			Grain Size in Millimeters	



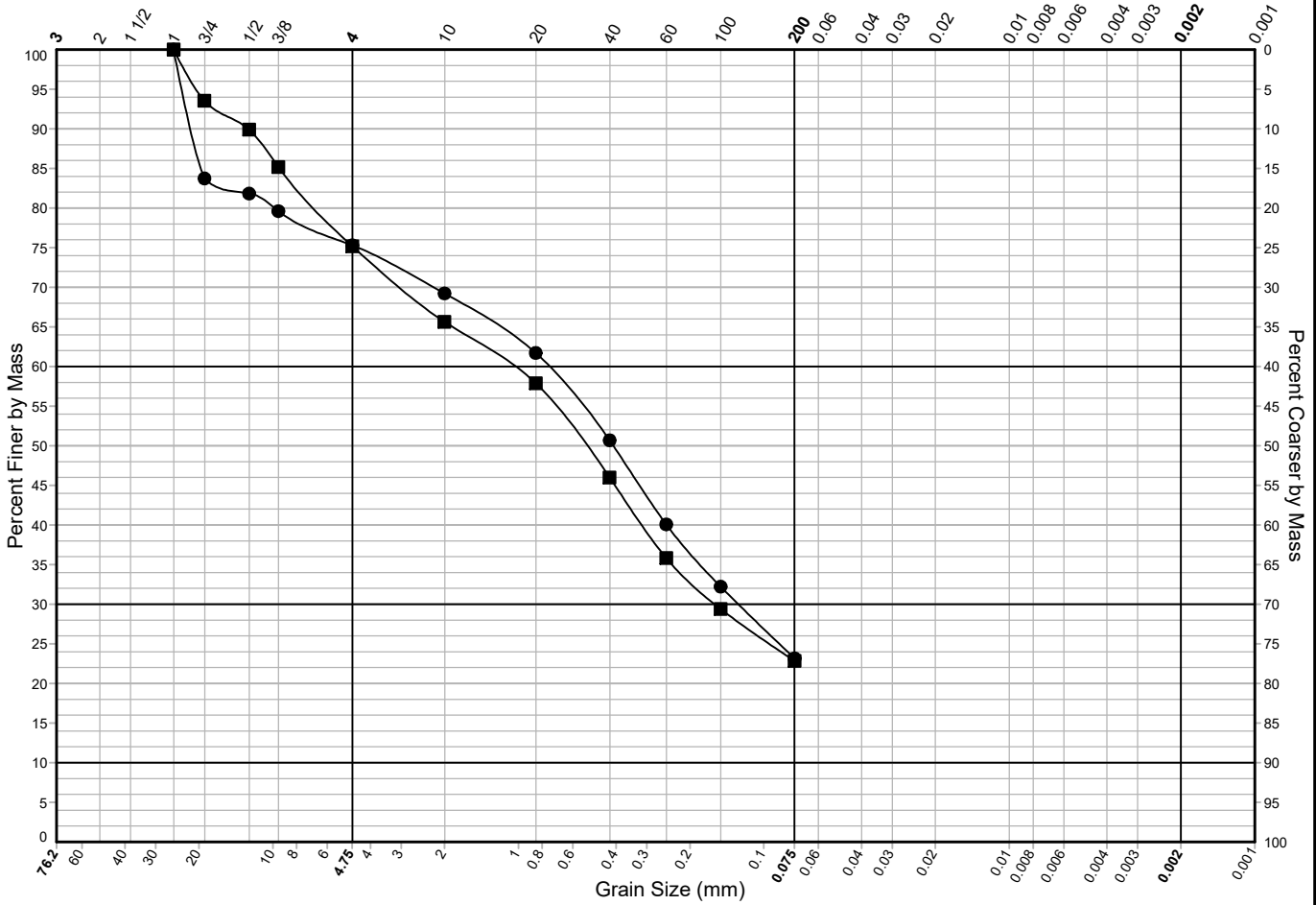
Sample Identification	Depth (ft)	USCS Group Symbol	USCS Group Name	Gravel %	Sand %	Fines %	< 20µm %	< 2µm %	WC %	Tested By	Review By	ASTM Std.
● WD4-2, S-5'	12.5	ML	Sandy Silt	7	37	56			19.5	MXC	JFL	C136

* Test specimen did not meet minimum mass recommendations.

Wenatchee Digester #4
Wenatchee, WA

BORING WD4-3

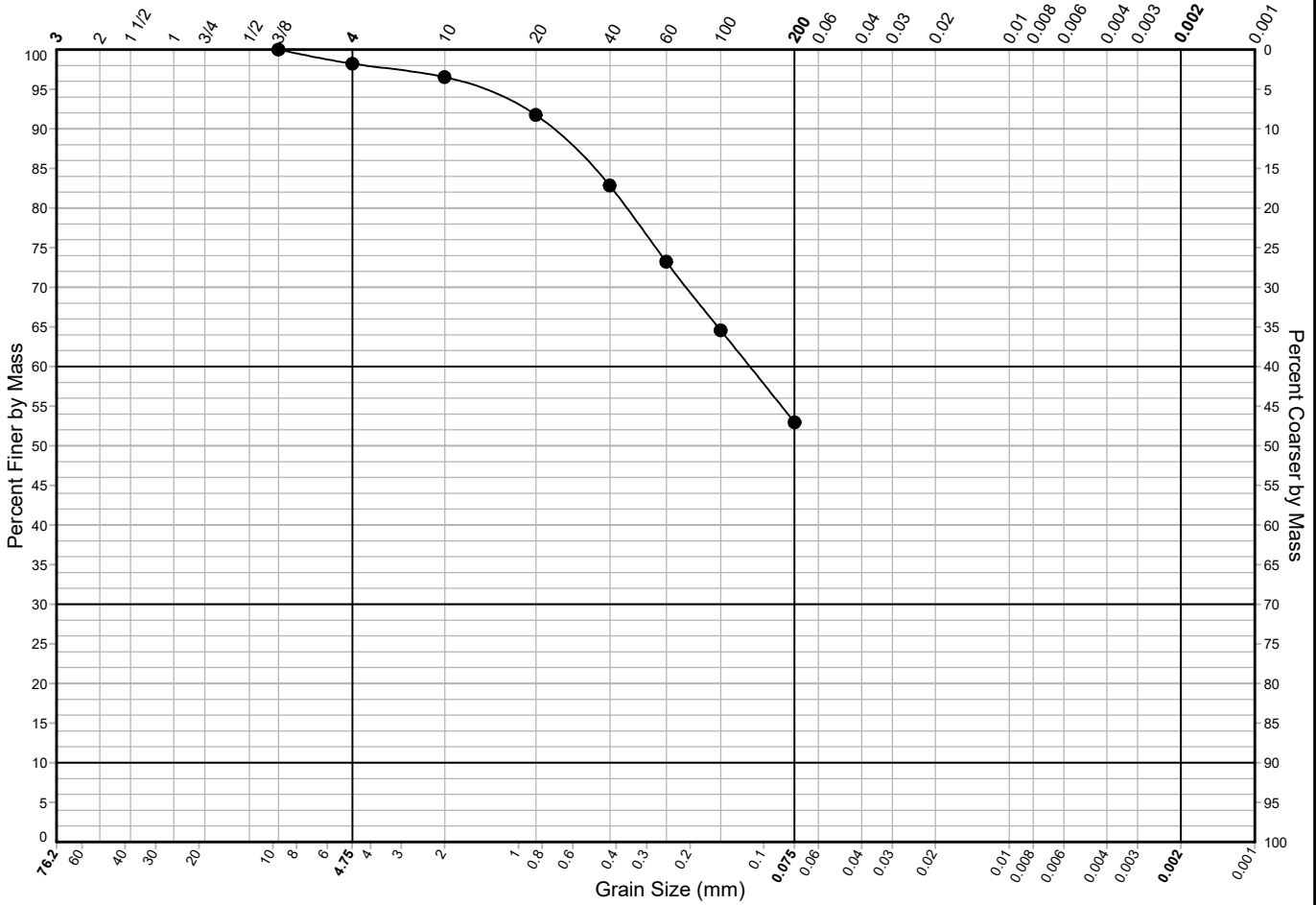
Gravel		Sand			Fines	
Coarse	Fine	Coarse	Medium	Fine	Silt & Clay-Size	
Mesh Opening in Inches		Mesh Openings per Inch, U.S. Standard			Grain Size in Millimeters	



