USF HEALTH
MORSANI COLLEGE OF MEDICINE & HEART INSTITUTE

UNIVERSITY OF SOUTH FLORIDA
CONTRACT NUMBER: USF 519 & 535 MDD-4023
TAMPA, FLORIDA

PROJECT MANUAL

CONSTRUCTION DOCUMENTS
DECEMBER 20, 2017

VOLUME 4 OF 4
DIVISIONS 20 - 31

Hellmuth, Obata & Kassabaum, Inc.
One Tampa City Center
201 N. Franklin Street, Suite 1800
Tampa, FL 33602
Florida Registration: AAC001139

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Architect/LEED	Hellmuth, Obata & Kassabaum, Inc. Tampa City Center 201 N. Franklin Street Suite 1800 Tampa, FL 33602 Florida Registration: AAC001139
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Structural Engineer:	Walter P. Moore & Associates 201 E Kennedy Blvd Ste 300 Tampa, FL 33602 (813) 221-2424
Fire Protection, Plumbing, Mechanical, Electrical, Communications Engineers	R.G. Vanderweil Engineers, LLP 274 Summer Street Boston, MA 02210 (407) 567-2001
Fire Protection, Plumbing, Mechanical Electrical Engineers	TLC Engineering for Architecture 4890 W. Kennedy Blvd, Suite 250 Tampa, FL 33609 (813) 637-0110
Code Consultant	GHD 3050 Premiere Parkway, Suite 470 Duluth, GA 30096 (813) 971-3882
Audio Visual	Waveguide Consulting, Inc. One West Court Square Suite 300 Decatur, GA 30030 (813) 948 1500

Wind Studies	CPP Inc. 2400 Midpoint Drive, Suite 190 Fort Collins, Colorado 80525 (970) 221 3371
Acoustic/Vibration	Colin Gordon & Associates 150 North Hill Drive, Suite 15 P.O. Box 2070 Brisbane, CA 94005 415-570-0350
Commissioning Agents	Affiliate Engineers (AEI) Tioga Town Center, 12921 SW 1st Road Ste 205 Newberry, FL 32669 352 3765500
Elevator Consultant	Lerch Bates 12421 NW 35th Street Coral Springs, FL 770-416-6765
WELL Building Consultant	Delos Living LLC 22 Little West 12th, 4th Floor New York, NY 10014 (646) 308.1565
Building Envelope Consultant	CMC Construction Moisture Consulting 4508 Oak Fair Boulevard Suite 200 Tampa, Florida (800) 839-3987
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SECTION 200000 - COMMON MECHANICAL/ELECTRICAL REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. Some paragraphs in this Section mirror similar paragraphs in Division 01; but those in this section are specific to the mechanical and electrical trades. Contractor shall comply with Division 01 as well as those requirements of this Division that are additional to or more stringent than those in Division 01.

C. This section shall apply to the following Divisions:

1. Division 21 - Fire Suppression
2. Division 22 - Plumbing
3. Division 23 - Heating, Ventilating, and Air Conditioning (HVAC)
4. Division 26 - Electrical
5. Division 27 - Communications
6. Division 28 - Electronic Safety and Security

1.2 SUMMARY

A. Give notices, file plans, obtain permits and licenses, pay fees and back charges, and obtain necessary approvals from authorities that have jurisdiction.

B. Completely coordinate work of this Division with work of others and provide a complete and fully functional installation.

C. Drawings and Specifications form complimentary requirements. Provide work specified and not shown, work shown and not specified as though explicitly required by both. Although work is not specifically shown or specified, provide supplementary or miscellaneous items, appurtenances, devices and materials for a sound, secure and complete installation

D. These documents are not intended to be complete construction documents. They are issued for the purpose of obtaining a guaranteed maximum price (GMP) and are not suitable for takeoff bidding. These documents do, however, describe the systems required and approximately where the larger equipment is to be located. Include allowances in estimates to fully complete the system including all interconnecting and coordination and installation details and components and extending the system into and throughout all spaces. Include allowances for startup and for making the systems fully operational, and for scope and design contingencies. Future changes in price above the GMP, for items not shown on these GMP drawings will not be allowed if the system itself if shown or described in these documents. The only future changes in price that will be allowed are if new systems are added.

E. This project is intended to be LEED-certified. Refer to Division 01 for specification of work to be performed by mechanical and electrical trade Contractors.

1.3 DEFINITIONS

A. As used in all Sections covered by Division 20, "provide" means "furnish and install." "Furnish" means "to purchase and deliver to the project site complete with every necessary appurtenance and support," and "Install" means "to unload at the delivery point at the site and perform every operation necessary to establish secure mounting and correct operation at the proper location in the project. "Architect" means the "Prime Design Consultant." If R.G. Vanderweil Engineers, LLP is not the Prime Design Consultant, the Architect may authorize R.G. Vanderweil Engineers, LLP to act on the Architect's behalf in matters concerning the systems Vanderweil has designed.

B. The words “Architect” and “Engineer” may be used interchangeably in the mechanical and electrical Division specifications.

C. The terms “Contractor,” “General Contractor,” “Construction Manager,” and “Design-Builder,” may appear in the mechanical and electrical Divisions. Wherever such a term is used, it shall mean the entity that is directing all the construction.

D. A “substitution” means a product proposed by the Contractor that is from a manufacturer not listed in the individual sections of the Division 20 specifications as an “Acceptable Manufacturer.”

E. “AHJ” means “Authorities Having Jurisdiction.”

1.4 CONTRACT DOCUMENTS

A. The two dimensional drawings govern the construction. They show the design intent and are part of the Contract Documents. BIM models are not part of contract documents. They are developed for convenience only.

B. Except where modified by a specific notation to the contrary, it shall be understood that the indication and/or description of an item in the drawings or specifications or both, carries with it the instruction to furnish and install the item, regardless of whether or not this instruction is explicitly stated as part of the indication or description.

C. Items referred to in singular number in Contract Documents shall be provided in quantities necessary to complete work.

D. Information and components shown on riser diagrams, but not shown on plans, and vice versa, shall apply or be provided as if expressly required on both.

E. In spaces used by building occupants, but not in mechanical rooms, the architectural drawings shall govern the location of visible mechanical and electrical components. In order to obtain the intended aesthetics in such spaces, prior to installation of visible material and equipment (including access panels), review Architectural Drawings for desired locations and where not definitively indicated, request information from Architect.

F. Maintain maximum headroom at all locations. All piping, duct, conduit, and associated components to be as tight to underside of structure as possible.

G. Systems shall be run in a rectilinear fashion.

H. Requirement for Complete Systems and Coordination Adjustments

1. The two dimensional drawings and the BIM model are diagrammatic, whether furnished electronically or in hard copy. They indicate general arrangements of mechanical systems and other work, and are intended to convey sufficient information for skilled contractors and tradesmen to furnish and install complete systems. They are not intended to be absolutely precise; they are not intended to specify or to show every offset, fitting, and component. The purpose of the drawings and BIM model is to indicate a systems concept, the main components of the systems, and the approximate geometrical relationships. Based on the systems concept, the main components, and the approximate geometrical relationships, provide all other components and materials to make the systems fully complete, coordinated with other systems and the structure and space available, and operational.
2. The drawings and BIM model are not designed to the level of detail of contractor's or manufacturer's fabrication drawings, shop drawings, sheet metal layout drawings, or coordination drawings.
3. Certain information is specified and is intentionally not included on the drawings and BIM model such as hangers and supports, insulation, and routing of branch circuits. Provide installation in accordance with the specifications.
4. Similarly, the drawings and BIM model do not show all offsets required for coordination nor do they show the exact routings and locations needed to coordinate with structure and other trades in order to avoid interferences and to meet ceiling heights and other Architectural requirements. Establish and provide offsets, changes in direction, and exact routings to coordinate all systems.
5. Where conflicts or potential conflicts exist and engineering guidance is desired, submit a "Request for Information" (RFI).

1.5 DISCREPANCIES IN DOCUMENTS

A. Where Drawings or Specifications conflict or are unclear, submit clarification request in writing before Award of Contract. Otherwise, Architect's interpretation of Contract Documents shall be final, and no additional compensation shall be permitted due to discrepancies or un-clarities thus resolved.

B. Where Drawings or Specifications do not coincide with manufacturers' recommendations or with applicable codes and standards, submit clarification request in form of an RFI before installation. Otherwise, make changes in installed work required for compliance with manufacturer instructions or codes and standards within Contract Price.

C. If the required material, installation, or work can be interpreted differently from drawing to drawing, or between drawings and specs, provide material, installation or work that is of the higher standard.

D. Provide systems and components that are fully complete and operational and fully suitable for the intended use. Where insufficient information exists in the documents to precisely describe a certain component or subsystem, or the routing of a component or its coordination with other building elements, where notification required by Paragraph (A) above has not been submitted, provide the specific component or subsystem with all parts necessary for the intended use, fully complete and operational, and installed in workmanlike manner either concealed or exposed in accordance with the design intent.

E. In cases covered by Paragraph (D) above, where the contractor believes engineering guidance is needed, submit an RFI.

F. Where discrepancies exist between the mechanical, plumbing, fire protection, and electrical drawings in regards to what trade owns disconnects or starters, the discrepancy shall be brought to the Architect's attention in accordance with paragraph (A) above. If the scope is not resolved prior to the Award of Contract, Division 26 shall provide such items.

1.6 CLASH DETECTION

A. Coordination drawings are specified in the paragraph titled Coordination Drawings. These are required whether engineering drawings have been produced from 2-D or 3-D models. In the latter case, the Contractor may use a BIM model to perform a clash detection study, and subsequently to work out the significant clashes and update the model, and use this as the basis for coordination drawings. The engineer will provide his BIM model for the contractor's use for this purpose if the contractor so requests and signs the appropriate release.

B. The great majority of clashes in a BIM model involve non-clashing adjacencies or interferences of small MEP components, like piping 2 inches or less in diameter (excluding insulation). Such clashes shall be worked out by the contractor as part of his coordination effort. If a clash consists of a major routing or other impasse, upon submittal of an RFI, the engineer will provide guidance.

1.7 REQUESTS FOR INFORMATION (RFI'S)

A. Where an RFI is a request to resolve a conflict or an un-clarity, or a request for additional detail, contractor's RFI shall include a sketch or equivalent description of contractor's proposed solution.

B. To expedite the processing of RFIs, submit the attached form, or similar form including the same information to the Architect, with a copy to the Engineer. Include Contractor proposed solution, with sketches as required, in the indicated space on the form.

C. The form and all RFI related documents shall be submitted as one PDF (non-binder) format file, without password protection. If it is impossible to convert some information to PDF, it may be submitted as a second file, not password protected.

RFI FORM

FAX RFI

RFI No. _____

Date Submitted: _____

Contractor: _____

Date Required: _____

Job Name: _____

Person: _____

Spec. Sec.: _____

Contr. Fax No.: _____

Vanderweil Fax No.: (617) 423-7401

Arch. Fax No.: _____

Contractor Field Question (Provide narrative and/or sketch):
Contractor Proposed Solution (Provide narrative and/or sketch):
Vanderweil Response:

1.8 COORDINATION DRAWINGS AND COORDINATION MODEL

A. Coordination drawings are required for all Divisions covered by this Section. These drawings require information on all mechanical and electrical trades. The content and procedures described in Division 01 shall be followed, with the additional requirements specifically for the mechanical and electrical trades as described in this Section. If a BIM model is not used on this project, the below requirements shall be accomplished in CAD.

B. The main paths of egress and for equipment removal from main mechanical and electrical rooms shall be clearly shown on the coordination drawings.

C. The initiation of these drawings begins with the Sheet Metal Subcontractor's BIM model and the resultant sheet metal shop drawings.

D. The Sheet Metal Subcontractor's BIM model shall incorporate the sheet metal as well as structure and other information for spatial coordination. Provide cross sections in congested areas. Access panels shall be shown, as well as all fire walls and smoke partitions, which shall be shown in a different color than the regular partitions and the sheet metal.

E. Each of the mechanical, electrical and other specialty trades shall electronically add its work to the model in a separate color, with appropriate offsets, elevations and grid dimensions, and showing access panels. Mechanical, electrical, and specialty trade information is required for fan rooms and mechanical rooms, horizontal exits from duct shafts, crossovers, and for spaces in and above ceilings. Drawings shall indicate horizontal and vertical dimensions to avoid interference with structural framing, ceilings, partitions, and other services.

F. The following shall be submitted to the Engineer for review:

1. The 3-D electronic model showing all trades and color coded by trade.
2. For HVAC review:

    a. An electronic set of 2-D PDFs of all floor plans and sections, made from the 3-D electronic model showing all trades color coordinated.
    b. An electronic set of 2-D PDFs of all floor plans, made from the 3-D electronic model, but showing only the HVAC superimposed on the architectural layout.

3. For electrical review:

    a. An electronic set of 2-D PDFs of all floor plans and sections, made from the 3-D electronic model showing all trades color coordinated.
    b. An electronic set of 2-D PDFs of all floor plans, made from the 3-D electronic model, but showing only the electrical superimposed on the architectural layout.

4. For plumbing review:

    a. An electronic set of 2-D PDFs of all floor plans and sections, made from the 3-D electronic model showing all trades color coordinated.
    b. An electronic set of 2-D PDFs of all floor plans, made from the 3-D electronic model, but showing only the plumbing superimposed on the architectural layout.

5. For fire protection review:

a. An electronic set of 2-D PDFs of all floor plans and sections, made from the 3-D electronic model showing all trades color coordinated.
b. An electronic set of 2-D PDFs of all floor plans, made from the 3-D electronic model, but showing only the fire protection superimposed on the architectural layout.

6. One complete set of 2-D coordination drawings, printed out full size with individual trades superimposed and color coded.

G. The 2-D PDFs are considered the coordination drawings. The engineering review is based on these, not on the 3-D model, which the engineer may need to refer to for clarification in congested spaces.

H. Fabrication shall not start until the coordinated model, PDF's, and prints are received by the Engineer and have been reviewed.

I. Review by Engineer of coordination drawings is limited to confirming that requirements for coordination and preparation of plans have been complied with by the Contractor and shall not diminish responsibility under this Contract for final coordination of installation and maintenance clearances of all systems and equipment with Architectural, Structural, Mechanical, Electrical and other related work.

J. After Review:

1. The Engineer will provide comments.
2. All changes to reviewed coordination drawings shall be approved in writing by the Architect prior to start of work in affected area.

K. Coordination Drawings shall include, but are not limited to:

1. Plumbing systems, piping and equipment.
2. HVAC piping, systems and equipment.
3. Control systems.
4. Electrical distribution, systems and equipment.
5. Lighting systems and fixtures.
6. Sheet metal work, components and accessories (e.g. coils, terminal boxes).
7. Fire protection and sprinkler system, piping and heads.
8. Structural.
9. Electrical Equipment Room layouts.
10. Environmental Rooms and associated refrigeration/heating systems.
11. Partition/room layout.
12. Ceiling tile and grid
13. Access panels.
14. Smoke and fire dampers.
15. Roof drain piping.
16. Major electrical conduit runs, panel boards, feeder conduit and racks of branch conduit.
17. Above ceiling miscellaneous metal.
18. Heat tracing of piping.

1.9 ENGINEER'S ELECTRONIC BIM FILES

A. Electronic BIM files for Fire Protection, Plumbing, HVAC, Electrical, Communication, or Electronic Safety and Security drawings will be furnished by Engineer at contractor's request. These files will be provided on Engineer's FTP site in the software release used by the Engineer. If other media or software version is requested, Engineer will require advance reimbursement of processing costs.

B. Requests should be made by filling out the following form letter and providing an authorized signature. The requested information will not be released prior to receipt of this letter for the appropriate documents.

[DATE]
TLC Engineering for Architecture
Attn: [NAME]
[ADDRESS]
Re: [JOB NAME]
Dear [NAME]:
We hereby request that you provide us with the following electronic files:

[ELECTRONIC FILE Name, date of file, description]

TLC Engineering for Architecture ("TLC") agrees to provide the above-referenced electronic files to [_____] (the "Recipient."). Recipient recognizes that data recorded on or transmitted as electronic files are subject to undetectable alteration, either intentional or unintentional, due to among other causes, transmission, conversion, media degradation, software error, or human alteration. Accordingly, the electronic files are provided to Recipient for informational purposes only and not as an end product or Contract Document.

TLC makes no warranties, either express or implied, regarding the fitness or suitability of the electronic files. The electronic files are instruments of professional service, and shall not be used, in whole or in part, for any project other than that for which they were created, without the express written consent of TLC.

Accordingly, Recipient agrees to waive any and all claims against TLC resulting in any way from the use, unauthorized reuse or alteration, or misuse of the electronic files, and to defend, indemnify and hold TLC harmless from any claims, losses, damages, or costs, including attorney's fees, arising out of the use, reuse, alteration, or misuse of the electronic files.

Further:

1. Recipient agrees that any electronic/model data provided in the Electronic Files is for reference only and does not relieve the contractor and subcontractors from the responsibility for material take offs and cost estimations, coordination of systems, sequencing, and means and methods.
2. Recipient agrees not to sell, assign or lease any rights in the designs, models, drawings, information and depicted works in any form to any person or entity.
3. Recipient agrees not to remove any copyright notices, labels or marks on the designs, drawings, information and depicted works.
4. Under no circumstances shall the transfer of ownership of electronic data, or hard copy thereof, be deemed to be a sale by TLC of tangible goods, and TLC makes no warranties, express or implied, of merchantability or of fitness for a particular purpose.
5. The Electronic Files issued are current as of the date of the last revisions as imbedded in the files. TLC is not responsible or liable for providing any updates or modifications that may or may not have occurred since the revision dates shown in the files. The Electronic Files may also represent only a portion - not a complete set - of the construction documents or model data and, as such, they may be incomplete or inconsistent with the most recent design. TLC makes no representation as to its completeness, currency or accuracy and TLC shall not be responsible to advise the Recipient of any changes which may hereafter be made to the Project plan or configuration or other information contained in the Electronic Files.
6. Recipient acknowledges that the designs, drawings, information and depicted works are protected by copyright laws, and that TLC, or its Consultants, as appropriate, is the author and/or owner of same.
7. TLC, or its Consultants, as appropriate, retains all copyrights to the designs, drawings, information and depicted works on the disk and grants to Recipient a limited license to reproduce such information in connection with Recipient or their contractors' or subcontractors work on the Project, and no other.
8. If specifications are provided, recipient agrees not to modify same.
9. If BIM models are provided, the following shall apply:
    - Contract Documents Govern the Project. Recipient agrees that, notwithstanding the use of BIM technology and the transfer of BIM Data, the specifications, and the 2-dimensional Contract Documents and subsequently issued Change Orders, Change Directives, Bulletins, RFI Responses and the like are the sole source of information regarding the requirements for construction of the Project. Recipient will notify TLC if it becomes aware of discrepancy between

the BIM Data and any drawing, specification or other document issued for construction of the Project.

- BIM (i.e. Revit/Navisworks) models and associated files will only contain elements and content that TLC deems necessary and as required to produce the two dimensional drawings that govern the project. No specific Level of Detail (LOD) is implied or expected. The Recipient agrees that no Revit families or Revit content shall be removed from the model and/or used for any other purpose than supporting this specific project.
- The BIM model is for general informational and reference purposes only, and is not to be used by the contractor as an alternative to performing field measurements, preparing coordination drawings, or developing shop drawings. Access to the BIM model does not relieve the contractor of the contractual responsibility to implement the design intent through various means. These means include verifying existing conditions, producing coordination drawings (compiled from various sub-contractors), preparing shop drawings, and controlling means and methods of construction.

10. If an Energy Model is required, the following will apply:
    - TLC has created a comparative energy model for the project to either: (1) inform design by comparing alternative designs, or (2) to determine compliance with codes or LEED requirements by comparing against a reference building, in both cases using reference weather data. The models use industry standard tools such as eQuest or Trane-Trace.
    - The models are for comparative purposes and are not intended to predict actual energy, since in the actual building, the operation, installed components, weather, control setpoints and many other parameters will be different than the inputs, defaults, and assumptions used in the comparative model.
    - This computerized energy model is being transmitted with the following understanding: (1) The recipient acknowledges the purpose and limitations of the TLC energy model, as described above. (2) The recipient can operate the model only for the building it was developed for. (3) TLC is not expected to analyze or comment on modeling results obtained by the recipient, which are expected to be different than those obtained by TLC. (4) TLC is not expected to explain the assumptions, inputs and defaults used in the model, although if requested, TLC will provide the occupancy, plug load, and lighting schedules used. (5) TLC is not expected to conduct additional runs of the model with changes to the assumptions, inputs, and defaults that it used.

Accepted and Agreed:

Authorized signature: _____

Print Name: _____

Title: _____

Company: _____

Date: _____

1.10 RELATED WORK IN OTHER SECTIONS

A. The following work is not included and shall be performed under other Sections. Coordinate requirements with other Divisions.

1. Excavation and backfill.
2. Concrete work, including concrete housekeeping pads and other pads and blocks for vibrating and rotating equipment, and cast in place manholes and handholes.
3. Cutting and patching of masonry, concrete, tile and other parts of structure, with the exception of drilling for hangers and providing holes and openings in metal decks.
4. Flashing of wall and roof penetrations.
5. Installation of access panels in floors, walls, furred spaces or above ceilings.
6. Painting, except as specified herein.
7. Structural supports necessary to distribute loading from equipment to roof or floor except as specified herein.
8. Temporary light, power, water, heat, gas and sanitary facilities for use during construction and testing.
9. Outdoor air intake and exhaust louvers.
10. Wall and ceiling enclosures and shafts for supply, return and exhaust ductwork as shown on drawings.

B. Installation of circuit breakers (furnished by ATC Contractor) and final electrical panel terminal connections for ATC control power wiring shall be provided by Division 26.

C. Electric power wiring for all equipment shall be provided by Division 26.

1.11 SITE VISIT

A. Before submitting bid, visit and carefully examine site to identify existing conditions and difficulties that will affect work of this Section. No extra payment will be allowed for additional work caused by unfamiliarity with site conditions that are visible or readily construed by an experienced observer.

1.12 EXISTING CONDITIONS AND PREPARATORY WORK

A. Before starting work in a particular area of the project, visit the location and examine conditions under which work must be performed including preparatory work done under other Sections or other Contracts or by the Owner. Review geometrical constraints, such as ceiling heights, to ensure constructability and access for maintenance. Report conditions that might adversely affect work in writing to the Architect. Do not proceed with work until defects have been corrected and conditions are satisfactory. Commencement of work shall be construed as complete acceptance of existing conditions and preparatory work.

B. Existing Concrete Slabs. Before coring or other penetration of existing slabs, scan the area where the work is to be performed in order to locate existing in-slab or below-slab utilities, and position the slab penetrations so as to avoid these.

1.13 CODES, STANDARDS, AUTHORITIES AND PERMITS

A. Perform work in accordance with rules, regulations, standards, codes, ordinances, and laws of local, state, and Federal governments, and other authorities that have legal jurisdiction over the site.

B. Secure and pay for all permits and inspections required by the Authorities having Jurisdiction. Secure trade permits prior to beginning work.

C. Materials and equipment shall be manufactured, installed and tested as specified in latest editions of applicable publications, standards, rulings and determinations of:

1. Applicable local and state codes.
2. National Fire Protection Association (NFPA).
3. American Insurance Association (AIA) (formerly National Board of Fire Underwriters).
4. Occupational Safety and Health Act (OSHA).
5. Underwriters Laboratories (UL)
6. Factory Mutual Association (FM)
7. Owner’s Insurance Underwriter.

D. Specific reference is made to the following NFPA standards which contain an exceptionally high quantity of mechanical, electrical, and fire protection requirements. These standards as referenced by the applicable building, fire, and mechanical codes shall apply.

1. No. 13 - Installation of Sprinkler Systems
2. No. 14 - Installation of Standpipe and Hose Systems
3. No. 20 - Installation of Centrifugal Fire Pumps
4. No. 30 - Combustible Liquids
5. No. 37 - Installation of Use of Stationary Combustion Engines and Gas Turbines
6. No. 45 - Fire Protection for Laboratories Using Chemicals
7. No. 70 - National Electric Code
8. No. 72 - National Fire Alarm Code
9. No. 101 - Life Safety Code

E. Material and equipment shall be listed by Underwriters' Laboratories (UL).

F. When requirements cited in the various parts of the Contract Documents conflict with each other, most stringent shall govern work. Architect may relax this requirement when relaxation does not violate ruling of AHJ. Approval for relaxation shall be obtained from AHJ in writing.

G. Unless indicated otherwise, the most recent editions of applicable specifications and publications of the following organizations form part of these Contract Documents. Material and Equipment shall be approved by the relevant organizations for intended service.

1. American Gas Association (AGA).
2. American National Standards Institute (ANSI).
3. American Society of Mechanical Engineers (ASME).
4. National Electric Manufacturers Association (NEMA).
5. American Society for Testing and Materials (ASTM).
6. American Water Works Association (AWWA).
7. American Society for Heating, Refrigerating and Air Conditioning Engineers (ASHRAE).
8. Air Moving and Conditioning Association (AMCA).
9. Sheet Metal and Air Conditioning Contractors National Association (SMACNA).

10. Air Conditioning and Refrigeration Institute (ARI).
11. Thermal Insulation Manufacturers Association (TIMA).
12. Institute of Electrical and Electronics Engineers (IEEE).
13. Insulated Cable Engineers Association (ICEA).
14. Manufacturer's Standardization Society of the Valve & Fittings Industry (MSS)

1.14 WARRANTY AND 24 HOUR SERVICE

A. This Paragraph shall not be interpreted to limit Owner's rights under applicable codes and laws and under this Contract.

B. Part 2 paragraphs of all specification Sections may specify warranty requirements that exceed those of this Paragraph.

C. Warranty the Work of this Section in writing for one year following the date of Substantial Completion. If the equipment is used for ventilation, temporary heat, or other use prior to initial beneficial occupancy by the Owner, the bid price shall include an extended period of warranty covering the one-year of beneficial occupancy by the Owner. The warranty shall be to repair or replace defective products, materials, equipment, workmanship and installation that develop within this period promptly and to Architect's satisfaction, and to correct damage caused in making necessary repairs and replacements under warranty within Contract Price.

D. In addition to warranty requirements of Division 01 and of Paragraph C above, obtain written equipment and material warranties offered in manufacturer's published data, without exclusion or limitation, in Owner's name.

E. Replace material and equipment that require excessive service during warranty period. Excessive service shall be defined as more than three service calls for the same material or equipment within a 12 month period.

F. Provide 24-hour service beginning on the date of Substantial Completion and lasting until the termination of the warranty period. Service may be provided by a separate service organization subject to Owner approval. Submit name and a phone number that will be answered on a 24-hour basis each day of the week, for the duration of the service.

G. Submit copies of equipment and material warranties before final payment.

H. Use of systems provided under this Section for temporary services and facilities shall NOT constitute Final Acceptance of work nor beneficial use by Owner, and shall not institute warranty period.

I. Provide manufacturer's engineering and technical staff at site to analyze and rectify problems that develop during warranty period immediately. If problems cannot be rectified immediately to Owner's satisfaction, advise Architect in writing, describe efforts to rectify situation, and provide analysis of cause of problem. Architect will recommend course of action.

1.15 ACCEPTABLE MANUFACTURERS

A. Acceptable Manufacturers: The Engineer’s design for each product is based on the single manufacturer listed in the schedule or shown on the drawings. In Part 2 of the individual Specification Sections certain Alternate Manufacturers may be listed as being acceptable.

These are acceptable only if, as a minimum, they are in compliance with the following requirements:

1. Meet all performance criteria listed in the schedules and outlined in the specification. For example, to be acceptable, an air handling unit must deliver equal CFM against equal external static pressure using equal or less horsepower as the air handler listed in the schedules.
2. Have identical operating characteristics to those called for in the specification. For example, a reciprocating compressor will not be acceptable if a rotary model is specified.
3. Fit within the available space it was designed for, including space for maintenance and component removal, with no modification to either the space or the product. Clearances to walls, ceilings and other equipment will be at least equal to those shown on the design drawings. The fact that a manufacturer's name appears as acceptable shall not be taken to mean that the Architect has determined that the manufacturer's products will fit within the available space - this determination is solely the responsibility of the contractor.
4. For rooftop mounted equipment and for equipment mounted in areas where structural matters are a consideration, the products must have a weight no greater than the product listed in the schedules or specifications.
5. Products must adhere to all architectural considerations including, but not limited to: being of the same color as the product scheduled or specified, fitting within architectural enclosures and details, and for diffusers and plumbing fixtures - being the same size and of the same physical appearance as scheduled for specified products.

B. Required Use of Acceptable Manufacturers on this Project

1. Substitution of products other than those of the Acceptable Manufacturers specified herein shall not be made. Only the specified items or the comparable product by one of the specified Alternate Manufacturers shall be submitted. Products by other manufacturers shall not be used on this project.

C. Deviations

1. Proposed deviations from Contract Documents shall be requested individually in wiring whether deviations result from field conditions, standard shop practice, or other cause. Submit letter with transmittal of Shop Drawings which flags the deviation to the attention of the Architect.
2. Without letters flagging the deviation to the Architect, it is possible that the Architect may not notice such deviation or may not realize its ramifications. Therefore, if such letter are not submitted to the Architect, the Contractor shall hold the Architect and his consultants harmless for any and all adverse consequences resulting from deviations being implemented. This shall apply regardless of whether the Architect has reviewed or approved shop drawings containing the deviation, and will be strictly enforced.
3. Approval of proposed deviations, if any, will be made at discretion of the Architect.

1.16 SUBMITTALS

A. This Paragraph supplements Division 01.

B. Definitions

1. Submittals include product data, shop drawings, coordination drawings, and sheet metal shop drawings. Product data and shop drawings are information prepared to illustrate, in

more detail than shown on the contract documents, the fixtures, equipment and other components of the work as proposed by the contractor. These are action submittals.

2. Coordination Drawings are detailed, large-scale layout Shop Drawings showing HVAC, Electrical, Plumbing and Fire Protection work superimposed in order to identify conflicts, ensure inter-coordination of Mechanical, Electrical, Plumbing, Architectural, Structural and other work, and to conform the engineering layouts to best construction practices. Coordination drawings are information submittals.
3. Sheet Metal Shop Drawings are 3/8 inch scale detailed sheet metal layouts showing all offsets, fittings, and hangers and supports, and other appurtances. These are information submittals.
4. Electronic Copy means copy in a searchable PDF format, and excludes scanned material and faxed material. Scanned material and faxed material shall not be submitted.

C. Submittal Cover Sheet

1. In addition to the information required for all submittals on the project as specified in Division 01, provide the below special cover sheet for submittals falling within Division 20, 21, 22, 23, 26, 27 and 28. Information on the special cover sheet shall be completely filled out. Submit a separate cover sheet with shop drawings for each section of the specifications.
2. Where the section specifies a class of products (for example, plumbing fixtures, wiring devices, insulation) the submission for that section shall either be complete, including all products within that class or it shall contain an index listing all products within that class and designating which ones are included with that submittal. Where the submission covers more than one product, the information required on the cover sheet shall be clearly differentiated by product if it does not apply in common for all included products.

SUBMITTAL COVER SHEET

PROJECT: _____ DATE: _____

DIVISION NO. _____ SECTION NO. _____ PARA. NO. _____

DESCRIPTION: _____

CONTRACTOR: _____

CONTRACT DRAWING REFERENCE NO: _____

EQUIPMENT TAG (From Dwg. Schedules): _____

SUBMISSION (check one): ☐ First ☐ Second ☐ Third ☐ Fourth

INFORMATION AND CHECKLIST

1. Direct contact information for product representative or supplier to which questions can be referred (name, address, phone number, and email address).
   Name: _____
   Address: _____
   Phone Number: _____ Email: _____

				Comment
2.	Are all specified or scheduled items included and exactly match scheduled/specified items?	Yes	No	
3.	Is this item a substitution or other deviation? If so, follow procedures In Section 012500.	Yes	No	
4.	Does equipment fit space shown on construction documents, coordination drawings, and actual field conditions?	Yes	No	
5.	Does this material/equipment add expense to other trades or project costs?	Yes	No	
6.	Is control interface coordinated?	Yes	No	
7.	List electrical characteristics (Voltage/Phase/Hz/Amps)	_____		

D. Submittal Contents, Format, Procedures

1. For the submittals covered by Division 20, Contractor review of submittals is intended to ensure that the submittals include the foregoing cover sheet, are in the correct electronic or paper format as specified below, and that the specified item physically fits into the space available. Contractor shall verify that the submittal contains adequate information to verify specification requirements as well as the performance and dimensional requirements shown on the drawings.
2. Submittal Contents

    a. Submittals shall be comprehensive and fully self-contained.
    b. Submittals shall include page numbers to allow reviewer to identify specific location where comment applies.
    c. Electronic submittals shall be fully self-contained and shall not contain links to associated websites. The submittal coversheet, transmittal, and document shall be prepared as one searchable PDF (non-binder) format file, without password protection. If it is not possible to convert some material into PDF, it is acceptable to submit this as a second file.
    d. Submittals shall include all catalog data and physical and performance characteristics and plans and diagrams as necessary to confirm compliance with plans and specifications.
    e. Submittals shall contain only information relevant to the particular equipment or materials to be furnished. Clearly indicate the piece of equipment or material being provided. Do not submit generic catalog cuts which describe several different items in addition to those specific items being provided, unless all irrelevant information is marked out or relevant information is clearly differentiated. Those items and features that are not being proposed for this project shall be crossed out so as not to imply that they are included.
    f. Where applicable, equipment Product Data shall include wiring and interlock diagrams using the standard wiring diagrams with all terminals, which have been provided for use by the various Subcontractors clearly indicated. For example, remote start/stop wiring from BMS system to a motor control center shall be clearly identified.
    g. Provide shop drawing submittals showing details of piping connections to ALL equipment. If connection details are not submitted and connections are installed incorrectly in the field, reinstall within the original contract price.
    h. Division 23 shop drawings and installation layout drawings for heating, pumping, process piping, and refrigeration systems prepared by the Installer shall note name(s), license number(s), and license expiration dates of the installing firm.
    i. Submit the following for review, including a submittal cover sheet for each product:

        1) Electronic copy (see above requirements for electronic copy) for each submittal.

    j. In addition to electronic copy, submit one paper copy by overnight mail, for the following specific submittals:

        1) Air handling unit
        2) Chiller
        3) Cooling Tower
        4) Boiler
        5) Electrical switchgear and generator

6) Electrical short circuit, coordination, and arc flash studies
7) Lighting
8) Fire protection calculations
9) Other submittals if larger than 8-1/2x11

k. Submit electronic copy with cover sheet plus one paper copy in 11x17 format with cover sheet, by overnight mail for all controls submittals.

E. Sheet Metal Shop Drawings

1. The Sheet Metal Subcontractor shall prepare a complete electronic background model in a current version of AutoCAD, REVIT, or Navisworks. Request for use of an alternative software shall be submitted to the Architect for approval before preparation of shop drawings. This background shall be used to develop sheet metal shop drawings. Electronic copy of these shall be submitted, containing sufficient plans, elevations, sections, details and schematics to describe work clearly. Plans shall be 3/8 inch = 1 foot-0 inches scale and shall indicate work of other Sections where physical clearances are critical and where interferences are possible. Provide larger scale details to show complete installation. Sheet metal drawings shall show elements of Architect's reflected ceiling plan, exposed ductwork, walls, partitions, diffusers, registers, grilles, fire dampers, sleeves and other aspects of construction for coordination. Show horizontal and vertical offsets and changes of direction. Show all firewalls and smoke partitions. These are action submittals.
2. These shop drawings shall be submitted before the coordination drawings are prepared, and once the Architect’s comments are received back shall serve as the starting point for coordination drawings as specified above.

F. Post-Submittal Actions

1. After review, Contractor to receive electronically transmitted response report for all reviewed submittals which includes the following information:

a. Submittal status
b. List of reviewer’s comments
c. Copy of returned submittal. All submittals will be returned electronically, with the exception of coordination drawings, which will have one copy returned with comments through overnight mail.
d. Re-submittals shall be complete and shall include a cover letter summarizing the corrections made in response to the review comments and the submittal page numbers which were revised.
e. Submittal Status: Electronic and paper submittals will be returned notated as illustrated below:

"APPROVED AS NOTED"

“Reviewed and found generally acceptable. Minor deviations may be noted. No further submittal required if notations are complied with."

"REJECTED;
REVISE AND RESUBMIT"
“Submittal contains deviations which shall be corrected and confirmed by a new submittal."

"REJECTED"
Submittal is incorrect to such an extent that material is unacceptable, or is incomplete to such an extent that a complete review cannot be made. Resubmit in accordance with requirements of the Contract Documents."

"NO ACTION"
Submittal not reviewed.

“REVIEWED FOR INFORMATION”
This Submittal is for information only.

2. Where initial submittal is rejected, revised submittal shall be labelled identically to previous submittal and shall include a memo identifying where each comment has been address in the new version.

G. Responsibility

1. Intent of Architect’s submittal review is to check for capacity, rating, and certain construction features. Contractor shall ensure that work meets requirements of Contract Documents regarding information that pertains to fabrication processes or means, methods, techniques, sequences and procedures of construction; and for coordination of work of this and other Sections. Work shall comply with submittals marked “APPROVED AS NOTED” to extent that they agree with Contract Documents. Submittal review shall not diminish responsibility under this Contract for dimensional coordination, quantities, installation, wiring, supports and access for service, nor shop drawing errors or deviations from requirements of Contract Documents. Noting of some errors while overlooking others will not excuse proceeding in error. Contract Documents requirements are not limited, waived nor superseded by review.
2. Inform Subcontractors, Manufacturers and Suppliers of scope and limited nature of review process and enforce compliance with contract documents.