Wenatchee Digester #4
Wenatchee, WA

BORING WD4-5

Gravel		Sand			Fines	
Coarse	Fine	Coarse	Medium	Fine	Silt	
Mesh Opening in Inches		Mesh Openings per Inch, U.S. Standard			Grain Size in Millimeters	



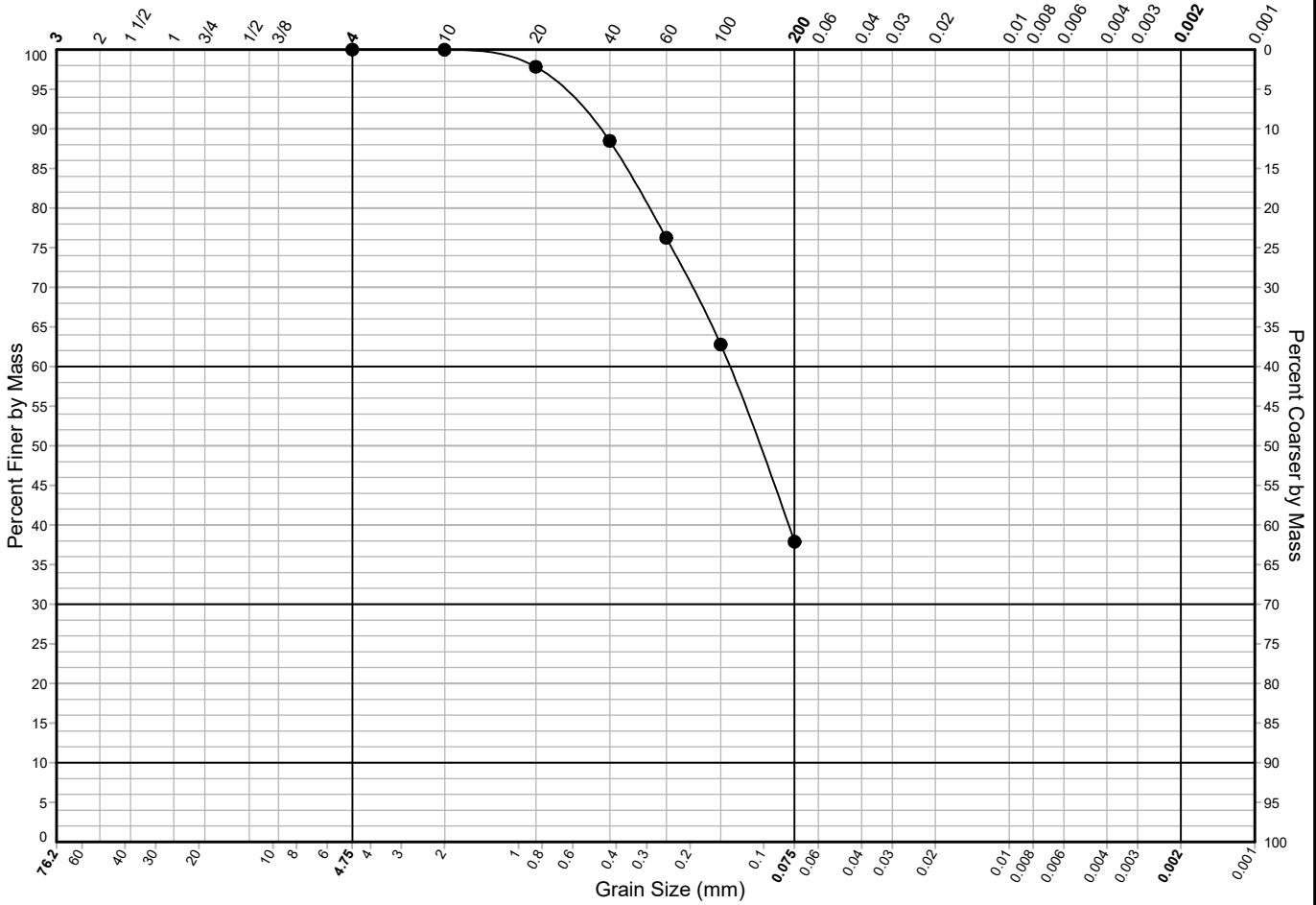
Sample Identification	Depth (ft)	USCS Group Symbol	USCS Group Name	Gravel %	Sand %	Fines %	< 20µm %	< 2µm %	WC %	Tested By	Review By	ASTM Std.
● WD4-5, S-5'	12.5	ML	Sandy Silt	2	45	53			18.0	MXC	JFL	C136

* Test specimen did not meet minimum mass recommendations.