H. Schedule: Incorporate shop drawing review period into construction schedule so that Work is not delayed. Contractor shall assume full responsibility for delays caused by not incorporating the following shop drawing review time requirements into his project schedule. Working days listed refer to the time in the Engineer's office. It does not include transmittal or review time of others. Unless longer review periods are specified in Division 01, allow at least 10 working days, exclusive of transmittal time, for review each time shop drawing is submitted or resubmitted for Divisions covered by this Section, with the exception that 20 working days, exclusive of transmittal time, are required for the following:

1. HVAC temperature control submittals.
2. HVAC balancing report.
3. Coordination Drawings.
4. Distribution equipment including Panelboards.
5. Short circuit and coordination study
6. Fire protection fabrication drawings.

7. If more than five shop drawings of a single trade are received in one calendar week.

1.17 RECORD DRAWINGS AND PHOTOS

A. The photos called for in this paragraph are in addition to those required in Division 01 (the latter are general construction progress/status photos). The photos required here are specifically for the mechanical and electrical trades in concealed areas and shall be included in the base contract(s) for these trades.

B. As work progresses and for duration of Contract, maintain complete and separate set of prints of Contract Drawings at job site at all times. Record work completed and all changes from original Contract Drawings. Such changes shall include, but not be limited to, those resulting from RFIs, field conditions, and modifications and additions. Include actual locations of MEP/FP systems and existing and new utilities. Record valve tags as they are installed.

C. Photos. Take photographs of all concealed systems and equipment in inaccessible ceilings, shafts, underground (buried) piping routes and other concealed, not readily-accessible areas. At completion of work, make copies of photographs with written explanation on back, or, at Architect's request, submit digitally. These are information submittals.

D. Underground and utility work shall be located by distances to landmarks, such as building foundations. Give actual dimensions of everything installed including elevations and elevations at each change in direction.

E. Drawings shall show record condition of details, sections, riser diagrams, control changes and corrections to schedules. Schedules shall show actual manufacturer and make and model numbers of final equipment installation.

F. "Record Drawings" are a complete set of drawings containing the information in (B), (D) and (E) above, and shall be accompanied by the photographs in (C) above. If BIM is used to create the record drawings, the model shall incorporate all the above information and be developed to AIA LOD 500.

G. The installing Contractor shall certify Record Drawings for accuracy. The Architect/Engineer will not certify the accuracy of the record drawings - this is the sole responsibility of the Contractor.

H. If required by the Authority having jurisdiction, each trade shall submit a set of record drawings for approval by the Authority. Format for submission shall be acceptable to the Authority. Drawing format and size changes, and supplemental information required for the submittal are the responsibility of the installing contractor. Provide copies of submittal to the Construction Manager, General Contractor, Owner, Architect, and Engineer.

I. At completion of work, prepare a complete set of record drawings with all markups incorporated in electronic format. Deliver these to the Architect for approval. Vanderweil can provide 2-D CAD drawings of its BIM model to the contractor to serve as the basis for the electronic format drawings, upon signing of a release.

J. After approval, final record drawing deliverable shall be as defined in Division 01. After approval, final record drawings submitted shall be as required by Division 01.

1.18 OPERATING AND MAINTENANCE MANUALS – ELECTRONIC FORMAT

A. Section 017823 describes requirements for Operating and Maintenance Manuals, and Section 017900 describes requirements for training and operating instructions. This section includes additional requirements specifically for the mechanical and electrical trades.

B. “Electronic Format” means searchable PDF format. It does not include scanned items, which are considered inappropriate.

C. Obtain at time of purchase of equipment, electronically formatted versions of operation, lubrication, and maintenance manuals for all items. Assemble this literature along with other information in coordinated electronic manuals with additional information describing combined operation of field assembled units, including as-built wiring diagrams. Manual shall contain names and addresses of manufacturers and local representatives who stock or furnish repair parts for items or equipment. Divide manuals into three sections or books as follows:

1. Engineering flow diagrams and controls sequences from project mechanical drawings, approved automatic temperature controls submittal, equipment startup procedures and operational instructions. Startup and operational instructions shall list valves, switches, and other devices used to start, stop and control systems. Describe procedure to be followed in case of malfunctions. Include approved valve directory showing each valve number, location of each valve, and equipment or fixture controlled by valve.
2. Detailed maintenance and troubleshooting manuals containing data furnished by manufacturer for complete maintenance. Include copy of balancing report.
3. Lubrication instructions detailing type of lubricant, amount, and intervals recommended by manufacturer for each item of equipment. Include additional instructions necessary for implementation of first class lubrication program. Include approved summary of lubrication instructions in chart form, where appropriate.

D. Submit electronic format version of manual(s) for approval. After approval, submit electronic version and one hard copy for distribution to Owner. Deliver manuals no less than 30 days prior to acceptance of equipment to permit Owner's personnel to become familiar with equipment and operation prior to acceptance.

1.19 OPERATING INSTRUCTION

A. Upon completion of installation, prior to Owner accepting portions of building and equipment for operational use, instruct Owner's operating personnel in operation of systems and equipment. Instruction shall be performed by equipment and controls vendors’ factory-trained personnel. Owner shall determine which systems require additional instruction. Duration of instructions for controls shall take equipment through complete cycle of operation (at least five working days). (Not to be confused with the two-week demonstration of automatic controls operation specified in Part 3.) Make necessary adjustments under operating conditions.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 LIFE SAFETY SYSTEMS CERTIFICATION OF COMPLETION

A. Definitions

1. Life Safety Systems - Mechanical and electrical systems including:

   a. Fire Suppression Systems
   b. Fire Notification (Alarm) and Detection Systems
   c. Smoke Control Systems and Special Inspections
   d. Egress Signage and Lighting Systems
   e. Emergency Power Systems

2. Complete - For a system to be complete the following shall be true:

   a. No further work is required to satisfy the requirements specified in the drawings, specifications and applicable codes and standards.
   b. Systems are fully operational with power to components, valves open, status indicators in "normal" condition and otherwise ready "as-is" to perform required functions.
   c. Required product data and shop drawing submittals have been submitted and returned with a "Reviewed" status. See Paragraph titled “Submittals” for submittal requirements.
   d. Test certificates have been submitted and returned with a ”Approved as Noted” status. See Paragraph titled “Submittals”.
   e. Project visit report observations and "punch list" items have been addressed and/or corrected.
   f. "O&M" documentation and "as-built" plans have been submitted and returned with a "Reviewed" status.

B. Notification of Completion

1. Notify the Architect in writing that the life safety systems are complete at least five (5) working days prior to requesting final certification of completion ("affidavits") from the Architect. The notification shall be in the form of a single formal document endorsed by an individual charged with management responsibility for all trades associated with the life safety systems.
2. Schedule work so life safety systems are complete in advance of other systems. This requirement is to allow the Architect to conduct a final project visit and correction of issues found without affecting issuance of a Substantial Completion Certificate or a Certificate of Occupancy by the Authorities Having Jurisdiction.
3. Operate and maintain systems and equipment until final acceptance by the Owner and AHJ.
4. All guarantees and warranties shall not begin until final acceptance of the systems and equipment by the Owner and AHJ. Acceptance requires, at a minimum, completed systems testing and inspections.

3.2 SPECIAL INSPECTIONS FOR SMOKE CONTROL SYSTEMS, INCLUDING ATRIUMS AND STAIR PRESSURIZATION SYSTEMS.

A. General

1. Special inspections for all smoke control systems shall be accomplished, in accordance with the version of the International Building Code in effect in the jurisdiction in which the project is located. The inspection shall cover associated mechanical systems, controls, and interface with building fire alarm system and smoke control panel.

B. Special Inspections Team

1. The special inspections team shall consist of:

   a. A 3rd party Smoke Control Special Inspector ("SCSI").
   b. The Contractor's Project Manager ("CPM"), plus the Project Manager for the Controls Vendor, plus designated representatives of sheet metal, electrical and fire alarm subcontractors.
   c. A representative of the HVAC and Fire Alarm Engineers.
   d. A representative of the Owner.

2. Coordinate the timely hiring by the Owner of the SCSI. The SCSI shall meet the requirements for the SCSI as defined in the applicable building code; namely have expertise in mechanical engineering, fire protection engineering and be a certified air balancer and approved by the AHJ. The SCSI may be comprised of multiple building professionals.
3. The CPM shall serve as the construction team's single point of contact for the SCSI. The CPM shall be responsible for Contractor oversight and direction of the inspections effort and for communications to all contractors' and subcontractors' representatives on the inspections team. This includes coordinating the SCSI's work with the TAB contractor and startup efforts. It shall be the CPM's responsibility to ensure that all required parties, including technical representatives of equipment vendors, are present at smoke control and fire alarm inspections-related efforts when required by this specification and/or when requested by the SCSI. The CPM shall witness all inspection activities and shall initial inspection forms to indicate satisfactory completion.

C. Special Inspection Requirements and Team Responsibilities

1. Perform the testing, as directed by the SCSI. Prior to testing, Contractor shall submit proposed test protocol for approval by SCSI and Engineer.
2. Include all meetings, planning, scheduling, coordination, special inspection, testing, adjustment, re-testing, and material and labor to ensure that all smoke control systems operate according to the Construction Documents.
3. A report of all testing shall be prepared by the SCSI, submitted to the Engineer and the AHJ and stored at an approved location in the building upon completion of the inspections. The report shall include device identification by manufacturer, nameplate data, design values, measured values and identification tags.
4. The HVAC and Fire Alarm Engineers will review the report, and when satisfied that the design intent has been achieved, stamp the report with applicable PE seal. Any modifications to the testing, installation or documentation required by the PE must be made by the inspection team prior to stamping.

5. Special inspector shall review and comment on all related shop drawings. Submit SCSI comments on the reviewed shop drawings to Engineer in time for engineer to incorporate into design team review.
6. The phases and overall scope of testing are as follows:

    a. Planning. Meeting, scheduling, and coordination to ensure that all parties, including vendors' representatives, know in advance the scope and schedule of what is required of them in the testing process.
    b. Pre-Inspection (leakage testing and device location documentation). After equipment is installed, connected, and ready to operate, but before walls are sealed, the Contractor shall conduct and the SCSI observe pre-inspection to validate the installation of all equipment, ductwork, controls, smoke control panel and fire alarm being inspected. The CPM and the respective contractor's inspection team members shall witness and shall certify the results of the pre-inspection by initialing the respective forms. The CPM shall advise the SCSI and Engineer of the exact schedule for pre-inspection so that the SCSI and Engineer can witness parts or all of the pre-inspection.
    c. After equipment has been successfully started up and operated, the Contractor shall have the systems tested and balanced. Testing shall include testing and verification of all controls sequences and pressure differentials. The SCSI shall witness the testing and balancing and controls verification.
    d. Performance Tests (pressure-difference testing, flow measurements, detection and control verification). After systems are complete and equipment pre-inspection, startup, and testing and balancing have been completed, and test protocols have been approved, Contractor shall conduct performance testing, in order to validate component and systems performance. The CPM and the respective contractor's inspection team members shall witness and shall certify the results by initialing the respective forms. The CPM shall ensure that representatives of equipment vendors are present to observe and assist in the testing of respective equipment. The CPM shall advise the SCSI and Engineer of the exact schedule for functional performance testing so that the SCSI and Engineer can witness parts or all of it. The inspections effort shall be continuous day to day for whatever duration is required to complete it, and the CPM and other contractor team members must be consistently available for the testing. Performance tests shall be conducted under normal building power and repeated under emergency power.
    e. Final system overall testing and acceptance by the Fire Department.
    f. Acceptance of Special Inspections

        1) Acceptance shall be accomplished when the following has been satisfactorily completed by the contractor and certified by the SCSI and Engineer:

            a) Pre-inspection
            b) Startup, testing, and balancing
            c) Performance Testing
            d) Completed testing report, approved and stamped by the Engineer.
            e) Acceptance of system by Fire Department, and issuance of final occupancy permit.

3.3 SPECIAL RESPONSIBILITIES

A. Cooperate and coordinate with work of other Sections in executing work of this Section.

1. Perform work so that progress of entire project including work of other Sections shall not be interfered with or delayed.
2. Provide information requested on items furnished under one Section which shall be installed under other Sections.
3. For equipment provided under any division or section which has connection made under the mechanical or electrical sections, obtain detailed installation and hookup information from the equipment manufacturers.
4. Obtain final roughing dimensions or other information needed for complete installation of items furnished under other Sections or by Owner.
5. Keep fully informed as to shape, size and position of openings required for material or equipment to be provided under all Sections. Give full information so that openings required by work of this Section may be coordinated with other work and other openings and may be provided for in advance. In case of failure to provide sufficient information in proper time, provide cutting and patching or have same done, at own expense and to full satisfaction of Architect.
6. Provide information requested as to sizes, number and locations of concrete housekeeping pads necessary for floor-mounted vibrating and rotating equipment provided under this Section.
7. Notify Architect of location and extent of existing piping, conduit, ductwork and equipment that interferes with new construction. In coordination with and with approval of Architect, relocate piping, ductwork and equipment to permit new work to be provided. Remove non-functioning and abandoned piping, ductwork and equipment. Dispose of or store items.

B. Building Expansion Joints and Firewalls

1. Ductwork, conduit, cable tray, piping, and other horizontal distribution systems shall be provided with expansion provisions when passing by building expansion joints. Provide copper ground jumper across expansion joints for electrical components. Systems shall be run through rated walls, partitions, and floors via approved fireproofed sleeves.

C. Installation Shall Provide Access to Systems

1. Installation shall allow clearances for easy access to systems for routine maintenance, for repairs, and for installing new cable in conduit and cable trays.
2. Access panels shall be installed in ceilings that are not composed of removable tiles. These shall be located where system components exist that have moving parts, motors, or other components requiring periodic maintenance, adjustment, or replacement. Access panels shall be shown on Coordination Drawings and shall be of the type and finish approved by the Architect.

D. Protection of Work

1. Each contractor shall be responsible for work and equipment until finally inspected, tested, and accepted. Carefully store materials and equipment that is not immediately installed after delivery to site. Close open ends of work with temporary covers or plug during construction to prevent entry of obstructing material. Cover work subject to falling debris with temporary covers.
2. Provide all materials, equipment and labor to provide adequate protection of all equipment during the course of construction. This includes protection from moisture and foreign material. At completion, all work must be turned over to Owner clean and in new condition.

3. Protect the work and material of other trades that might be damaged by work or workmen and make good all damage thus caused.

E. Installation Only Items

1. Where a Contractor is required to install items that it does not purchase, coordinate the delivery and be responsible for their unloading from delivery vehicles and for safe handling and field storage up to the time of installation.

    a. Provide field assembly and internal connections, as well as mounting in place of the items, including the purchase and installation of dunnage supporting members and fastenings to adapt them to architectural and structural conditions.
    b. Provide connection to building systems including the purchase and installation of terminating fittings necessary to adapt and connect them to the building systems.

2. Carefully examine items upon delivery. Claims that items have been received in a condition that their installation will require procedures beyond the scope of work of this contract will be considered only if presented in writing within one week of their date of delivery. Unless claims have been submitted, fully recondition or replace damaged items.

F. Maintenance of equipment and systems: Maintain equipment and systems until Final Acceptance. Ensure adequate protection of equipment and material during delivery, storage, installation and shutdown and during delays pending final test of systems and equipment because of seasonal conditions. Protect work and equipment from damage and exposure to moisture and outdoor extreme temperature conditions until finally inspected, tested, and accepted. Carefully store materials and equipment that is not immediately installed after delivery to site. Close open ends of work including piping and ductwork with temporary covers or plugs during construction to prevent entry of obstructing material or debris.

G. Use of premises shall be restricted as follows

1. Remove and dispose of dirt and debris, and keep premises clean. During progress of work, remove unused material and equipment. Maintain building and premises in neat and clean condition, clean and wash required to maintain appearance and operation of equipment.
2. Store materials in a manner that will maintain an orderly clean appearance. If stored on-site in open or unprotected areas, equipment and material shall be kept off the ground by means of pallets or racks, and covered with tarpaulins.
3. Do not interfere with function of existing sewers and water and gas mains, electrical, or mechanical systems and services. Extreme care shall be observed to prevent debris from entering pipe, ductwork and equipment.

H. Surveys and Measurements

1. Base measurements, both horizontal and vertical, on reference points established by Contractor and be responsible for correct lay out of work.
2. In event of discrepancy between actual measurements and those indicated, notify Architect in writing and do not proceed with work until written instructions have been issued.

I. Fireproofing

1. Clips, hangers, clamps, supports and other attachments to surfaces to be fireproofed shall be installed, insofar as possible, prior to start of spray fiber work.
2. Ducts, piping and other items that would interfere with proper application of fireproofing shall be installed after completion of spray fiber work.
3. Patching and repairing of fireproofing due to cutting or damaging to fireproofing during course of work specified under this Section shall be performed by installer of fireproofing and paid for by trade responsible for damage and shall not constitute grounds for an extra to Owner.

J. Temporary Utilities

1. Refer to Division 01 for project requirements.
2. Coordinate work under this Section with progress of construction so that permanent heating system will be ready to provide temporary heating if permitted by Owner and Architect as soon as building is closed in.
3. Provide and direct labor required for attendance, operation and final restoration of permanent heating system if used for temporary heating purposes. Continuous direct attendance shall be provided whenever permanent system is in operation prior to acceptance of permanent heating system by Owner.

K. Air Bound Systems

1. If, after systems are operational, piping systems, coils or other apparatus are stratified or air bound (by vacuum or pressure), they shall be repiped with new fittings, air vents, or vacuum breakers at no extra cost. If connections are concealed in furring, floors, or ceilings, installing trade shall bear all expenses of tearing up and refinishing construction and finish, leaving same in as good condition as before it was disturbed.

L. Site Logistics

1. Unload materials and equipment delivered to site. Pay costs for rigging, hoisting, lowering and moving equipment on and around site, in building or on roof.

3.4 CONTINUITY OF SERVICES

A. Do not interrupt existing services without Owner's approval.

B. Schedule interruptions in advance, according to Owner's instructions. Submit, in writing, with request for interruption, methods proposed to minimize length of interruption.

C. Interruptions shall be scheduled at times of day and work so that they have minimal impact on Owner's operations.

D. Coordinate shutdowns of existing systems as follows:

1. Give proper notice to Owner when making shutdowns; a minimum of fourteen full days are required.
2. Minimize shutdowns.
3. Provide temporary services where required and perform shutdowns and tie ins at a time convenient to Owner.
4. Complete and file the Owner's shutdown notice questionnaire.
5. Perform required survey and inspection work required by the notice for shutdown.

E. Include premium time work associated with interruptions of services and/or shutdowns to avoid disruption to Owner's operations.

3.5 CLEANING

A. Cleaning shall be performed prior to commissioning. Refer to individual Division 23 Sections for additional requirements.

B. Ductwork

1. Ducts shall be thoroughly cleaned so that no dirt or dust shall be discharged from diffusers, registers or grilles, when system is operated.
2. Provide temporary connections required for cleaning. Provide cheesecloth for openings during cleaning.
3. Replace filters prior to final inspection and testing.

C. Piping

1. Furnish pipe cleaning chemicals, chemical feed equipment, materials and labor necessary to clean piping.
2. Permanently install necessary chemical injection fittings complete with stop valves.
3. After piping systems have been pressure tested and approved for tightness, clean and flush piping as specified and in accordance with applicable codes.
4. Maintain continuous blowdown and make-up during flushing operation.

D. Equipment

1. After completion of project, clean the exterior surface of equipment, including concrete residue, dirt and paint residue.

3.6 PROJECT PUNCH LIST PROCEDURE AND REPRESENTATIONS TO AUTHORITIES

A. When the contract work is substantially complete, if requested by the Contractor, the Engineer will do an inspection of the relevant work. Prior to the inspection, the Contractor shall submit a punch list of remaining items to be completed as well as the Testing, Adjustment, and Balance report. In the course of the inspection the Engineer will add to the Contractor’s punch list any observed remaining work that is not already on it, and provide the modified punch list, in a medium selected at the Engineer’s discretion, for the Contractor’s convenience in closing out the work.

B. Regardless of what the Engineer observes and does not observe in the inspection, the responsibility for successful completion of the contract in all of its details remains with the Contractor.

C. If, when the Engineer arrives at the site certain areas are not complete and ready for inspection at the substantial completion stage, the Engineer will not review these areas.

D. Confirmation of Punch List Remediation. Once the engineer has submitted the punch list so modified, it shall be the responsibility of the Contractor to confirm that all the listed items have been correctly remedied. Upon receipt of such confirmation, and at the request of the Contractor, the engineer will re-inspect the site to confirm completion.

E. Representations to Authorities. Contractor shall provide certifications to authorities such as Building Departments if so required. Also, if authorities require from the Engineer certifications, affidavits, or other type of representations from the Engineer, the contractor shall provide to the Engineer a certified punch list of remaining work for final completion of the project, suitable for the Engineer to attach to the requested representation.

3.7 STARTUP, PRE-COMMISSIONING, AND COMMISSIONING

A. Completion of startup, pre-commissioning, and commissioning shall be accomplished as a prerequisite for substantial completion.

B. Below are minimum requirements for startup and pre-commissioning. Additional requirements may be found in other specifications sections such as “Commissioning” or “Testing, Adjustment and Balancing.”

C. Testing and balancing of HVAC shall occur after startup and pre-commissioning.

D. Operate and maintain systems and equipment until final acceptance by the Owner.

E. All warranties shall not begin until final acceptance of the systems and equipment by the Owner, which does not occur until systems have completed commissioning.

F. The Owner maintains the right to have access to the entire project site to develop his own operational procedures.

G. For each of the mechanical and electrical trades, prepare a room by room Startup and Pre-Commissioning Form which lists equipment with moving parts or with combustion or electric heating processes. Lighting controls shall be included in the list. Include equipment name, make and model number, date of Visual Inspection and names and signatures of attendees, date of Startup and names and signatures of attendees, date that the item has been placed into system-wide automatic operation.

H. Visual Inspection shall be attended by a qualified representative of the manufacturer. Confirm that equipment is installed, mounted and supported per manufacturer’s recommendations. Confirm proper direction of rotation.

I. Startup. Conform to startup and testing procedures outlined in the relevant specification sections. Startup shall be attended by a qualified representative of the manufacturer. Start each piece of equipment and check its operation in accordance with manufacturer’s recommendations. Confirm that equipment operates and cycles appropriately under automatic control. Confirm satisfactory operation in all operating modes (e.g. normal shutdown, normal auto position, normal manual position, unoccupied cycle, emergency power, and alarm conditions).

J. Leaks, damage and defects discovered or resulting from startup and pre-commissioning shall be repaired or replaced to like-new condition with acceptable materials. Tests shall be continued until system operates without adjustments or repairs.

K. When all equipment in a system has been started, place entire system in operation under automatic control and confirm system-wide operation.

L. Submit completed Startup Forms as an Information Submittal.

3.8 DEMONSTRATION OF SUCCESSFUL OPERATION

A. After components and systems have been commissioned (or, if there is no commissioning, after startup), provide a 2 week, 24 hour per day fully functional automatic operation period of systems simultaneously. This shall be successfully concluded before systems are accepted by Owner.

3.9 PROJECT CLOSE-OUT PROCEDURE

A. General

1. The requirements of this section are in addition to and supplement the requirements outlined in Division 01.

B. Project Close-Out Checklist

1. Review requirements of each section of the specifications and submit for approval to Architect the sign-off forms that shall become the project close-out checklist. Do not group items; provide a separate line item for each required item. The checklist, at a minimum, shall include the information shown below in the Project Close-Out Checklist Example. The Architect and/or Owner may incorporate additional specific items to the following checklist which shall become part of the project requirements.
2. Project Close-Out Checklist Example.

PROJECT CLOSE-OUT				
PROJECT:				
DIVISION NO.:				
CONTRACTOR:				

ITEM[1]	DATES		OWNER'S SIGN-OFF
	COMPLETED	RECEIVED BY OWNER	
Permits			
City and County Inspection			
Manufacturer's Warranties			
Contractor's Warranties			
State Fire Rating Data			
Copy of Final Shop Drawings			
List and Possession of Spare Parts			
Pressure Tests			
Equipment Tests Required by Specs			
Startup and Pre-Commissioning Forms			
Testing Adjustment and Balancing Report			
Manufacturer/Vendor Training of Owner's Personnel Required by Specs			
O & M Manuals			
Record Documents			
Coordination Drawings			
Sanitization Reports			
Commissioning Reports/Letters/Forms			
On Site Training Complete			
Protective Device Settings			
Valve Tags and Charts			
Final ATC Installation Drawings			
Insurance Underwriters Approvals			
Final Punch List (Initialed by contractor that items are complete)			
Building Certificate of Occupancy (CO)			
24 Hour Phone No. for Service During Guarantee Period			
Smoke Control Special Inspection Report			

PART 4 - BID ALTERNATES

4.1 GENERAL

[1] Provide separate line item for each specified item (do not group items)

A. Submit with bid, alternate prices as hereinafter requested stating the total difference in price (add or deduct) from the total base bid amount.

B. Prices of Alternates shall be the total price without further addition, mark-up, subtraction, change, discount or other changes to determine the cost of work.

C. Each alternate price shall include provision of work, material, connections, installation, related work, electrical and plumbing connections, control interface work, accessories, testing, adjusting and balancing, freight, rigging, labor, profits, overhead and taxes, and all other items necessary to provide complete and functional installation as required by Contract Document.

D. Alternate work shall in no way limit the provisions of the Contract Documents, nor change, reduce or limit the Contractor's responsibility to comply fully with the provisions of Contract Documents.

E. The Owner reserves the right to accept or reject any or all alternates.

F. In accepting an alternate, the Owner understands that the bidder has examined the Contract Documents and is aware of all adjustments of affected work necessary to accomplish the stated desired results, whether or not all such adjustments are described within the alternates.

PART 5 - PREPURCHASED EQUIPMENT

5.1 GENERAL

A. The Owner has prepurchased certain equipment in order to expedite delivery. The Owner will assign this equipment to the appropriate traditional trade contractor.

B. Upon assignment, the Assignee shall assume all responsibility for coordination of and the installation of the equipment.

C. See additional instructions from the Owner, General Contractor/Construction Manager as to the obligations assumed by this assignment. Incorporate those instructions into the requirement of this Contractor's work.

D. The prepurchase technical specification (as offered for bids), is included for information purposes.

END OF SECTION

SECTION 210500 - COMMON WORK RESULTS FOR FIRE SUPPRESSION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. Certain requirements common to all the mechanical and electrical trades (Fire Suppression, Plumbing, HVAC, Electrical, and Tele/Data) are specified in Division 20. To avoid repetition, they are not repeated in each relevant Section. These requirements are applicable to the work of this Division, and are hereby incorporated by reference.

1.2 SUMMARY

A. This Section includes the following:

1. Pipe hangers and fasteners
2. Sleeves, sleeve-seals, stack-sleeves
3. Alarm Devices
4. Pressure Gauges
5. Escutcheons
6. Grout
7. Concrete bases

1.3 METAL SUPPORTS AND ANCHORAGE PERFORMANCE REQUIREMENTS

A. The design, installation and commissioning of the fire suppression systems shall comply with the following:

1. NFPA Standards, as referenced by the Florida Building Code:

   a. NFPA 13 - Installation of Sprinkler Systems.
   b. NFPA 14 - Installation of Standpipe and Hose Systems.
   c. NFPA 20 - Installation of Stationary Pumps for Fire Protection.
   d. NFPA 25 - Inspection, Testing, and Maintenance of Water-based Fire Protection Systems.

2. Owner Standards.

B. All system components shall be UL listed and/or FM approved.

1.4 QUALITY ASSURANCE

A. Qualifications of Installer

1. Installing Contractor shall have successfully installed multiple automatic sprinkler/standpipe/fire pump systems of similar type and size, for buildings of similar construction and occupancy in Florida.

B. Qualifications of System Technician

1. Shop drawings, fabrication plans, system calculations and as-built drawings shall be prepared by or under the direct supervision of a technician with a minimum Level III

Certification in Automatic Sprinkler System Layout by the National Institute for Certification in Engineering Technologies (NICET), or a Professional Engineer.

2. A cover letter shall accompany all drawings and calculations identifying the technician or engineer which the documents were prepared by and/or under the supervision of including the person's name, registration number and expiration date.

C. Record Drawings

1. As work progresses and for the duration of the Contract, maintain complete and separate set of prints of Working Plans at job site at all times. Record work completed and all deviations from reviewed fabrication plans clearly and accurately. Include actual locations of existing utilities if they differ from design documents. Valve tags shall be recorded on working plans as installed.

D. Welding Procedure

1. Welding procedure(s) to be used and performance of all welders and welding operators shall meet or exceed the requirements of AWS B2.1 Specification for Welding Procedure and Performance Qualification.
2. Contractor shall have a written quality control program, mark all welds and maintain certified records for all welding in accordance with NFPA 13 requirements.

E. Project Punchlist Procedure

1. When the contract work is substantially complete, the Contractor shall physically walk down the installation and prepare a punchlist containing an itemization of work remaining for 100 percent completion. The punchlist shall be submitted to the Architect prior to request for final project visit.

F. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

1.5 DEFINITIONS

A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.

B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.

C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.

D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in chases.

E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

F. The following are industry abbreviations for rubber materials:

1. EPDM: Ethylene-propylene-diene terpolymer rubber.
2. NBR: Acrylonitrile-butadiene rubber.

1.6 SUBMITTALS

A. Comply with Division 20, Common Mechanical and Electrical Requirements.

B. As indicated by each Division 21 Section, submit the following:

1. Qualification Data: For installer and system technician.
2. Welding certificates.
3. Fire-hydrant flow test NFPA 291 format report performed within one (1) year of the calculations which accompany the shop drawings.
4. Product Data: Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
5. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work. Plans shall include all information required of Working Plans in NFPA 13, 14 and 20.

    a. Hydraulic Calculations prepared in accordance with the requirements of NFPA 13 and NFPA 14 shall accompany the Working Plans. A separate calculation for each system shall be submitted as indicated by the drawings. All calculations shall demonstrate a minimum 10 psi safety margin, including but not limited to loss through water service piping, backflow preventers, pressure reducing valves, and hose valves.

6. Field Test Reports and Certificates: Indicate and interpret test results for compliance with performance requirements and as described in the applicable NFPA standards for each system installed.
7. Field quality-control reports.
8. Operation and Maintenance Data: For sprinkler specialties to include in emergency, operation, and maintenance manuals.

1.7 QUALITY ASSURANCE

A. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."

B. Steel Pipe Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."

1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

C. Electrical Characteristics for Fire-Suppression Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver pipes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.

B. Pipe and fittings shall be protected from moisture. Pipe and fittings shall not be stored directly on ground. Pipe and fittings exposed to moisture and showing significant rust shall be removed from site, and shall not be installed.

1.9 COORDINATION

A. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for fire-suppression installations.

B. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.

C. Coordinate requirements for access panels and doors for fire-suppression items requiring access that are concealed behind finished surfaces. Access panels and doors are specified in Division 08.

PART 2 - PRODUCTS

2.1 PIPE HANGERS AND FASTENERS

A. General Requirements

1. Structural attachments and pipe hangers shall be UL listed and FM approved.
2. Powder driven or pre-expanded inserts shall not be used.
3. Threaded connections shall not be used for attachments to concrete.

B. Drop in Anchors

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Hilti Corp.
   b. ITW Red Head
   c. Powers Fastners, Inc.

2. Standard: UL 203.
3. Material: Mild steel with zinc plating.

C. Concrete Inserts (Cast-In)

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Tolco
   b. Hilti Corp.
   c. Powers Fasteners, Inc.

2. Material: Carbon steel, galvanized

D. Hanger Rod

1. Material: Carbon steel, galvanized

E. Manufacturers for Pipe Hangers and Attachments to Steel: Subject to compliance with requirements, provide products by one of the following:

1. Tolco
2. Cooper B-Line
3. Anvil International

F. Pipe Hangers, piping 3 inches and smaller

1. Material: Steel, galvanized
2. Type: Adjustable band type, or clevis
3. Band type hangers used on CPVC piping shall have flared or beveled edges

G. Pipe Hangers, piping 4 inches and larger

1. Material: Steel, galvanized
2. Type: Clevis; band hangers shall not be used on piping 4 inches and larger

H. Attachments to Steel

1. Material: Carbon or malleable steel, galvanized
2. Type: Beam clamp
3. Beam clamps shall be installed with retaining straps

2.2 PIPE, TUBE, FITTINGS AND JOINING METHODS.

A. Refer to individual Division 21 piping Sections for pipe, tube, and fitting materials and joining methods.

2.3 SLEEVES

A. Cast-Iron Wall Pipes: Cast or fabricated of cast or ductile iron and equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.

B. Galvanized-Steel Wall Pipes: ASTM A 53/A 53M, Schedule 40, with plain ends and welded steel collar; zinc coated.

C. Galvanized-Steel-Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc coated, with plain ends.

D. Galvanized-Steel-Sheet Sleeves: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.

2.4 STACK-SLEEVE FITTINGS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Smith, Jay R. Mfg. Co.
2. Zurn Specification Drainage Operation; Zurn Plumbing Products Group.

B. Description: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring, bolts, and nuts for membrane flashing.

1. Underdeck Clamp: Clamping ring with setscrews.

2.5 SLEEVE-SEAL SYSTEMS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following :

1. Advance Products & Systems, Inc.
2. CALPICO, Inc.
3. Metraflex Company (The).
4. Pipeline Seal and Insulator, Inc.
5. Proco Products, Inc.

B. Description: Modular sealing-element unit, designed for field assembly, for filling annular space between piping and sleeve.

1. Sealing Elements: EPDM-rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
2. Pressure Plates: Stainless Steel.
3. Connecting Bolts and Nuts: Carbon steel, with corrosion-resistant coating, of length required to secure pressure plates to sealing elements.

2.6 ALARM DEVICES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Potter Electric Signal Company.
2. System Sensor; a Honeywell company.
3. Viking Corporation.

B. Standard: UL 346.

C. Construction: Corrosion resistant metal base and components; die cast metal red enamel cover with tamper resistant screws; NEMA 4 enclosure rating.

D. Hazardous Area Applications: NEMA 9 enclosure rating.

E. Water-Flow Indicators:

1. Type: Electrically supervised; paddle operated with adjustable delay feature.
2. Pressure Rating: 250 psig.
3. Components: Two single-pole, double-throw circuit switches for isolated alarm and auxiliary contacts, 7 A, 125-V ac and 0.25 A, 24-V dc.
4. Design: Horizontal or vertical.

F. Pressure Switches:

1. Type: Air / water electrically supervised with adjustable delay feature.
2. Pressure Rating: 250 psig.
3. Components: Single-pole, double-throw switch with normally closed contacts.
4. Waterflow Application Design Operation: Rising pressure signals water flow.
5. Supervisory Application Design Operation: Hi or low air / water pressure signals off-normal system pressure.

G. Valve Supervisory Switches:

1. Type: Electrically supervised, with follower / target assembly appropriate for intended valve application.
2. Components: Two Single-pole, double-throw switch with normally closed contacts.
3. Design: Signals that controlled valve is in other than fully open position.
4. Not permitted: Plug-type.

2.7 PRESSURE GAGES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. AMETEK; U.S. Gauge Division.
2. Ashcroft, Inc.
3. Brecco Corporation.
4. WIKA Instrument Corporation.

B. Standard: UL 393.

C. Dial Size: 3-1/2- to 4-1/2-inch diameter.

D. Pressure Gage Range: 0 to 250 psig minimum.

E. Water System Piping Gage: Include "WATER" or "AIR/WATER" label on dial face.

F. Air System Piping Gage: Include "AIR" or "AIR/WATER" label on dial face.

2.8 GROUT

A. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.

B. Characteristics: Nonshrink; recommended for interior and exterior applications.

C. Design Mix: 5000-psi, 28-day compressive strength.

D. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 PREPARATION

A. Prior to preparation of Shop Drawings, perform hydrant flow test in accordance with NFPA 291 to validate the basis of design test data indicated on the Drawings. Indicate results on shop drawing submittal. Promptly report in writing via NFPA 291 reporting format significant deviations between validation test results and basis of design test data.

3.2 PIPE SIZING

A. General

1. Do not perform pipe sizing calculations prior to submitting water supply flow test results for review.
2. Do not perform pipe sizing calculations prior to submitting a manufacturer’s characteristic pump curve for the fire pump.
3. A legible water supply graph sheet shall be included with each hydraulic calculation.
4. Elevations used in hydraulic calculations shall have the same datum as the fire protection riser diagram included in the drawings.
5. The actual churn pressure of the fire pump as indicated by the manufacturer's characteristic pump curve shall be used in the calculations.
6. For systems with pressures exceeding 175 psi, a calculation at no flow conditions shall be submitted to indicate where pressure regulating valves are required. Static pressure shall be indicated for each level on riser diagram.
7. Where direct acting pressure regulating valves are used, submittal of calculations shall include a copy of the manufacturer's pressure loss chart with the calculated flow through the valve and resulting pressure drop clearly indicated.

B. Standpipes and Feed mains

1. Sprinkler/Standpipe feed mains and standpipes upstream of floor control valve assemblies shall be no smaller than as indicated on the drawings.
2. As part of the work, confirm the pipe sizing shown on the drawings with hydraulic calculations using the Hazen-Williams correlation in accordance with NFPA 14.
3. Calculations shall be in accordance with NFPA 14 using the design criteria shown on the drawings.
4. Standpipe hydraulic calculations shall include a 10 psi pressure loss for standard 2 1/2 inches fire department angle valves.

5. The calculations shall confirm that the design criteria can be met with a minimum 10 psi "safety factor".

C. Sprinkler piping

1. Sprinkler mains including the floor control valve assembly shall be no smaller than as indicated on the drawings.
2. As part of the work, sprinkler branch piping shall be sized based upon hydraulic calculations using the Hazen-Williams correlation in accordance with NFPA 13.
3. Pipe sizing shall be such that the system demand can be met with a minimum 10 psi "safety factor".
4. Where sprinkler systems are fed by two risers, pipe sizing shall be based upon supply from the hydraulically most remote riser only.
5. Provide additional hydraulic calculations as required when the hydraulically most remote area is not readily apparent (not the geometrically most remote).
6. For gridded systems, a minimum of three calculation areas shall be provided clearly demonstrating that the hydraulically most demanding area is being used.
7. Calculation areas indicated by the design criteria shown on the drawings shall not be reduced due to the use of quick response sprinklers.
8. Hydraulic calculations shall include manufacturer specific pressure loss for building separation assemblies and flexible sprinkler connections.

3.3 PIPING SYSTEMS - COMMON REQUIREMENTS

A. Install piping according to the following requirements and Division 21 Sections specifying piping systems.

B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

C. Use system components with pressure rating equal to or greater than system operating pressure.

D. At the end of day all pipe opening shall be covered or capped to minimize the likelihood of introduction of foreign materials into piping. All piping not covered or which has had covering damaged shall be visually inspected internally to confirm no obstructions have been introduced to the piping.

E. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.

F. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

G. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

H. Install piping to permit valve and component access and servicing.

I. Install piping at NFPA required minimum slopes; unless more stringent requirements are specified.

J. Install piping free of sags and bends.

K. Install fittings for changes in direction and branch connections.

L. Install piping to allow application of insulation where heat tracing is required.

M. Install alarm devices on piping.

N. Install pressure gauges on piping.

3.4 SLEEVE INSTALLATION

A. Install sleeves for piping passing through penetrations in floors, partitions, roofs, and walls.

B. For sleeves that will have sleeve-seal system installed, select sleeves of size large enough to provide NFPA required clearance between piping and concrete slabs and walls.

1. Sleeves are not required for core-drilled holes located in stairwells.

C. Install sleeves in concrete floors, concrete roof slabs, and concrete walls as new slabs and walls are constructed.

1. Cut sleeves to length for mounting flush with both surfaces.

a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level.

2. Using grout, seal the space outside of sleeves in slabs and walls without sleeve-seal system.

D. Install sleeves for pipes passing through interior partitions.

1. Cut sleeves to length for mounting flush with both surfaces.
2. Install sleeves that are large enough to provide NFPA 13 required clearance.
3. Seal annular space between sleeve and piping or piping insulation; use joint sealants appropriate for size, depth, and location of joint. Comply with requirements for sealants specified in Division 07.

E. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements for firestopping specified in Division 07.

3.5 STACK-SLEEVE-FITTING INSTALLATION

A. Install stack-sleeve fittings in new slabs as slabs are constructed.

1. Install fittings that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation.
2. Secure flashing between clamping flanges for pipes penetrating floors with membrane waterproofing. Comply with requirements for flashing specified in Division 07.
3. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level.
4. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
5. Using grout, seal the space around outside of stack-sleeve fittings.

B. Fire-Barrier Penetrations: Maintain indicated fire rating of floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements for firestopping specified in Division 07.

3.6 SLEEVE-SEAL-SYSTEM INSTALLATION

A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at service piping entries into building.

B. Select type, size, and number of sealing elements required for piping material and size and for sleeve ID or hole size. Position piping in center of sleeve. Center piping in penetration, assemble sleeve-seal system components, and install in annular space between piping and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make a watertight seal.

3.7 SLEEVE AND SLEEVE-SEAL SCHEDULE

A. Use sleeves and sleeve seals for the following piping-penetration applications:

1. Exterior Concrete Walls above Grade:

   a. Piping Smaller Than NPS 6: Cast-iron wall sleeves system.
   b. Piping NPS 6 and Larger: Cast-iron wall sleeves.

2. Exterior Concrete Walls below Grade:

   a. Piping Smaller Than NPS 6: Cast-iron wall sleeves with sleeve-seal system.

      1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.

   b. Piping NPS 6 and Larger: Cast-iron wall sleeves with sleeve-seal system.

      1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.

3. Concrete Slabs-on-Grade:

   a. Piping Smaller Than NPS 6: Cast-iron wall sleeves with sleeve-seal system.

      1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.

   b. Piping NPS 6 and Larger: Cast-iron wall sleeves with sleeve-seal system.

      1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.

4. Concrete Slabs above Grade:

   a. Piping Smaller Than NPS 6: Galvanized-steel-pipe sleeves.
   b. Piping NPS 6 and Larger: Galvanized-steel-pipe sleeves.

5. Interior Partitions:

   a. Piping Smaller Than NPS 6: Galvanized-steel-pipe sleeves.
   b. Piping NPS 6 and Larger: Galvanized-steel-sheet sleeves.

B. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Refer to Division 07 for materials.

C. Verify final equipment locations for roughing-in.

D. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

3.8 ESCUTCHEON INSTALLATION

A. Install escutcheons for penetrations of walls, ceilings, and floors.

B. Escutcheons for New Piping:

1. Piping with Fitting or Sleeve Protruding from Wall: One piece, deep pattern.
2. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One piece, cast brass with polished chrome-plated finish.
3. Bare Piping at Ceiling Penetrations in Finished Spaces: One piece, cast brass with polished chrome-plated finish.
4. Bare Piping in Unfinished Service Spaces: One piece, cast brass with rough-brass finish.
5. Bare Piping in Equipment Rooms: One piece, cast brass.
6. Bare Piping at Floor Penetrations in Equipment Rooms: One-piece floor plate.

C. Escutcheons for Existing Piping:

1. Chrome-Plated Piping: Split casting, cast brass with chrome-plated finish.
2. Insulated Piping: Split plate, stamped steel with concealed hinge and spring clips.
3. Bare Piping at Wall and Floor Penetrations in Finished Spaces: Split casting, cast brass with chrome-plated finish.
4. Bare Piping at Ceiling Penetrations in Finished Spaces: Split casting, cast brass with chrome-plated finish.
5. Bare Piping in Unfinished Service Spaces: Split casting, cast brass with rough-brass finish.
6. Bare Piping in Equipment Rooms: Split casting, cast brass.
7. Bare Piping at Floor Penetrations in Equipment Rooms: Split-casting floor plate.

3.9 GROUTING

A. Mix and install grout for fire-suppression equipment base bearing surfaces, pump and other equipment base plates, and anchors.

B. Clean surfaces that will come into contact with grout.

C. Provide forms as required for placement of grout.

D. Avoid air entrapment during placement of grout.

E. Place grout, completely filling equipment bases.

F. Place grout on concrete bases and provide smooth bearing surface for equipment.

G. Place grout around anchors.

H. Cure placed grout.

3.10 CONCRETE BASES

A. Concrete Bases: Anchor equipment to concrete base according to equipment manufacturer's written instructions.

1. Construct concrete bases of dimensions indicated, but not less than 4 inches larger in both directions than supported unit.
2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of the base.

3. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.
4. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
5. Install anchor bolts to elevations required for proper attachment to supported equipment.
6. Install anchor bolts according to anchor-bolt manufacturer's written instructions.
7. Use 3000-psi, 28-day compressive-strength concrete and reinforcement as specified in Division 03.

3.11 ERECTION OF METAL SUPPORTS AND ANCHORAGES

A. Refer to Division 05 for structural steel.

B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor fire-suppression materials and equipment.

C. Field Welding: Comply with AWS D1.1.

END OF SECTION

SECTION 210513 - COMMON MOTOR REQUIREMENTS FOR FIRE SUPPRESSION EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes general requirements for single-phase and polyphase, general-purpose, horizontal, small and medium, squirrel-cage induction motors for use on ac power systems up to 600 V and installed at equipment manufacturer's factory or shipped separately by equipment manufacturer for field installation.

1.3 COORDINATION

A. Coordinate features of motors, installed units, and accessory devices to be compatible with the following:

1. Motor controllers.
2. Torque, speed, and horsepower requirements of the load.
3. Ratings and characteristics of supply circuit and required control sequence.
4. Ambient and environmental conditions of installation location.

PART 2 - PRODUCTS

2.1 GENERAL MOTOR REQUIREMENTS

A. Comply with NEMA MG 1 unless otherwise indicated.

B. Comply with IEEE 841 for severe-duty motors.

2.2 MOTOR CHARACTERISTICS

A. Duty: Continuous duty at ambient temperature of 40 deg C and at altitude of 3300 feet above sea level.

B. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.

2.3 POLYPHASE MOTORS

A. Description: NEMA MG 1, Design B, medium induction motor.

B. Efficiency: Energy efficient, as defined in NEMA MG 1.

C. Service Factor: 1.15.

D. Multispeed Motors: Variable torque.

1. For motors with 2:1 speed ratio, consequent pole, single winding.
2. For motors with other than 2:1 speed ratio, separate winding for each speed.

E. Multispeed Motors: Separate winding for each speed.

F. Rotor: Random-wound, squirrel cage.

G. Bearings: Regreasable, shielded, antifriction ball bearings suitable for radial and thrust loading.

H. Temperature Rise: Match insulation rating.

I. Insulation: Class F.

J. Code Letter Designation:

1. Motors 15 HP and Larger: NEMA starting Code F or Code G.
2. Motors Smaller than 15 HP: Manufacturer's standard starting characteristic.

K. Enclosure Material: Cast iron for motor frame sizes 324T and larger; rolled steel for motor frame sizes smaller than 324T.

2.4 POLYPHASE MOTORS WITH ADDITIONAL REQUIREMENTS

A. Motors Used with Reduced-Voltage and Multispeed Controllers: Match wiring connection requirements for controller with required motor leads. Provide terminals in motor terminal box, suited to control method.

B. Motors Used with Variable Frequency Controllers: Ratings, characteristics, and features coordinated with and approved by controller manufacturer.

1. Windings: Copper magnet wire with moisture-resistant insulation varnish, designed and tested to resist transient spikes, high frequencies, and short time rise pulses produced by pulse-width modulated inverters.
2. Energy- and Premium-Efficient Motors: Class B temperature rise; Class F insulation.
3. Inverter-Duty Motors: Class F temperature rise; Class H insulation.

4. Thermal Protection: Comply with NEMA MG 1 requirements for thermally protected motors.

C. Severe-Duty Motors: Comply with IEEE 841, with 1.15 minimum service factor.

2.5 SINGLE-PHASE MOTORS

A. Motors larger than 1/20 hp shall be one of the following, to suit starting torque and requirements of specific motor application:

1. Permanent-split capacitor.
2. Split phase.
3. Capacitor start, inductor run.
4. Capacitor start, capacitor run.

B. Multispeed Motors: Variable-torque, permanent-split-capacitor type.

C. Bearings: Prelubricated, antifriction ball bearings or sleeve bearings suitable for radial and thrust loading.

D. Motors 1/20 HP and Smaller: Shaded-pole type.

E. Thermal Protection: Internal protection to automatically open power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of motor insulation. Thermal-protection device shall automatically reset when motor temperature returns to normal range.

PART 3 - EXECUTION (NOT APPLICABLE)

END OF SECTION

SECTION 210523 - GENERAL-DUTY VALVES FOR FIRE SUPPRESSION PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Bronze butterfly valves with indicators.
2. Iron butterfly valves with indicators.
3. Check valves.
4. Bronze OS&Y gate valves.
5. Iron OS&Y gate valves.
6. Indicator posts.
7. Trim and drain valves.

1.3 DEFINITIONS

A. NBR: Acrylonitrile-butadiene, Buna-N, or nitrile rubber.

B. NRS: Nonrising stem.

C. OS&Y: Outside screw and yoke.

D. SBR: Styrene-butadiene rubber.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of valve.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Prepare valves for shipping as follows:

1. Protect internal parts against rust and corrosion.
2. Protect threads, flange faces, and weld ends.
3. Set valves open to minimize exposure of functional surfaces.

B. Use the following precautions during storage:

1. Maintain valve end protection.
2. Store valves indoors and maintain at higher than ambient dew point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.

C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use operating handles or stems as lifting or rigging points.

D. Protect flanges and specialties from moisture and dirt.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR VALVES

A. Source Limitations for Valves: Obtain valves for each type from single manufacturer

B. ASME Compliance:

1. ASME B16.1 for flanges on iron valves.
2. ASME B1.20.1 for threads for threaded-end valves.
3. ASME B31.9 for building services piping valves.

C. AWWA Compliance: Comply with AWWA C606 for grooved-end connections.

D. NFPA Compliance: Comply with NFPA 13, 14, 20, and 24 for valves.

E. Valve Pressure Ratings: Not less than the minimum pressure rating indicated or higher as required by system pressures.

F. Valve Sizes: Same as upstream piping unless otherwise indicated.

G. Valve Actuator Types:

1. Worm-gear actuator with handwheel for quarter-turn valves, except for trim and drain valves.
2. Handwheel: For other than quarter-turn trim and drain valves.
3. Handlever: For quarter-turn trim and drain valves NPS 2 and smaller.

2.2 BRONZE BUTTERFLY VALVES WITH INDICATOR

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. NIBCO INC.
2. Victaulic Company.

B. Description:

1. Standard: UL 1091 and FM Global standard for indicating valves, (butterfly or ball type), Class Number 1112.
2. Minimum: Pressure rating: 175 psig.
3. Body Material: Bronze.
4. Seat Material: EPDM.
5. Stem Material: Bronze or stainless steel.
6. Disc: Bronze or Stainless steel.
7. Actuator: Worm gear or traveling nut.
8. Supervisory Switch: Internal or external.
9. Ends Connections for Valves NPS 1 through NPS 2: Threaded ends.
10. Ends Connections for Valves NPS 2-1/2: Grooved ends.

2.3 IRON BUTTERFLY VALVES WITH INDICATORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Anvil International, Inc.
2. Fivalco Inc.
3. Globe Fire Sprinkler Corporation.
4. Kennedy Valve; a division of McWane, Inc.
5. NIBCO INC.
6. Tyco Fire & Building Products LP.
7. Victaulic Company.

B. Description:

1. Standard: UL 1091 and FM Global standard for indicating valves, (butterfly or ball type), Class Number 112.
2. Minimum Pressure Rating: 175 psig.
3. Body Material: Cast or ductile iron with nylon, EPDM, epoxy, or polyamide coating.
4. Seat Material: EPDM.
5. Stem: Stainless steel.
6. Disc: Ductile iron, nickel plated and EPDM or SBR coated.
7. Actuator: Worm gear or traveling nut.
8. Supervisory Switch: Internal or external.
9. Body Design: Lug or wafer or Grooved-end connections.

2.4 CHECK VALVES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Anvil International, Inc.
2. Fire Protection Products, Inc.
3. Fivalco Inc.
4. Globe Fire Sprinkler Corporation.
5. Kennedy Valve; a division of McWane, Inc.
6. NIBCO INC.
7. Reliable Automatic Sprinkler Co., Inc.
8. Shurjoint Piping Products.
9. Tyco Fire & Building Products LP.
10. Victaulic Company.
11. Viking Corporation.

B. Description:

1. Standard: UL 312 and FM Global standard for swing check valves, Class Number 1210.
2. Minimum Pressure Rating: 175 psig.
3. Type: Single swing check.
4. Body Material: Cast iron, ductile iron, or bronze.
5. Clapper: Bronze, ductile iron, or stainless steel with elastomeric seal.
6. Clapper Seat: Brass, bronze, or stainless steel.
7. Hinge Shaft: Bronze or stainless steel.
8. Hinge Spring: Stainless steel.
9. End Connections: Flanged, grooved, or threaded.

2.5 BRONZE OS&Y GATE VALVES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. American Cast Iron Pipe Company; Waterous Company subsidiary.
2. Clow Valve Company; a division of McWane, Inc.
3. Kennedy Valve; a division of McWane, Inc.
4. Mueller Co.; Water Products Division.
5. NIBCO INC.
6. Victaulic Company.

B. Description:

1. Standard: UL 262 and FM Global standard for fire-service water control valves (OS&Y- and NRS-type gate valves).
2. Minimum Pressure Rating: 175 psig.
3. Body and Bonnet Material: Bronze or brass.
4. Wedge: One-piece bronze or brass.
5. Wedge Seat: Bronze.
6. Stem: Bronze or brass.
7. Packing: Non-asbestos PTFE.
8. Supervisory Switch: External.
9. End Connections: Threaded.

2.6 IRON OS&Y GATE VALVES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. American Cast Iron Pipe Company; Waterous Company subsidiary.
2. Clow Valve Company; a division of McWane, Inc.
3. Kennedy Valve; a division of McWane, Inc.
4. Mueller Co.; Water Products Division.
5. NIBCO INC.
6. Victaulic Company.

B. Description:

1. Standard: UL 262 and FM Global standard for fire-service water control valves (OS&Y- and NRS-type gate valves).
2. Minimum Pressure Rating: 175 psig.
3. Body and Bonnet Material: Cast or ductile iron.
4. Wedge: Cast or ductile iron, or bronze with elastomeric coating.
5. Wedge Seat: Cast or ductile iron, or bronze with elastomeric coating.
6. Stem: Brass or bronze.
7. Packing: Non-asbestos PTFE.
8. Supervisory Switch: External.
9. End Connections: Flanged.

2.7 INDICATOR POSTS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. American Cast Iron Pipe Company; Waterous Company subsidiary.
2. Clow Valve Company; a division of McWane, Inc.
3. Kennedy Valve; a division of McWane, Inc.
4. Mueller Co.; Water Products Division.

5. NIBCO INC.

B. Description:

1. Standard: UL 789 and FM Global standard for indicator posts.
2. Type: Underground Pit Wall.
3. Base Barrel Material: Cast or ductile iron.
4. Extension Barrel: Cast or ductile iron.
5. Cap: Cast or ductile iron.
6. Operation: Wrench or Handwheel.

2.8 TRIM AND DRAIN VALVES

A. Ball Valves:

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Conbraco Industries, Inc.; Apollo Valves.
2. Fire-End & Croker Corporation.
3. Fire Protection Products, Inc.
4. Flowserve.
5. FNW; Ferguson Enterprises, Inc.
6. Milwaukee Valve Company.
7. NIBCO INC.
8. Potter Roemer.
9. Tyco Fire & Building Products LP.
10. Victaulic Company.
11. Watts Water Technologies, Inc.

C. Description:

a. Pressure Rating: 175 psig 250 psig.
b. Body Design: Two piece.
c. Body Material: Forged brass or bronze.
d. Port size: Full or standard.
e. Seats: PTFE.
f. Stem: Bronze or stainless steel.
g. Ball: Chrome-plated brass.
h. Actuator: Handlever.
i. End Connections for Valves NPS 1 through NPS 2-1/2: Threaded ends.
j. End Connections for Valves NPS 1-1/4 and NPS 2-1/2: Grooved ends.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.

B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.

C. Examine threads on valve and mating pipe for form and cleanliness.

D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.

E. Do not attempt to repair defective valves; replace with new valves.

3.2 GENERAL REQUIREMENTS FOR VALVE INSTALLATION

A. Comply with requirements in the Division 21 for specific valve installation requirements and application.

B. Install listed fire-protection shutoff valves supervised-open, located to control sources of water supply except from fire-department connections. Install permanent identification signs indicating portion of system controlled by each valve.

C. Install check valve in each water-supply connection. Install backflow preventers instead of check valves in potable-water-supply sources.

D. Install valves having threaded connections with unions at each piece of equipment arranged to allow easy access, service, maintenance, and equipment removal without system shutdown. Provide separate support where necessary.

E. Install valves in horizontal piping with stem at or above the pipe center.

F. Install valves in position to allow full stem movement.

G. Install valve tags. Comply with Division 21 requirements in for valve tags and schedules and signs on surfaces concealing valves; and the NFPA standard applying to the piping system in which valves are installed. Install permanent identification signs indicating the portion of system controlled by each valve.

H. Install listed fire-protection shutoff valves supervised-open, located to control sources of water supply except from fire-department connections.

I. Install check valve in each water-supply connection. Install backflow preventers instead of check valves in potable-water-supply sources.

END OF SECTION

SECTION 210553 - IDENTIFICATION FOR FIRE-SUPPRESSION PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Equipment labels.
2. Warning signs and labels.
3. Pipe labels.
4. Stencils.
5. Valve tags.
6. Warning tags.
7. Hydraulic design information sign.
8. General information sign.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples: For color, letter style, and graphic representation required for each identification material and device.

C. Equipment-Label Schedule: Include a listing of all equipment to be labeled and the proposed content for each label.

D. Valve Schedules: Valve numbering scheme.

E. Information Sign Proofs: Submit proposed completed information signs with all required data, as well as proposed installation details.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: For each piping system to include in maintenance manuals.

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

A. Provide custom labels for all equipment, in addition to manufacturer's provided nameplates.

B. Metal Labels for Equipment:

1. Material and Thickness: Brass, 0.032 inch (0.8 mm) thick, with predrilled holes for attachment hardware.
2. Letter Color: White.
3. Background Color: Red.
4. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch (64 by 19 mm).
5. Minimum Letter Size: 1/4 inch (6.4 mm) for name of units if viewing distance is less than 24 inches (600 mm), 1/2 inch (13 mm) for viewing distances up to 72 inches (1830 mm), and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
6. Fasteners: Stainless-steel rivets.
7. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

C. Plastic Labels for Equipment:

1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch (3.2 mm) thick, with predrilled holes for attachment hardware.
2. Letter Color: White.
3. Background Color: Red.
4. Maximum Temperature: Able to withstand temperatures up to 160 deg F (71 deg C).
5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch (64 by 19 mm).
6. Minimum Letter Size: 1/2 inch (13 mm) for viewing distances up to 72 inches (1830 mm), and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
7. Fasteners: Stainless-steel rivets.
8. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

D. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), and the Specification Section number and title where equipment is specified.

E. Equipment-Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch (A4) bond paper. Tabulate equipment identification number and identify Drawing numbers where equipment is indicated (plans, details, and schedules) and the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

2.2 WARNING SIGNS AND LABELS

A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, with predrilled holes for attachment hardware.

B. Letter Color: White.

C. Background Color: Red.

D. Maximum Temperature: Able to withstand temperatures up to 160 deg F (71 deg C).

E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.

F. Minimum Letter Size: 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.

G. Fasteners: Stainless-steel rivets.

H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

I. Label Content: Include caution and warning information, plus emergency notification instructions.

2.3 PIPE LABELS

A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service and showing flow direction.

B. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to cover full circumference of pipe and to attach to pipe without fasteners or adhesive.

C. Pipe-Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings; pipe size; and an arrow indicating flow direction.

1. Flow-Direction Arrows: Integral with piping-system service lettering to accommodate both directions, or as separate unit on each pipe label to indicate flow direction.
2. Lettering Size: At least 1-1/2 inches high.

D. Pipe-Label Colors:

1. Background Color: Red.
2. Letter Color: White.

2.4 VALVE TAGS

A. Valve Tags: Stamped or engraved with 1/4-inch (6.4-mm) letters for piping-system abbreviation and 1/2-inch (13-mm) numbers.

1. Tag Material: Brass, 0.032 inch (0.8 mm) thick, with predrilled holes for attachment hardware.
2. Fasteners: Brass wire-link chain, beaded chain, or S-hook.
3. Valve-Tag Color: Red.
4. Letter Color: White.

B. Valve Schedules: For each piping system, on 8-1/2-by-11-inch (A4) bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal-operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.

1. Valve-tag schedule shall be included in operation and maintenance data.

2.5 WARNING TAGS

A. Warning Tags: Preprinted or partially preprinted, accident-prevention tags, of plasticized card stock with matte finish suitable for writing.

1. Size: 3 by 5-1/4 inches (75 by 133 mm) minimum.
2. Fasteners: Brass grommet and wire.
3. Nomenclature: Large-size primary caption such as "DANGER," "CAUTION," or "DO NOT OPERATE."
4. Color: Yellow background with black lettering.

2.6 HYDRAULIC DESIGN INFORMATION SIGN

A. Material and Thickness: Multi-layer, multi-color plastic, mechanically engraved, 1/8 inch (32 mm) thick.

B. Letter Color: White

C. Background Color: Red

D. Maximum Temperature: Able to withstand temperatures up to 160 deg F (71 deg C).

E. Minimum Letter Size: 1/4 inch (6.4 mm).

F. Adhesive: Contact type permanent adhesive, compatible with label and with substrate.

G. Sign shall contain the following information at minimum:

1. Location of design area
2. Discharge density over the design area
3. Required flow and residual pressure at the fire pump discharge, or if no pump is present at the connection to the water supply.
4. Occupancy classification, or commodity classification, maximum storage height, and configuration.
5. Hose stream allowance.
6. Installing Contractor’s name and contact information.

2.7 GENERAL INFORMATION SIGN

A. Material and Thickness: Multi-layer, multi-color plastic, mechanically engraved, 1/8 inch (32 mm) thick.

B. Letter Color: White

C. Background Color: Red

D. Maximum Temperature: Able to withstand temperatures up to 160 deg F (71 deg C).

E. Minimum Letter Size: 1/4 inch (6.4 mm).

F. Adhesive: Contact type permanent adhesive, compatible with label and with substrate.

G. Sign shall contain the following information at minimum:

1. Name and location of facility protected
2. Occupancy classification
3. Commodity classification
4. Presence of high-piled and/or rack storage
5. Maximum height of storage planned
6. Aisle width planned
7. Encapsulation of pallet loads
8. Presence of solid shelving
9. Flow test data
10. Presence of flammable/combustible liquids
11. Pressure of hazardous materials
12. Presence of other special storage
13. Location of auxiliary drains and low point drains on dry pipe and preaction systems
14. Original results of main drain flow test and date conducted
15. Name of installing contractor and contact information

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

3.2 LABEL INSTALLATION

A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

B. Coordinate installation of identifying devices with locations of access panels and doors.

C. Install or permanently fasten labels on each major item of mechanical equipment.

D. Locate equipment labels where accessible and visible.

E. Pipe-Label Locations: Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:

1. Near each valve and control device.
2. Near each branch connection excluding short takeoffs. Where flow pattern is not obvious, mark each pipe at branch.
3. Near penetrations through walls, floors, ceilings, and inaccessible enclosures.
4. At access doors, manholes, and similar access points that permit view of concealed piping.
5. Near major equipment items and other points of origination and termination.
6. Spaced at maximum intervals of 50 feet (15 m) along each run. Reduce intervals to 25 feet (7.6 m) in areas of congested piping and equipment.
7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.

3.3 VALVE-TAG INSTALLATION

A. Install tags on valves and control devices in piping systems. List tagged valves in a valve-tag schedule.

B. Valve-Tag Application Schedule: Tag valves according to size, shape, and with captions similar to those indicated in "Valve-Tag Size and Shape" Subparagraph below:

1. Valve-Tag Size and Shape:

a. Fire-Suppression Standpipe: 2 inches (50 mm), round.
b. Wet-Pipe Sprinkler System: 2 inches (50 mm), round.
c. Water-mist Fire Suppression System: 2 inches (50mm), round.

3.4 WARNING-TAG INSTALLATION

A. Write required message on, and attach warning tags to, equipment and other items where required.

3.5 INFORMATION SIGN INSTALLATION

A. Provide separate hydraulic design information sign for each system design criteria.

B. Hydraulic design information signs shall be permanently mounted within fire pump room.

C. General information sign shall be permanently mounted at fire service entrance. Provide second general information sign in fire command center.

END OF SECTION

SECTION 211100 - FACILITY FIRE-SUPPRESSION WATER-SERVICE PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes fire-suppression water-service piping and related components outside the building and service entrance piping through floor into the building and the following:

1. Pipes, fittings, and specialties.
2. Fire-suppression specialty valves.
3. Backflow preventers.

B. Utility-furnished products include water meters that are furnished to the site, ready for installation.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: For piping and specialties including relation to other services in same area, drawn to scale. Show piping and specialty sizes and valves, meter and specialty locations, and elevations.

B. Feld Test Reports and Certificates: Indicate and interpret test results for compliance with performance requirements and as described in NFPA 24. Use "Contractor's Material and Test Certificate for Underground Piping.

1.5 QUALITY ASSURANCE

A. Regulatory Requirements:

1. Comply with requirements of utility company supplying the water. Include tapping of water mains and backflow prevention.
2. Comply with standards of authorities having jurisdiction for fire-suppression water-service piping, including materials, hose threads, installation, and testing.

B. Piping materials shall bear label, stamp, or other markings of specified testing agency.

C. Comply with FM Global's "Approval Guide" or UL's "Fire Protection Equipment Directory" for fire-service-main products.

D. NFPA Compliance: Comply with NFPA 24 for materials, installations, tests, flushing, and valve and hydrant supervision for fire-suppression water-service piping.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Preparation for Transport: Prepare valves, including fire hydrants, according to the following:

1. Ensure that valves are dry and internally protected against rust and corrosion.
2. Protect valves against damage to threaded ends and flange faces.
3. Set valves in best position for handling. Set valves closed to prevent rattling.

B. During Storage: Use precautions for valves, including fire hydrants, according to the following:

1. Do not remove end protectors unless necessary for inspection; then reinstall for storage.
2. Protect from weather. Store indoors and maintain temperature higher than ambient dew point temperature. Support off the ground or pavement in watertight enclosures when outdoor storage is necessary.

C. Handling: Use sling to handle valves and fire hydrants if size requires handling by crane or lift. Rig valves to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.

D. Deliver piping with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe-end damage and to prevent entrance of dirt, debris, and moisture.

E. Protect stored piping from moisture and dirt. Elevate above grade. Do not exceed structural capacity of floor when storing inside.

F. Protect flanges, fittings, and specialties from moisture and dirt.

G. Store plastic piping protected from direct sunlight. Support to prevent sagging and bending.

1.7 PROJECT CONDITIONS

A. Interruption of Existing Fire-Suppression Water-Service Piping: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary water-distribution service according to requirements indicated:

1. Notify Construction Manager no fewer than two days in advance of proposed interruption of service.
2. Do not proceed with interruption of service without Construction Manager's written permission.

PART 2 - PRODUCTS

2.1 DUCTILE-IRON PIPE AND FITTINGS

A. Mechanical-Joint, Ductile-Iron Pipe: AWWA C151, with mechanical-joint bell and plain spigot end.

B. Push-on-Joint, Ductile-Iron Pipe: AWWA C151, with push-on-joint bell and plain spigot end.

C. Mechanical-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.

1. Glands, Gaskets, and Bolts: AWWA C111, ductile- or gray-iron glands, rubber gaskets, and steel bolts.

D. Push-on-Joint, Ductile-Iron Fittings: AWWA C153, ductile-iron compact pattern.

1. Gaskets: AWWA C111, rubber.

E. Flanges: ASME B16.1, Class 125, cast iron.

2.2 SPECIAL PIPE FITTINGS

A. Ductile-Iron Flexible Expansion Joints:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. EBAA Iron, Inc.
b. ROMAC Industries Inc.
c. Star Pipe Products.

B. Description: Compound, ductile-iron fitting with combination of flanged and mechanical-joint ends complying with AWWA C110 or AWWA C153. Include two gasketed ball-joint sections and one or more gasketed sleeve sections. Assemble components for offset and expansion indicated. Include AWWA C111, ductile-iron glands, rubber gaskets, and steel bolts.

1. Pressure Rating: 250 psig minimum.

C. Ductile-Iron Deflection Fittings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. EBAA Iron, Inc.

2. Description: Compound, ductile-iron coupling fitting with sleeve and one or two flexing sections for up to 15-degree deflection, gaskets, and restrained-joint ends complying with AWWA C110 or AWWA C153. Include AWWA C111, ductile-iron glands, rubber gaskets, and steel bolts.
3. Pressure Rating: 250 psig minimum.

2.3 ENCASEMENT FOR PIPING

A. Standard: ASTM A 674 or AWWA C105.

B. Material: Linear low-density PE film of 0.008-inch minimum thickness high-density.

C. Form: Sheet or tube.

D. Color: Black or natural.

2.4 JOINING MATERIALS

A. Gaskets for Ferrous Piping and Copper-Alloy Tubing: ASME B16.21, asbestos free.

B. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series.

C. Bonding Adhesive for Fiberglass Piping: As recommended by fiberglass piping manufacturer.

2.5 PIPING SPECIALTIES

A. Transition Fittings: Manufactured fitting or coupling same size as, with pressure rating at least equal to and ends compatible with, piping to be joined.

B. Tubular-Sleeve Pipe Couplings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Dresser, Inc.; Dresser Piping Specialties.
    b. Ford Meter Box Company, Inc. (The); Pipe Products Division.
    c. JCM Industries.
    d. ROMAC Industries Inc.
    e. Smith-Blair, Inc.; a Sensus company.

2. Description: Metal, bolted, sleeve-type, reducing or transition coupling, with center sleeve, gaskets, end rings, and bolt fasteners, and with ends of same sizes as piping to be joined.
3. Standard: AWWA C219.
4. Center-Sleeve Material: Manufacturer's standard.
5. Gasket Material: Natural or synthetic rubber.
6. Pressure Rating: 150 psig minimum.
7. Metal Component Finish: Corrosion-resistant coating or material.

2.6 BACKFLOW PREVENTERS

A. Double-Check, Detector-Assembly Backflow Preventers:

1. Ames Fire & Waterworks; a division of Watts Water Technologies, Inc.
2. FEBCO; SPX Valves & Controls.
3. Watts Water Technologies, Inc.

4. Zurn Plumbing Products Group; Wilkins Water Control Products Division.
5. Standards: ASSE 1048 and UL's "Fire Protection Equipment Directory" listing or FM Global's "Approval Guide."
6. Operation: Continuous-pressure applications.
7. Pressure Loss: 5 psig maximum, through middle one-third of flow range.
8. Size: 8 NPS.
9. Design Flow Rate: 1,500 gpm.
10. Body Material: Cast iron with interior lining complying with AWWA C550 or that is FDA approved.
11. End Connections: Flanged.
12. Configuration: Designed for horizontal, straight through flow.
13. Accessories:

    a. Valves: UL 262 and FM Global's "Approval Guide" listing; OS&Y gate type with flanged ends on inlet and outlet.
    b. Bypass: With displacement-type water meter, shutoff valves, and reduced-pressure backflow preventer.

PART 3 - EXECUTION

3.1 EARTHWORK

A. Comply with excavating, trenching, and backfilling requirements in Division 31.

3.2 PIPING INSTALLATION

A. Comply with NFPA 24 for fire-service-main piping materials and installation.

B. Install ductile-iron, water-service piping according to AWWA C600 and AWWA M41.

1. Install encasement for piping according to ASTM A 674 or AWWA C105.

C. Bury piping with depth of cover over top at least 5 feet, with top at least 12 inches below level of maximum frost penetration, and according to the following:

D. Extend fire-suppression water-service piping and connect to water-supply source and building fire-suppression water-service piping systems at locations and pipe sizes indicated.

1. Terminate fire-suppression water-service piping within the building at the wall until building-water-piping systems are installed. Terminate piping with caps, plugs, or flanges as required for piping material. Make connections to building's fire-suppression water-service piping systems when those systems are installed.

E. Install underground piping with restrained joints at horizontal and vertical changes in direction. Use restrained-joint piping, thrust blocks, anchors, tie-rods and clamps, and other supports.

F. Comply with requirements in Division 21 for fire-suppression-water piping inside the building.

G. Comply with requirements in Division 22 for potable-water piping inside the building.

H. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Division 21.

I. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Division 21.

3.3 JOINT CONSTRUCTION

A. Install couplings, flanges, flanged fittings, unions, nipples, and transition and special fittings that have finish and pressure rating same as or higher than systems pressure rating for aboveground applications unless otherwise indicated.

B. Install unions adjacent to each valve in tubing NPS 2 and smaller.

C. Install flanges, flange adaptors, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 and larger end connections.

D. Ream ends of tubes and remove burrs.

E. Remove scale, slag, dirt, and debris from outside and inside of pipes, tubes, and fittings before assembly.

F. Ductile-Iron Piping, Gasketed Joints for Fire-Service-Main Piping: UL 194.

G. Flanged Joints: Select appropriate gasket material in size, type, and thickness suitable for water service. Join flanges with bolts according to ASME B31.9.

H. Dissimilar Materials Piping Joints: Use adapters compatible with both piping materials, with OD, and with system working pressure.

I. Do not use flanges or unions for underground piping.

3.4 ANCHORAGE INSTALLATION

A. Anchorage, General: Install water-distribution piping with restrained joints. Anchorages and restrained-joint types that may be used include the following:

1. Concrete thrust blocks.
2. Locking mechanical joints.
3. Set-screw mechanical retainer glands.
4. Bolted flanged joints.
5. Pipe clamps and tie rods.