Wenatchee Digester #4
Wenatchee, WA

BORING WD4-6

Gravel		Sand			Fines	
Coarse	Fine	Coarse	Medium	Fine	Silt & Clay-Size	
Mesh Opening in Inches		Mesh Openings per Inch, U.S. Standard			Grain Size in Millimeters	

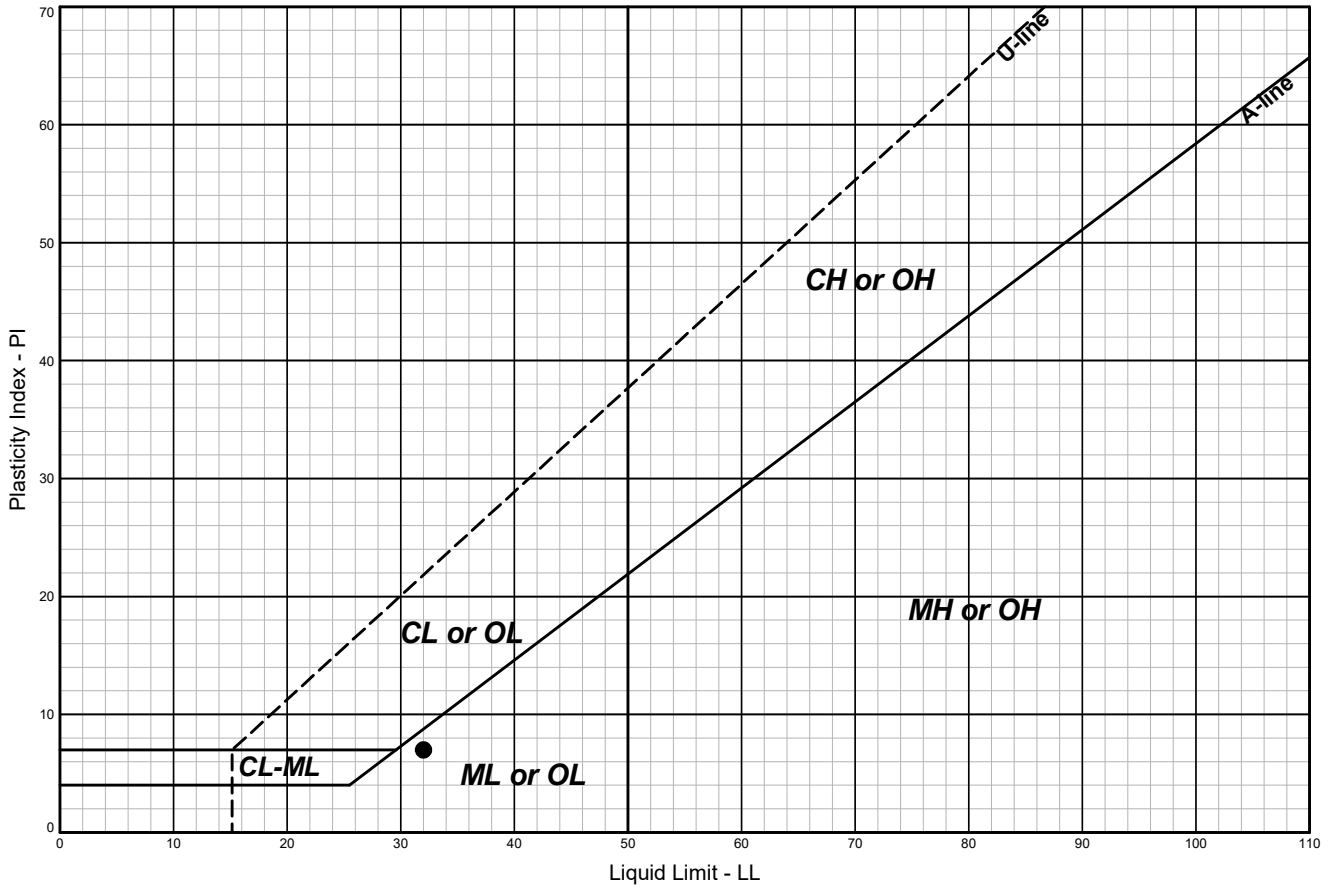


Sample Identification	Depth (ft)	USCS Group Symbol	USCS Group Name	Gravel %	Sand %	Fines %	< 20µm %	< 2µm %	WC %	Tested By	Review By	ASTM Std.
● WD4-6, S-8'	20.0	SM	Silty Sand		62	38			12.0	MXC	JFL	C136

* Test specimen did not meet minimum mass recommendations.

Wenatchee Digester #4
Wenatchee, WA

BORING WD4-2



Sample Identification	Depth (ft)	USCS Group Symbol	USCS Group Name	LL	PL	PI	WC %	Gravel %	Sand %	Fines %	< 2µm %	Tested By	Review By	ASTM Std.
● WD4-2, S-11	35.0	ML	Silt	32	25	7	9.3					AKV	JFL	D4318

NORTON CORROSION LIMITED

CORROSION EVALUATION
DUCTILE IRON PIPE

DATA SHEET: 1 OF 1
NCL JOB #: E-22839
DATE IN: 06-05-19
DATE OUT: 06-20-19
BY: R. HUNT

SOIL ANALYSIS

CUSTOMER: Shannon & Wilson
PROJECT: Wenatchee Digester 4
JOB #: 102083-002

NCL SAMPLE NO.	SAMPLE I.D.	Soil Wt.	Soil Wt.	% MOISTURE	pH	SULFIDE SCREEN (ppm)	RESISTIVITY (OHM-CM)		REDOX (Millivolts)	DIPRA SCORE
		Native	Dry				NATIVE	SATURATED		
1	WD4-5, 0-26.5'	29.366	24.174	17.68	6.6	ND	12,000	6,200	220	1
2										
3										
4										
5										
6										
TESTING METHOD					ASTM 4972	EPA 9030B	ASTM G-57	ASTM G-57	ASTM D1498	

ND Analyte NOT DETECTED at or above the reporting limit

Appendix C

Existing Exploration Log

APPENDIX C: EXISTING EXPLORATION LOG

BORING B-1

(Log Sheet 1 of 2)

Project: Wenatchee Pollution Control Plant Expansion

Location: Wenatchee, Washington

Ground Surface Elevation: Approx. 632 ft. NGVD

Logger: D. Simon-Gilles/PDX

Drilling Method: Mobile 8-65 4" Hollow-Stem Auger

Driller: Pacific Testing Laboratories

Start Date: January 25, 1989

Client: City of Wenatchee, Washington

Depth (ft)	Sample		Standard Penetration Test (6"-6"-6")	Sample Description	Comments
	Type- No.	Recovery (inches)			
1				6 inches asphalt/clean sand	
2					
3	S-1	4	10-5-3 (8)	SILTY SAND W/GRAVEL-dark gray, coarse to fine sand, some silt lenses, 2" minus gravel, (fill) (SM)	HNu = 0ppm
4					
5					
6					
7					
8	S-2	8	12-8-7 (15)	SILTY SAND W/GRAVEL- light tan/brown, coarse to fine sand, some silt lenses 2" minus gravel, (fill) (SM)	Wet at 6 ft - easier drilling HNu = 0ppm
9					
10					
11					
12					
13	S-3	4	50/5	SILTY SAND- light gray, moist to dry, v.dense, (SM)	HNu = 0ppm
14					
15					
16					
17					
18	S-4	3	50/6	SILTY SAND TO SILT- light gray, moist to dry, v.dense to hard, (sandstone/siltstone) (SM/ML)	
19					
20					
21					
22					
23	S-5	5	50/5	SILTY SAND- light gray, moist to dry, v. dense, (sandstone) (SM)	very slow drilling
24					
25					

BORING B-1

(Log Sheet 2 of 2)

Depth (ft)	Sample		Standard Penetration Test (6"-6"-6")	Sample Description	Comments
	Type- No.	Recovery (inches)			
26					
27					
28	S-6	3	50/4	SILTY SAND AND SILT- layered light gray silty sand to light brown silt, moist to dry, v. dense silty sand to hard silt, (siltstone/sandstone) (ML/SH)	very slow drilling
29					
30					
31					
32					
33	S-7		45-50/2	SILT- light brown, moist to dry v.hard (siltstone) (ML)	approx 5 ft/hour drilling rate
34					
35					
36					
37					
38	S-8		50/4	SILT- similar to S-7 except sandier, (siltstone) (ML)	Refusal at 38.5 ft
39					
40				Bottom of boring at 38.5 feet	
41					
42					
43					
44					
45					
46					
47					
48					
49					
50					
51					
52					
53					
54					
55					

PIEZOMETER B-1

(Log Sheet 1 of 1)

Project: Wenatchee Pollution Control Plant Expansion

Location: Wenatchee, Washington

Ground Surface Elevation: Approx. 632 ft. NGVD

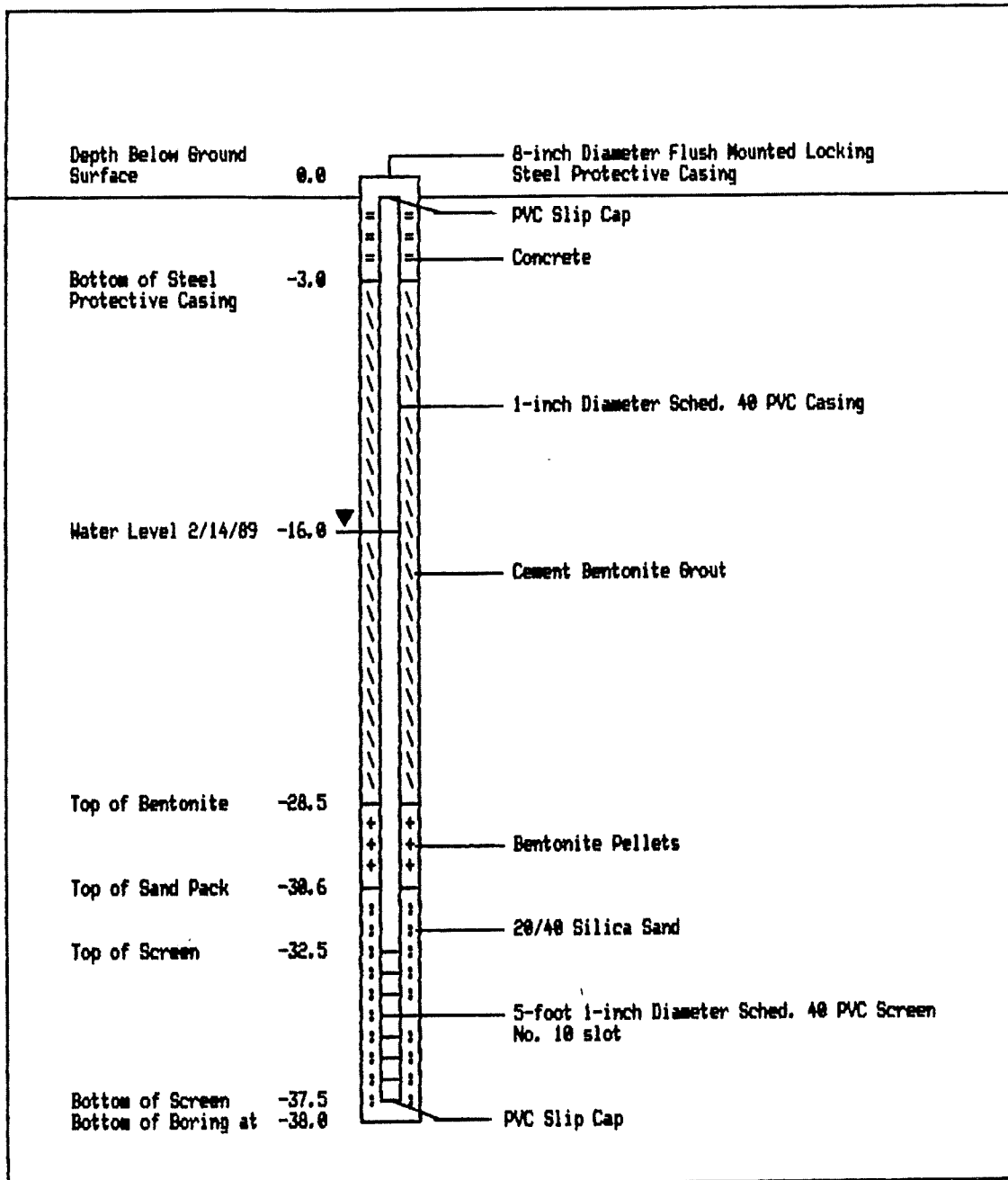
Logger: D. Simon-Gilles/PDX

Drilling Method: Mobile B-65 4" Hollow-Stem Auger

Driller: Pacific Testing Laboratories

Installation Date: January 25, 1989

Client: City of Wenatchee, Washington



SEA24579.61

BORING B-2

(Log Sheet 1 of 1)

Project: Wenatchee Pollution Control Plant Expansion

Location: Wenatchee, Washington

Ground Surface Elevation: Approx. 631 ft. NGVD

Logger: D. Simon-Gilles/PDX

Drilling Method: Mobile B-65 4" Hollow-Stem Auger

Driller: Pacific Testing Laboratories

Start Date: January 27, 1989

Client: City of Wenatchee, Washington

Depth (ft)	Sample		Standard Penetration Test (5'-6"-6")	Sample Description	Comments
	Type No.	Recovery (inches)			
1				No Samples Attempted.	6" minus rounded gravel
2					- refusal at 1.5 ft, move east
3					some rubble, noted concrete,
4					tile. Refusal again at
5					approx. 1.5 ft moved towards
6					river a few feet
7					- Refusal for the third time
8					move north 5 ft refusal for
9					the fourth time at 1.5 ft
10					- Refusal fifth and sixth time
11					at 8.5 ft, concrete
12					foundation ?
13					
14					
15					
16					
17					
18					
19					
20					
21					
22					
23					
24					
25					