B. Install anchorages for tees, plugs and caps, bends, crosses, valves, and hydrant branches in fire-suppression water-service piping according to NFPA 24 and the following:

1. Gasketed-Joint, Ductile-Iron, Water-Service Piping: According to AWWA C600.

C. Apply full coat of asphalt or other acceptable corrosion-resistant material to surfaces of installed ferrous anchorage devices.

3.5 VALVE INSTALLATION

A. AWWA Gate Valves: Comply with AWWA C600 and AWWA M44. Install each underground valve with stem pointing up and with valve box.

B. AWWA Valves Other Than Gate Valves: Comply with AWWA C600 and AWWA M44.

C. UL-Listed or FM Global-Approved Gate Valves: Comply with NFPA 24. Install each underground valve and valves in vaults with stem pointing up and with vertical cast-iron indicator post.

D. UL-Listed or FM Global-Approved Valves Other Than Gate Valves: Comply with NFPA 24.

E. MSS Valves: Install as component of connected piping system.

F. Corporation Valves and Curb Valves: Install each underground curb valve with head pointed up and with service box.

3.6 BACKFLOW PREVENTER INSTALLATION

A. Install backflow preventers of type, size, and capacity indicated. Include valves and test cocks. Install according to requirements of plumbing and health department and authorities having jurisdiction.

B. Do not install backflow preventers that have relief drain in vault or in other spaces subject to flooding.

C. Do not install piping around backflow preventers.

3.7 CONNECTIONS

A. Connect fire-suppression water-service piping to interior fire-suppression piping.

3.8 FIELD QUALITY CONTROL

A. Use test procedure prescribed by authorities having jurisdiction or, if method is not prescribed by authorities having jurisdiction, use procedure described below.

B. Piping Tests: Conduct piping tests before joints are covered and after concrete thrust blocks have hardened sufficiently. Fill pipeline 24 hours before testing and apply test pressure to stabilize system. Use only potable water.

C. Hydrostatic Tests: Test at not less than one-and-one-half times the working pressure for two hours.

1. Increase pressure in 50-psig increments and inspect each joint between increments. Hold at test pressure for one hour; decrease to zero psig. Slowly increase again to test pressure and hold for one more hour. Maximum allowable leakage is 2 quarts per hour per 100 joints. Remake leaking joints with new materials and repeat test until leakage is within allowed limits.

D. Prepare test and inspection reports.

3.9 IDENTIFICATION

A. Install continuous underground warning tape during backfilling of trench for underground fire-suppression water-service piping. Locate below finished grade, directly over piping. Underground warning tapes are specified in Division 31.

3.10 CLEANING

A. Clean and disinfect fire-suppression water-service piping as follows:

1. Purge new piping systems and parts of existing systems that have been altered, extended, or repaired before use.
2. Use purging and disinfecting procedure prescribed by authorities having jurisdiction or, if method is not prescribed by authorities having jurisdiction, use procedure described in NFPA 24 for flushing of piping. Flush piping system with clean, potable water until dirty water does not appear at points of outlet.
3. Use purging and disinfecting procedure prescribed by authorities having jurisdiction or, if method is not prescribed by authorities having jurisdiction, use procedure described in AWWA C651 or do as follows:

    a. Fill system or part of system with water/chlorine solution containing at least 50 ppm of chlorine; isolate and allow it to stand for 24 hours.
    b. Drain system or part of system of previous solution and refill with water/chlorine solution containing at least 200 ppm of chlorine; isolate and allow it to stand for three hours.
    c. After standing time, flush system with clean, potable water until no chlorine remains in water coming from system.
    d. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedure if biological examination shows evidence of contamination.

B. Prepare reports of purging and disinfecting activities.

3.11 PIPING SCHEDULE

A. Underground fire-suppression water-service piping NPS 6 to NPS 12 shall be one of the following:

1. Mechanical-joint, ductile-iron pipe; mechanical-joint, ductile- or gray-iron, standard-pattern or ductile-iron, compact-pattern fittings; glands, gaskets, and bolts; and gasketed joints.
2. Push-on-joint, ductile-iron pipe; push-on-joint, ductile-iron compact-pattern fittings; and gasketed joints.

END OF SECTION

SECTION 211119 - FIRE-DEPARTMENT CONNECTIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Flush-type fire-department connections.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each fire-department connection.

PART 2 - PRODUCTS

2.1 FLUSH-TYPE FIRE-DEPARTMENT CONNECTION

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. American Fire Hose & Cabinet.
2. Elkhart Brass Mfg. Company, Inc.
3. Potter Roemer.

B. Standard: UL 405.

C. Type: Flush, for wall mounting.

D. Pressure Rating: 250 psig minimum.

E. Body Material: Corrosion-resistant metal.

F. Inlets: Brass with threads according to NFPA 1963 and matching local fire-department sizes and threads. Include extension pipe nipples, brass lugged swivel connections, and check devices or clappers.

G. Caps: Brass, lugged type, with gasket and chain.

H. Escutcheon Plate: Rectangular, brass, wall type.

I. Outlet: With pipe threads.

J. Body Style: Horizontal.

K. Number of Inlets: Refer to FP drawings.

L. Outlet Location: Back.

M. Escutcheon Plate Marking: Similar to "AUTO SPKR & STANDPIPE."

N. Finish: Polished chrome plated.

O. Outlet Size: Refer to FP drawings.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of fire-department connections.

B. Examine roughing-in for fire-suppression standpipe system to verify actual locations of piping connections before fire-department connection installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install wall-type fire-department connections.

B. Install automatic (ball-drip) drain valve at each check valve for fire-department connection.

END OF SECTION

SECTION 211200 - FIRE-SUPPRESSION STANDPIPES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Pipes, fittings, and specialties.
2. Fire-protection specialty valves.
3. Hose connections.
4. Fire department valve cabinets.

B. Related Requirements: Division 28 for connections to alarm devices.

1.3 DEFINITIONS

A. High-Pressure Standpipe Piping: Fire-suppression standpipe piping designed to operate at working pressure higher than standard 175 psig, but not higher than 300 psig.

B. Standard-Pressure Standpipe Piping: Fire-suppression standpipe piping designed to operate at working pressure 175 psig maximum.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Shop Drawings: For fire-suppression standpipes.

1. Include plans, elevations, sections, and attachment details.
2. Include diagrams for power, signal, and control wiring.

C. Delegated-Design Submittal: For standpipe systems indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Prepare a single set of coordination drawings with all mechanical and electrical trades, in accordance with division 20.

B. Qualification Data: For Installer.

C. Approved Standpipe Drawings: Working plans, prepared according to NFPA 14, that have been approved by authorities having jurisdiction, including hydraulic calculations if applicable.

D. Welding certificates.

E. Fire-hydrant flow test report. NFPA 291 formal test report performed with one (1) year of the calculations which accompany the shop drawings.

F. Field Test Reports and Certificates: Indicate and interpret test results for compliance with performance requirements and as described in NFPA 14. Include "Contractor's Material and Test Certificate for Aboveground Piping" and "Contractor's Material and Test Certificate for Underground Piping."

G. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For fire-suppression standpipes specialties to include in emergency, operation, and maintenance manuals.

1.7 QUALITY ASSURANCE

A. Installer Qualifications:

1. Installer's responsibilities include designing, fabricating, and installing fire-suppression standpipes and providing professional engineering services needed to assume engineering responsibility. Base calculations on results of fire-hydrant flow test.

    a. Engineering Responsibility: Preparation of working plans, calculations, and field test reports by a qualified professional engineer.

B. Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

D. NFPA Standards: Fire-suppression standpipe equipment, specialties, accessories, installation, and testing shall comply with NFPA 14.

1.8 PROJECT CONDITIONS

A. Interruption of Existing Fire-Suppression Standpipe Service: Do not interrupt fire-suppression standpipe service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary fire-suppression standpipe service according to requirements indicated:

1. Notify Construction Manager no fewer than two days in advance of proposed interruption of fire-suppression standpipe service.
2. Do not proceed with interruption of fire-suppression standpipe service without Construction Manager's written permission.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTIONS

A. Automatic Wet-Type, Class I Standpipe System: Includes NPS 2-1/2 hose connections. Has open water-supply valve with pressure maintained and is capable of supplying water demand.

2.2 PERFORMANCE REQUIREMENTS

A. Standard-Pressure, Fire-Suppression Standpipe System Component: Listed for 175-psig minimum working pressure.

B. High-Pressure, Fire-Suppression Standpipe System Component: Listed for 300-psig working pressure.

C. Delegated Design: Design fire-suppression standpipes, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

D. Fire-suppression standpipe design shall be approved by authorities having jurisdiction.

1. Minimum residual pressure at each hose-connection outlet is as follows:

a. NPS 2-1/2 Hose Connections: 100 psig.

2.3 PIPING MATERIALS

A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, and fitting materials and for joining methods for specific services, service locations, and pipe sizes.

2.4 BLACK STEEL PIPE AND ASSOCIATED FITTINGS

A. Schedule 40: ASTM A 53/A 53M, Type E, Grade B; with factory- or field-formed ends to accommodate joining method.

B. Schedule 10: ASTM A 135/A 135M or ASTM A 795/A 795M, Schedule 10 in NPS 5 and smaller; and NFPA 13-specified wall thickness in NPS 6 to NPS 10, plain end.

C. Uncoated, Steel Couplings: ASTM A 865/A 865M, threaded.

D. Uncoated, Gray-Iron Threaded Fittings: ASME B16.4, Class 125, standard pattern.

E. Malleable- or Ductile-Iron Unions: UL 860.

F. Cast-Iron Flanges: ASME B16.1, Class 125.

G. Steel Flanges and Flanged Fittings: ASME B16.5, Class 150.

H. Steel Welding Fittings: ASTM A 234/A 234M and ASME B16.9.

I. Grooved-Joint, Steel-Pipe Appurtenances:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Anvil International, Inc.
   b. National Fittings, Inc.
   c. Tyco Fire & Building Products LP.
   d. Victaulic Company.

2. Pressure Rating: 300 psig minimum.
3. Uncoated, Grooved-End Fittings for Steel Piping: ASTM A 47/A 47M, malleable-iron casting or ASTM A 536, ductile-iron casting; with dimensions matching steel pipe.
4. Grooved-End-Pipe Couplings for Steel Piping: AWWA C606 and UL 213, rigid pattern, unless otherwise indicated, for steel-pipe dimensions. Include ferrous housing sections, EPDM-rubber gasket, and bolts and nuts.

2.5 PIPING JOINING MATERIALS

A. Pipe-Flange Gasket Materials: AWWA C110, rubber, flat face, 1/8 inch thick or ASME B16.21, nonmetallic and asbestos free.

1. Class 125, Cast-Iron Flanges and Class 150, Bronze Flat-Face Flanges: Full-face gaskets.
2. Class 250, Cast-Iron Flanges and Class 300, Steel Raised-Face Flanges: Ring-type gaskets.

B. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.

C. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys for general-duty brazing unless otherwise indicated.

D. Welding Filler Metals: Comply with AWS D10.12/D10.12M for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

2.6 SPECIALTY VALVES

A. General Requirements:

1. Standard: UL's "Fire Protection Equipment Directory" listing or FM Global's "Approval Guide."
2. Pressure Rating:

   a. Standard-Pressure Piping Specialty Valves: 175 psig minimum.
   b. High-Pressure Piping Specialty Valves: 300 psig.

3. Body Material: Cast or ductile iron.
4. Size: Same as connected piping.
5. End Connections: Flanged or grooved.

B. Riser Check Valve:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Reliable Automatic Sprinkler Co., Inc.
    b. Tyco Fire & Building Products LP.
    c. Victaulic Company.
    d. Viking Corporation.

2. Standard: UL 193.
3. Design: vertical installation.
4. Include trim sets for bypass, drain, electrical sprinkler alarm switch, pressure gages, and fill-line attachment with strainer.
5. Drip Cup Assembly: Pipe drain with check valve to main drain piping.

C. Pressure-Reducing Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. CLA-VAL Automatic Control Valves.
    b. Fire-End & Croker Corporation.
    c. OCV Control Valves.
    d. Potter Roemer.
    e. Zurn Plumbing Products Group; Wilkins Water Control Products Division.

2. UL 668 hose valve, with integral UL 1468 reducing device.
3. Pressure Rating: 300 psig minimum.
4. Material: Brass or bronze.
5. Inlet: Female pipe threads.
6. Outlet: Threaded with or without adapter having male hose threads.
7. Pattern: Angle.
8. Finish: Polished chrome-plated.

D. Automatic (Ball Drip) Drain Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Reliable Automatic Sprinkler Co., Inc.
    b. Tyco Fire & Building Products LP.
    c. Victaulic Company.
    d. Viking Corporation.

2. Standard: UL 1726.
3. Pressure Rating: 175 psig minimum.
4. Type: Automatic draining, ball check.
5. Size: NPS 3/4.

6. End Connections: Threaded.

2.7 HOSE CONNECTIONS

A. Nonadjustable-Valve Hose Connections:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Elkhart Brass Mfg. Company, Inc.
   b. Fire-End & Croker Corporation.
   c. Potter Roemer.

2. Standard: UL 668 hose valve for connecting fire hose.
3. Pressure Rating: 300 psig minimum.
4. Material: Brass or bronze.
5. Size: NPS 2-1/2, as indicated.
6. Inlet: Female pipe threads.
7. Outlet: Male hose threads with lugged cap, gasket, and chain. Include hose valve threads according to NFPA 1963 and matching local fire-department threads.
8. Pattern: Angle.
9. Finish: Polished chrome-plated.
10. Where system pressures exceed 170 psi under flow or no flow condition valves shall be direct-acting type pressure regulating valves.

2.8 FIRE DEPARTMENT VALVE CABINETS

A. Nonadjustable-Valve Hose Connections

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Elkhart Brass Mfg. Company, Inc.
   b. Fire-End & Croker Corporation.
   c. Potter Roemer.
   d. Larsen's Manufacturing Company, Inc.
   e. J.L. Industries, Inc.
2. Standard: UL 668 hose valve for connecting fire hose.
3. Pressure Rating: 300 psig (2070 kPa) minimum.
4. Material: Brass or bronze.
5. Size: NPS 2-1/2 (DN 40 or DN 65).
6. Inlet: Female pipe threads.
7. Outlet: Male hose threads with lugged cap, gasket, and chain. Include hose valve threads according to NFPA 1963 and matching local fire-department threads.
8. Pattern: Angle.
9. Accessories: Provide fire hose valve cabinet with room for fire extinguisher. Refer to Division 10 for additional information.
10. Finish: Comply with Division 10 for finish type.

PART 3 - EXECUTION

3.1 PREPARATION

A. Perform fire-hydrant flow test according to NFPA 14 and NFPA 291. Use results for system design calculations required in "Quality Assurance" Article.

B. Report test results promptly and in writing.

3.2 EXAMINATION

A. Examine roughing-in for hose connections and stations to verify actual locations of piping connections before installation.

B. Examine walls and partitions for suitable thickness, fire- and smoke-rated construction, framing for hose-station cabinets, and other conditions where hose connections and stations are to be installed.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.3 PIPING INSTALLATION

A. Locations and Arrangements: Drawing plans, schematics, and diagrams indicate general location and arrangement of piping. Install piping as indicated, as far as practical.

1. Deviations from approved working plans for piping require written approval from authorities having jurisdiction. File written approval with Architect before deviating from approved working plans.

B. Piping Standard: Comply with requirements in NFPA 14 for installation of fire-suppression standpipe piping.

C. Install listed fittings to make changes in direction, branch takeoffs from mains, and reductions in pipe sizes.

D. Install drain valves on standpipes. Extend drain piping to outside of building.

E. Install automatic (ball drip) drain valves to drain piping between fire-department connections and check valves. Drain to floor drain or outside building.

F. Install alarm devices in piping systems.

G. Install hangers and supports for standpipe system piping according to NFPA 14. Comply with requirements in NFPA 13 for hanger materials.

H. Install pressure gages on riser or feed main and at top of each standpipe. Include pressure gages with connection not less than NPS 1/4 and with soft-metal seated globe valve, arranged for draining pipe between gage and valve. Install gages to permit removal, and install where they are not subject to freezing.

I. Drain dry-type standpipe system piping.

J. Fill wet-type standpipe system piping with water.

K. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Division 21.

L. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Division 21.

M. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Division 21

3.4 JOINT CONSTRUCTION

A. Install couplings, flanges, flanged fittings, unions, nipples, and transition and special fittings that have finish and pressure ratings same as or higher than system's pressure rating for aboveground applications unless otherwise indicated.

B. Install unions adjacent to each valve in pipes NPS 2 and smaller.

C. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 and larger end connections.

D. Ream ends of pipes and tubes, and remove burrs. Bevel plain ends of steel pipe.

E. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.

F. Flanged Joints: Select appropriate gasket material in size, type, and thickness suitable for water service. Join flanges with gasket and bolts according to ASME B31.9.

G. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads.
2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.

H. Steel-Piping, Roll-Grooved Joints: Roll rounded-edge groove in end of pipe according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe grooved joints.

I. Welded Joints: Construct joints according to AWS D10.12/D10.12M, using qualified processes and welding operators according to "Quality Assurance" Article.

1. Shop weld pipe joints where welded piping is indicated. Do not use welded joints for galvanized-steel pipe.

J. Dissimilar-Material Piping Joints: Make joints using adapters compatible with materials of both piping systems.

3.5 VALVE AND SPECIALTIES INSTALLATION

A. Install listed fire-protection valves, trim and drain valves, specialty valves and trim, controls, and specialties according to NFPA 14 and authorities having jurisdiction.

B. Install listed fire-protection shutoff valves supervised-open, located to control sources of water supply except from fire-department connections. Install permanent identification signs indicating portion of system controlled by each valve.

C. Specialty Valves:

1. General Requirements: Install in vertical position for proper direction of flow, in main supply to system.

3.6 HOSE-CONNECTION INSTALLATION

A. Install hose connections adjacent to standpipes.

B. Install freestanding hose connections for access and minimum passage restriction.

C. Install NPS 2-1/2 hose connections with quick-disconnect NPS 2-1/2 by NPS 1-1/2 reducer adapter and flow-restricting device.

D. Install wall-mounted-type hose connections in cabinets. Include pipe escutcheons, with finish matching valves, inside cabinet where water-supply piping penetrates cabinet. Install valves at angle required for connection of fire hose. Comply with requirements for cabinets in Division 10.

3.7 IDENTIFICATION

A. Install labeling and pipe markers on equipment and piping according to requirements in NFPA 14.

B. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Division 21.

3.8 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Tests and Inspections:

1. Leak Test: After installation, charge systems and test for leaks. Repair leaks and retest until no leaks exist.
2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
3. Flush, test, and inspect standpipe systems according to NFPA 14, "System Acceptance" Chapter.
4. Energize circuits to electrical equipment and devices.
5. Coordinate with fire-alarm tests. Operate as required.
6. Coordinate with fire-pump tests. Operate as required.

7. Verify that equipment hose threads are same as local fire-department equipment.

C. Fire-suppression standpipe system will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

3.9 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain specialty valves.

3.10 PIPING SCHEDULE

A. Piping between Fire-Department Connections and Check Valves: Galvanized, standard-weight steel pipe with grooved ends; grooved-end fittings; grooved-end-pipe couplings; and grooved joints.

B. Standard-pressure, wet-type fire-suppression standpipe piping, NPS 2 and smaller, shall be one of the following:

1. Schedule 40, black-steel pipe with roll-grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
2. Schedule 40, black-steel pipe with plain ends; steel welding fittings; and welded joints.

C. Standard-pressure, wet-type fire-suppression standpipe piping, NPS 2.5 to NPS 8, shall be one of the following:

1. Schedule 10, black-steel pipe with roll-grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.

D. High-pressure, wet-type fire-suppression standpipe piping, NPS 2 and smaller, shall be one of the following:

1. Schedule 40, black-steel pipe with roll-grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
2. Schedule 40, black-steel pipe with plain ends; steel welding fittings; and welded joints.

E. High-pressure, wet-type fire-suppression standpipe piping, NPS 2.5 and larger, shall be one of the following:

1. Schedule 40, black-steel pipe with roll-grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
2. Schedule 40, black-steel pipe with plain ends; steel welding fittings; and welded joints.

END OF SECTION

SECTION 211313 - WET-PIPE SPRINKLER SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Pipes, fittings, and specialties.
2. Specialty valves.
3. Sprinklers.

1.3 DEFINITIONS

A. Standard-Pressure Sprinkler Piping: Wet-pipe sprinkler system piping designed to operate at working pressure of 175-psig maximum.

1.4 SYSTEM DESCRIPTIONS

A. Wet-Pipe Sprinkler System: Automatic sprinklers are attached to piping containing water and that is connected to water supply through alarm valve. Water discharges immediately from sprinklers when they are opened. Sprinklers open when heat melts fusible link or destroys frangible device. Hose connections are included if indicated.

1.5 PERFORMANCE REQUIREMENTS

A. Standard-Pressure Piping System Component: Listed for 175-psig minimum working pressure.

B. High-Pressure Piping System Component: Listed for 250-psig minimum working pressure.

C. Contractor shall develop detailed layout and provide, install, and test complete combination sprinkler/standpipe system as indicated on plans and specifications.

D. Drawings are diagrammatic. They are not intended to be absolutely precise; they are not intended to specify or to show every offset, fitting and component. The purpose of the drawings is to indicate a system concept, the main components of the system and the approximate geometrical relationships, provide all other components and materials necessary to make the systems fully complete and operational.

E. NFPA Standards: Sprinkler/standpipe system layout, equipment, specialties, accessories, installation and testing shall comply with the following:

1. NFPA 13 - Installation of Sprinkler Systems.
2. NFPA 14 - Installation of Standpipes and Hose Systems.
3. NFPA 24 - Installation of Private Fire Service Mains and Their Appurtenances

F. All system components shall be UL listed as required by referenced standards above.

G. Where conflicts between referenced standards, codes, drawings, and specifications exist the most stringent shall apply unless approved in writing by the Engineer.

H. Sprinkler protection shall be provided in all spaces including but not limited to:

1. Electric room and closets
2. Tel/data closets
3. Entry vestibules

I. Sprinkler protection shall not be provided in the following locations where indicated on the drawings:

1. Top of passenger elevator hoistways
2. Elevator machine rooms
3. Elevator pits

J. Location of all visible system components shall be approved by the Architect. Provide additional sprinklers above code required minimums as required by the Architect.

K. Sprinkler system design shall be approved by authorities having jurisdiction.

L. Margin of Safety for Available Water Flow and Pressure: 10 psi, including losses through water-service piping, valves, and backflow preventers.

M. Refer to drawings for sprinkler system design criteria.

1.6 SUBMITTALS

A. All submittals shall be in accordance with Division 20, Common Mechanical and Electrical Requirements.

B. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

C. Shop Drawings: For wet-pipe sprinkler systems. Include plans, elevations, sections, details, and attachments to other work. Plans shall include all information required of working plans in NFPA 13.

D. Hydraulic Calculations prepared in accordance with the requirements of NFPA 13 shall accompany the Working Plans. A separate calculation for each system shall be submitted as indicated by the drawings.

E. Coordination Drawings: Prepare a single set of coordination drawings with all mechanical and electrical trades, in accordance with Division 20.

F. Qualification Data: For qualified Installer and system technician.

G. Approved Sprinkler Piping Drawings: Working plans, prepared according to NFPA 13, that have been approved by authorities having jurisdiction, including hydraulic calculations if applicable.

H. Welding certificates.

I. Fire-hydrant flow test report. NFPA 291 formal report performed within one (1) year of the calculations which accompany the shop drawings.

J. Field Test Reports and Certificates: Indicate and interpret test results for compliance with performance requirements and as described in NFPA 13. Include "Contractor's Material and Test Certificate for Aboveground Piping."

K. Field quality-control reports.

L. Operation and Maintenance Data: For sprinkler specialties to include in emergency, operation, and maintenance manuals.

1.7 QUALITY ASSURANCE

A. Qualifications of Installer

1. Installing Contractor shall have successfully installed multiple automatic sprinkler/standpipe systems of similar type and size, for buildings of similar construction and occupancy.

B. Qualifications of System Technician

1. Shop drawings, fabrication plans, system calculations and as-built drawings shall be prepared by or under the direct supervision of a technician with a minimum Level III Certification in Automatic Sprinkler System Layout by the National Institute for Certification in Engineering Technologies (NICET), or a Professional Engineer.

C. Record Drawings

1. As work progresses and for the duration of the Contract, maintain complete and separate set of prints of Working Plans at job site at all times. Record work completed and all deviations from reviewed fabrication plans clearly and accurately. Include actual locations of existing utilities if they differ from design documents. Valve tags shall be recorded on working plans as installed.

D. Welding Procedure

1. Welding procedure(s) to be used and performance of all welders and welding operators shall meet or exceed the requirements of AWS B2.1 Specification for Welding Procedure and Performance Qualification.
2. Contractor shall have a written quality control program, mark all welds and maintain certified records for all welding in accordance with NFPA 13 requirements.

E. Project Punchlist Procedure

1. When the contract work is substantially complete, the Contractor shall physically walk down the installation and prepare a punchlist containing an itemization of work remaining

for 100 percent completion. The punchlist shall be submitted to the Architect prior to request for final project visit.

F. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

G. NFPA Standards: Sprinkler system equipment, specialties, accessories, installation, and testing shall comply with the following:

1. NFPA 13, "Installation of Sprinkler Systems."
2. NFPA 24, "Installation of Private Fire Service Mains and Their Appurtenances."

1.8 COORDINATION

A. Contractor shall coordinate with other trades in accordance with Division 20, Common Mechanical and Electrical Requirements.

1.9 EXTRA MATERIALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Sprinkler Cabinets: Finished, wall-mounted, steel cabinet with hinged cover, and with space for minimum of six spare sprinklers plus sprinkler wrench. Include number of sprinklers required by NFPA 13 and sprinkler wrench. Include separate cabinet with sprinklers and wrench for each type of sprinkler used on Project.
2. Custom Sprinklers: Provide a minimum of six spare coverplates or sprinklers for each custom finish in addition to spares required by NFPA 13.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Sprinkler system equipment, specialties, accessories, installation, and testing shall comply with the following:

1. NFPA 13.

B. Standard-Pressure Piping System Component: Listed for 175-psig minimum working pressure.

C. Delegated Design: Engage a qualified professional engineer, as defined in Division 01, to design wet-pipe sprinkler systems.

1. Available fire-hydrant flow test records indicate the following conditions:

a. Date: Insert test date.
b. Time: Insert time.
c. Performed by: Insert firm.
d. Location of Residual Fire Hydrant R: Insert location.

e. Location of Flow Fire Hydrant F: Insert location.
f. Static Pressure at Residual Fire Hydrant R: Insert psig.
g. Measured Flow at Flow Fire Hydrant F: Insert gpm.
h. Residual Pressure at Residual Fire Hydrant R: Insert psig.

2. Sprinkler system design shall be approved by authorities having jurisdiction.

a. Margin of Safety for Available Water Flow and Pressure: 10 percent, including losses through water-service piping, valves, and backflow preventers.
b. Sprinkler Occupancy Hazard Classifications:

1) Building Service Areas: Ordinary Hazard, Group 1.
2) Classrooms (non-laboratory spaces) Light Hazard.
3) Classrooms (laboratory spaces) Class A or B (high fire hazard): Ordinary Hazard Group 2.
4) Classrooms (laboratory spaces) Class C or D (low fire hazard): Ordinary Hazard Group 1.
5) Electrical Equipment Rooms: Ordinary Hazard, Group 1.
6) General Storage Areas: Ordinary Hazard, Group 1.
7) Libraries except Stack Areas: Light Hazard.
8) Library Stack Areas: Ordinary Hazard, Group 2.
9) Machine Shops: Ordinary Hazard, Group 2.
10) Mechanical Equipment Rooms: Ordinary Hazard, Group 1.
11) Office and Public Areas: Light Hazard.
12) Retail: Ordinary Hazard, Group 2.
13) Restaurant Service Areas: Ordinary Hazard, Group 1.
14) Generator Room: Extra Hazard, Group 1.

3. Minimum Density for Automatic-Sprinkler Piping Design:

a. Light-Hazard Occupancy: 0.10 gpm over 1500-sq. ft. area.
b. Ordinary-Hazard, Group 1 Occupancy: 0.15 gpm over 1500-sq. ft. area.
c. Ordinary-Hazard, Group 2 Occupancy: 0.20 gpm over 1500-sq. ft. area.
d. Extra-Hazard, Group 1 Occupancy: 0.30 gpm over 2500-sq. ft. area.

4. Maximum Protection Area per Sprinkler: According to UL listing.
5. Maximum Protection Area per Sprinkler:

a. Office Spaces: 225 sq. ft.
b. Storage Areas: 130 sq. ft.
c. Mechanical Equipment Rooms: 130 sq. ft.
d. Electrical Equipment Rooms: 130 sq. ft.
e. Generator Rooms: 100 sq. ft.

f. Other Areas: According to NFPA 13 recommendations unless otherwise indicated.

2.2 STEEL PIPE AND FITTINGS

A. Standard-Weight, Black-Steel Pipe: ASTM A 53/A 53M, Type E, Grade B. Pipe ends may be factory or field formed to match joining method.

B. Schedule 10: ASTM A 135/A 135M or ASTM A 795/A 795M, Schedule 10 in NPS 5 and smaller; and NFPA 13-specified wall thickness in NPS 6 to NPS 10, plain end.

C. Malleable- or Ductile-Iron Unions: UL 860.

D. Cast-Iron Flanges: ASME 16.1, Class 125.

E. Steel Flanges and Flanged Fittings: ASME B16.5, Class 150.

1. Pipe-Flange Gasket Materials: AWWA C110, rubber, flat face, 1/8 inch thick ASME B16.21, nonmetallic and asbestos free or EPDM rubber gasket.

a. Class 125 and Class 250, Cast-Iron, Flat-Face Flanges: Full-face gaskets.
b. Class 150 and Class 300, Ductile-Iron or -Steel, Raised-Face Flanges: Ring-type gaskets.

2. Metal, Pipe-Flange Bolts and Nuts: Carbon steel unless otherwise indicated.

F. Steel Welding Fittings: ASTM A 234/A 234M and ASME B16.9.

1. Welding Filler Metals: Comply with AWS D10.12M/D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

G. Grooved-Joint, Steel-Pipe Appurtenances:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Anvil International, Inc.
b. Tyco Fire & Building Products LP.
c. Victaulic Company.

2. Pressure Rating: 250 psig minimum.
3. Painted, Grooved-End Fittings for Steel Piping: ASTM A 47/A 47M, malleable-iron casting or ASTM A 536, ductile-iron casting; with dimensions matching steel pipe.
4. Grooved-End-Pipe Couplings for Steel Piping: AWWA C606 and UL 213, rigid pattern, unless otherwise indicated, for steel-pipe dimensions. Include ferrous housing sections, EPDM-rubber gasket, and bolts and nuts.

2.3 SPECIALTY VALVES

A. Listed in UL's "Fire Protection Equipment Directory" or FM Global's "Approval Guide."

B. Pressure Rating:

1. Standard-Pressure Piping Specialty Valves: 175-psig minimum.

C. Body Material: Cast or ductile iron.

D. Size: Same as connected piping.

E. End Connections: Flanged or grooved.

F. Alarm Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Reliable Automatic Sprinkler Co., Inc.
   b. Tyco Fire & Building Products LP.
   c. Victaulic Company.
   d. Viking Corporation.

2. Standard: UL 193.
3. Design: For horizontal or vertical installation.
4. Include trim sets for bypass, drain, electrical sprinkler alarm switch, pressure gages, retarding chamber, and fill-line attachment with strainer.
5. Drip Cup Assembly: Pipe drain with check valve to main drain piping.

G. Automatic (Ball Drip) Drain Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following :

   a. AFAC Inc.
   b. Reliable Automatic Sprinkler Co., Inc.
   c. Tyco Fire & Building Products LP.

2. Standard: UL 1726.
3. Pressure Rating: 175 psig minimum.
4. Type: Automatic draining, ball check.
5. Size: NPS 3/4.
6. End Connections: Threaded.

2.4 SPRINKLER PIPING SPECIALTIES

A. Branch Outlet Fittings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Anvil International, Inc.
   b. National Fittings, Inc.
   c. Tyco Fire & Building Products LP.
   d. Victaulic Company.

2. Standard: UL 213.
3. Pressure Rating: 175 psig minimum.
4. Body Material: Ductile-iron housing with EPDM seals and bolts and nuts.
5. Type: Mechanical-T and -cross fittings.
6. Configurations: Full ductile-iron housing with branch outlets. Snap on and strapless type shall not be used.
7. Size: Of dimension to fit onto sprinkler main and with outlet connections as required to match connected branch piping.
8. Branch Outlets: Grooved, plain-end pipe, or threaded.

B. Flow Detection and Test Assemblies:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. AGF Manufacturing Inc.
   b. Reliable Automatic Sprinkler Co., Inc.
   c. Tyco Fire & Building Products LP.
   d. Victaulic Company.

2. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
3. Pressure Rating: 175 psig minimum.
4. Body Material: Cast- or ductile-iron housing with orifice, sight glass, and integral test valve.
5. Size: Same as connected piping.
6. Inlet and Outlet: Threaded.

C. Sprinkler Inspector's Test Fittings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. AGF Manufacturing Inc.
   b. Tyco Fire & Building Products LP.
   c. Victaulic Company.
   d. Viking Corporation.

2. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
3. Pressure Rating: 175 psig minimum.
4. Body Material: Cast- or ductile-iron housing with sight glass.
5. Size: Same as connected piping.
6. Inlet and Outlet: Threaded.

D. Flexible, Sprinkler Hose Fittings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Tyco Fire and Building Products LP.
   b. FlexHead Industries, Inc.
   c. Viking Corporation.
   d. Victaulic Company,

2. Standard: UL 1474.
3. Type: Flexible hose for connection to sprinkler, with bracket for connection to ceiling grid. Connection shall be minimum 1 inch internal diameter corrugated stainless steel tubing with braided stainless steel jacket. Assembly shall be UL-listed and FM approved.
4. Pressure Rating: 175 psig minimum.
5. Size: Same as connected piping, for sprinkler.

2.5 SPRINKLERS

A. Manufacturers: Subject to compliance with requirements, provide products by the following:

1. Reliable Automatic Sprinkler Co., Inc.
2. Tyco Fire & Building Products LP.
3. Victaulic Company.
4. Viking Corporation.

B. General Requirements:

1. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
2. Pressure Rating for Automatic Sprinklers: 175 psig minimum.

C. Automatic Sprinklers with Heat-Responsive Element:

1. Nonresidential Applications: UL 199.
2. Characteristics: Nominal 1/2-inch orifice with discharge coefficient K of 5.6, and for "Ordinary" temperature classification rating unless otherwise indicated or required by application.

D. Sprinkler Finishes:

1. Bronze.
2. Painted.

E. Sprinkler Guards:

1. Standard: UL 199 listed for use with sprinkler.
2. Type: Wire cage with fastening device for attaching to sprinkler.

PART 3 - EXECUTION

3.1 PREPARATION

A. Perform fire-hydrant flow test according to NFPA 13 and NFPA 291. Use results for system design calculations required in "Quality Assurance" Article.

B. Report test results promptly and in writing.

3.2 PIPING INSTALLATION

A. Locations and Arrangements: Drawing plans, schematics, and diagrams indicate general location and arrangement of piping. Install piping as indicated on approved working plans.

1. Deviations from approved working plans for piping require written approval from authorities having jurisdiction. File written approval with Architect before deviating from approved working plans.

2. Coordinate layout and installation of sprinklers with other construction that penetrates ceilings, including light fixtures, HVAC equipment, and partition assemblies.

B. Piping Standard: Comply with NFPA 13 requirements for installation of sprinkler piping.

C. Use listed fittings to make changes in direction, branch takeoffs from mains, and reductions in pipe sizes.

D. Install unions adjacent to each valve in pipes NPS 2 and smaller.

E. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 and larger end connections.

F. Install "Inspector's Test Connections" in sprinkler system piping, complete with shutoff valve, and sized and located according to NFPA 13.

G. Install sprinkler piping with drains for complete system drainage.

H. Install sprinkler control valves, test assemblies, and drain risers adjacent to standpipes when sprinkler piping is connected to standpipes.

I. Install automatic (ball drip) drain valve at each check valve for fire-department connection, to drain piping between fire-department connection and check valve. Install drain piping to and spill over floor drain or to outside building.

J. Install alarm devices in piping systems.

K. Install hangers and supports for sprinkler system piping according to NFPA 13. Comply with requirements for hanger materials in NFPA 13.

L. Install pressure gages on riser or feed main, at each sprinkler test connection, and at top of each standpipe. Include pressure gages with connection not less than NPS 1/4 and with soft-metal seated globe valve, arranged for draining pipe between gage and valve. Install gages to permit removal, and install where they are not subject to freezing.

M. Fill sprinkler system piping with water.

N. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 210517 Division 21.

O. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Division 21.

P. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Division 21.

3.3 JOINT CONSTRUCTION

A. Install couplings, flanges, flanged fittings, unions, nipples, and transition and special fittings that have finish and pressure ratings same as or higher than system's pressure rating for aboveground applications unless otherwise indicated.

B. Install unions adjacent to each valve in pipes NPS 2 and smaller.

C. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 and larger end connections.

D. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

E. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.