SEA24579.61

BORING B-3

(Log Sheet 1 of 1)

Project: Wenatchee Pollution Control Plant Expansion

Location: Wenatchee, Washington

Ground Surface Elevation: Approx. 632 ft. NGVD

Logger: D. Simon-Gilles/PDX

Drilling Method: Mobile B-65 4" Hollow-Stem Auger

Driller: Pacific Testing Laboratories

Start Date: January 27, 1989

Client: City of Wenatchee, Washington

Depth (ft)	Sample		Standard Penetration Test (6"-6"-6")	Sample Description	Comments
	Type- No.	Recovery (inches)			
1				3 inches asphalt	Gravel between surface asphalt and approx. 1.5 feet
2				SILTY SAND W/GRAVEL-brown, moist, (SM)	
3	S-1	18	9-12-10 (22)	SANDY SILT with pea gravel- moist to dry, change in color bottom 4 inches, med. stiff, black coal like pieces, granite pieces, (fill) (SM)	Color change at 5 ft, some gravel HNu = 1.4ppm in augers
4					
5					
6					
7					
8	S-2	3	5-7-8 (15)	SANDY SILT- dark gray, moist to dry, med. stiff, 1 inch minus rounded gravel, (fill) (ML)	Hard drilling at 9 ft
9					
10				Bottom of boring at 9 feet	
11					
12					
13					
14					
15					
16					
17					
18					
19					
20					
21					
22					
23					
24					
25					

BORING B-4

(Log Sheet 1 of 1)

Project: Wenatchee Pollution Control Plant Expansion

Location: Wenatchee, Washington

Ground Surface Elevation: Approx. 632 ft. NGVD

Logger: D. Simon-Gilles/PDX

Drilling Method: Mobile B-65 4" Hollow-Steer Auger

Driller: Pacific Testing Laboratories

Start Date: January 30, 1989

Client: City of Wenatchee, Washington

Depth (ft)	Sample		Standard Penetration Test (6"-6"-6")	Sample Description	Comments
	Type- No.	Recovery (inches)			
1				2" Asphalt - some subbase	tile pieces noted, some 2 inch minus gravel
2					Rough drilling at 2 feet. Refusal at 2.5 ft moved hole
3	S-1	3	10-8-5 (13)	SILTY SAND- light brown, moist to dry- med. dense, some hard consolidated dark brown to black pieces, ? old asphalt (SM)	Asphalt in tip of sampler
4	S-2	3	6-9-5 (14)		refusal at 3 ft move 3 ft east
5				Bottom of boring at 3 feet	Refusal again at 3 ft
6					
7					
8					
9					
10					
11					
12					
13					
14					
15					
16					
17					
18					
19					
20					
21					
22					
23					
24					
25					

BORING B-5

(Log Sheet 1 of 1)

Project: Wenatchee Pollution Control Plant Expansion

Location: Wenatchee, Washington

Ground Surface Elevation: Approx. 637 ft. NSVD

Logger: D. Simon-Gilles/PDX

Drilling Method: Mobile B-65 4" Hollow-Stem Auger

Driller: Pacific Testing Laboratories

Start Date: January 30, 1989

Client: City of Wenatchee, Washington

Depth (ft)	Sample		Standard Penetration Test (6"-6"-6")	Sample Description	Comments
	Type- No.	Recovery (inches)			
1				6-8 inches of asphalt/gravel subbase	
2					
3	S-1	18	8-23-25 (48)	Top 3 inches- SILT- dark brown, wet, Bottom 15 inches- SANDY SILT- moist to dry light greenish grey, v. stiff, (fill) (ML)	HNu augers = 1.2ppm HNu sample = 0ppm
4					
5					
6					
7					
8	S-2		50/4	SILT- dark brown to black, moist to wet, some pea gravel, 1 inch rounded gravel (fill) (ML)	Hard drilling at 8 ft HNu sample = 0ppm Refusal at 8 ft
9				Bottom of boring at 8 feet	
10					
11					
12					
13					
14					
15					
16					
17					
18					
19					
20					
21					
22					
23					
24					
25					

BORING B-6

(Log Sheet 1 of 1)

Project: Wenatchee Pollution Control Plant Expansion

Location: Wenatchee, Washington

Ground Surface Elevation: Approx. 637 ft. NGVD

Logger: D. Simon-Gilles/PDX

Drilling Method: Mobile B-65 4" Hollow-Stem Auger

Driller: Pacific Testing Laboratories

Start Date: January 30, 1989

Client: City of Wenatchee, Washington

Depth (ft)	Sample		Standard Penetration Test (6"-6"-6")	Sample Description	Comments
	Type- No.	Recovery (inches)			
1				6 inches asphalt/gravel subbase	
2					
3	S-1	6	24-50/6	SILTY SAND- light gray to brown, moist to dry, very dense some gravel, granite pieces in split spoon, (SM)	HNu soil = 4ppm spike to 5ppm HNu sample = 0ppm
4					Difficult drilling at approx 3 ft, granite with quartz in cuttings
5					
6					
7					Refusal at 6.5 ft move 4 ft toward road. Refusal at 7 ft
8				Bottom of boring at 7 feet	
9					
10					
11					
12					
13					
14					
15					
16					
17					
18					
19					
20					
21					
22					
23					
24					
25					

BORING B-12

(Log Sheet 1 of 2)

Project: Wenatchee Pollution Control Plant Expansion

Location: Wenatchee, Washington

Ground Surface Elevation: Approx. 639 ft. NGVD

Logger: D. Simon-Gilles/PDX

Drilling Method: Mobile B-65 4" Hollow-Stem Auger

Driller: Pacific Testing Laboratories

Start Date: February 1, 1989

Client: City of Wenatchee, Washington

Depth (ft)	Sample		Standard Penetration Test (6"-6"-6")	Sample Description	Comments
	Type- No.	Recovery (inches)			
1				TOPSOIL- root material 6 inches.	
2					
3	S-1	14	8-10-16 (20)	SILTY SAND -dark gray, wet, med. dense some gravel, (fill) (SM)	HNU = 0ppm
4					
5					
6					
7					
8	S-2	0	7-12-12 (24)	NO RECOVERY	HNU = 0ppm Organic smell, small piece of plastic
9					
10					
11					
12					
13	S-3	14	1-12-4 (16)	ORGANIC SLUDGE -black, soft.	HNU = 6ppm Some plastic and rags in cuttings
14					
15					
16					
17					
18	S-4	0	50/0	NO RECOVERY	Hard drilling
19					
20					
21					
22					
23	S-5	2	50/4	SANDY SILT -light tan, moist to dry, v. stiff, (siltstone) (ML)	Organic smell
24					
25					

BORING B-12

(Log Sheet 2 of 2)

Depth (ft)	Sample		Standard Penetration Test (6"-5"-6")	Sample Description	Comments
	Type No.	Recovery (inches)			
26					
27					
28	S-6	5	50/3	SILTY SAND -light gray, moist, some silt lenses, (sandstone/siltstone) (SM/ML)	V. hard smooth drilling
29					
30					
31					
32					
33	S-7	0	50/2	NO RECOVERY	
34				Bottom of boring at 32.5 feet	
35					
36					
37					
38					
39					
40					
41					
42					
43					
44					
45					
46					
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48					
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51					
52					
53					
54					
55					

PIEZOMETER B-12

(Log Sheet 1 of 1)

Project: Wenatchee Pollution Control Plant Expansion

Location: Wenatchee, Washington

Ground Surface Elevation: Approx. 639 ft. NGVD

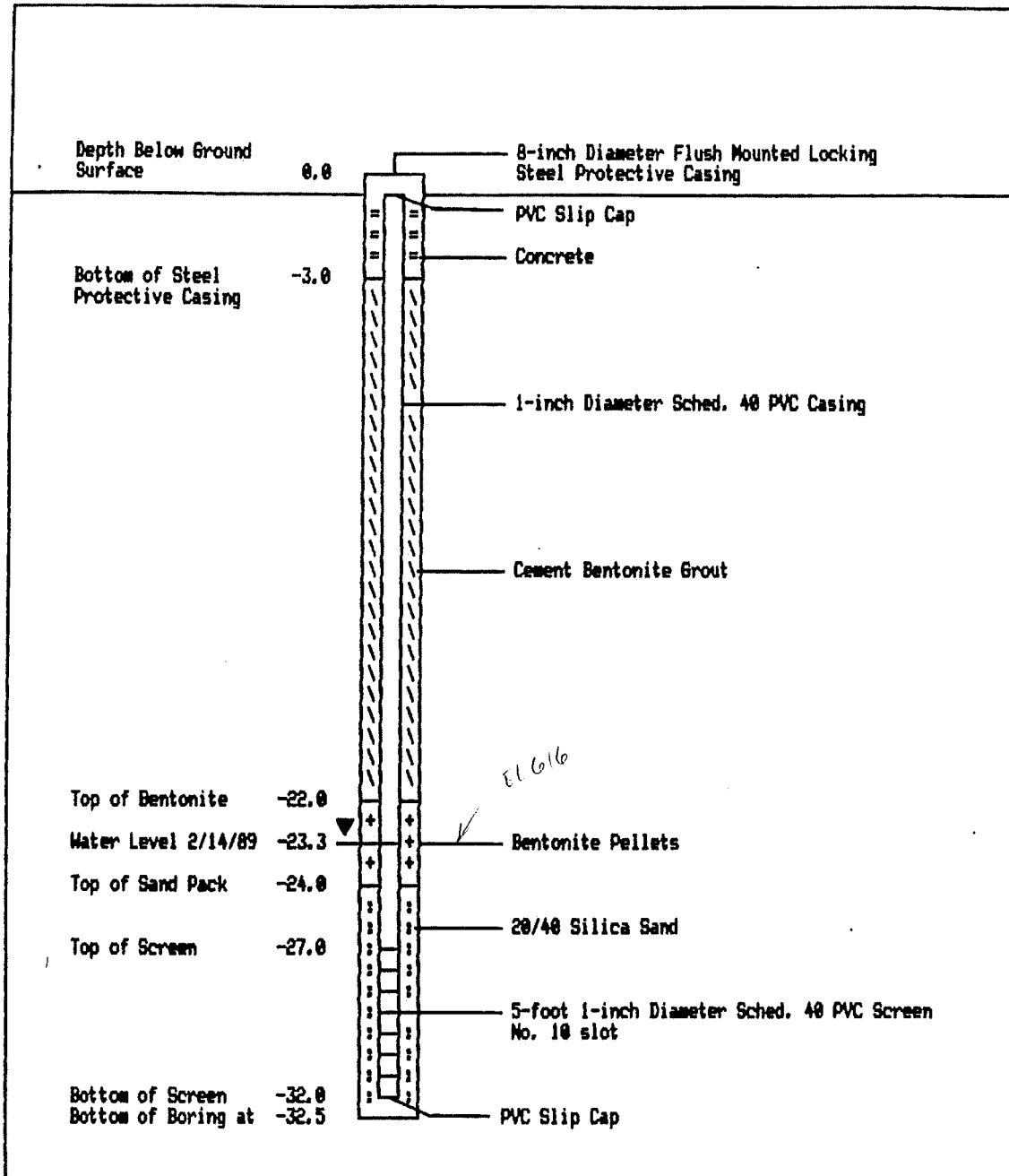
Logger: D. Simon-Gilles/PDX

Drilling Method: Mobile B-65 4" Hollow-Stem Auger

Driller: Pacific Testing Laboratories

Installation Date: February 8, 1989

Client: City of Wenatchee, Washington



SEA24579.61

BORING B-13

(Log Sheet 1 of 2)

Project: Wenatchee Pollution Control Plant Expansion

Location: Wenatchee, Washington

Ground Surface Elevation: Approx. 639 ft. NGVD

Logger: D. Simon-Gilles/PDX

Drilling Method: Mobile B-65 4" Hollow-Stem Auger

Driller: Pacific Testing Laboratories

Start Date: February 8, 1989

Client: City of Wenatchee, Washington

Depth (ft)	Sample		Standard Penetration Test (6"-6"-6")	Sample Description	Comments
	Type-No.	Recovery (inches)			
1					
2					
3	S-1	3	5-3-2 (5)	SILTY SAND with GRAVEL and CLAY-brick pipe tile pieces, (fill) (SM)	HNU = 0 ppm
4					
5					
6					Hard drilling at 6 ft.
7					HNU = 1 ppm inside auger - vapor probably water coming from augers.
8	S-2	6	8-26-29 (55)	SAND with SILT and GRAVEL-light brown/gray, dry to moist, v.dense, some cemented zones, coarse to fine sand, (fill) (SM)	HNU = 0ppm
9					Hard drilling at 9 ft.
10					
11					
12					
13	S-3	1	50/6	SILTY SAND with GRAVEL-dark brown/gray, moist to wet, v.dense, (SM)	HNU = 0ppm
14					
15					
16					
17					
18	S-4	6	17-43-37 (80)	SILTY SAND with GRAVEL-dark brwn/gray some silt zones, coarse to fine sand, rounded gravel, granite & sandstone, (SM)	HNU = 0 ppm
19					
20					Smooth hard drilling
21					
22					
23	S-5		7-24-50/2	SAND- light gray, dry, v.dense, fine to med. sand, micaceous, (Sandstone) (SP)	
24					
25					Smooth hard drilling

BORING B-13

(Log Sheet 2 of 2)