F. Flanged Joints: Select appropriate gasket material in size, type, and thickness suitable for water service. Join flanges with gasket and bolts according to ASME B31.9.

G. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads.
2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.

H. Welded Joints: Construct joints according to AWS D10.12M/D10.12, using qualified processes and welding operators according to "Quality Assurance" Article.

1. Shop weld pipe joints where welded piping is indicated. Do not use welded joints for galvanized-steel pipe.

I. Steel-Piping, Roll-Grooved Joints: Roll rounded-edge groove in end of pipe according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe grooved joints.

3.4 VALVE AND SPECIALTIES INSTALLATION

A. Install listed fire-protection valves, trim and drain valves, specialty valves and trim, controls, and specialties according to NFPA 13 and authorities having jurisdiction.

B. Install listed fire-protection shutoff valves supervised open, located to control sources of water supply except from fire-department connections. Install permanent identification signs indicating portion of system controlled by each valve.

C. Specialty Valves:

1. Install valves in vertical position for proper direction of flow, in main supply to system.

3.5 SPRINKLER INSTALLATION

A. Install sprinklers in suspended ceilings in center of acoustical ceiling panels.

B. Install sprinklers into flexible, sprinkler hose fittings, and install hose into bracket on ceiling grid.

3.6 IDENTIFICATION

A. Install labeling and pipe markers on equipment and piping according to requirements in NFPA 13.

B. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Division 26.

3.7 FIELD QUALITY CONTROL

A. Perform the following tests and inspections with the assistance of a factory-authorized service representative:

1. Leak Test: After installation, charge systems and test for leaks. Repair leaks and retest until no leaks exist.
2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
3. Flush, test, and inspect sprinkler systems according to NFPA 13, "Systems Acceptance" Chapter.
4. Energize circuits to electrical equipment and devices.
5. Coordinate with fire-alarm tests. Operate as required.
6. Coordinate with fire-pump tests. Operate as required.
7. Verify that equipment hose threads are same as local fire department equipment.

B. Sprinkler piping system will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.

3.8 CLEANING

A. Clean dirt and debris from sprinklers.

B. Only sprinklers with their original factory finish are acceptable. Remove and replace any sprinklers that are painted or have any other finish than their original factory finish.

3.9 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain specialty valves and pressure-maintenance pumps.

1. Provide 16 hours of training, divided into two 8-hour sessions.

3.10 PIPING SCHEDULE

A. Piping between Fire Department Connections and Check Valves: Galvanized, standard-weight steel pipe with grooved ends, grooved-end fittings, grooved-end-pipe couplings, and grooved joints.

B. Sprinkler specialty fittings may be used, downstream of control valves, instead of specified fittings.

C. Standard-pressure, wet-pipe sprinkler system, NPS 2 and smaller, shall be the following:

1. Schedule 40, black-steel pipe with threaded ends; uncoated, gray-iron threaded fittings; and threaded joints.

D. Standard-pressure, wet-pipe sprinkler system, NPS 2-1/2 and larger, shall be one of the following:

1. Schedule 40, black-steel pipe with threaded ends; uncoated, gray-iron threaded fittings; and threaded joints.
2. Schedule 40, black-steel pipe with cut-grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
3. Schedule 10, black-steel pipe with roll-grooved ends; painted, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.

3.11 SPRINKLER SCHEDULE

A. Use sprinkler types in subparagraphs below for the following applications:

1. Rooms without Ceilings: Upright sprinklers.
2. Rooms with Suspended Ceilings: Concealed sprinklers.
3. Wall Mounting: Sidewall sprinklers.

B. Provide sprinkler types in subparagraphs below with finishes indicated.

1. Concealed Sprinklers: Rough brass, with factory-painted white cover plate.
2. Flush Sprinklers: Bright chrome, with painted white escutcheon.
3. Recessed Sprinklers: Bright chrome, with bright chrome escutcheon.
4. Upright or Pendent and/or Sidewall Sprinklers: Chrome plated in finished spaces exposed to view; rough bronze in unfinished spaces not exposed to view; wax coated where exposed to acids, chemicals, or other corrosive fumes.

END OF SECTION

SECTION 211316 - DRY-PIPE SPRINKLER SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Pipes, fittings, and specialties.
2. Specialty valves.
3. Sprinkler specialty pipe fittings.
4. Sprinklers.
5. Alarm devices.
6. Control panels.

1.3 DEFINITIONS

A. Standard-Pressure Sprinkler Piping: Dry-pipe sprinkler system piping designed to operate at working pressure of 175-psig maximum.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Shop Drawings: For dry-pipe sprinkler systems.

1. Include plans, elevations, sections, and attachment details.
2. Include diagrams for power, signal, and control wiring.

C. Delegated-Design Submittal: For dry-pipe sprinkler systems indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.5 SUBMITTALS

A. All submittals shall be in accordance with Division 20.

B. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

C. Shop Drawings: For dry-pipe sprinkler systems. Include plans, elevations, sections, details, and attachments to other work. Plans shall include all information required of working plans in NFPA 13.

D. Hydraulic Calculations prepared in accordance with the requirements of NFPA 13 shall accompany the Working Plans. A separate calculation for each system shall be submitted as indicated by the drawings.

E. Coordination Drawings: Prepare a single set of coordination drawings with all mechanical and electrical trades, in accordance with Division 20.

F. Qualification Data: For qualified Installer and system technician.

G. Approved Sprinkler Piping Drawings: Working plans, prepared according to NFPA 13, that have been approved by authorities having jurisdiction, including hydraulic calculations if applicable.

H. Fire-hydrant flow test report. NFPA 291 formal report performed within one (1) year of the calculations which accompany the shop drawings.

I. Field Test Reports and Certificates: Indicate and interpret test results for compliance with performance requirements and as described in NFPA 13. Include "Contractor's Material and Test Certificate for Aboveground Piping."

J. Field quality-control reports.

K. Operation and Maintenance Data: For sprinkler specialties to include in emergency, operation, and maintenance manuals.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For dry-pipe sprinkler systems and specialties to include in emergency, operation, and maintenance manuals.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Sprinkler Cabinets: Finished, wall-mounted, steel cabinet with hinged cover, and with space for minimum of six spare sprinklers plus sprinkler wrench. Include number of sprinklers required by NFPA 13 and sprinkler wrench. Include separate cabinet with sprinklers and wrench for each type of sprinkler used on Project.

1.8 QUALITY ASSURANCE

A. Installer Qualifications:

1. Installer's responsibilities include designing, fabricating, and installing sprinkler systems and providing professional engineering services needed to assume engineering responsibility. Base calculations on results of fire-hydrant flow test.

    a. Engineering Responsibility: Preparation of working plans, calculations, and field test reports by a qualified professional engineer.

1.9 FIELD CONDITIONS

A. Interruption of Existing Sprinkler Service: Do not interrupt sprinkler service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary sprinkler service according to requirements indicated:

1. Notify Construction Manager no fewer than two days in advance of proposed interruption of sprinkler service.
2. Do not proceed with interruption of sprinkler service without Construction Manager's written permission.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTIONS

A. Single-Interlock Preaction Sprinkler System: Automatic sprinklers are attached to piping containing low-pressure air. Actuation of fire-detection system, located in same area as sprinklers, opens deluge valve, permitting water to flow into sprinkler piping and to discharge from opened sprinklers.

B. Double-Interlock Preaction Sprinkler System: Automatic sprinklers are attached to piping containing low-pressure air. Actuation of a fire-detection system in the same area as sprinklers opens the deluge valve permitting water to flow into the sprinkler piping; a closed solenoid valve in the sprinkler piping is opened by another fire-detection device; then water will discharge from sprinklers that have opened.

2.2 PERFORMANCE REQUIREMENTS

A. Sprinkler system equipment, specialties, accessories, installation, and testing shall comply with the following:

1. NFPA 13.

B. Standard-Pressure Piping System Component: Listed for 175-psig minimum working pressure.

C. Delegated Design: Engage a qualified professional engineer, as defined in Division 01, to design dry-pipe sprinkler systems.

1. Available fire-hydrant flow test records indicate the following conditions:

    a. Date: Insert test date.
    b. Time: Insert time.

c. Performed by: Insert firm.
d. Location of Residual Fire Hydrant R: Insert location.
e. Location of Flow Fire Hydrant F: Insert location.
f. Static Pressure at Residual Fire Hydrant R: Insert psig.
g. Measured Flow at Flow Fire Hydrant F: Insert gpm.
h. Residual Pressure at Residual Fire Hydrant R: Insert psig.

D. Sprinkler system design shall be approved by authorities having jurisdiction.

1. Margin of Safety for Available Water Flow and Pressure: 10 percent, including losses through water-service piping, valves, and backflow preventers.
2. Sprinkler Occupancy Hazard Classifications:

a. Main Distribution Frame (MDF), Main Tel/Data Room: Ordinary hazard, Group 1.
b. Magnetic Resonance Imaging (MRI), Ordinary hazard, Group 1.

3. Minimum Density for Automatic-Sprinkler Piping Design:

a. Ordinary-Hazard, Group 1 Occupancy: 0.15 gpm over 1500-sq. ft.

4. Maximum Protection Area per Sprinkler: According to UL listing.
5. Maximum Protection Area per Sprinkler:

a. Main Distribution Frame (MDF) Equipment Rooms: 130 sq. ft.
b. Magnetic Resonance Imaging (MRI) and associated rooms: 130 sq. ft.
c. Other Areas: According to NFPA 13 recommendations unless otherwise indicated.

6. Total Combined Hose-Stream Demand Requirement: According to NFPA 13 unless otherwise indicated:

a. Ordinary-Hazard Occupancies: 250 gpm for 60 to 90 minutes.

2.3 STEEL PIPE AND FITTINGS

A. Schedule 40, Galvanized-Steel Pipe: ASTM A 53/A 53M, Type E, Pipe ends may be factory or field formed to match joining method.

B. Galvanized-Steel Pipe Nipples: ASTM A 733, made of ASTM A 53/A 53M, standard-weight, seamless steel pipe with threaded ends.

C. Galvanized-Steel Couplings: ASTM A 865/A 865M, threaded.

D. Galvanized, Gray-Iron Threaded Fittings: ASME B16.4, Class 125, standard pattern.

E. Malleable- or Ductile-Iron Unions: UL 860.

F. Cast-Iron Flanges: ASME B16.1, Class 125.

G. Grooved-Joint, Steel-Pipe Appurtenances:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

a. Anvil International, Inc.
b. Tyco Fire & Building Products LP.
c. Victaulic Company.

2. Pressure Rating: 175 psig (1200 kPa) minimum.
3. Galvanized, Grooved-End Fittings for Steel Piping: ASTM A 47/A 47M, malleable-iron casting or ASTM A 536, ductile-iron casting; with dimensions matching steel pipe.
4. Galvanized, Grooved-End-Pipe Couplings for Steel Piping: AWWA C606 and UL 213, rigid pattern, unless otherwise indicated, for steel-pipe dimensions. Include ferrous housing sections, EPDM-rubber flush seal gasket, and bolts and nuts.
5. Pressure Rating: 175-psig minimum.
6. Galvanized, Grooved-End Fittings for Steel Piping: ASTM A 47/A 47M, malleable-iron casting or ASTM A 536, ductile-iron casting, with dimensions matching steel pipe.
7. Grooved-End-Pipe Couplings for Steel Piping: AWWA C606 and UL 213 rigid pattern, unless otherwise indicated, for steel-pipe dimensions. Include ferrous housing sections, EPDM-rubber gasket, and bolts and nuts.

2.4 SPECIALTY VALVES

A. Listed in UL's "Fire Protection Equipment Directory" or FM Global's "Approval Guide."

B. Pressure Rating:

1. Standard-Pressure Piping Specialty Valves: 175-psig minimum.

C. Body Material: Cast or ductile iron.

D. Size: Same as connected piping.

E. End Connections: Grooved.

2.5 SPECIALTY VALVES

A. Preaction Valves:

1. Manufacturers: Subject to compliance with requirements, provide products the following:

a. Reliable Automatic Sprinkler Co., Inc.
b. Tyco Fire & Building Products LP.
c. Victaulic Company.
d. Viking Corporation.
e. Standard: UL 260.
f. Type: Automatic device to maintain minimum air pressure in piping.
g. Include shutoff valves to permit servicing without shutting down sprinkler piping, bypass valve for quick filling, pressure regulator or switch to maintain pressure, strainer, pressure ratings with 14- to 60-psig adjustable range, and 175-psig outlet pressure.

1. Air Compressor:

a. Manufacturers: Subject to compliance with requirements, provide products by one of the following

1) Gast Manufacturing Inc.
2) General Air Products, Inc.

2. Standard: UL's "Fire Protection Equipment Directory" or FM Global's "Approval Guide."
3. Motor Horsepower: Fractional.
4. Power: 120-V ac, 60 Hz, single phase.
5. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application

2.6 SPRINKLER PIPING SPECIALTIES

A. General Requirements for Dry-Pipe System Fittings: UL listed for dry-pipe service.

2.7 SPRINKLER PIPING SPECIALTIES

A. Branch Outlet Fittings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Anvil International, Inc.
b. National Fittings, Inc.
c. Tyco Fire & Building Products LP.
d. Victaulic Company.

2. Standard: UL 213.
3. Pressure Rating: 175 psig minimum.
4. Body Material: Ductile-iron housing with EPDM seals and bolts and nuts.
5. Type: Mechanical-T and -cross fittings.
6. Configurations: Full ductile-iron housing with branch outlets. Snap on and strapless type shall not be used.
7. Size: Of dimension to fit onto sprinkler main and with outlet connections as required to match connected branch piping.
8. Branch Outlets: Grooved, plain-end pipe, or threaded.

B. Flow Detection and Test Assemblies:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. AGF Manufacturing Inc.
b. Reliable Automatic Sprinkler Co., Inc.
c. Tyco Fire & Building Products LP.
d. Victaulic Company.

2. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
3. Pressure Rating: 175 psig minimum.

4. Body Material: Cast- or ductile-iron housing with orifice, sight glass, and integral test valve.
5. Size: Same as connected piping.
6. Inlet and Outlet: Threaded.

C. Sprinkler Inspector's Test Fittings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. AGF Manufacturing Inc.
   b. Tyco Fire & Building Products LP.
   c. Victaulic Company.
   d. Viking Corporation.

2. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
3. Pressure Rating: 175 psig minimum.
4. Body Material: Cast- or ductile-iron housing with sight glass.
5. Size: Same as connected piping.
6. Inlet and Outlet: Threaded.

2.8 SPRINKLERS

A. Manufacturers: Subject to compliance with requirements, provide products by the following:

1. Reliable Automatic Sprinkler Co., Inc.
2. Tyco Fire & Building Products LP.
3. Victaulic Company.
4. Viking Corporation.

B. General Requirements:

1. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
2. Pressure Rating for Automatic Sprinklers: 175 psig minimum.

C. Automatic Sprinklers with Heat-Responsive Element:

1. Nonresidential Applications: UL 199.
2. Characteristics: Nominal 1/2-inch orifice with discharge coefficient K of 5.6, and for "Ordinary" temperature classification rating unless otherwise indicated or required by application.

D. Sprinkler Finishes:

1. Bronze.
2. Painted.

E. Sprinkler Guards:

1. Standard: UL 199 listed for use with sprinkler.

2. Type: Wire cage with fastening device for attaching to sprinkler.

2.9 CONTROL PANELS

A. Description: Single-area, two-area, or single-area cross-zoned type control panel as indicated, including NEMA ICS 6, Type 1 enclosure, detector, alarm, and solenoid-valve circuitry for operation of deluge valves.

1. Listed in UL's "Fire Protection Equipment Directory" or FM Global's "Approval Guide" when used with thermal detectors and Class A detector circuit wiring.
2. Electrical characteristics are 120-V ac, 60 Hz, with 24-V dc rechargeable batteries.
3. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application

B. Panels Components:

1. Power supply.
2. Battery charger.
3. Standby batteries.
4. Field-wiring terminal strip.
5. Electrically supervised solenoid valves and polarized fire-alarm bell.
6. Lamp test facility.
7. Single-pole, double-throw auxiliary alarm contacts.
8. Rectifier.

PART 3 - EXECUTION

3.1 PREPARATION

A. Perform fire-hydrant flow test according to NFPA 13 and NFPA 291. Use results for system design calculations required in "Quality Assurance" Article.

B. Report test results promptly and in writing.

3.2 PIPING INSTALLATION

A. Locations and Arrangements: Drawing plans, schematics, and diagrams indicate general location and arrangement of piping. Install piping as indicated on approved working plans.

1. Deviations from approved working plans for piping require written approval from authorities having jurisdiction. File written approval with Architect before deviating from approved working plans.
2. Coordinate layout and installation of sprinklers with other construction that penetrates ceilings, including light fixtures, HVAC equipment, and partition assemblies.

B. Piping Standard: Comply with NFPA 13 requirements for installation of sprinkler piping.

C. Use listed fittings to make changes in direction, branch takeoffs from mains, and reductions in pipe sizes.

D. Install unions adjacent to each valve in pipes NPS 2 and smaller.

E. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 and larger end connections.

F. Install "Inspector's Test Connections" in sprinkler system piping, complete with shutoff valve, and sized and located according to NFPA 13.

G. Install sprinkler piping with drains for complete system drainage.

H. Install sprinkler control valves, test assemblies, and drain risers adjacent to standpipes when sprinkler piping is connected to standpipes.

I. Install automatic (ball drip) drain valves to drain piping between fire department connections and check valves. Drain to floor drain or to outside building.

J. Connect compressed-air supply to preaction sprinkler piping.

K. Connect air compressor to the following piping and wiring:

1. Pressure gages and controls.
2. Electrical power system.
3. Fire-alarm devices, including low-pressure alarm.

L. Install alarm devices in piping systems.

M. Install hangers and supports for sprinkler system piping according to NFPA 13. Comply with requirements in NFPA 13.

N. Install pressure gages on riser or feed main, at each sprinkler test connection, and at top of each standpipe. Include pressure gages with connection not less than NPS 1/4 (DN 8) and with soft-metal seated globe valve, arranged for draining pipe between gage and valve. Install gages to permit removal, and install where they are not subject to freezing.

O. Drain dry-pipe sprinkler piping.

P. Pressurize and check dry-pipe sprinkler system piping and air-pressure maintenance devices.

Q. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Division 21.

R. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Division 21

S. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Division 20.

3.3 JOINT CONSTRUCTION

A. Install couplings, flanges, flanged fittings, unions, nipples, and transition and special fittings that have finish and pressure ratings same as or higher than system's pressure rating for aboveground applications unless otherwise indicated.

B. Install unions adjacent to each valve in pipes NPS 2 and smaller.

C. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 and larger end connections.

D. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

E. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.

F. Flanged Joints: Select appropriate gasket material in size, type, and thickness suitable for water service. Join flanges with gasket and bolts according to ASME B31.9.

G. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads.
2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.

H. Steel-Piping, Roll-Grooved Joints: Roll square-edge groove in end of pipe according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe joints.

3.4 VALVE AND SPECIALTIES INSTALLATION

A. Install listed fire-protection valves, trim and drain valves, specialty valves and trim, controls, and specialties according to NFPA 13 and authorities having jurisdiction.

B. Install listed fire-protection shutoff valves supervised open, located to control sources of water supply except from fire-department connections. Install permanent identification signs indicating portion of system controlled by each valve.

C. Install check valve in each water-supply connection. Install backflow preventers instead of check valves in potable-water-supply sources.

D. Specialty Valves:

1. Install valves in vertical position for proper direction of flow, in main supply to system.
2. Install preaction valves with trim sets for air supply, drain, priming level, alarm connections, ball drip valves, pressure gages, priming chamber attachment, and fill-line attachment.

    a. Install air compressor and compressed-air-supply piping.
    b. Install air-pressure maintenance device with shutoff valves to permit servicing without shutting down sprinkler system; bypass valve for quick system filling; pressure regulator or switch to maintain system pressure; strainer; pressure ratings with 14- to 60-psig adjustable range; and 175-psig maximum inlet pressure.
    c. Install compressed-air-supply piping from building's compressed-air piping system.

3.5 SPRINKLER INSTALLATION

A. Install sprinklers in suspended ceilings in center of acoustical ceiling panels.

B. Install dry-type sprinklers with water supply from heated space. Do not install pendent or sidewall, wet-type sprinklers in areas subject to freezing.

3.6 IDENTIFICATION

A. Install labeling and pipe markers on equipment and piping according to requirements in NFPA 13.

B. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Division 26.

3.7 FIELD QUALITY CONTROL

A. Perform the following tests and inspections with the assistance of a factory-authorized service representative:

1. Leak Test: After installation, charge systems and test for leaks. Repair leaks and retest until no leaks exist.
2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
3. Flush, test, and inspect sprinkler systems according to NFPA 13, "Systems Acceptance" Chapter.
4. Energize circuits to electrical equipment and devices.
5. Start and run air compressors.
6. Verify that equipment hose threads are same as local fire department equipment.

B. Sprinkler piping system will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.

3.8 CLEANING

A. Clean dirt and debris from sprinklers.

B. Only sprinklers with their original factory finish are acceptable. Remove and replace any sprinklers that are painted or have any other finish than their original factory finish.

3.9 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain specialty valves.

1. Provide 16 hours of training, divided into two 8-hour sessions.

3.10 PIPING SCHEDULE

A. Sprinkler specialty fittings may be used, downstream of control valves, instead of specified fittings.

B. Standard-pressure, dry-pipe sprinkler system, NPS 2 and smaller, shall be the following:

1. Schedule 40, galvanized-steel pipe with threaded ends; galvanized, gray-iron threaded fittings; and threaded joints.

C. Standard-pressure, dry-pipe sprinkler system, NPS 2-1/2 and larger, shall be one of the following:

1. Schedule 40, galvanized-steel pipe with threaded ends; galvanized, gray-iron threaded fittings; and threaded joints.
2. Schedule 40, galvanized-steel pipe with roll-grooved ends; galvanized, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.

3.11 SPRINKLER SCHEDULE

A. Use sprinkler types in subparagraphs below for the following applications:

1. Rooms without Ceilings: Upright sprinklers.
2. Rooms with Suspended Ceilings: Dry pendent sprinklers.
3. Wall Mounting: Dry sidewall sprinklers.

B. Provide sprinkler types in subparagraphs below with finishes indicated.

1. Recessed Sprinklers: Bright chrome, with bright chrome escutcheon.
2. Upright or Pendent and/or Sidewall Sprinklers: Chrome plated in finished spaces exposed to view; rough bronze in unfinished spaces not exposed to view; wax coated where exposed to acids, chemicals, or other corrosive fumes.

END OF SECTION

SECTION 213000 - HYBRID FIRE-EXTINGUISHING SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Piping and piping specialties.
2. System components.

1.3 DEFINITIONS

A. AHJ: Authority Having Jurisdiction

1.4 SYSTEM DESCRIPTION

A. Hybrid fire-extinguishing system: Open emitters connected to nitrogen cylinders and water tank(s) via two separate fixed piping networks. Actuation of a fire-detection or manual release associated with protected space energizes solenoids on nitrogen cylinders and water supply discharging hybrid nitrogen-water mist through all emitters in the associated discharge zone.

1. Refer to division 28 for detection, notification and releasing systems.

1.5 DELEGATED DESIGN

A. Provide design services for the hybrid fire-extinguishing systems conforming to the system arrangement, performance criteria, and design criteria requirements identified within Division 21 and design drawings.

1. Prepare and submit all drawings, calculations, product data sheets, and forms required for building and fire protection permitting.

1.6 SUBMITTALS

A. Comply with Division 20 for common mechanical/electrical requirements.

B. Comply with Division 21 specifications and drawings; state/local regulations; and manufacturer's requirements. For purposes of applying manufacturer's requirements, all identified documentation requirements are a mandatory part of the Work, including those that "apply only where required by other governing laws, codes, or standards, by other parts of the Code; or by project specifications or drawings".

C. Submit "Pre-installation Submittals" prior to applying for authority having jurisdiction installation permits (where required) and system installation.

D. Submit "Approval Testing Submittals" after successful initial system testing and prior to scheduling authority having jurisdiction final approval demonstration testing.

E. Submit “Closeout Submittals” as part of project closeout procedure.

1.7 PRE-INSTALLATION SUBMITTALS

A. Qualification Data: For Designers and Field Technicians.

1. Include NICET/PE certifications and hybrid fire-extinguishing system manufacturer integrator certifications.

B. Product Data: For each type of product, including furnished options and accessories. All components shall be UL listed and/or FM approved.

1. Include approvals and listings, construction details, material descriptions, dimensions, profiles, and finishes.

2. Include rated capacities, operating characteristics, and electrical characteristics.

3. Include statement from manufacturer that all equipment and components have been tested as a system and meet all requirements of this Specification.

C. Sample Warranty: For special warranty.

D. Shop Drawings: For each hybrid fire-extinguishing system; comply with manufacturer’s published “Required Documentation”.

1. Floor plans. Include floor plans to indicate final panel, water tank(s), nitrogen storage cylinders, piping and emitter locations. All system components shall be coordinated with partitions, ceilings, structure and other trades as applicable.

2. Installation details. Include panel container securement, solenoid, piping support/restraint, and emitter installation details.

3. Calculations – General System Design. Include emitter quantity, discharge time, nitrogen quantity, water quantity calculations based upon zone volume, altitude correction factor, flow rate and effective oxygen level. Comply with manufacturer published requirements.

1.8 APPROVAL TESTING SUBMITTALS

A. Statement of Completion: Written statement that system has been installed in accordance with approved plans and tested in accordance with the manufacturer’s published instructions.

B. Record of Inspection and Testing. Detailed documentation of completed 100 percent hybrid fire-extinguishing system initial acceptance testing.

1.9 CLOSEOUT SUBMITTALS

A. Record Drawings. Provide complete Shop Drawing re-submittal updated to reflect actual final system installation and sequence of operation of all components.

B. Operation and Maintenance Data: For hybrid fire-extinguishing systems and components to include in emergency, operation, and maintenance manuals.

1. Provide manufacturer's Owner’s Operation and Maintenance Manuals with required related system warranty requirements.

2. Provide manufacturer published tables indicating required component inspection and testing activities and frequencies.

C. Inspection and Testing Results: Submit formal inspection and testing results as required by manufacturer.

1.10 QUALITY ASSURANCE

A. Installing Contractor Experience: Installing contractor shall have successfully installed multiple hybrid fire-extinguishing systems of similar types and sizes for similar hazards.

B. Field Technician Qualifications: Personnel trained and certified by the hybrid fire-extinguishing system manufacturer as an approved integrator.

C. Designer Qualifications: Shop Drawings and Calculations prepared by personnel certified by NICET as fire suppression Level III or IV technician or licensed professional engineer. Designer shall be certified by fire-extinguisher manufacturer as an approved integrator.

D. Source Limitations for Hybrid Fire-Extinguishing System and Components: Single vendor source to provide system components and connected non-system components as a single listed hybrid fire-extinguishing system.

1. All components (excluding piping, joints and fittings): Victaulic.

2. Modifications to Existing Systems: Components compatible with, and operate as an extension of, existing system.

E. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

1. Specific Agency Requirements for All Products: Underwriters Laboratories (UL) listed and/or Factory Mutual (FM) Approved.

PART 2 - PRODUCTS

2.1 HYBRID FIRE-EXTINGUISHING SYSTEMS

A. Basis of Design Product: Subject to compliance with requirements, provide **Vortex 1500 Engineered** Fire Suppression System by Victaulic.

B. Performance Requirements: Comply with manufacturers published design formulas for Machine Spaces].

2.2 NITROGEN PIPE AND FITTINGS

A. High Pressure Zone (3000 psi Nitrogen Pressure)

1. Steel Pipe: ASTM A53 or ASTM A-106B; Schedule 160, seamless steel pipe.

a. Threaded Fittings:

b. High Pressure Fittings in accordance with manufacturer requirements

B. Low Pressure Zone (175 psi Nitrogen Pressure)

1. Steel Pipe: ASTM A53 or ASTM A-106B; Schedule 10, steel pipe.

a. Grooved Fittings:

1) ASTM A 47/A 47M, malleable-iron casting or ASTM A 536, ductile-iron casting; with dimensions matching steel pipe

b. Galvanized, Grooved-End-Pipe Couplings for Steel Piping:

1) AWWA C606 and UL 213, rigid pattern, unless otherwise indicated, for steel-pipe dimensions. Include ferrous housing sections, EPDM-rubber flush seal gasket, and bolts and nuts.

2.3 WATER PIPE AND FITTINGS

A. Steel Pipe: ASTM A53 or ASTM A-106B; Schedule 40, steel pipe.

1. Threaded Fittings:

a. Galvanized Malleable-Iron Fittings: ASME B16.3, Class 300.

b. Fittings Working Pressure: 620 psig minimum.

2.4 HYBRID FIRE-EXTINGUISHING SYSTEM COMPONENTS

A. Active release manifold: Multi-cylinder assembly, interconnected hoses, common manifold and release solenoids plumbed to the automatic regulating valve.

B. Nitrogen Cylinders:

1. Material: Chrome-Moly Steel AISI 4130x

2. DOT Service Pressure: 3000 psi

3. Test Pressure: 5000 psi

4. Tanks shall be firmly affixed to the floor via a manufacturer provided racking.

5. Cylinders shall be provided with pressure gauge and cylinder valve

C. Cylinder Valve

1. Working Pressure: 4,500 psig

2. Test Pressure: 5,400 psig

3. Integrated 4000 psi pressure Release Disc

4. Complying with CGA V-9, CGA S1.1, CGA V-1, ISO 10297, EN 849, and AS2473

D. Control enclosure components: System water control valve, system water strainer, automatic regulating valve, pressure transducer with relief assembly and multi-function key switch.

1. Multiple zone systems: Standalone fluid control enclosure and zone control enclosure(s) (24vdc power from releasing fire alarm system).

a. Automatic regulating valve

b. Pressure Transducer

c. Pressure Gauge

d. Automatic Nitrogen Control Valve

e. Automatic Water Control Valve

f. Y-Strainer

g. Manual Water Control Valve (Supervised)

E. Emitter Kit: Emitter, water flow control cartridge, system water strainer and applicable pipe nipples.

F. Captive water supply: Manufacturer supplied, epoxy-lined (ASME rated) tank Tank accessories shall include:

1. Water fill connection with ball valve

2. Threaded nitrogen inlet connection
3. Pressure Gauge
4. Low pressure switch
5. Low water Level Switch
6. Sight glass

G. Accessories: Discharge and low air/water pressure switches. Provide dedicated switches for each water tank and nitrogen cylinder.

PART 3 - EXECUTION

3.1 GENERAL

A. Comply with manufacturer's published requirements.

3.2 EXAMINATION

A. Examine areas and conditions, with Installer present, for compliance with hazard-area leakage requirements, installation tolerances, and other conditions affecting work performance.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.3 HYBRID FIRE-EXTINGUISHING SYSTEM PIPING APPLICATIONS

A. Nitrogen deliver piping upstream of fluid control valve shall be one of the following:

1. Threaded:
   a. Schedule 160, steel pipe; malleable-iron threaded fittings; and threaded joints.
2. Welded:
   a. NPS 3 and Smaller: Schedule 80, steel pipe; malleable-iron threaded fittings; and threaded joints.
   b. NPS 4 and Larger: Schedule 160, steel pipe; malleable-iron threaded fittings; and threaded joints.

B. Nitrogen deliver piping downstream of fluid control valve shall be one of the following:

1. Schedule 10, steel pipe; grooved ends and grooved joints.

C. Water deliver piping shall be the following:

3.4 GALVANIZED SCHEDULE 40, STEEL PIPE; THREADED ENDS AND THREADED JOINTS PIPING INSTALLATION

A. Field check all dimensions. If fabrication plans interfere with field objects obtain approval from designer prior to installation.

B. Install hybrid fire-extinguishing piping and other components level and plumb, according to manufacturers' written instructions.

C. Pipes shall be reamed, blown clear and swabbed with appropriate solvent to remove mill varnish and cutting oil prior to assembly.

D. Grooved Piping Joints: Groove pipe ends according to AWWA C606 dimensions. Assemble grooved-end steel pipe and steel, grooved-end fittings with steel, keyed couplings and lubricant according to manufacturer's written instructions.

E. Install nitrogen and water containers anchored to substrate.

F. Install control enclosures.

G. Install pipe and fittings, valves, and discharge emitters according to requirements listed in manufacturer’s published documentation.

1. Install valves designed to prevent entrapment of liquid, or install pressure relief devices in valved sections of piping systems.

2. Support piping using supports and methods according to NFPA 13.

3.5 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Where installing piping adjacent to equipment, allow space for service and maintenance.

C. Connect pressure transducer(s) to fluid panel(s). Wiring shall be installed in continuous metal raceway. Comply with requirements specified in Division 26.

D. Connect solenoid(s) to fluid panel(s). Wiring shall be installed within flexible metal conduit (FMC). Comply with requirements specified in Division 26.

E. Connect electrical devices to releasing fire alarm system. Electrical power, wiring, and devices are specified in Division 28.

3.6 IDENTIFICATION

A. Identify system components and equipment. Comply with requirements for identification specified in Division 26.

B. Identify piping, containers, other equipment, and panels according to manufacturer’s published requirements.

C. Install safety signage/placards in accordance with manufacturer’s requirements.

3.7 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

C. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

D. Tests and Inspections:

1. After installing hybrid-fire extinguishing piping system and after electrical circuitry has been energized, test for compliance with requirements.

2. Perform each electrical test and visual and mechanical inspection stated in NETA ATS, Sections "Inspection and Test Procedures" and "System Function Tests." Certify compliance with test parameters.

3. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation. Remove malfunctioning units, replace with new units, and retest.
4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
5. Partial Discharge Test: Perform partial discharge test (nitrogen only).

E. Units will be considered defective if they do not pass tests and inspections.

F. Prepare test and inspection reports.

3.8 CLEANING

A. Pipes shall be reamed, blown clear and swabbed with appropriate solvent to remove mill varnish and cutting oil prior to assembly.

3.9 SYSTEM FILLING

A. Preparation:
1. Verify that piping system installation is completed and cleaned.

B. Filling Procedures:
1. Fill containers with nitrogen/water, and pressurize to indicate charging pressure.
2. Install filled nitrogen/water containers.
3. Energize circuits.
4. Adjust operating controls.

3.10 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain hybrid fire-extinguishing systems.

B. Train personnel who will routinely occupy protected space in accordance with manufacturer’s requirements.

END OF SECTION

SECTION 213113 - ELECTRIC-DRIVE, CENTRIFUGAL FIRE PUMPS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Split-case fire pumps.
2. Fire-pump accessories and specialties.

1.3 PERFORMANCE REQUIREMENTS

A. Pump Equipment, Accessory, and Specialty Pressure Rating: 250 psig minimum unless higher pressure rating is indicated.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, performance curves, electrical characteristics, and furnished specialties and accessories.

B. Shop Drawings: For fire pumps, motor drivers, and fire-pump accessories and specialties. Include plans, elevations, sections, details, and attachments to other work.

1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

    a. Details shall include project specific installation details of pressure sensing lines and supports. Generic non-project specific sensing line details shall not be used.

2. Wiring Diagrams: For power, signal, and control wiring.

C. Testing Plan

1. Minimum 4 weeks prior to testing provide formal testing plan for fire pump testing.
2. Plan shall include at a minimum

a. Step-by-step testing procedure including pass fail criteria.
b. The list of required personnel.
c. List of required tools and equipment.
d. Final equipment settings.
e. Equipment calibration certificates.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For fire pumps to include operation and maintenance manuals.

1. Data shall include Site specific summary indicating the following:

a. Manufacturer recommended periodic maintenance

1) Including packing replacement, and
2) Inspection schedule

b. NFPA Required inspection testing and maintenance

1.6 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. NFPA Compliance: Comply with NFPA 20, "Installation of Stationary Pumps for Fire Protection."

1.7 COORDINATION

A. Coordinate sizes and locations of concrete bases with actual equipment provided.

B. Coordinate floor drain location for pump drains with plumbing contractor.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR CENTRIFUGAL FIRE PUMPS

A. Description: Factory-assembled and -tested fire-pump and driver unit.

B. Base: Fabricated and attached to fire-pump and driver unit with reinforcement to resist movement of pump events when base is anchored to building substrate.

C. Finish: Red paint applied to factory-assembled and -tested unit before shipping.

2.2 HORIZONTALLY MOUNTED, SINGLE-STAGE, SPLIT-CASE FIRE PUMPS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. A-C Fire Pump Systems; a business of ITT Industries.
2. Patterson Pump Company; a subsidiary of the Gorman-Rupp Company.
3. Peerless Pump, Inc.
4. Pentair Pump Group; Aurora Pump.

B. Pump:

1. Standard: UL 448, for split-case pumps for fire service.
2. Casing: Axially split case, cast iron with ASME B16.1 pipe-flange connections.
3. Impeller: Cast bronze, statically and dynamically balanced, and keyed to shaft.
4. Wear Rings: Replaceable bronze.
5. Shaft and Sleeve: Steel shaft with bronze sleeve.

    a. Shaft Bearings: Grease-lubricated ball bearings in cast-iron housing.
    b. Seals: Stuffing box with minimum of four rings of graphite-impregnated braided yarn and bronze packing gland.