Depth (ft)	Sample		Standard Penetration Test (6"-6"-6")	Sample Description	Comments
	Type- No.	Recovery (inches)			
26					
27					
28	S-6	6	50/6	SILTY SAND- light gray, micaceous, v.dense, fine sand, (sandstone) (SM)	
29				Bottom of boring at 28 feet	
30					
31					
32					
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PIEZOMETER B-13

(Log Sheet 1 of 1)

Project: Wenatchee Pollution Control Plant Expansion

Location: Wenatchee, Washington

Ground Surface Elevation: Approx. 639 ft. MSVD

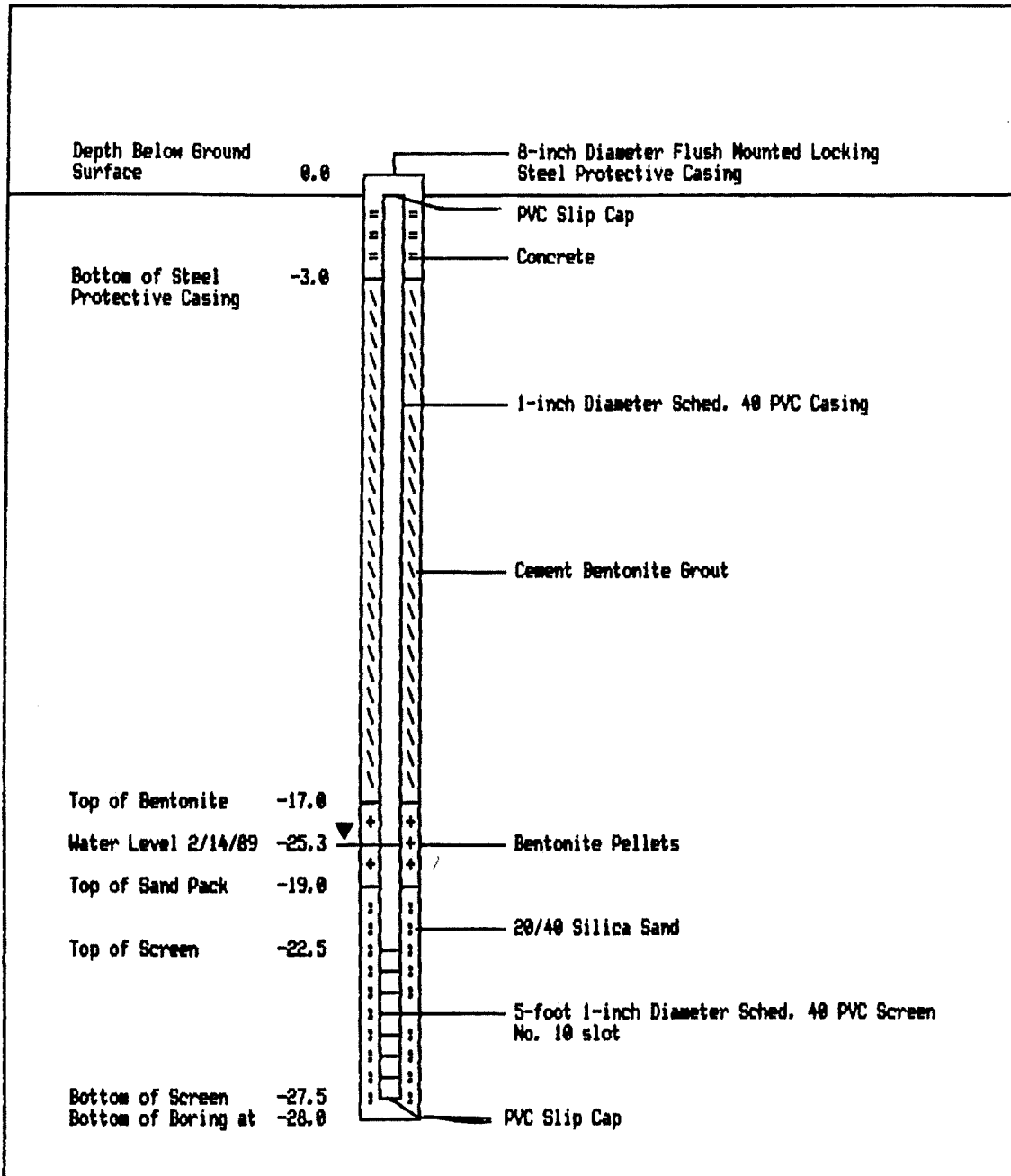
Logger: D. Simon-Gilles/PDX

Drilling Method: Mobile B-65 4" Hollow-Stem Auger

Driller: Pacific Testing Laboratories

Installation Date: February 8, 1989

Client: City of Wenatchee, Washington



SEA24579.61

BORING LOG

B-6

Surveyed Ground Surface Elevation: 639 feet

Logged by: MEB on 6/29/2010

Soil Profile			Sample Data		Penetration Resistance (Blows/foot - ●)					Laboratory Testing	Piezometer Installation - Ground Water Data (Depth in Feet)	
Description	Graphic Log	Group Symbol	Blow Count	Sample Location (Depth in feet)	10	20	30	40	50			50+
0.0 - 0.3 feet weeds												
Brown, silty fine to coarse sand with gravel (loose, moist) (FILL) Pounding on a rock			50 for 5"	5"								
Broken rock (medium dense, dry to moist) (FILL)				5"								
Brown, silty fine to coarse sand (loose, moist) (FILL)			5	10"								
Green-gray, silty fine sand (loose, moist) (FILL)			17	15"								
Brown-green, silty fine to coarse sand with gravel and trace organics (medium dense, moist) (FILL)			20	20"								
Brown, silt with fine sand (very stiff to hard, moist) Siltstone		ML	50 for 5"	25"								G
Brown-pink, silt with fine to coarse sand (very stiff to hard, moist) Siltstone		ML	50 for 6"	27.9"								
Boring terminated below existing grade at 27.9 feet on 6/29/10. Groundwater seepage was not encountered during drilling.												

LEGEND

Depth Driven and Amount Recovered with 2-inch O.D. Split-Spoon Sampler

Depth Driven and Amount Recovered with 3-inch Shelby Tube Sampler

- Solid PVC Pipe
- Slotted PVC Pipe
- Monument/ Cap to Piezometer
- * Liquid Limit
- + Plastic Limit

- Concrete
- Bentonite
- Native Soil
- Silica Sand
- Water Level

- M Moisture Content
- A Atterberg Limits
- G Grain-size Analysis
- DS Direct Shear
- PP Pocket Penetrometer Readings, tons/ft
- P Sample Pushed
- T Triaxial

NOTE: Subsurface conditions depicted represent our observations at the time and location of this exploratory hole, modified by engineering tests, analysis and judgement. They are not necessarily representative of other times and locations. We cannot accept responsibility for the use or interpretation by others of information presented on this log.

Project Number 829110	Wenatchee Waste Water Treatment Plant Expansion Boring Log	 NELSON GEOTECHNICAL ASSOCIATES, INC. GEOTECHNICAL ENGINEERS & GEOLOGISTS <small>17311-135th Ave. NE, A-500 Woodinville, WA 98072 (425) 486-1669 / Fax 481-2510</small>	No.	Date	Revision	By	CK
Figure 10			1	7/1/10	Original	DPN	MEB
Page 1 of 1							

NGA Drafting 2010/2 Central Washington 829110 Waste Water Treatment Plant Borings.dwg

Important Information

About Your Geotechnical/Environmental Report

IMPORTANT INFORMATION

CONSULTING SERVICES ARE PERFORMED FOR SPECIFIC PURPOSES AND FOR SPECIFIC CLIENTS.

Consultants prepare reports to meet the specific needs of specific individuals. A report prepared for a civil engineer may not be adequate for a construction contractor or even another civil engineer. Unless indicated otherwise, your consultant prepared your report expressly for you and expressly for the purposes you indicated. No one other than you should apply this report for its intended purpose without first conferring with the consultant. No party should apply this report for any purpose other than that originally contemplated without first conferring with the consultant.

THE CONSULTANT'S REPORT IS BASED ON PROJECT-SPECIFIC FACTORS.

A geotechnical/environmental report is based on a subsurface exploration plan designed to consider a unique set of project-specific factors. Depending on the project, these may include the general nature of the structure and property involved; its size and configuration; its historical use and practice; the location of the structure on the site and its orientation; other improvements such as access roads, parking lots, and underground utilities; and the additional risk created by scope-of-service limitations imposed by the client. To help avoid costly problems, ask the consultant to evaluate how any factors that change subsequent to the date of the report may affect the recommendations. Unless your consultant indicates otherwise, your report should not be used (1) when the nature of the proposed project is changed (for example, if an office building will be erected instead of a parking garage, or if a refrigerated warehouse will be built instead of an unrefrigerated one, or chemicals are discovered on or near the site); (2) when the size, elevation, or configuration of the proposed project is altered; (3) when the location or orientation of the proposed project is modified; (4) when there is a change of ownership; or (5) for application to an adjacent site. Consultants cannot accept responsibility for problems that may occur if they are not consulted after factors that were considered in the development of the report have changed.

SUBSURFACE CONDITIONS CAN CHANGE.

Subsurface conditions may be affected as a result of natural processes or human activity. Because a geotechnical/environmental report is based on conditions that existed at the time of subsurface exploration, construction decisions should not be based on a report whose adequacy may have been affected by time. Ask the consultant to advise if additional tests are desirable before construction starts; for example, groundwater conditions commonly vary seasonally.

Construction operations at or adjacent to the site and natural events such as floods, earthquakes, or groundwater fluctuations may also affect subsurface conditions and, thus, the continuing adequacy of a geotechnical/environmental report. The consultant should be kept apprised of any such events and should be consulted to determine if additional tests are necessary.

MOST RECOMMENDATIONS ARE PROFESSIONAL JUDGMENTS.

Site exploration and testing identifies actual surface and subsurface conditions only at those points where samples are taken. The data were extrapolated by your consultant, who then applied judgment to render an opinion about overall subsurface conditions. The actual interface between materials may be far more gradual or abrupt than your report indicates. Actual conditions in areas not sampled may differ from those predicted in your report. While nothing can be done to prevent such situations, you and your consultant can work together to help reduce their impacts. Retaining

your consultant to observe subsurface construction operations can be particularly beneficial in this respect.

A REPORT'S CONCLUSIONS ARE PRELIMINARY.

The conclusions contained in your consultant's report are preliminary, because they must be based on the assumption that conditions revealed through selective exploratory sampling are indicative of actual conditions throughout a site. Actual subsurface conditions can be discerned only during earthwork; therefore, you should retain your consultant to observe actual conditions and to provide conclusions. Only the consultant who prepared the report is fully familiar with the background information needed to determine whether or not the report's recommendations based on those conclusions are valid and whether or not the contractor is abiding by applicable recommendations. The consultant who developed your report cannot assume responsibility or liability for the adequacy of the report's recommendations if another party is retained to observe construction.

THE CONSULTANT'S REPORT IS SUBJECT TO MISINTERPRETATION.

Costly problems can occur when other design professionals develop their plans based on misinterpretation of a geotechnical/environmental report. To help avoid these problems, the consultant should be retained to work with other project design professionals to explain relevant geotechnical, geological, hydrogeological, and environmental findings, and to review the adequacy of their plans and specifications relative to these issues.

BORING LOGS AND/OR MONITORING WELL DATA SHOULD NOT BE SEPARATED FROM THE REPORT.

Final boring logs developed by the consultant are based upon interpretation of field logs (assembled by site personnel), field test results, and laboratory and/or office evaluation of field samples and data. Only final boring logs and data are customarily included in geotechnical/environmental reports. These final logs should not, under any circumstances, be redrawn for inclusion in architectural or other design drawings, because drafters may commit errors or omissions in the transfer process.

To reduce the likelihood of boring log or monitoring well misinterpretation, contractors should be given ready access to the complete geotechnical engineering/environmental report prepared or authorized for their use. If access is provided only to the report prepared for you, you should advise contractors of the report's limitations, assuming that a contractor was not one of the specific persons for whom the report was prepared, and that developing construction cost estimates was not one of the specific purposes for which it was prepared. While a contractor may gain important knowledge from a report prepared for another party, the contractor should discuss the report with your consultant and perform the additional or alternative work believed necessary to obtain the data specifically appropriate for construction cost estimating purposes. Some clients hold the mistaken impression that simply disclaiming responsibility for the accuracy of subsurface information always insulates them from attendant liability. Providing the best available information to contractors helps prevent costly construction problems and the adversarial attitudes that aggravate them to a disproportionate scale.

READ RESPONSIBILITY CLAUSES CLOSELY.

Because geotechnical/environmental engineering is based extensively on judgment and opinion, it is far less exact than other design disciplines. This situation has resulted in wholly unwarranted claims

being lodged against consultants. To help prevent this problem, consultants have developed a number of clauses for use in their contracts, reports, and other documents. These responsibility clauses are not exculpatory clauses designed to transfer the consultant's liabilities to other parties; rather, they are definitive clauses that identify where the consultant's responsibilities begin and end. Their use helps all parties involved recognize their individual responsibilities and take appropriate action. Some of these definitive clauses are likely to appear in your report, and you are encouraged to read them closely. Your consultant will be pleased to give full and frank answers to your questions.

The preceding paragraphs are based on information provided by the ASFE/Association of Engineering Firms Practicing in the Geosciences, Silver Spring, Maryland

IMPORTANT INFORMATION