6. Mounting: Pump and driver shafts are horizontal, with pump and driver on same base.

C. Coupling: Flexible and capable of absorbing torsional vibration and shaft misalignment. Include metal coupling guard. Coupling shall be UL listed for use with fire pump, and shall not be all elastomeric type

D. Driver:

1. Standard: UL 1004A.
2. Type: Electric motor; NEMA MG 1, polyphase Design B.

E. Capacities and Characteristics:

1. Rated Capacity: 1,000 gpm
2. Total Rated Head: 180 psig
3. Inlet Flange: Class 250.
4. Outlet Flange: Class 250.
5. Suction Head Available at Pump: Not Available.
6. Motor Horsepower: 150 HP.
7. Motor Speed: 1,770 rpm.
8. Electrical Characteristics:

    a. Volt: 460.
    b. Phase: Three.
    c. Hertz: 60.

9. Pump Start, Pressure-Switch Setting: N/A
10. Pump-Stop, Pressure-Switch Setting: N/A

2.3 FIRE-PUMP ACCESSORIES AND SPECIALTIES

A. Automatic Air-Release Valves: Comply with NFPA 20 for installation in fire-pump casing.

B. Circulation Relief Valves: UL 1478, brass, spring loaded; for installation in pump discharge piping.

C. Inlet Fitting: Eccentric tapered reducer at pump suction inlet.

D. Outlet Fitting: Concentric tapered reducer at pump discharge outlet.

E. Hose Valve Manifold Assembly:

1. Standard: Comply with requirements in NFPA 20.
2. Header Pipe: ASTM A 53/A 53M, Schedule 40, galvanized steel with ends threaded according to ASME B1.20.1.
3. Header Pipe Fittings: ASME B16.4, galvanized cast-iron threaded fittings.
4. Automatic Drain Valve: UL 1726.
5. Manifold:

    a. Test Connections: Comply with UL 405 except provide outlets without clappers instead of inlets.
    b. Body: Flush type, brass or ductile iron, with number of outlets required by NFPA 20.
    c. Nipples: ASTM A 53/A 53M, Schedule 40, galvanized-steel pipe with ends threaded according to ASME B1.20.1.
    d. Adapters and Caps with Chain: Brass or bronze, with outlet threaded according to NFPA 1963 and matching local fire-department threads.
    e. Escutcheon Plate: Brass or bronze; rectangular.
    f. Hose Valves: UL 668, bronze, with outlet threaded according to NFPA 1963 and matching local fire-department threads.
    g. Exposed Parts Finish: Polished brass, chrome plated.
    h. Escutcheon Plate Marking: Equivalent to "FIRE PUMP TEST."

2.4 SOURCE QUALITY CONTROL

A. Testing: Test and inspect fire pumps according to UL 448 requirements for "Operation Test" and "Manufacturing and Production Tests."

1. Verification of Performance: Rate fire pumps according to UL 448.

B. Fire pumps will be considered defective if they do not pass tests and inspections.

C. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine equipment bases and anchorage provisions, with Installer present, for compliance with requirements and for conditions affecting performance of fire pumps.

B. Examine roughing-in for fire-suppression piping systems to verify actual locations of piping connections before fire-pump installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Fire-Pump Installation Standard: Comply with NFPA 20 for installation of fire pumps, relief valves, and related components.

B. Equipment Mounting:

1. Install fire pumps on cast-in-place concrete equipment bases. Comply with requirements for equipment bases and foundations specified in Division 03.
2. Comply with requirements for vibration isolation control devices specified in Division 21.
3. Comply with requirements for vibration isolation devices specified in Division 21.

C. Install fire-pump suction and discharge piping equal to or larger than sizes required by NFPA 20.

D. Support piping and pumps separately so weight of piping does not rest on pumps.

E. Install valves that are same size as connecting piping. Comply with requirements for fire-protection valves specified in Division 21.

F. Install pressure gages on fire-pump suction and discharge flange pressure-gage tappings. Comply with requirements for pressure gages specified in Division 21.

G. Install piping hangers and supports, anchors, valves, gages, and equipment supports according to NFPA 20.

H. Electrical Wiring: Install electrical devices furnished by equipment manufacturers but not factory mounted. Furnish copies of manufacturers' wiring diagram submittals to electrical Installer.

I. Wiring Method: Conceal conductors and cables in accessible ceilings, walls, and floors where possible.

J. Tie all drains, including frame channel together and spill to floor drain. Small diameter drainage piping shall not run across equipment access or walkways

3.3 ALIGNMENT

A. Align pump and driver shafts after complete unit has been leveled on concrete base, grout has set, and anchor bolts have been tightened.

B. After alignment is correct, tighten anchor bolts evenly. Fill baseplate completely with grout, with metal blocks and shims or wedges in place. Tighten anchor bolts after grout has hardened. Check alignment and make required corrections.

C. Align piping connections.

D. Align pump and driver shafts for angular and parallel alignment according to HI 1.4 and to tolerances specified by manufacturer.

3.4 CONNECTIONS

A. Comply with requirements for piping and valves specified in Division 21. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to pumps and equipment to allow service and maintenance.

C. Connect fire pumps to their controllers.

3.5 IDENTIFICATION

A. Identify system components. Comply with requirements for fire-pump marking according to NFPA 20.

B. Provide permanent custom engraved plastic signage in accordance with Division 21 Section “IDENTIFICATION FOR FIRE-SUPPRESSION PIPING AND EQUIPMENT” FOR PUMP INDICATING:

1. Fire Pump Flow and Pressure Rating
2. Net Pressure Boost at No Flow Condition.
3. Net Pressure Boost at 150 percent of Rated Capacity
4. Maximum Pump Discharge Pressure Based upon Sprinkler/Standpipe System Component Pressure Ratings

3.6 FIELD QUALITY CONTROL

A. Test each fire pump with its controller as a unit. Comply with requirements for electric-motor-driver fire-pump controllers specified in Division 21.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

C. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

D. Tests and Inspections:

1. After installing components, assemblies, and equipment including controller, test for compliance with requirements.
2. Test according to NFPA 20 for acceptance and performance testing.
3. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
4. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
5. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

E. Components, assemblies, and equipment will be considered defective if they do not pass tests and inspections.

F. Prepare test and inspection reports.

G. Furnish fire hoses in number, size, and length required to reach storm drain or other acceptable location to dispose of fire-pump test water. Hoses are for tests only and do not convey to Owner.

3.7 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.

3.8 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain fire pumps.

1. Provide 16 hours of training, divided into two 8-hour sessions.

END OF SECTION

SECTION 213400 - PRESSURE-MAINTENANCE PUMPS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Multistage, pressure-maintenance pumps.

1.3 PERFORMANCE REQUIREMENTS

A. Pump Equipment, Accessory, and Specialty Pressure Rating: 175 psig minimum unless higher pressure rating is indicated.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, performance curves, electrical characteristics, and furnished specialties and accessories.

B. Shop Drawings: For pumps, accessories, and specialties. Include plans, elevations, sections, details, and attachments to other work.

1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

a. Details shall include project specific installation details of pressure sensing lines and supports. Generic non-project specific sensing line details shall not be used.

2. Wiring Diagrams: For power, signal, and control wiring.

1.5 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For pumps to include in operation and maintenance manuals.

1.7 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

1.8 COORDINATION

A. Coordinate sizes and locations of concrete bases with actual equipment provided.

PART 2 - PRODUCTS

2.1 MULTISTAGE, PRESSURE-MAINTENANCE PUMPS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. A-C Fire Pump Systems; a business of ITT Industries.
2. Grundfos Management A/S; Grundfos Pumps Corporation U.S.A.
3. PACO Pumps; Grundfos Pumps Corporation U.S.A.
4. TACO Incorporated.

B. Description: Factory-assembled and -tested, multistage, barrel-type vertical pump as defined in HI 2.1-2.2 and HI 2.3; designed for surface installation with pump and motor direct coupled and mounted vertically.

C. Pump Construction:

1. Barrel: Stainless steel.
2. Suction and Discharge Chamber: Cast iron with flanged inlet and outlet.
3. Pump Head/Motor Mount: Cast iron.
4. Impellers: Stainless steel, balanced, and keyed to shaft.
5. Pump Shaft: Stainless steel.
6. Seal: Mechanical type with carbon rotating face and silicon-carbide stationary seat.
7. Intermediate Chamber Bearings: Aluminum-oxide ceramic or bronze.
8. Chamber-Base Bearing: Tungsten carbide.
9. O-Rings: EPDM or NBR.

D. Motor: Single speed with permanently lubricated ball bearings and rigidly mounted to pump head. Comply with requirements in Division 21.

1. Power Cord: Factory-connected to motor for field connection to controller and at least 10 feet (3 m) long.

E. Nameplate: Permanently attached to pump and indicating capacity and characteristics.

F. Capacities and Characteristics:

1. Refer to drawings.

2.2 MOTORS

A. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Division 21.

1. Motor Sizes: Minimum size as indicated; if not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.

PART 3 - EXECUTION

3.1 EQUIPMENT INSTALLATION

A. NFPA Standard: Comply with NFPA 20 for installation of pressure-maintenance pumps.

B. Base-Mounted Pump Mounting: Install pumps on concrete bases. Comply with requirements for concrete bases specified in Division 03.

1. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch (450-mm) centers around the full perimeter of concrete base.
2. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
4. Install anchor bolts to elevations required for proper attachment to supported equipment.
5. Attach pumps to equipment base using anchor bolts.

C. Install multistage, pressure-maintenance pumps according to HI 1.4.

3.2 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

B. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

C. Tests and Inspections:

1. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

D. Pressure-maintenance pumps will be considered defective if they do not pass tests and inspections.

E. Prepare test and inspection reports.

3.3 ADJUSTING

A. Lubricate pumps as recommended by manufacturer.

B. Set field-adjustable pressure-switch ranges as indicated.

3.4 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain fire pumps.

1. Provide 16 hours of training, divided into two 8-hour sessions.

END OF SECTION

SECTION 213900 - CONTROLLERS FOR FIRE-PUMP DRIVERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
   1. Full-service, reduced-voltage variable frequency drive controllers rated 600 V and less.
   2. Controllers for pressure-maintenance pumps.

B. ATS: Automatic transfer switch(es).

C. ECM: Electronic control module.

D. MCCB: Molded-case circuit breaker.

E. N.O.: Normally open.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories**.**

B. Shop Drawings: For each type of product indicated. Include dimensioned plans, elevations, sections, details, and attachments to other work, including required clearances and service spaces around controller enclosures.

   1. Show tabulations of the following:

      a. Each installed unit's type and details.
      b. Enclosure types and details for types other than NEMA 250, Type 12.
      c. Factory-installed devices.
      d. Nameplate legends.
      e. Project specific Controller Identification Label
      f. Short-circuit current (withstand) rating of integrated unit.
      g. Features, characteristics, ratings, and factory settings of individual overcurrent protective devices.
      h. Specified modifications.

2. Detail equipment assemblies and indicate dimensions, weights, loads, method of field assembly, components, and location and size of each field connection.
3. Schematic and Connection Diagrams: For power, signal, alarm, and control wiring and for pressure-sensing tubing.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified testing agency.

B. Product Certificates: For each type of product indicated, from manufacturer.

C. Manufacturer's factory test reports of fully assembled and tested equipment.

D. Source quality-control reports.

E. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For each type of product indicated to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01, include the following:

1. Manufacturer's written instructions for setting field-adjustable timers, controls, and status and alarm points.
2. Manufacturer's written instructions for testing, adjusting, and reprogramming microprocessor-based logic controls.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Indicating Lights: Two of each type and color of lens installed; two of each type and size of lamp installed.

1.7 QUALITY ASSURANCE

A. Testing Agency Qualifications: Member company of an NRTL.

B. Source Limitations: Obtain fire-pump controllers and all associated equipment from single source or producer.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

D. Comply with standards of authorities having jurisdiction pertaining to materials and installation.

E. Comply with NFPA 20 and NFPA 70.

F. IEEE Compliance: Fabricate and test enclosed controllers according to IEEE 344

1.8 DELIVERY, STORAGE, AND HANDLING

A. Store controllers indoors in clean, dry space with uniform temperature to prevent condensation. Protect enclosed controllers from exposure to dirt, fumes, water, corrosive substances, and physical damage.

B. If stored in areas subject to weather, protect controllers from weather, dirt, dust, corrosive substances, and physical damage. Remove loose packing and flammable materials from inside controllers.

1.9 PROJECT CONDITIONS

A. Environmental Limitations:

1. Ambient Temperature Rating: Not less than 40 deg F and not exceeding 122 deg F unless otherwise indicated.
2. Altitude Rating: Not exceeding 6600 feet unless otherwise indicated.

B. Interruption of Existing Electric Service: Notify Construction Manager no fewer than seven days in advance of proposed interruption of electric service, and comply with NFPA 70E.

1.10 COORDINATION

A. Coordinate layout and installation of controllers with other construction including conduit, piping, fire-pump equipment, and adjacent surfaces. Maintain required clearances for workspace and equipment access doors and panels. Ensure that controllers are within sight of fire-pump drivers.

B. Coordinate sizes and locations of concrete bases with actual equipment provided.

PART 2 - PRODUCTS

2.1 FULL-SERVICE CONTROLLERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. ASCO Power Technologies, LP; Firetrol Products.
2. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
3. Master Control Systems, Inc.

B. General Requirements for Full-Service Controllers:

1. Comply with NFPA 20 and UL 218.
2. Listed by an NRTL for electric-motor driver for fire-pump service.
3. Combined automatic and non-automatic operation.
4. Factory assembled, wired, and tested; continuous-duty rated.
5. Service Equipment Label: NRTL labeled for use as service equipment.

C. Method of Starting:

1. Reduced voltage variable frequency drive with digital soft start bypass.
2. Pressure-switch actuated.
    a. Water-pressure-actuated switch and pressure transducer with independent high- and low-calibrated adjustments responsive to water pressure in fire-suppression piping.
    b. Programmable minimum-run-time relay to prevent short cycling.

D. Programmable timer for weekly tests.

1. Pressure-switch actuated.
    a. Water-pressure-actuated switch and pressure transducer with independent high- and low-calibrated adjustments responsive to water pressure in fire-suppression piping.
    b. Programmable minimum-run-time relay to prevent short cycling.
    c. Programmable timer for weekly tests.
2. Starter Type Controller: Digital Solid state soft start.
3. Emergency Start: Mechanically operated start handle that closes and retains the motor RUN contactor independent of all electric or pressure actuators.

E. Method of Stopping: Manual.

F. Capacity: Rated for fire-pump-driver horsepower and short-circuit-current (withstand) rating equal to or greater than short-circuit current available at controller location.

G. Method of Isolation and Overcurrent Protection: Interlocked isolating switch and nonthermal MCCB; with a common, externally mounted operating handle, and providing locked-rotor protection.

H. Door-Mounted Operator Interface and Controls:

1. Monitor, display, and control the devices, alarms, functions, and operations listed in NFPA 20 as required for drivers and controller types used.
2. Method of Control and Indication:
    a. Microprocessor-based logic controller, with multiline digital readout.
    b. Membrane keypad.
    c. LED and remit alarm and status indicating lights.
3. Local Alarm and Status Indications:

a. Controller power on.
b. Motor running condition.
c. Loss-of-line power.
d. Line-power phase reversal.
e. Line-power single-phase condition.
f. VFD drive-failure.
g. Controller in bypass mode.
h. VFD overpressure.

4. Audible alarm, with silence push button.
5. Nonautomatic START and STOP push buttons or switches.

I. Optional Features:

1. Extra Output Contacts:

a. One N.O. contact(s) for motor running condition.
b. One set(s) of contacts for loss-of-line power.

2. Local alarm bell.
3. Operator Interface Communications Ports: USB, Ethernet, and RS485.
4. NEMA 12 rated enclosure.

J. ATS:

1. Complies with NFPA 20, UL 218, and UL 1008.
2. Integral with controller as a listed combination fire-pump controller and power transfer switch.
3. Automatically transfers fire-pump controller from normal power supply to alternate power supply in event of power failure.
4. Allows manual transfer from one source to the other.
5. Alternate-Source Isolating and Disconnecting Means: Integral molded-case switch, with an externally mounted operating handle.
6. Alternate-Source Isolating and Disconnecting Means: Mechanically interlocked isolation switch and circuit breaker rated at a minimum of 115 percent of rated motor full-load current, with an externally mounted operating handle; circuit breaker shall be provided with nonthermal sensing, instantaneous-only short-circuit overcurrent protection to comply with available fault currents.
7. Local and Remote Alarm and Status Indications:

a. Normal source available.
b. Alternate source available.
c. In normal position.
d. In alternate position.
e. Isolating means open.

8. Audible alarm, with silence push button.
9. Nonautomatic (manual, nonelectric) means of transfer.
10. Start generator output contacts.
11. Timer for weekly generator tests.

2.2 CONTROLLERS FOR PRESSURE-MAINTENANCE PUMPS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. ASCO Power Technologies, LP; Firetrol Products.
2. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
3. Master Control Systems, Inc.

B. Manufacturer Shall be the same as fire pump controller manufacturer

C. General Requirements for Pressure-Maintenance-Pump Controllers:

1. Type: UL 508 factory assembled, -wired, and tested, across-the-line; for combined automatic and manual operation.
2. Controller shall have pressure transducer digital control of pump start and stop points.
3. Enclosure: UL 508 and NEMA 250, Type 12 for wall-mounting.
4. Factory assembled, wired, and tested.
5. Finish: Manufacturer's standard color paint.

D. Rate controller for scheduled horsepower and include the following:

1. Fusible disconnect switch.
2. Pressure transducer.
3. Hand-off-auto selector switch.
4. Pilot light.
5. Running period timer.

2.3 ENCLOSURES

A. Fire-Pump Controllers, ATS, Remote Alarm Panels, and Low-Suction-Shutdown Panels: NEMA 250, to comply with environmental conditions at installed locations and NFPA 20.

B. Enclosure Color: Manufacturer's standard "fire-pump-controller red".

C. Nameplates: Comply with NFPA 20; complete with capacity, characteristics, approvals, listings, and other pertinent data.

D. Optional Features:

1. Floor stands, 12 inches high, for floor-mounted controllers.

2.4 SOURCE QUALITY CONTROL

A. Testing: Test and inspect fire-pump controllers according to requirements in NFPA 20 and UL 218.

1. Verification of Performance: Rate controllers according to operation of functions and features specified.

B. Fire-pump controllers will be considered defective if they do not pass tests and inspections.

C. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and surfaces to receive equipment, with Installer present, for compliance with requirements and other conditions affecting performance.

B. Examine equipment before installation. Reject equipment that is wet or damaged by moisture or mold.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 CONTROLLER INSTALLATION

A. Install controllers within sight of their respective drivers.

B. Connect controllers to their dedicated pressure-sensing lines.

C. Wall-Mounting Controllers: Install controllers on walls with disconnect operating handles not higher than 79 inches above finished floor, and bottom of enclosure not less than 12 inches above finished floor unless otherwise indicated. Bolt units to wall or mount on lightweight structural-steel channels bolted to wall. For controllers not on walls, provide freestanding racks complying with Division 26.

D. Floor-Mounting Controllers: Install controllers on 4-inch nominal-thickness concrete bases, using floor stands high enough so that the bottom of enclosure cabinet is not less than 12 inches above finished floor. Comply with requirements for concrete bases specified in Division 03.

1. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of concrete base.
2. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base, and anchor into structural concrete floor.
3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
4. Install anchor bolts to elevations required for proper attachment to supported equipment.

E. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.

F. Comply with NEMA ICS 15.

3.3 POWER WIRING INSTALLATION

A. Install power wiring between controllers and their services or sources, and between controllers and their drivers. Comply with requirements in NFPA 20, NFPA 70, and Division 26.

3.4 CONTROL AND ALARM WIRING INSTALLATION

A. Install wiring between controllers and remote devices. Comply with requirements in NFPA 20, NFPA 70, and Division 26.

B. Install wiring between remote alarm panels and controllers. Comply with requirements in NFPA 20, NFPA 70, and Division 26.

C. Install wiring between controllers and the building's fire-alarm system. Comply with requirements specified in Division 28.

D. Bundle, train, and support wiring in enclosures.

E. Connect remote manual and automatic activation devices where applicable.

3.5 IDENTIFICATION

A. Comply with requirements in NFPA 20 for marking fire-pump controllers.

B. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification in NFPA 20 and as specified in Division 26.

C. In addition to Manufacturer’s Nameplates provide permanent custom engraved plastic signage in accordance with Division 21 Section “IDENTIFICATION FOR FIRE-SUPPRESSION PIPING AND EQUIPMENT” FOR EACH CONTROLLER INDICATING AS FOLLOWS:

1. Controller start pressure setpoint.
2. Controller stop pressure setpoint.
3. Primary Power Supply Switchboard Designation and Location
4. Secondary Power Supply Source Designation and Location
5. Local Manufacturers Representative Name
6. Local Manufacturers Representative Address
7. Local Manufacturers Representative 24-hour emergency service phone number.

3.6 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

C. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

D. Acceptance Testing Preparation:

1. Inspect and Test Each Component:

   a. Inspect wiring, components, connections, and equipment installations. Test and adjust components and equipment.
   b. Test insulation resistance for each element, component, connecting supply, feeder, and control circuits.
   c. Test continuity of each circuit.

2. Verify and Test Each Electric-Driver Controller:

   a. Verify that voltages at controller locations are within plus 10 or minus 1 percent of motor nameplate rated voltages, with motors off. If outside this range for any motor, notify Construction Manager before starting the motor(s).
   b. Test each motor for proper phase rotation.

3. Operational Test: After electrical circuitry has been energized, start units to confirm proper unit operation.
4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

E. Field Acceptance Tests:

1. Do not begin field acceptance testing until suction piping has been flushed and hydrostatically tested and the certificate for flushing and testing has been submitted to Construction Manager and authorities having jurisdiction.
2. Prior to starting, notify authorities having jurisdiction of the time and place of the acceptance testing.
3. Engage manufacturer's factory-authorized service representative to be present during the testing.
4. Perform field acceptance tests as outlined in NFPA 20.

F. Controllers will be considered defective if they do not pass tests and inspections.

G. Prepare test and inspection reports.

H. Test reports shall include copy of fire and jockey pump controller digital data records from testing period.

I. Controllers subjected to water, fire or smoke damage prior to substantial completion and turn over to owner shall be replaced with new equipment.

3.7 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.

3.8 ADJUSTING

A. Adjust controllers and battery charger systems to function smoothly and as recommended by manufacturer.

B. Set field-adjustable switches, auxiliary relays, time-delay relays, and timers.

C. Program microprocessors for required operational sequences, status indications, alarms, event recording, and display features. Clear events memory after final acceptance testing and prior to Substantial Completion.

D. Set field-adjustable pressure switches.

3.9 PROTECTION

A. Temporary Heating: Apply temporary heat to maintain temperature according to manufacturer's written instructions until enclosed controllers are ready to be energized and placed into service.

B. Replace controllers whose interiors have been exposed to water or other liquids prior to Substantial Completion.

3.10 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain controllers.

1. Provide 16 hours of training, divided into two 8-hour sessions.

END OF SECTION

SECTION 220513 - COMMON MOTOR REQUIREMENTS FOR PLUMBING EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes:

1. General motor requirements.
2. Motor characteristics.
3. Polyphase motors.
4. Motors served by variable frequency controllers.
5. Polyphase motors with additional requirements.
6. Single phase motors.
7. Motor starters.

1.3 COORDINATION

A. Coordinate features of motors, installed units, and accessory devices to be compatible with the following:

1. Motor controllers.
2. Torque, speed, and horsepower requirements of the load.
3. Ratings and characteristics of supply circuit and required control sequence.
4. Ambient and environmental conditions of installation location.

PART 2 - PRODUCTS

2.1 GENERAL MOTOR REQUIREMENTS

A. Comply with NEMA MG 1 unless otherwise indicated

B. Comply with IEEE 841 for severe-duty motors.

2.2 MOTOR CHARACTERISTICS

A. Duty: Continuous duty at ambient temperature of 40 deg C and at altitude of 3300 feet above sea level.

B. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.

2.3 POLYPHASE MOTORS

A. Description: NEMA MG 1, Design B, medium induction motor.

B. Efficiency: Energy efficient, as defined in NEMA MG 1.

C. Service Factor: 1.15.

D. Multispeed Motors: Variable torque.

1. For motors with 2:1 speed ratio, consequent pole, single winding.
2. For motors with other than 2:1 speed ratio, separate winding for each speed.

E. Multispeed Motors: Separate winding for each speed.

F. Rotor: Random-wound, squirrel cage.

G. Bearings: Regreasable, shielded, antifriction ball bearings suitable for radial and thrust loading.

H. Temperature Rise: Match insulation rating.

I. Insulation: Class F for motors with variable speed controllers. Class B for ODP motors of nominal efficiency

J. Code Letter Designation:

1. Motors 15 HP and Larger: NEMA starting Code F or Code G.
2. Motors Smaller than 15 HP: Manufacturer's standard starting characteristic.

K. Enclosure Material: Cast iron for motor frame sizes 324T and larger; rolled steel for motor frame sizes smaller than 324T.

2.4 MOTORS SERVED BY VARIABLE FREQUENCY CONTROLLERS

A. Drives are to be provided with each division 22 piece of equipment where specified in all division 22 sections

B. Motors served by variable frequency controllers (VFC) (also known as variable frequency drives (VFDs) shall be "inverter-duty" or "drive duty" motors. Motors shall meet or exceed all requirements of NEMA MG–1 Parts 30 and 31 for AC induction motors powered from adjustable

speed controls. Use of the motor with a VFD shall not adversely affect the operation, useful life, or warranty of the motor.

C. Motors shall have Class H insulation.

D. Windings: Copper magnet wire with moisture-resistant insulation varnish, designed and tested to resist transient spikes, high frequencies, and short time rise pulses produced by pulse-width modulated inverters. Motor windings shall be spike resistant to withstand a minimum of 1,600 peak volts.

E. Motors shall have shaft grounding system to protect bearings from induced voltage. Shaft grounding system shall have very low drag, less than 1/2 percent of motor HP, and shall operate for a minimum of three (3) years without periodic adjustments. All consumables of the shaft grounding system shall be replaceable without a shutdown of the motor or VFD. The shaft grounding system shall be as manufactured by AEGIS or equal.

F. Motors used with VFD shall have a minimum three (3) year warranty

2.5 POLYPHASE MOTORS WITH ADDITIONAL REQUIREMENTS

A. Motors Used with Reduced-Voltage and Multispeed Controllers: Match wiring connection requirements for controller with required motor leads. Provide terminals in motor terminal box, suited to control method.

1. Thermal Protection: Comply with NEMA MG 1 requirements for thermally protected motors.

B. Severe-Duty Motors: Comply with IEEE 841, with 1.15 minimum service factor.

2.6 SINGLE-PHASE MOTORS

A. Motors larger than 1/20 hp shall be one of the following, to suit starting torque and requirements of specific motor application:

1. Permanent-split capacitor.
2. Split phase.
3. Capacitor start, inductor run.
4. Capacitor start, capacitor run.

B. Multispeed Motors: Variable-torque, permanent-split-capacitor type.

C. Bearings: Pre-lubricated, anti-friction ball bearings or sleeve bearings suitable for radial and thrust loading.

D. Motors 1/20 HP and Smaller: Shaded-pole type.

E. Thermal Protection: Internal protection to automatically open power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of motor insulation. Thermal-protection device shall automatically reset when motor temperature returns to normal range.

2.7 MOTOR STARTERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the work include, but are not limited to:

1. Eaton Electrical (Cutler Hammer).
2. General Electric Company.
3. Rockwell Automation, Inc.
4. Siemens Energy and Automation.
5. Square D.

B. All starters for motors without variable frequency drives are to be provided under this specification section division 22.

C. Provide magnetic starter with HAND-OFF-AUTO switch (fast-slow-off-auto for two speed motors) in cover for starters that require interlocks or remote control. Provide magnetic starters, with auxiliary contacts, buttons and switches.

D. Each three phase, 60 Hz motor shall be provide with magnetic starter with hand -off-automatic switch.

E. Other motors shall be provided with a manual starter with on-off switch.

F. Control relay for each starter shall be for operation on 120V, 1 phase. Provide Transformer of sufficient capacity within starter case.

G. Provide inverse time limit overload and under voltage protection in each leg and with pilot lights. Provide red and green on/off pilot lights

H. Provide nameplates with engraved white lettering to designate area and equipment served.

I. Furnish for all single speed motors, 25 hp and above, 95 percent power factor correction capacitors. Capacitors shall be in NEMA enclosure of the same rating as the motor’s starter.

PART 3 - EXECUTION (NOT APPLICABLE)

END OF SECTION

SECTION 220514 - COMMON CONTROL PANEL REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes:

1. General control panel requirements.
2. Programmable Logic Controllers
3. General Control Panels (not PLC)

1.3 DEFINITIONS

A. $I_{n:}$ Nominal Discharge Current.

B. MCOV: Maximum Continuous Operating Voltage.

C. Mode(s), also Modes of Protection: The pair of electrical connections where the VPR applies.

D. MOV: Metal Oxide Varistor; an electronic component with a significant non-ohmic current-voltage characteristic.

E. OCPD: Overcurrent Protective Device.

F. SCCR: Short Circuit Current Rating.

G. SPD: Surge Protective Device.

H. VPR: Voltage Protection Rating.

1.4 COORDINATION

A. Short-circuit current rating (SCCR) is the amount of available fault current that an electrical component or equipment can safely withstand, when properly applied.

B. SCCRs are required to be marked on industrial control panels and other equipment in accordance with the product standards and the *NEC*.

C. Comply with UL 508A to ensure the quality and construction of the control panels

D. For proper protection and compliance with NEC 110.10, the short-circuit current rating for a component or equipment shall be equal to or greater than the available short-circuit current where the equipment is being installed in the system.

E. Failure to provide equipment with adequate SCCR will not be accepted. Further, panels furnished with inadequate SCCR ratings shall be changed or upgraded by the contractor at no cost to the owner.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. For each control panel on the project, include the withstand rating of said control panel.

B. Equipment Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.

C. Panel numbering scheme.

D. Panel Schedules: For each system to include in maintenance manuals.

PART 2 - PRODUCTS

2.1 GENERAL

A. Coordinate features of all control panels, installed units, and accessory devices. Assure these to be compatible with the following:

1. Electrical Contractor final short circuit analysis regarding available fault current to each control panel furnished under this section.
2. Furnish control panels with adequate withstand rating based on item 1 above
3. Each control panel shall be labeled to identify the rated SCCR
4. All control panels shall comply with the latest edition of the National Electric Code
5. Ratings and characteristics of supply circuit and required control sequence.
6. Ambient and environmental conditions of installation location.

B. At general bid phase of project, the, short circuit Current Rating:

1. All three phase 480 volt System Control Panels identified on the drawings shall accommodate minimum available fault rating of 35,000 amperes RMS.

2. For all single phase 120 volt control panels identified on the drawings shall accommodate a minimum available fault rating of 10,000 amperes RMS.
3. For other ratings see Plumbing Drawings schedule sheet where SCCR ratings are specified per panel

C. At final installation phase of project, the, Short Circuit Current Rating for each control panel shall be based on the electrical contractor final available short circuit analysis for the building electrical system. Submittals shall include this information.

PART 3 - EXECUTION (NOT APPLICABLE)

END OF SECTION

SECTION 220516 - EXPANSION FITTINGS AND LOOPS FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Performance requirements
2. Packless expansion joints
3. Grooved-joint expansion joints.
4. Alignment guides and anchors.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Design Calculations: Calculate requirements for thermal expansion of piping systems and for selecting and designing expansion joints, loops, and swing connections.
2. Anchor Details: Detail fabrication of each anchor indicated. Show dimensions and methods of assembly and attachment to building structure.
3. Alignment Guide Details: Detail field assembly and attachment to building structure.
4. Schedule: Indicate type, manufacturer's number, size, material, pressure rating, end connections, and location for each expansion joint.

1.4 INFORMATIONAL SUBMITTALS

A. Welding certificates.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For expansion joints to include in maintenance manuals.

1.6 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

B. Pipe and Pressure-Vessel Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Compatibility: Products shall be suitable for piping service fluids, materials, working pressures, and temperatures.

B. Capability: Products to absorb 200 percent of maximum axial movement between anchors.

2.2 PACKLESS EXPANSION JOINTS

A. Rubber Union Connector Expansion Joints

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

    a. Flex-Hose Co., Inc.
    b. Flexicraft Industries.
    c. General Rubber Corporation.
    d. Mason Industries, Inc.
    e. Proco Products, Inc.
    f. Unaflex.

2. Material: Twin reinforced-rubber spheres with external restraining cables.
3. Minimum Pressure Rating: 150 psig at 170 deg F, unless otherwise indicated.
4. End Connections for NPS 2 and Smaller: Threaded.

B. Flexible-Hose Packless Expansion Joints

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

    a. Flex Pression Ltd.
    b. Flex-Hose Co., Inc.
    c. Flexicraft Industries.
    d. Mason Industries, Inc.
    e. Metraflex Company (The).
    f. Unisource Manufacturing, Inc.

2. Description: Manufactured assembly with inlet and outlet elbow fittings and two flexible-metal-hose legs joined by long-radius, 180-degree return bend or center section of flexible hose.
3. Flexible Hose: Corrugated-metal inner hoses and braided outer sheaths.
4. Expansion Joints for Copper Tubing NPS 2 and Smaller: Copper-alloy fittings with solder-joint end connections.

    a. Bronze hoses and double-braid bronze sheaths with 700 psig at 70 deg F and 500 psig at 450 deg F ratings.

5. Expansion Joints for Copper Tubing NPS 2-1/2 to NPS 4: Copper-alloy fittings with threaded flanged or mechanical end connections.

    a. Stainless-steel hoses and double-braid, stainless-steel sheaths with 420 psig at 70 deg F and 315 psig at 450 deg F ratings.

6. Expansion Joints for Steel Piping NPS 2 and Smaller: Carbon-steel fittings with threaded end connections.

    a. Stainless-steel hoses and double-braid, stainless-steel sheaths with 700 psig at 70 deg F and 515 psig at 600 deg F ratings.

7. Expansion Joints for Steel Piping NPS 2-1/2 to NPS 6: Carbon-steel fittings with flanged welded end connections.

    a. Stainless-steel hoses and double-braid, stainless-steel sheaths with 275 psig at 70 deg F and 200 psig at 600 deg F ratings.

8. Expansion Joints for Steel Piping NPS 8 to NPS 12: Carbon-steel fittings with flanged welded end connections.

    a. Stainless-steel hoses and double-braid, stainless-steel sheaths with 165 psig at 70 deg F and 120 psig at 600 deg F ratings.

9. Expansion Joints for Steel Piping NPS 14 and Larger: Carbon-steel fittings with flanged welded end connections.

    a. Stainless-steel hoses and double-braid, stainless-steel sheaths with 165 psig at 70 deg F and 120 psig at 600 deg F ratings.

C. Metal-Bellows Packless Expansion Joints

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

    a. Flex-Hose Co., Inc.
    b. Flexicraft Industries.
    c. Flex-Weld, Inc.
    d. Mason Industries, Inc.
    e. Metraflex Company (The).
    f. Proco Products, Inc.

2. Standards: ASTM F 1120 and EJMAs "Standards of the Expansion Joint Manufacturers Association, Inc."
3. Type: Circular, corrugated bellows with external tie rods.
4. Minimum Pressure Rating: 150 psig, unless otherwise indicated.
5. Configuration: Single joint Single joint with base and double joint with base class (es), unless otherwise indicated.
6. Expansion Joints for Copper Tubing: Single- or multi- ply phosphor-bronze bellows, copper pipe ends, and brass shrouds.

    a. End Connections for Copper Tubing NPS 2 and Smaller: Solder joint or threaded.
    b. End Connections for Copper Tubing NPS 2-1/2 to NPS 4: Solder joint or threaded.
    c. End Connections for Copper Tubing NPS 5 and Larger: Flanged.

7. Expansion Joints for Steel Piping: Single- or multi- ply stainless-steel bellows, steel pipe ends, and carbon-steel shroud.

    a. End Connections for Steel Pipe NPS 2 and Smaller: Threaded.
    b. End Connections for Steel Pipe NPS 2-1/2 and Larger: Welded.

D. Externally Pressurized Metal-Bellows Packless Expansion Joints

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

    a. Flex-Hose Co., Inc.
    b. Hyspan Precision Products, Inc.
    c. Mason Industries, Inc.
    d. Metraflex Company (The).
    e. U.S. Bellows, Inc.

2. Minimum Pressure Rating: 150 psig 200 psig, unless otherwise indicated.
3. Description

    a. Totally enclosed, externally pressurized, multi-ply, stainless-steel bellows isolated from fluid flow by an internal pipe sleeve.
    b. Carbon-steel housing.
    c. Drain plugs and lifting lug for NPS 3 and larger.
    d. Bellows shall have operating clearance between the internal pipe sleeves and the external shrouds.
    e. Joints shall be supplied with a built-in scale to confirm the starting position and operating movement.
    f. Joint Axial Movement: 6 inches of compression and 1 inch of extension.

4. Permanent Locking Bolts: Set locking bolts to maintain joint lengths during installation. Temporary welding tabs that are removed after installation in lieu of locking bolts are not acceptable.
5. End Connection Configuration: Flanged; one raised, fixed and one floating flange.

E. Rubber Packless Expansion Joints

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

    a. Flex-Hose Co., Inc.
    b. Garlock Sealing Technologies.
    c. General Rubber Corporation.
    d. Mason Industries, Inc.
    e. Metraflex Company (The).
    f. Proco Products, Inc.

2. Standards: ASTM F 1123 and FSA's "Technical Handbook: Non-Metallic Expansion Joints and Flexible Pipe Connectors."
3. Material: Fabric-reinforced rubber complying with FSA-PSJ-703.
4. Arch Type: Single or multiple arches with external control rods.
5. Spherical Type: Single or multiple spheres with external control rods.
6. Minimum Pressure Rating for NPS 1-1/2 to NPS 4: 150 psig at 220 deg F.
7. Minimum Pressure Rating for NPS 5 and NPS 6: 140 psig at 200 deg F.
8. Minimum Pressure Rating for NPS 8 to NPS 12: 140 psig at 180 deg F.
9. Material for Fluids Containing Acids, Alkalis, or Chemicals: Butyl rubber Chlorosulfonyl-polyethylene rubber Ethylene-propylene-diene terpolymer rubber.
10. Material for Fluids Containing Gas, Hydrocarbons, or Oil: Buna-N Chlorosulfonated polyethylene synthetic rubber.
11. Material for Water: Butyl rubber Buna-N Chlorosulfonated polyethylene synthetic rubber Chlorosulfonyl-polyethylene rubber Ethylene-propylene-diene terpolymer rubber Natural rubber.
12. End Connections: Full-faced, integral steel flanges with steel retaining rings.

2.3 GROOVED-JOINT EXPANSION JOINTS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

    1. Anvil International.
    2. Shurjoint Piping Products.
    3. Victaulic Company.

B. Description: Factory-assembled expansion joint made of several grooved-end pipe nipples, couplings, and grooved joints.

C. Standard: AWWA C606, for grooved joints.

D. Nipples: Galvanized, ASTM A 53/A 53M, Schedule 40, Type E or S, steel pipe with grooved ends.

E. Couplings: Flexible type for steel-pipe dimensions. Include ferrous housing sections, Buna-N gasket suitable for diluted acid, alkaline fluids, and cold and hot water ethylene-propylene-diene terpolymer rubber gasket suitable for cold and hot water, and bolts and nuts.

2.4 ALIGNMENT GUIDES AND ANCHORS

A. Alignment Guides

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

   a. Flex-Hose Co., Inc.
   b. Flexicraft Industries.
   c. Mason Industries, Inc.
   d. Metraflex Company (The).
   e. U.S. Bellows, Inc.

2. Description: Steel, factory-fabricated alignment guide, with bolted two-section outer cylinder and base for attaching to structure; with two-section guiding slider for bolting to pipe.

B. Anchor Materials:

1. Steel Shapes and Plates: ASTM A 36/A 36M.
2. Bolts and Nuts: ASME B18.10 or ASTM A 183, steel hex head.
3. Washers: ASTM F 844, steel, plain, flat washers.
4. Mechanical Fasteners: Insert-wedge-type stud with expansion plug anchor for use in hardened Portland cement concrete, with tension and shear capacities appropriate for application.

   a. Stud: Threaded, zinc-coated carbon steel.
   b. Expansion Plug: Zinc-coated steel.
   c. Washer and Nut: Zinc-coated steel.

PART 3 - EXECUTION

3.1 EXPANSION JOINT INSTALLATION

A. Install expansion joints of sizes matching sizes of piping in which they are installed.

B. Install metal-bellows expansion joints according to EJMAs "Standards of the Expansion Joint Manufacturers Association, Inc."

C. Install rubber packless expansion joints according to FSA-PSJ-703.

D. Install grooved-joint expansion joints to grooved-end steel piping.

3.2 PIPE LOOP AND SWING CONNECTION INSTALLATION

A. Install pipe loops cold-sprung in tension or compression as required to partly absorb tension or compression produced during anticipated change in temperature.

B. Connect risers and branch connections to mains with at least four pipe fittings, including tee in main.

C. Connect risers and branch connections to terminal units with at least four pipe fittings, including tee in riser.

D. Connect mains and branch connections to terminal units with at least four pipe fittings, including tee in main.

3.3 ALIGNMENT-GUIDE AND ANCHOR INSTALLATION

A. Install alignment guides to guide expansion and to avoid end-loading and torsional stress.

B. Install one guide(s) on each side of pipe expansion fittings and loops. Install guides nearest to expansion joint not more than four pipe diameters from expansion joint.

C. Attach guides to pipe, and secure guides to building structure.

D. Install anchors at locations to prevent stresses from exceeding those permitted by ASME B31.9 and to prevent transfer of loading and stresses to connected equipment.

E. Anchor Attachments:

1. Anchor Attachment to Steel Pipe: Attach by welding. Comply with ASME B31.9 and ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
2. Anchor Attachment to Copper Tubing: Attach with pipe hangers. Use MSS SP-69, Type 24; U bolts bolted to anchor.

F. Fabricate and install steel anchors by welding steel shapes, plates, and bars. Comply with ASME B31.9 and AWS D1.1/D1.1M.

1. Anchor Attachment to Steel Structural Members: Attach by welding.
2. Anchor Attachment to Concrete Structural Members: Attach by fasteners. Follow fastener manufacturer's written instructions.

G. Use grout to form flat bearing surfaces for guides and anchors attached to concrete.

END OF SECTION

SECTION 220517 - SLEEVES AND SLEEVE SEALS FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes:

1. Sleeves.
2. Stack-sleeve fittings.
3. Sleeve-seal systems.
4. Sleeve-seal fittings.
5. Grout.
6. Firestopping.

1.3 PENETRATION FIRE STOPPING ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

1.4 DESCRIPTION OF THE FIRE STOPPING WORK OF THIS SECTION

A. Only tested fire stop systems shall be used in specific locations as follows:

1. Fire stop or fire seal plumbing penetrations for the passage of piping, and other equipment through fire-rated vertical barriers (walls and partitions), horizontal barriers (floor/ceiling assemblies), and vertical service shaft walls and partitions.
2. Repetitive plumbing penetrations in fire-rated floor assemblies. Penetrations exist for the installation of tubs, showers, aerators and other plumbing fixtures.

1.5 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.

1.6 REFERENCES

A. Test Requirements: ASTM E 814, "Standard Method of Fire Tests of Through Penetration Fire Stops".

B. Test Requirements: UL 1479, “Fire Tests of Through-Penetration Fire Stops”.

C. Underwriters Laboratories (UL) of Northbrook, IL publishes tested systems in their "FIRE RESISTANCE DIRECTORY" that is updated annually.

1. UL Fire Resistance Directory

    a. Fire Stop Devices (XHJI).
    b. Fire Resistance Ratings (BXRH).
    c. Through-Penetration Fire Stop Systems (XHEZ).
    d. Fill, Voids, or Cavity Material (XHHW).
    e. Forming Materials (XHKU).

D. International Fire Stop Council Guidelines for Evaluating Fire Stop Systems Engineering Judgments

E. Inspection Requirements: ASTM E 2174, “Standard Practice for On-site Inspection of Installed Fire Stops”.

F. ASTM E 84, “Standard Test Method for Surface Burning Characteristics of Building Materials”.

G. All major building codes: ICBO, SBCCI, BOCA, and IBC.

H. NFPA 101 - Life Safety Code.

1.7 QUALITY ASSURANCE

A. A manufacturer's direct representative (not distributor or agent) to be on-site during initial installation of fire stop systems to train appropriate contractor personnel in proper selection and installation procedures. This will be done per manufacturer's written recommendations published in their literature and drawing details.

B. Fire stop System installation must meet requirements of ASTM E814 or UL1479 tested assemblies that provide a fire rating equal to that of construction being penetrated.

C. Proposed fire stop materials and methods shall conform to applicable governing codes having local jurisdiction.

D. Fire stop Systems do not reestablish the structural integrity of load bearing partitions/assemblies, or support live loads and traffic. Installer shall consult the structural engineer prior to penetrating any load bearing assembly.

E. For those fire stop applications that exist for which no UL tested system is available through a manufacturer, a manufacturer's engineering judgment derived from similar UL system designs or other tests will be submitted to local authorities having jurisdiction for their review and

approval prior to installation. Engineering judgment drawings must follow requirements set forth by the International Fire Stop Council.

1.8 SUBMITTALS

A. Submit Product Data: Manufacturer's specifications and technical data for each material including the composition and limitations, documentation of UL fire stop systems to be used and manufacturer's installation instructions.

B. Manufacturer's engineering judgment identification number and drawing details when no UL system is available for an application. Engineering judgment must include both project name and contractor's name who will install fire stop system as described in drawing.

C. Submit material safety data sheets provided with product delivered to job-site.

1.9 INSTALLER QUALIFICATIONS

A. Engage an experienced Installer who is certified, licensed, or otherwise qualified by the fire stopping manufacturer as having been provided the necessary training to install manufacturer's products per specified requirements. A manufacturer's willingness to sell its fire stopping products to the Contractor or to an Installer engaged by the Contractor does not in itself confer qualification on the buyer.

B. Installation Responsibility: Assign installation of through-penetration fire stop systems and fire-resistive joint systems in Project to a single sole source fire stop specialty contractor.

C. The work is to be installed by a contractor with at least one of the following qualifications:

1. FM 4991 Approved Contractor.
2. UL Approved Contractor.
3. Hilti 3rd, Fire Spec, or approved equal Accredited Fire Stop Specialty Contractor

D. Firm with not less than three (3) years experience with fire stop installation.

E. Successfully completed not less than three (3) comparable scale projects using similar systems.

1.10 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials undamaged in manufacturer's clearly labeled, unopened containers, identified with brand, type, and UL label where applicable.

B. Coordinate delivery of materials with scheduled installation date to allow minimum storage time at job-site.

C. Store materials under cover and protect from weather and damage in compliance with manufacturer's requirements.

D. Comply with recommended procedures, precautions or remedies described in material safety data sheets as applicable.

E. Do not use damaged or expired materials.

1.11 PROJECT CONDITIONS

A. Do not use materials that contain flammable solvents.

B. Scheduling

1. Schedule installation of CAST IN PLACE fire stop devices after completion of floor formwork, metal form deck, or composite deck but before placement of concrete.
2. Schedule installation of other fire stopping materials after completion of penetrating item installation but prior to covering or concealing of openings.

C. Verify existing conditions and substrates before starting work. Correct unsatisfactory conditions before proceeding.

D. Weather conditions: Do not proceed with installation of fire stop materials when temperatures exceed the manufacturer's recommended limitations for installation printed on product label and product data sheet.

E. During installation, provide masking and drop cloths to prevent fire stopping materials from contaminating any adjacent surfaces.

1.12 REFERENCES

A. Test Requirements: ASTM E 814, "Standard Method of Fire Tests of Through Penetration Fire Stops"

B. Test Requirements: UL 1479, “Fire Tests of Through-Penetration Fire Stops.”

C. Underwriters Laboratories (UL) of Northbrook, IL publishes tested systems in their "FIRE RESISTANCE DIRECTORY" that is updated annually.

1. UL Fire Resistance Directory

a. Fire Stop Devices (XHJI).
b. Fire Resistance Ratings (BXRH).
c. Through-Penetration Fire stop Systems (XHEZ)
d. Fill, Voids, or Cavity Material (XHHW)
e. Forming Materials (XHKU)

D. International Fire stop Council Guidelines for Evaluating Fire stop Systems Engineering Judgments

E. Inspection Requirements: ASTM E 2174, “Standard Practice for On-site Inspection of Installed Fire Stops.”

F. ASTM E 84, “Standard Test Method for Surface Burning Characteristics of Building Materials.”

G. All major building codes: ICBO, SBCCI, BOCA, and IBC.

H. NFPA 101 - Life Safety Code

PART 2 - PRODUCTS

2.1 SLEEVES

A. Cast-Iron Wall Pipes: Cast or fabricated of cast or ductile iron and equivalent to ductile-iron pressure pipe, with plain ends and integral water stop unless otherwise indicated.

B. Galvanized-Steel Wall Pipes: ASTM A 53/A 53M, Schedule 40, with plain ends and welded steel collar; zinc coated.

C. Galvanized-Steel-Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc coated, with plain ends.

D. Galvanized-Steel-Sheet Sleeves: 0.0239 inch minimum thickness; round tube closed with welded longitudinal joint.

2.2 STACK-SLEEVE FITTINGS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. Smith, Jay R. Mfg. Co.
2. Zurn Industries, LLC.
3. Watts Water Technologies

B. Description: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring, bolts, and nuts for membrane flashing.

1. Under deck Clamp: Clamping ring with setscrews.

2.3 SLEEVE-SEAL SYSTEMS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. CALPICO, Inc.
2. Link-Seal.
3. Metraflex Company (The).
4. Pipeline Seal and Insulator, Inc.
5. Proco Products, Inc.

B. Description: Modular sealing-element unit, designed for field assembly, for filling annular space between piping and sleeve.

1. Sealing Elements: EPDM-rubber NBR interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
2. Pressure Plates: Polymer Plastic or Stainless steel.
3. Connecting Bolts and Nuts: Carbon Steel with corrosion resistant coating or Stainless steel of length required to secure pressure plates to sealing elements.

2.4 SLEEVE-SEAL FITTINGS

A. Manufacturers: Subject to compliance with requirements, provide products by the following:

1. HOLDRITE.

2. Metraflex Corp

3. Calpico, Inc

B. Description: Manufactured plastic, sleeve-type, water stop assembly made for imbedding in concrete slab or wall. Unit has plastic or rubber water stop collar with center opening to match piping OD.

2.5 GROUT

A. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.

B. Characteristics: Non-shrink; recommended for interior and exterior applications.

C. Design Mix: 5000-psi, 28-day compressive strength.

D. Packaging: Premixed and factory packaged.

2.6 FIRESTOPPING

A. Provide fire stopping composed of components that are compatible with each other, the substrates forming openings, and the items, if any, penetrating the fire stopping under conditions of service and application, as demonstrated by the fire stopping manufacturer based on testing and field experience.

B. Provide components for each fire stopping system that are needed to install fill material. Use only components specified by the fire stopping manufacturer and approved by the qualified testing agency for the designated fire-resistance-rated systems.

C. Division 07 of the general specifications define products and methods. Follow the instruction delineated in division 7 of the general specifications.

D. Penetrations in Fire Resistance Rated Walls: Provide fire stopping with ratings determined in accordance with UL 1479 or ASTM E 814.

1. F-Rating: Not less than the fire-resistance rating of the wall construction being penetrated.

E. Penetrations in Horizontal Assemblies: Provide fire stopping with ratings determined in accordance with UL 1479 or ASTM E 814.

1. F-Rating: Minimum of 1-hour rating, but not less than the fire-resistance rating of the floor construction being penetrated.
2. T-Rating: When penetrant is located outside of a wall cavity, minimum of 1-hour rating, but not less than the fire-resistance rating of the floor construction being penetrated.
3. W-Rating: Class 1 rating in accordance with water leakage test per UL 1479.

F. Penetrations in Smoke Barriers: Provide fire stopping with ratings determined in accordance with UL 1479 or ASTM E 814.

1. L-Rating: Not exceeding 5.0 cfm/sf of penetration opening at both ambient and elevated temperatures.

G. Mold Resistance: Provide penetration fire stopping with mold and mildew resistance rating of 0 as determined by ASTM G21.

H. Acceptable Manufacturers

1. Subject to compliance with through penetration fire stop systems (XHEZ) listed in Volume II of the UL Fire Resistance Directory, provide products of the following manufacturers as identified below, or as approved equal:

a. Hilti, Inc., Tulsa, Oklahoma, 800-879-8000, www.us.hilti.com.

b. 3M Corporation

c. Fireseal Inc

PART 3 - EXECUTION

3.1 SLEEVE INSTALLATION

A. Install sleeves for piping passing through penetrations in floors, partitions, roofs, and walls.

B. For sleeves that will have sleeve-seal system installed, select sleeves of size large enough to provide 1 inch annular clear space between piping and concrete slabs and walls.

1. Sleeves are not required for core-drilled holes.

C. Install sleeves in concrete floors, concrete roof slabs, and concrete walls as new slabs and walls are constructed.

1. Cut sleeves to length for mounting flush with both surfaces.

    a. Exception: Extend sleeves installed in floors 2 inches above finished floor level in the following areas:

        1) Mechanical equipment areas
        2) Mechanical Penthouses
        3) Vivariums
        4) Operating rooms
        5) Biosafety Level 3 or higher laboratories
        6) Interstitial spaces housing mechanical equipment and piping above any of the above spaces 1-5.
        7) All laboratory floors
        8) In the floor slab above all computer rooms
        9) In the floor slab above all clean rooms
        10) Clean rooms
        11)
        12) Or other wet areas

2. Using grout, seal the space outside of sleeves in slabs and walls without sleeve-seal system.

D. Install sleeves for pipes passing through interior partitions.

1. Cut sleeves to length for mounting flush with both surfaces.
2. Install sleeves that are large enough to provide 1/4 inch annular clear space between sleeve and pipe or pipe insulation.
3. Seal annular space between sleeve and piping or piping insulation; use joint sealants appropriate for size, depth, and location of joint. Comply with requirements for sealants specified in Division 07.

E. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with fire stop materials. Comply with requirements for fire stopping specified in Division 07.

3.2 STACK-SLEEVE-FITTING INSTALLATION

A. Install stack-sleeve fittings in new slabs as slabs are constructed.

1. Install fittings that are large enough to provide 1/4 inch annular clear space between sleeve and pipe or pipe insulation.
2. Secure flashing between clamping flanges for pipes penetrating floors with membrane waterproofing. Comply with requirements for flashing specified in Division 07.
3. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level.
4. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
5. Using grout, seal the space around outside of stack-sleeve fittings.

B. Fire-Barrier Penetrations: Maintain indicated fire rating of floors at pipe penetrations. Seal pipe penetrations with fire stop materials. Comply with requirements for fire stopping specified in Division 07.

3.3 SLEEVE-SEAL-SYSTEM INSTALLATION

A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at service piping entries into building.

B. Select type, size, and number of sealing elements required for piping material and size and for sleeve ID or hole size. Position piping in center of sleeve. Center piping in penetration, assemble sleeve-seal system components, and install in annular space between piping and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make a watertight seal.

3.4 SLEEVE-SEAL-FITTING INSTALLATION

A. Install sleeve-seal fittings in new walls and slabs as they are constructed.

B. Assemble fitting components of length to be flush with both surfaces of concrete slabs and walls. Position water stop flange to be centered in concrete slab or wall.

C. Secure nailing flanges to concrete forms.

D. Using grout, seal the space around outside of sleeve-seal fittings.

3.5 SLEEVE AND SLEEVE-SEAL SCHEDULE

A. Use sleeves and sleeve seals for the following piping-penetration applications:

1. Exterior Concrete Walls above Grade:

    a. Piping Smaller Than NPS 6: Galvanized-steel wall sleeves. Sleeve-seal fittings.
    b. Piping NPS 6 and Larger: Galvanized-steel wall sleeves. Insert material.

2. Exterior Concrete Walls below Grade:

    a. Piping Smaller Than NPS 6: Galvanized-steel wall sleeves with sleeve-seal system sleeve-seal fittings

        1) Select sleeve size to allow for 1 inch annular clear space between piping and sleeve for installing sleeve-seal system.

    b. Piping NPS 6: Galvanized-steel wall sleeves with sleeve-seal system

        1) Select sleeve size to allow for 1 inch annular clear space between piping and sleeve for installing sleeve-seal system.

3. Concrete Slabs-on-Grade:

    a. Piping Smaller Than NPS 6: Galvanized-steel wall sleeves with sleeve-seal system Galvanized-steel-pipe sleeves with sleeve-seal system

1) Select sleeve size to allow for 1 inch annular clear space between piping and sleeve for installing sleeve-seal system.

b. Piping NPS 6: Galvanized-steel-wall sleeves with sleeve-seal system Retain first subparagraph below if using sleeve-seal systems.

1) Select sleeve size to allow for 1 inch annular clear space between piping and sleeve for installing sleeve-seal system.

4. Concrete Slabs above Grade:

a. Piping Smaller Than NPS 6 Insert pipe size: Galvanized-steel-pipe sleeves
b. Piping NPS 6 Insert pipe size and Larger: Galvanized-steel-pipe sleeves Stack-sleeve fittings

5. Interior Partitions:

a. Piping Smaller Than NPS 6: Galvanized-steel-pipe sleeves.
b. Piping NPS 6 and Larger: Galvanized-steel-sheet sleeves.

3.6 FIRE STOPPING INSTALLATION

A. Preparation

1. Verification of Conditions: Examine areas and conditions under which work is to be performed and identify conditions detrimental to proper or timely completion.

a. Verify penetrations are properly sized and in suitable condition for application of materials.
b. Surfaces to which fire stop materials will be applied shall be free of dirt, grease, oil, rust, laitance, release agents, water repellents, and any other substances that may affect proper adhesion.
c. Provide masking and temporary covering to prevent soiling of adjacent surfaces by fire stopping materials.
d. Comply with manufacturer's recommendations for temperature and humidity conditions before, during and after installation of fire stopping.
e. Do not proceed until unsatisfactory conditions have been corrected.

B. Coordination

1. Coordinate location and proper selection of cast-in-place Fire Stop Devices with trade responsible for the work. Ensure device is installed before placement of concrete.
2. Responsible trade to provide adequate spacing of field runs pipes to allow for installation of cast-in-place fire stop devices without interferences.

C. Installation

1. Regulatory Requirements: Install fire stop materials in accordance with UL Fire Resistance Directory.
2. Manufacturer's Instructions: Comply with manufacturer's instructions for installation of through-penetration joint materials.

a. Seal all holes or voids made by penetrations to ensure an air and water resistant seal.
b. Consult with mechanical engineer, project manager, and damper manufacturer prior to installation of UL fire stop systems that might hamper the performance of fire dampers as it pertains to ductwork.
c. Protect materials from damage on surfaces subjected to traffic.

D. Field Quality Control

1. Examine sealed penetration areas to ensure proper installation before concealing or enclosing areas.
2. Keep areas of work accessible until inspection by applicable code authorities.
3. Inspection of through-penetration fire stopping shall be performed in accordance with ASTM E 2174, “Standard Practice for On-Site Inspection of Installed Fire Stops” or other recognized standard.
4. Perform under this section patching and repairing of fire stopping caused by cutting or penetrating of existing fire stop systems already installed by other trades.

E. Identification and Documentation

1. The fire stop contractor is to supply documentation for each single application addressed. This documentation is to identify each penetration location on the entire project.

    a. The Documentation Form for through penetrations is to include:

        1) A Sequential Location Number
        2) The Project Name
        3) Date of Installation
        4) Detailed description of the penetrations location
        5) Tested System or Engineered Judgment Number
        6) Type of assembly penetrated
        7) A detailed description of the size and type of penetrating item
        8) Size of opening
        9) Number of sides of assemblies addressed
        10) Hourly rating to be achieved
        11) Installers Name

2. Copies of these documents are to be provided to the general contractor at the completion of the project.
3. Identify through-penetration fire stop systems with pressure-sensitive, self-adhesive, preprinted vinyl labels. Attach labels permanently to surfaces of penetrated construction on both sides of each fire stop system installation where labels will be visible to anyone seeking to remove penetrating items or fire stop systems. Include the following information on labels:

    a. The words: "Warning -Through Penetration Fire stop System-Do Not Disturb. Notify Building Management of Any Damage."
    b. Contractor's Name, address, and phone number.
    c. Through-Penetration firestop system designation of applicable testing and inspecting agency.
    d. Date of Installation.
    e. Through-Penetration fire stop system manufacturer's name.
    f. Installer's Name.

F. Fire stop documentation manager software shall be used to document, track, and maintain the passive fire stop systems throughout the construction and maintenance phase of the facility. The software solution shall be used to track and document every fire stop system installed on the project and each subsequent addition, change, or removal of the fire stop system. The fire stop documentation shall be managed with cloud-based software which allows the installer to use a standard Smartphone or tablet device (either iOS, Android or Windows capable) to capture the relevant information for the installation. The following data shall be tracked for each penetration within the facility: product installed, system installed, date of installation, location of the penetration including a notation on the 2D plan image, F-rating, name of installer, photo (pre-installation and post-installation), and inspection status. The Owner and/ or Construction Manager may designate additional items to be tracked. The fire stop documentation manager software must perform the following basic functions:

1. Create multiple projects/ facilities, add/create/ remove users for each project, upload documents including UL systems, 2D floor plans, product data, engineering judgments, etc.
2. Define data to track using pre-defined input fields or creating custom input fields as desired.
3. Capture multiple photos for each penetration, including a pre-installation and post-installation photo.
4. Scan QR Code on Hilti identification label to link the program data to a specific penetration location.
5. Annotate (mark) location of penetration on 2D floor plan.
6. Create reports by filtering data and utilizing report templates.
7. Online/ offline (for use in areas where data service is unavailable) synchronization of data between mobile device, online application and cloud-based system.
8. Ability to transfer ownership of projects from one customer to another from construction phase to facility maintenance.

G. Permanently attach Hilti identification labels to surfaces adjacent to and within 6 inches (150 mm) of fire stopping edge so labels will be visible to anyone seeking to remove or change penetrating items or fire stopping. Labels shall have a unique QR code for each penetration which can be scanned by the fire stop documentation software to quickly identify the penetration attributes.

H. Acceptable Software: Hilti CFS-DM, from Hilti Inc., Tulsa, OK. Tel: (800) 879-8000 website: www.us.hilti.com

1. Substitutions: Upon submission.
2. Single Source: Obtain fire stop documentation manager software and fire stop systems for each type of penetration and construction condition indicated only from a single manufacturer.

I. Adjusting and Cleaning

1. Remove equipment, materials and debris, leaving area in undamaged, clean condition.
2. Clean all surfaces adjacent to sealed holes and joints to be free of excess fire stop materials and soiling as work progresses.

J. Labor Use to Install Fire Stop Systems

1. To ensure complete harmony on the project site, the installation of each scope of work is to be performed jurisdictionally correct per existing trade agreements.

END OF SECTION

SECTION 220518 - ESCUTCHEONS FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes:

1. Escutcheons.
2. Floor plates.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

PART 2 - PRODUCTS

2.1 FINISH

A. `unless otherwise noted all exposed escutcheons, fittings, pipes traps and appurnatures shall be of a brushed chrome finish

2.2 ESCUTCHEONS

A. Note: the finish for all exposed escutcheons shall match a surfaceappearance as selected by the architect.

B. One-Piece, Cast-Brass Type: With polished, finish selected by the architect finish and setscrew fastener.

C. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with finish selected by the architect finish and spring-clip fasteners.

D. One-Piece, Stamped-Steel Type: With finish selected by the architect finish and spring-clip fasteners.

E. Split-Casting Brass Type: With polished, finish selected by the architect finish and with concealed hinge and setscrew.

F. Split-Plate, Stamped-Steel Type: With finish selected by the architect finish, concealed and exposed-rivet hinge, and spring-clip fasteners.

2.3 FLOOR PLATES

A. One-Piece Floor Plates: Cast-iron flange with holes for fasteners.

B. Split-Casting Floor Plates: Cast brass with concealed hinge.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install escutcheons for piping penetrations of walls, ceilings, and finished floors.

B. Install escutcheons with ID to closely fit around pipe, tube, and insulation of insulated piping and with OD that completely covers opening.

1. Escutcheons for New Piping:

   a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
   b. Finish selected by the architect Piping: One-piece, cast-brass or split-casting brass type with polished, finish selected by the architect finish.
   c. Insulated Piping: One-piece, stamped-steel type or split-plate, stamped-steel type with concealed hinge or split-plate, stamped-steel type with exposed-rivet hinge.
   d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass or split-casting brass type with polished, finish selected by the architect finish.
   e. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, cast-brass or split-casting brass type with polished, finish selected by the architect finish.
   f. Bare Piping in Unfinished Service Spaces: One-piece, cast-brass or split-casting brass type with polished, finish selected by the architect finish.
   g. Bare Piping in Equipment Rooms: One-piece, cast-brass or split-casting brass type with polished, finish selected by the architect finish.

2. Escutcheons for Existing Piping:

   a. Finish selected by the architect Piping: Split-casting brass type with polished, finish selected by the architect finish.
   b. Insulated Piping: Split-plate, stamped-steel type with concealed or exposed-rivet hinge.
   c. Bare Piping at Wall and Floor Penetrations in Finished Spaces: Split-casting brass type with polished, finish selected by the architect finish.
   d. Bare Piping at Ceiling Penetrations in Finished Spaces: Split-casting brass type with polished, finish selected by the architect finish.

e. Bare Piping in Unfinished Service Spaces: Split-casting brass type with polished, finish selected by the architect finish.
f. Bare Piping in Equipment Rooms: Split-plate, stamped-steel type with concealed or exposed-rivet hinge.

C. Install floor plates for piping penetrations of equipment-room floors.

D. Install floor plates with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.

1. New Piping: One-piece, floor-plate type.
2. Existing Piping: Split-casting, floor-plate type.

3.2 FIELD QUALITY CONTROL

A. Replace broken and damaged escutcheons and floor plates using new materials.

END OF SECTION

SECTION 220519 - METERS AND GAGES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes:

1. Bimetallic-actuated thermometers.
2. Filled-system thermometers.
3. Liquid-in-glass thermometers.
4. Thermowells.
5. Pressure gages.
6. Gage attachments.
7. Test plugs.
8. Test-plug kits.
9. Sight flow indicators.
10. Water meters.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

1.4 INFORMATIONAL SUBMITTALS

A. Product Certificates: For each type of meter and gage, from manufacturer.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For meters and gages to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 BIMETALLIC-ACTUATED THERMOMETERS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Ashcroft Inc.
2. Marsh Bellofram.
3. Trerice, H. O. Co.
4. Watts; a Watts Water Technologies company.
5. WIKA Instrument Corporation.

B. Standard: ASME B40.3, Grade A.

C. Case: 304 stainless steel; hermetically sealed per ASME B40.3; ingress protection IP65; external reset slotted hex head on back of case

D. Dial: White aluminum, dished, with black markings.

E. Connector Type(s): Plain, NPT, Union

F. Connector Size: 1/2 inch, with ASME B1.1 screw threads.

G. Stem: 0.25 or 0.375 inch in diameter; stainless steel.

H. Window: Flat Instrument Glass.

I. Ring: Stainless steel.

J. Element: Bimetal helix.

K. Pointer: black aluminum.

L. Accuracy: ±1.0 percent full scale value per ASME B40.3, Grade 1A

M. Basis of Design: WIKA Instruments model T1.32

2.2 FILLED-SYSTEM THERMOMETERS

A. Direct-Mounted, Stainless steel case, Vapor-Actuated Thermometers:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Ashcroft.
b. Marsh Bellofram.
c. Trerice, HO Co.

d. WIKA Instrument Corporation.

2. Standard: ASME B40.200.
3. Case: Stainless steel, 4.5".
4. Dial: White coated aluminum with black markings
5. Pointer: Adjustable, balance, aluminum with matte black finish.
6. Window: Glass or Lexan
7. Ring: Stainless steel.
8. Connector Type(s): Union, Thermowell, or plain bulb. At system plain or union bulb. Copper or 316 stainless steel
9. Thermal System: Liquid-filled bulb in copper-plated steel, aluminum, or brass stem and of length to suit installation.

    a. Design for Thermowell Installation: Bare stem.

10. Accuracy: Plus or minus 1 percent of scale range.
11. Basis of Design: WIKA Instruments T1.V45

B. Remote-Mounted, Stainless steel, Vapor-Actuated Thermometers:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

    a. Ashcroft.
    b. Marsh Bellofram.
    c. WIKA Instrument Corporation.

    d. Trerice, HO Co.

2. Standard: ASME B40.200.
3. Case: Stainless steel, 4.5.
4. Dial: White coated aluminum with black markings.
5. Pointer: Adjustable, balance, aluminum with matte black finish
6. Window: Glass or Lexan
7. Ring: Stainless steel.
8. Connector Type(s): Plain, union, or thermowell.
9. Thermal System: Plain or Union. Copper or 316 stainless steel

    a. Design for Thermowell Installation: Bare stem.

10. Accuracy: Plus or minus 1 percent of scale range.
11. Basis of Design: WIKA Instruments T1.V45

2.3 LIQUID-IN-GLASS THERMOMETERS

A. Stainless -Case, Compact-Style, Liquid-in-Glass Thermometers:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

    a. Ashcroft.

b. Marsh Bellofram.
c. WIKA Instrument Corporation.

d. Trerice, HO Co.

2. Standard: ASME B40.200.
3. Case: Plastic; 6 inch nominal size.
4. Case Form: Back angle straight unless otherwise indicated.
5. Tube: Glass with magnifying lens and blue or red organic liquid.
6. Tube Background: Non-reflective with permanently etched scale markings graduated in deg F and deg C.
7. Window: Glass or plastic.
8. Stem: brass: length to suit installation.

a. Design for Thermowell Installation: Bare stem.

9. Connector: 3/4 inch, with ASME B1.1 screw threads.
10. Accuracy: plus or minus 1.0 percent of span.
11. Basis of Design: WIKA Instruments T1.901 or T1.701

B. Stainless Case, Industrial-Style, Liquid-in-Glass Thermometers:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Marsh Bellofram.
b. Watts.
c. WIKA Instrument Corporation.
d. Weiss.

2. Standard: ASME B40.200.
3. Case: Plastic: 7 inch or 9 inch nominal size unless otherwise indicated.
4. Case Form: Adjustable angle unless otherwise indicated.
5. Tube: Glass with magnifying lens and blue or red organic liquid.
6. Tube Background: Non-reflective aluminum with permanently etched scale markings graduated in deg F and deg C.
7. Window: Glass.
8. Stem: Brass. 3.5”, 6.0”, 9.0”, or 12.0”

a. Design for Thermowell Installation: Bare stem.

9. Connector: 1-1/4 inches, with ASME B1.1 screw threads.
10. Accuracy: ±1.0 percent for scale range.

2.4 THERMOWELLS

A. General

1. Standard: ASME B40.200.
2. Description: Pressure-tight, socket-type fitting made for insertion into piping tee fitting.
3. Material for Use with Copper Tubing: CNR or CUNI.

4. Material for Use with Steel Piping: CRES CSA.
5. Type: Stepped shank unless straight or tapered shank is indicated.
6. External Threads: NPS 1/2, NPS 3/4, or NPS 1, ASME B1.20.1 pipe threads.
7. Internal Threads: 1/2 inch, 3/4 inch, and 1 inch, with ASME B1.1 screw threads.
8. Bore: Diameter required to match thermometer bulb or stem.
9. Insertion Length: Length required matching thermometer bulb or stemming.
10. Lagging Extension: Include on thermowells for insulated piping and tubing.
11. Bushings: For converting size of thermowells internal screw thread to size of thermometer connection.

B. Heat-Transfer Medium: Mixture of graphite and glycerin.

2.5 PRESSURE GAGES

A. Direct-Mounted, Stainless-Case, Dial-Type Pressure Gages:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

    a. AMETEK, Inc.
    b. Ashcroft Inc.
    c. Marsh Bellofram.
    d. Watts; a Watts Water Technologies company.
    e. WIKA Instrument Corporation.
    f. Weiss Instruments, Inc.

2. Standard: ASME B40.100.
3. Case: Stainless steel, 4.5”.
4. Pressure-Element Assembly: Bourdon tube unless otherwise indicated.
5. Pressure Connection: Brass, with NPS 1/4, ASME B1.20.1 pipe threads and bottom-outlet type unless back-outlet type is indicated.
6. Movement: Mechanical, with link to pressure element and connection to pointer.
7. Dial: White aluminum with stop pin and black lettering.
8. Pointer: Black aluminum.
9. Window: Snap-in poly carbonate
10. Accuracy: plus or minus 1.0 percent of span (ASME B40.100, grade 1A)
11. Basis of Design: WIKA Instruments model 111.25CT

B. Remote-Mounted, Stainless-Case, Dial-Type Pressure Gages:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. AMETEK, Inc.
    b. Ashcroft Inc.
    c. Marsh Bellofram.
    d. Watts; a Watts Water Technologies company.
    e. WIKA Instrument Corporation.

    f. Weiss Instruments, Inc.

2. Standard: ASME B40.100.
3. Case: Stainless steel, 4.5".
4. Pressure-Element Assembly: Bourdon tube unless otherwise indicated.
5. Pressure Connection: Brass, with NPS 1/4 NPS 1/4 or NPS 1/2 NPS 1/2, ASME B1.20.1 pipe threads and bottom-outlet type unless back-outlet type is indicated.
6. Movement: Mechanical, with link to pressure element and connection to pointer.
7. Dial: White aluminum with stop pin and black lettering.
8. Pointer: Black aluminum
9. Window: Snap-in polycarbonate
10. Accuracy: Grade B, plus or minus 2 percent of middle half of scale range.

2.6 GAGE ATTACHMENTS

A. Snubbers: ASME B40.100, brass; with NPS 1/4 NPS 1/4 or NPS 1/2 NPS 1/2, ASME B1.20.1 pipe threads and piston porous-metal-type surge-dampening device. Include extension for use on insulated piping.

1. Basis of Design: WIKA Instrument model 910.12.X00

B. Valves: Brass ball Brass or stainless-steel needle, with NPS 1/4 NPS 1/4 or NPS 1/2 NPS 1/2, ASME B1.20.1 pipe threads.

1. Basis of Design: WIKA Instrument model 910.11.100

2.7 TEST PLUGS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. National Meter, Inc.
2. Watts; a Watts Water Technologies company.
3. WIKA Instrument Corporation.
4. Weiss Instruments, Inc.

B. Description: Test-station fitting made for insertion into piping tee fitting.

C. Body: Brass or stainless steel with core inserts and gasketed and threaded cap. Include extended stem on units to be installed in insulated piping.

D. Thread Size: NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe thread.

E. Minimum Pressure and Temperature Rating: 500 psig at 200 deg F.

F. Core Inserts: Chlorosulfonated polyethylene synthetic and EPDM self-sealing rubber.

G. Basis of Design: WIKA Instrument model 910.14.100

2.8 TEST-PLUG KITS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. National Meter, Inc.
2. Trerice, H. O. Co.
3. WIKA Instrument Corporation.
4. Weiss Instruments, Inc.

B. Furnish two test-plug kit(s) containing two thermometer(s), one pressure gage and adapter, and carrying case. Thermometer sensing elements, pressure gage, and adapter probes shall be of diameter to fit test plugs and of length to project into piping.

C. Low-Range Thermometer: Small, bimetallic insertion type with 1- to 2-inch- diameter dial and tapered-end sensing element. Dial range shall be at least 25 to 125 deg F.

D. High-Range Thermometer: Small, bimetallic insertion type with 1- to 2-inch-diameter dial and tapered-end sensing element. Dial range shall be at least 0 to 220 deg F.

E. Pressure Gage: Small, Bourdon-tube insertion type with 2- to 3-inch-diameter dial and probe. Dial range shall be at least 0 to 200 psig.

F. Carrying Case: Metal or plastic, with formed instrument padding.

2.9 SIGHT FLOW INDICATORS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. Dwyer Instruments, Inc.
2. Emerson Process Management; Rosemount Division.
3. Ernst Flow Industries.
4. KOBOLD Instruments, Inc. - USA.

B. Description: Piping inline-installation device for visual verification of flow.

C. Construction: Bronze or stainless-steel body, with sight glass and ball, flapper, or paddle wheel indicator, and threaded or flanged ends.

D. Minimum Pressure Rating: 125 psig.

E. Minimum Temperature Rating: 200 deg F.

F. End Connections for NPS 2 and Smaller: Threaded.

G. End Connections for NPS 2-1/2 and Larger: Flanged.

2.10 WATER METERS

A. General

1. Coordinate with the local water department and furnish and install compliant water meter in accordance to locality specifications, include requirements for remote reading devices and wiring there-of.
2. The specifications below offer general meter arrangements. Final selection and submission shall be based on local water purveyor standards.

B. Compound-Type Water Meters

1. Manufacturers: Provide Products by the following

   a. Neptune.

2. Description

   a. Domestic Water – Neptune compound meter with count transmitter and register. Compound water meter shall be 4 inch with a building peak demand flow of 400 gpm. Refer to Physical Plant Website: http://www.pplant.usf.edu/pdf/sys_arch.pdf.
   b. Standard: AWWA C702.
   c. Pressure Rating: 150-psig working pressure.
   d. Body Design: With integral mainline and bypass meters; totalization meter.
   e. Registration: In gallons or cubic feet as required by USF and the local utility company.
   f. Case: Bronze.
   g. Pipe Connections: Flanged.

C. Remote Registration System: Direct-reading type complying with AWWA C706; modified with signal-transmitting assembly, low-voltage connecting wiring, and remote register assembly as required by USF and the utility company.
   a. Furnish and install an Allen Bradley module panel 1803-EEM. Panel shall be mounted at the water meter location in the water meter room.
   b. The output module from the meter shall be connected to the Allen Bradley 1803 EEM Panel by division 22 contractor. Latest approved meters by Physical Plant may also be used. Refer to Physical Plant Website: http://www.pplant.usf.edu/pdf/sys_arch.pdf.
   c. Meter will ultimately report to the BMS. Wiring from the AB panel to the BMS is by division 23.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install thermowells with socket extending one-third of pipe diameter and in vertical position in piping tees.

B. Install thermowells of sizes required to match thermometer connectors. Include bushings if required to match sizes.

C. Install thermowells with extension on insulated piping.

D. Fill thermowells with heat-transfer medium.

E. Install direct-mounted thermometers in thermowells and adjust vertical and tilted positions.

F. Install remote-mounted thermometer bulbs in thermowells and install cases on panels; connect cases with tubing and support tubing to prevent kinks. Use minimum tubing length.

G. Install direct-mounted pressure gages in piping tees with pressure gage located on pipe at the most readable position.

H. Install remote-mounted pressure gages on panel.

I. Install valve and snubber in piping for each pressure gage for fluids.

J. Install test plugs in piping tees.

K. Install thermometers in the following locations:

1. Inlet and outlet of each water heater.
2. Inlets and outlets of each water heat exchanger.
3. Inlet and outlet of each hot-water storage tank.
4. Inlet and outlet of each remote water chiller.
5. Inlet and outlet of mixing valves.
6. Inlet of hot water recirculation pumps.
7. At each hot water balancing station.

L. Install pressure gages in the following locations:

1. Building water service entrance into building.
2. Inlet and outlet of each pressure-reducing valve.
3. Suction and discharge of each water pump.
4. Outlet of each hot water recirculation pump.
5. Top of each water riser.
6. Inlet and outlet of master mixing valves.

M. Water Meter Installation

1. Contact the municipal water department in the jurisdictional area of this project
2. Coordinate the type and model water meter accepted by the municipality
3. Provide a shop drawing to the Engineer and Architect with approval documentation from the authority of the accepted water meter for the project
4. Pay all local fees, procure the water meter from the water department or from an approved vendor, and install the water meter. Carry out commissioning instructions required by the municipal water authority and plumbing inspector.

3.2 CONNECTIONS

A. Install meters and gages adjacent to machines and equipment to allow service and maintenance of meters, gages, machines, and equipment.

3.3 ADJUSTING

A. Adjust faces of meters and gages to proper angle for best visibility.

3.4 THERMOMETER SCHEDULE

A. Thermometers at inlet and outlet of each water heaters and heat exchangers shall be one of the following:

1. Liquid-filled, sealed, bimetallic-actuated type.
2. Direct-mounted, plastic-case, vapor-actuated type.
3. Industrial-style, liquid-in-glass type.
4. Test plug with chlorosulfonated polyethylene synthetic EPDM self-sealing rubber inserts.

B. Thermometers at inlet and outlet of each hot-water storage tank shall be one of the following:

1. Liquid-filled, sealed, bimetallic-actuated type.
2. Direct-mounted, plastic-case, vapor-actuated type.
3. Compact Industrial-style, liquid-in-glass type.
4. Test plug with chlorosulfonated polyethylene synthetic EPDM self-sealing rubber inserts.

C. Thermometers at inlet and outlet of each remote water chiller shall be one of the following:

1. Liquid-filled, sealed, bimetallic-actuated type.
2. Direct Remote-mounted, plastic-case, vapor-actuated type.
3. Compact Industrial-style, liquid-in-glass type.
4. Test plug with chlorosulfonated polyethylene synthetic EPDM self-sealing rubber inserts.

D. Thermometers at inlet and outlet of each hot water recirculation pump shall be one of the following:

1. Liquid-filled, sealed, bimetallic-actuated type.
2. Direct remote-mounted, plastic-case, vapor-actuated type.
3. Compact Industrial-style, liquid-in-glass type.
4. Test plug with chlorosulfonated polyethylene synthetic EPDM self-sealing rubber inserts.

E. Thermometers at inlet and outlet of each hot water Master Mixing Station shall be one of the following:

1. Compact Industrial-style, liquid-in-glass type.
2. Test plug with chlorosulfonated polyethylene synthetic EPDM self-sealing rubber inserts.

F. Thermometer stems shall be of length to match thermowell insertion length.

3.5 THERMOMETER SCALE-RANGE SCHEDULE

A. Scale Range for Cold-Water Piping: 0 to 140 deg F ( )

B. Scale Range for Hot-Water Piping: 0 to 200 deg F)

C. Scale Range for Cooled-Water Piping: 0 to 100 deg F,)

D. Scale Range for Solar-Water Piping: 0 to 250 deg F.

3.6 PRESSURE-GAGE SCHEDULE

A. Pressure gages at discharge of each water service into building shall be the following:

1. Sealed, direct -mounted, plastic case.

B. Pressure gages at inlet and outlet of each water pressure-reducing valve shall be the following:

1. Sealed, direct-mounted, plastic case.
2. Test plug with chlorosulfonated polyethylene synthetic EPDM self-sealing rubber inserts.

C. Pressure gages at suction and discharge of each water pump shall be one of the following:

1. Liquid-filled, sealed open-front, pressure-relief solid-front, pressure-relief, direct-mounted, metal case.
2. Sealed, direct-mounted, plastic case.
3. Test plug with chlorosulfonated polyethylene synthetic EPDM self-sealing rubber inserts.

3.7 PRESSURE-GAGE SCALE-RANGE SCHEDULE

A. Scale Range for Water Service Piping: 0 to 160 psi and 0 to 1100 kPa.

B. Scale Range for Water Piping: 0 to 100 psi and 0 to 600 kPa.

C. Scale Range for Water Piping: 0 to 160 psi and 0 to 1100 kPa.

D. Scale Range for Water Piping: 0 to 200 psi and 0 to 1400 kPa.

END OF SECTION

SESECTION 220529 - HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes

1. Metal pipe hangers and supports.
2. Trapeze pipe hangers.
3. Fiberglass pipe hangers.
4. Metal framing systems.
5. Fiberglass strut systems.
6. Thermal-hanger shield inserts.
7. Fastener systems.
8. Pipe stands.
9. Pipe positioning systems.
10. Equipment supports.
11. Miscellaneous materials.
12. Acoustical isolation hangers and supports

B. Related Sections

1. Division 05 for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.

1.3 DEFINITIONS

A. MSS: Manufacturers Standardization Society of the Valve and Fittings Industry Inc.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: Show fabrication and installation details and include calculations for the following; include Product Data for components:

1. Trapeze pipe hangers.
2. Metal framing systems.

3. Fiberglass strut systems.
4. Pipe stands.
5. Equipment supports.

1.5 INFORMATIONAL SUBMITTALS

A. Welding certificates.

1.6 QUALITY ASSURANCE

A. Structural Steel Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

PART 2 - PRODUCTS

2.1 METAL PIPE HANGERS AND SUPPORTS

A. Carbon-Steel Pipe Hangers and Supports

1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
2. Galvanized Metallic Coatings: Pre-galvanized or hot dipped.
3. Nonmetallic Coatings: Plastic coating, jacket, or liner.
4. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
5. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.

B. Stainless-Steel Pipe Hangers and Supports

1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
2. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
3. Hanger Rods: Continuous-thread rod, nuts, and washer made of stainless steel.

C. Copper Pipe Hangers

1. Description: MSS SP-58, Types 1 through 58, copper-coated-steel, factory-fabricated components.
2. Hanger Rods: Continuous-thread rod, nuts, and washer made of copper-coated steel or stainless steel.

2.2 TRAPEZE PIPE HANGERS

A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural carbon-steel shapes with MSS SP-58 carbon-steel hanger rods, nuts, saddles, and U-bolts.

2.3 INSULATING OR ACOUSTIC SILENCING PIPE SUPPORTS

A. Where indicated on the drawings, all piping, (drainage and pressure piping systems) in specific areas designated shall be resiliently tied to the wall partitions or underside of the floors with silencer clamps, hangers or isolators to reduce noise from being transferred to adjacent areas

B. Isolate piping from trapeze hanger systems through the use of strut mounted cushion clamps Eliminate contact between piping, clamps and strut. The clamps allow piping to be added or removed from installations without disturbing adjacent lines

C. For supports in return air plenums utilize a flame and smoke rated variable closure clamp.

D. Use loop and clevis isolation hangers with acoustical insulation liner of 3/4 inch minimum thichness for drainage piping systems

E. For all pressure piping systems furnish and install a strong, sound rated variable closure clamp. Each support shall have two acoustical inserts isolate the pipe from the support structure, reducing piping noise and vibration, while allowing normal pipe expansion and contraction.

F. Products listed on this certificate have been tested by an IAPMO R&T recognized laboratory. This recognition has been granted based upon the laboratory's compliance to the applicable requirements of ISO/IEC 17025.

G. Basis of Design: Holdrite Silencer System

2.4 FIBERGLASS PIPE HANGERS

A. Clevis-Type, Fiberglass Pipe Hangers

1. Description: Similar to MSS SP-58, Type 1, steel pipe hanger except hanger is made of fiberglass or fiberglass-reinforced resin.
2. Hanger Rods: Continuous-thread rod, washer, and nuts made of fiberglass polyurethane or stainless steel.

B. Strap-Type, Fiberglass Pipe Hangers:

1. Description: Similar to MSS SP-58, Type 9 or Type 10, steel pipe hanger except hanger is made of fiberglass-reinforced resin.
2. Hanger Rod and Fittings: Continuous-thread rod, washer, and nuts made of stainless steel.

2.5 METAL FRAMING SYSTEMS

A. MFMA Manufacturer Metal Framing Systems

1. Description: Shop- or field-fabricated pipe-support assembly for supporting multiple parallel pipes.
2. Standard: MFMA-4.
3. Channels: Continuous slotted steel channel with inturned lips.
4. Channel Nuts: Formed or stamped steel nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.
5. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.
6. Metallic Coating: Electroplated zinc hot-dipped galvanized mill galvanized in-line, hot galvanized mechanically-deposited zinc.

B. Non-MFMA Manufacturer Metal Framing Systems

1. Description: Shop- or field-fabricated pipe-support assembly made of steel channels, accessories, fittings, and other components for supporting multiple parallel pipes.
2. Standard: Comply with MFMA-4.
3. Channels: Continuous slotted steel channel with inturned lips.
4. Channel Nuts: Formed or stamped steel nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.
5. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.
6. Coating: Zinc.

2.6 FIBERGLASS STRUT SYSTEMS

A. Description: Shop- or field-fabricated pipe-support assembly similar to MFMA-4 for supporting multiple parallel pipes.

1. Channels: Continuous slotted fiberglass or other plastic channel with inturned lips.
2. Channel Nuts: Fiberglass nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.
3. Hanger Rods: Continuous-thread rod, nuts, and washer made of fiberglass or stainless steel.

2.7 THERMAL-HANGER SHIELD INSERTS

A. Insulation-Insert Material for Cold Piping: ASTM C 552, Type II cellular glass with 100-psig minimum compressive strength and vapor barrier.

B. Insulation-Insert Material for Hot Piping: ASTM C 552, Type II cellular glass with 100-psig or ASTM C 591, Type VI, Grade 1 polyisocyanurate with 125-psig minimum compressive strength.

C. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.

D. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.

E. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

2.8 FASTENER SYSTEMS

A. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated or stainless- steel anchors, for use in hardened Portland cement concrete; with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

B. Internally Threaded Anchor for Installation into Metal Deck: Concrete anchor shall be carbon steel, cast-in type with single internal thread and a zinc/yellow chromate plating. Anchor shall have a protective sleeve, steel flange with pre-drilled additional fastening holes and placement spring for attachment to metal deck, anchor is to be secured by clamping the deck between the steel flange and the protective plastic sleeve. Anchor shall bear the diameter and the manufacturer name on hexagonal head.

C. Internally Threaded Anchor for Installation into Wood Deck: Concrete anchor shall be carbon steel, cast-in type with single internal thread and a zinc/yellow chromate plating and contained by a plastic flange. Anchor shall have break-off nails for attachment to the surface of wood forms. Anchor will bear the diameter and manufacturer name on hexagonal head.

2.9 PIPE STANDS

A. General Requirements for Pipe Stands: Shop- or field-fabricated assemblies made of manufactured corrosion-resistant components to support roof-mounted piping.

B. Compact Pipe Stand: One-piece plastic unit with integral-rod roller, pipe clamps, or V-shaped cradle to support pipe, for roof installation without membrane penetration.

C. Low-Type, Single-Pipe Stand: One-piece plastic or stainless-steel base unit with plastic roller, for roof installation without membrane penetration.

D. High-Type, Single-Pipe Stand

1. Description: Assembly of base, vertical and horizontal members, and pipe support, for roof installation without membrane penetration.
2. Base: Stainless steel.
3. Vertical Members: Two or more cadmium-plated-steel or stainless-steel, continuous-thread rods.
4. Horizontal Member: Cadmium-plated-steel or stainless-steel rod with plastic or stainless-steel, roller-type pipe support.

E. High-Type, Multiple-Pipe Stand

1. Description: Assembly of bases, vertical and horizontal members, and pipe supports, for roof installation without membrane penetration.
2. Bases: One or more; plastic.
3. Vertical Members: Two or more protective-coated-steel channels.
4. Horizontal Member: Protective-coated-steel channel.
5. Pipe Supports: Galvanized-steel, clevis-type pipe hangers.

F. Curb-Mounting-Type Pipe Stands: Shop- or field-fabricated pipe supports made from structural-steel shapes, continuous-thread rods, and rollers, for mounting on permanent stationary roof curb.

2.10 PIPE POSITIONING SYSTEMS

A. Description: IAPMO PS 42, positioning system of metal brackets, clips, and straps for positioning piping in pipe spaces; for plumbing fixtures in commercial applications.

2.11 EQUIPMENT SUPPORTS

A. Description: Welded, shop- or field-fabricated equipment support made from structural carbon-steel shapes.

2.12 MISCELLANEOUS MATERIALS

A. Structural Steel: ASTM A 36/A 36M, carbon-steel plates, shapes, and bars; black and galvanized.

B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, non-shrink and nonmetallic grout; suitable for interior and exterior applications.

1. Properties: Non-staining, noncorrosive, and nongaseous.
2. Design Mix: 5000-psi, 28-day compressive strength.

2.13 ACOUSTICAL ISOLATION HANGERS AND SUPPORTS

A. All devices, hangers, and supports shall be manufactured components and not field devised methods.

B. Acceptable Manufacturers:

1. Holdrite, Silencer System
2. LSP Products Group, Acousto-Plumb

C. Closure Clamp: Sound rated variable closure clamp compatible with copper, PEX, and CPVC pipe, for either side or top mounting. Nylon material with TPR pads with UL94V-2 fire rating. Equal to Holdrite #250, #255, #280 and #285.

D. Shower Head/Tub Spout Attachment Clamp: Acoustical clamp for attachment to in-wall framing system that will accept a drop eared 90 degree elbow. Shell shall be polypropylene with UL94V-2 fire rating with santoprene isolator material. Equal to Holdrite #265.

E. Through Stud Isolator/Suspension Clamp: sound rated suspension hanger or through-hole isolator in wood or metal framing for copper, PEX, and CPVC piping. Shell shall be polypropylene with UL94V-2 fire rating with TPE isolator material. Equal to Holdrite #261, #262, #263, and #264.

F. Acoustical Insulation Hanger Liner: TPE sound insulation lining to minimize occurrence of frictional noise caused by thermal expansion. Attaches to in-wall framing systems or around pipes to provide isolation from structure. Equal to Holdrite #270 and #271.

G. Isolation Felt: Felt used for providing sound insulation between piping and hangers, made from polyester felt, with one side being pressure-sensitive adhesive. Equal to Holdrite #272-2 and 272-4.

H. Vibration Isolation Pad: Engineered sound and neoprene vibration riser pad with 10 gage steel bearing plate for use with riser clamps and equipment isolation, minimum of 3/4 inch thick. Equal to Holdrite #275.

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT INSTALLATION

A. Metal Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89 and local codes. Install hangers, supports, clamps, and attachments as required to properly support piping from the building structure.

B. Metal Trapeze Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping, and support together on field-fabricated trapeze pipe hangers.

1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified for individual pipe hangers.
2. Field fabricate from ASTM A 36/A 36M, carbon-steel shapes selected for loads being supported. Weld steel according to AWS D1.1/D1.1M.

C. Fiberglass Pipe-Hanger Installation: Comply with applicable portions of MSS SP-69 and MSS SP-89. Install hangers and attachments as required to properly support piping from building structure.

D. Metal Framing System Installation: Arrange for grouping of parallel runs of piping, and support together on field-assembled metal framing systems.

E. Fiberglass Strut System Installation: Arrange for grouping of parallel runs of piping, and support together on field-assembled fiberglass struts.

F. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.

G. Fastener System Installation

1. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.

H. Pipe Stand Installation

1. Pipe Stand Types except Curb-Mounted Type: Assemble components and mount on smooth roof surface. Do not penetrate roof membrane.
2. Curb-Mounted-Type Pipe Stands: Assemble components or fabricate pipe stand and mount on permanent, stationary roof curb. See Division 07 for curbs.

I. Pipe Positioning-System Installation: Install support devices to make rigid supply and waste piping connections to each plumbing fixture.

J. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.

K. Equipment Support Installation: Fabricate from welded-structural-steel shapes.

L. Install hangers and supports to allow controlled thermal movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.

M. Install lateral bracing with pipe hangers and supports to prevent swaying.

N. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.

O. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

P. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.

Q. Insulated Piping

1. Attach clamps and spacers to piping.

    a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
    b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
    c. Do not exceed pipe stress limits allowed by ASME B31.9 for building services piping.

2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.

    a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.

3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.

    a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.

4. Shield Dimensions for Pipe: Not less than the following:

    a. NPS 1/4 to NPS 3-1/2: 12 inches long and 0.048 inch thick.
    b. NPS 4: 12 inches long and 0.06 inch thick.
    c. NPS 5 and NPS 6: 18 inches long and 0.06 inch thick.

d. NPS 8 to NPS 14: 24 inches long and 0.075 inch thick.
e. NPS 16 to NPS 24: 24 inches long and 0.105 inch thick.

5. Pipes NPS 8 and Larger: Include wood or reinforced calcium-silicate-insulation inserts of length at least as long as protective shield.
6. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.
7. Support of pipe, tubing and equipment shall be accomplished by means of engineered products, specific to each application. Makeshift, field devised methods are not allowed.
8. Comply with CISPI Designation 310-04, CISPI Designation 301-09 and the CISPI Cast Iron Soil Pipe Handbook, regarding auxiliary support for ho-hub cast iron pipe and fitting joints subjected to excessive thrust forces. Use manufactured assemblies with appropriate thrust pressure ratings, rather than field assembled miscellaneous materials.
9. No-hub pipe and fitting coupling joints that are exposed to thrust pressures greater than those recommended by the pipe and fitting manufacturer shall receive auxiliary support by means of appropriate bracing materials, as referred to in CISPI Designation 310-04, CIPSI Designation 301-09 and the CISPI Cast Iron Soil Pipe and Fittings Handbook. Auxiliary restraint products used shall be manufactured assemblies with thrust pressure rating adequate for the specific installation and shall be installed onto horizontal joints NPS 4 diameter and larger in size. Field devised methods and materials shall not be used to accomplish this application solution.

3.2 PEX PIPING SUPPORTS

A. Hangers and supports shall be designed for PEX tubing containing no sharp edges or surfaces.

B. Drop ear bend supports or pre-manufactured wall supports/pipe positioning systems shall be utilized to provide a rigid installation between the vertical piping in the wall to the fixture supply.

C. Bend supports shall be used at all locations where the tubing is making a 90 degree bend. This includes both in the ceiling and in the wall cavity.

D. Provide steel plate protectors in any location where there is possible damage from drywall, concrete board, or paneling screws or nails.

E. If PEX tubing passes through hollow masonry walls or metal studs, always protect with suitable sleeves or grommets.

F. Install hangers for PEX piping with the following maximum horizontal spacing and minimum rod diameters:

1. Method 1: 3 inches and smaller: 32 inches utilizing 3/8 inch rod.
2. Method 2: 3 inches and smaller: Continuously supported by metallic CTS support channels or metallic V channels that:

a. Are supported every 6 feet for NPS 1 inch and smaller.
b. Are supported every 8 feet for NPS 1-1/4 inches and larger.
c. Have a maximum cantilever, measured from the support to the end of the support channel of 1.5 feet.

3.3 ACOUSTICAL HANGERS AND SUPPORT ISOLATION INSTALLATION

A. Install all items per the manufacturer's recommendations.

B. Use any and all of the specified components to provide for a complete vibration and acoustical isolated system installation on all water, sanitary, storm and vent piping systems. Use the appropriate isolator type at each location.

C. Install acoustical hangers and support isolators to prevent all direct, rigid contact between piping and surrounding structures and hangers. No metal-to-metal contact is permissible.

D. Provide isolation of all riser clamps. The neoprene pads shall not be more than 25 percent compressed when retaining bolts are tightened. Size supports as required.

E. Pipes must not directly contact gypsum board, framing, conduit, or other structural elements. Use adequate clearance and approved felt pads to prevent direct contact between pipes and the structure. Holes and cutouts must be adequately oversized to allow clearance all around the piping.

3.4 EQUIPMENT SUPPORTS

A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.

B. Grouting: Place grout under supports for equipment and make bearing surface smooth.

C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.5 METAL FABRICATIONS

A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.

B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.

C. Field Welding: Comply with AWS D1.1/D1.1M procedures for shielded, metal arc welding; appearance and quality of welds; and methods used in correcting welding work; and with the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. Finish welds at exposed connections so no roughness shows after finishing and so contours of welded surfaces match adjacent contours.

3.6 ADJUSTING

A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches.

3.7 PAINTING

A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.

1. Apply paint by brush or spray to provide a minimum dry film thickness of 2.0 mils.

B. Touchup: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal are specified in Division 09 for painting.

C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

3.8 HANGER AND SUPPORT SCHEDULE

A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.

B. Comply with MSS SP-69 for pipe-hanger selections and applications that are not specified in piping system Sections.

C. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finish.

D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.

E. Use carbon-steel pipe hangers and supports metal trapeze pipe hangers and metal framing systems and attachments for general service applications.

F. Use stainless-steel pipe hangers and fiberglass pipe hangers and fiberglass strut systems and stainless-steel or corrosion-resistant attachments for hostile environment applications.

G. Use copper-plated pipe hangers and copper or stainless-steel attachments for copper piping and tubing.

H. Use padded hangers for piping that is subject to scratching.

I. Use thermal-hanger shield inserts for insulated piping and tubing.

J. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of non-insulated or insulated, stationary pipes NPS 1/2 to NPS 30.
2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of up to 1050 deg F, pipes NPS 4 to NPS 24, requiring up to 4 inches of insulation.
3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes NPS 3/4 to NPS 36, requiring clamp flexibility and up to 4 inches of insulation.
4. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes NPS 1/2 to NPS 24 if little or no insulation is required.
5. Pipe Hangers (MSS Type 5): For suspension of pipes NPS 1/2 to NPS 4, to allow off-center closure for hanger installation before pipe erection.
6. Adjustable, Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of non-insulated, stationary pipes NPS 3/4 to NPS 8.
7. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of non-insulated, stationary pipes NPS 1/2 to NPS 8.
8. Adjustable Band Hangers (MSS Type 9): For suspension of non-insulated, stationary pipes NPS 1/2 to NPS 8.
9. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of non-insulated, stationary pipes NPS 1/2 to NPS 8.
10. Split Pipe Ring with or without Turnbuckle Hangers (MSS Type 11): For suspension of non-insulated, stationary pipes NPS 3/8 to NPS 8.
11. Extension Hinged or Two-Bolt Split Pipe Clamps (MSS Type 12): For suspension of non-insulated, stationary pipes NPS 3/8 to NPS 3.
12. U-Bolts (MSS Type 24): For support of heavy pipes NPS 1/2 to NPS 30.
13. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.
14. Pipe Saddle Supports (MSS Type 36): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate.
15. Pipe Stanchion Saddles (MSS Type 37): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate, and with U-bolt to retain pipe.
16. Adjustable Pipe Saddle Supports (MSS Type 38): For stanchion-type support for pipes NPS 2-1/2 to NPS 36 if vertical adjustment is required, with steel-pipe base stanchion support and cast-iron floor flange.
17. Single-Pipe Rolls (MSS Type 41): For suspension of pipes NPS 1 to NPS 30, from two rods if longitudinal movement caused by expansion and contraction might occur.
18. Adjustable Roller Hangers (MSS Type 43): For suspension of pipes NPS 2-1/2 to NPS 24, from single rod if horizontal movement caused by expansion and contraction might occur.
19. Complete Pipe Rolls (MSS Type 44): For support of pipes NPS 2 to NPS 42 if longitudinal movement caused by expansion and contraction might occur but vertical adjustment is not necessary.
20. Pipe Roll and Plate Units (MSS Type 45): For support of pipes NPS 2 to NPS 24 if small horizontal movement caused by expansion and contraction might occur and vertical adjustment is not necessary.
21. Adjustable Pipe Roll and Base Units (MSS Type 46): For support of pipes NPS 2 to NPS 30 if vertical and lateral adjustment during installation might be required in addition to expansion and contraction.

K. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers NPS 3/4 to NPS 24.
2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers NPS 3/4 to NPS 24 if longer ends are required for riser clamps.

L. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.
2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.
3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11, split pipe rings.
4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
5. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F piping installations.

M. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joist construction, to attach to top flange of structural shape.
3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
6. C-Clamps (MSS Type 23): For structural shapes.
7. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
8. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
9. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.
10. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.
11. Malleable-Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.
12. Welded-Steel Brackets: For support of pipes from below or for suspending from above by using clip and rod. Use one of the following for indicated loads:

    a. Light (MSS Type 31): 750 lb.
    b. Medium (MSS Type 32): 1500 lb.
    c. Heavy (MSS Type 33): 3000 lb.

13. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
14. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
15. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where headroom is limited.

N. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel-Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
3. Thermal-Hanger Shield Inserts: For supporting insulated pipe.

O. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Restraint-Control Devices (MSS Type 47): Where indicated to control piping movement.
2. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches.
3. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41, roll hanger with springs.
4. Spring Sway Braces (MSS Type 50): To retard sway, shock, vibration, or thermal expansion in piping systems.
5. Variable-Spring Hangers (MSS Type 51): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from hanger.
6. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from base support.
7. Variable-Spring Trapeze Hangers (MSS Type 53): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from trapeze support.
8. Constant Supports: For critical piping stress and if necessary to avoid transfer of stress from one support to another support, critical terminal, or connected equipment. Include auxiliary stops for erection, hydrostatic test, and load-adjustment capability. These supports include the following types:

    a. Horizontal (MSS Type 54): Mounted horizontally.
    b. Vertical (MSS Type 55): Mounted vertically.
    c. Trapeze (MSS Type 56): Two vertical-type supports and one trapeze member.

P. Comply with MSS SP-69 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.

Q. Comply with MFMA-103 for metal framing system selections and applications that are not specified in piping system Sections.

R. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction.

S. Use pipe positioning systems in pipe spaces behind plumbing fixtures to support supply and waste piping for plumbing fixtures.

3.9 SPACING

A. Refer to individual piping sections for spacing requirements.

B. Where no requirement is specified elsewhere, pipe hangers and supports shall be per MSS SP-90.

C. Space pipe hangers and supports in accordance with following tables, with exceptions as indicated herein.

D. The vertical spacing shall be at each floor level, with spacing not to exceed that shown in the table below. Provide mid story guides on PEX, PVC, PP, and CPVC piping per local code requirements.

Table 1 – Maximum Horizontal Pipe Hanger and Support Spacing

		1		2		3		4		5	6	7	8	9	10	11	12	13
NOMINAL PIPE OR TUBE SIZE		STD WT STEEL PIPE				COPPER TUBE				CSST	DUCTILE IRON PIPE	CAST IRON SOIL	PEX	PLASTIC PVC	PLASTIC CPVC 1 inch AND SMALLER	PLASTIC CPVC 1-1/4 inch AND LARGER	PLASTIC PP 1 inch AND SMALLER	PLASTIC PP 1-1/4 inch AND LARGER
		WATER SERVICE		VAPOR SERVICE		WATER SERVICE		VAPOR SERVICE										
in.	mm	ft.	m	ft.	m	ft.	mm	ft.	m									
1/4	(6)					5	1.5	4	1.2	FOLLOW REQUIREMENTS OF THE PIPING MANUFACTURER.	10 FT. (3.0m) MAX SPACING.	5 FT. (3.0m) MAX SPACING EXCEPT MAY INCREASE TO 10 FT. WHERE 10 FOOT LENGTHS ARE INSTALLED. MIN OF ONE (1) HANGER PER PIPE SECTION CLOSE TO JOINT ON THE BARREL. ALSO AT CHANGE OF DIRECTION AND BRANCH CONNECTIONS.	32 IN. (813mm) MAX. SPACING.	4 FT. (1.22m) MAX SPACING.	3 FT. (.91m) MAX. SPACING.	4 FT. (1.22m) MAX. SPACING.	32 IN. (813mm) MAX. SPACING.	4 FT. (1.22m) MAXIMUM SPACING.
3/8	(10)	7	2.1	6	1.8	5	1.5	4	1.2									
1/2	(15)	7	2.1	6	1.8	5	1.5	4	1.2									
3/4	(20)	7	2.1	8	2.4	5	1.5	6	1.8									
1	(25)	7	2.1	8	2.4	6	1.8	8	2.4									
1-1/4	(32)	7	2.1	10	3.0	6	2.1	8	2.4									
1-1/2	(40)	9	2.7	10	3.0	8	2.4	8	2.4									
2	(50)	10	3.0	10	3.0	8	2.4	8	2.4									
2-1/2	(65)	11	3.4	10	3.0	9	2.7	8	2.4									
3	(80)	12	3.7	10	3.0	10	3.0	8	2.4									
3-1/2	(90)	12	3.7	10	3.0	10	3.0	8	2.4									
4	(100)	12	3.7	10	3.0	10	3.0	8	2.4									
5	(125)	12	3.7	10	3.0	10	30	8	2.4									
6	(150)	12	3.7	10	3.0	10	3.0	8	2.4									
8	(200)	12	3.7	10	3.0	10	3.0	8	2.4									
10	(250)	12	3.7	10	3.0	10	3.0	8	2.4									
12	(300)	12	3.7	10	3.0	10	3.0	8	2.4									
14	(350)	12	3.7	10	3.0													
16	(400)	12	3.7	10	3.0													
18	(450)	12	3.7	10	3.0													
20	(500)	12	3.7	10	3.0													
24	(600)	12	3.7	10	3.0													
30	(750)	12	3.7	10	3.0													

Vertical Spacing	15	4.5	15	4.5	10	3.0	10	3.0	Per manufacturer	15' (4.5m)	15' (4.5m)	10' (3.0m)	10' (3.0m)	10' (3.0m)	10' (3.0m)	10' (3.0m)	10' (3.0m)

Table 1 – Maximum Horizontal Pipe Hanger and Support Spacing

		1		2		3		4		5	6	7	8	9	10	11	12	13
NOMINAL PIPE OR TUBE SIZE		STD WT STEEL PIPE				COPPER TUBE				CSST	DUCTILE IRON PIPE	CAST IRON SOIL	PEX	PLASTIC PVC	PLASTIC CPVC 1 inch AND SMALLER	PLASTIC CPVC 1-1/4 inch AND LARGER	PLASTIC PP 1 inch AND SMALLER	PLASTIC PP 1-1/4 inch AND LARGER
		WATER SERVICE		VAPOR SERVICE		WATER SERVICE		VAPOR SERVICE										
in.	mm	ft.	m	ft.	m	ft.	mm	ft.	m									
1/4	(6)					5	1.5	5	1.5	FOLLOW REQUIREMENTS OF THE PIPING MANUFACTURER.	10 FT. (3.0m) MAX SPACING.	WITH LEAD AND OAKUM 5 FT. MAX SPACING EXCEPT MAY INCREASE TO 10 FT. WHERE 10 FOOT LENGTHS ARE INSTALLED. WITH COMPRESSION GASKETS AND NO-HUB, SUPPORT AT EVERY OTHER JOINT UNLESS OVER 4 FEET THEN SUPPORT AT EVERY JOINT. MIN OF ONE (1) HANGER PER PIPE SECTION CLOSE TO JOINT ON THE BARREL. ALSO AT CHANGE OF DIRECTION AND BRANCH CONNECTIONS.	32 IN. (813mm) MAX. SPACING.	4 FT. (1.22m) MAX SPACING.	3 FT. (.91m) MAX. SPACING.	4 FT. (1.22m) MAX. SPACING.	32 IN. (813mm) MAX. SPACING.	4 FT. (1.22m) MAXIMUM SPACING.
3/8	(10)	7	2.1	6	1.8	5	1.5	6	1.8									
1/2	(15)	7	2.1	6	1.8	5	1.5	6	1.8									
3/4	(20)	7	2.1	8	2.4	5	1.5	6	2.1									
1	(25)	7	2.1	8	2.4	6	1.8	6	2.4									
1-1/4	(32)	7	2.1	10	3.0	6	2.1	6	2.7									
1-1/2	(40)	9	2.7	10	3.0	6	2.1	6	3.0									
2	(50)	10	3.0	10	3.0	8	2.4	10	3.4									
2-1/2	(65)	11	3.4	10	3.0	9	2.7	10	4.0									
3	(80)	12	3.7	10	3.0	10	3.0	10	4.3									
3-1/2	(90)	12	3.7	10	3.0	10	3.0	10	4.6									
4	(100)	12	3.7	10	3.0	10	3.0	10	4.9									
5	(125)	12	3.7	10	3.0	10	30	10	4.9									
6	(150)	12	3.7	10	3.0	10	3.0	10	4.9									
8	(200)	12	3.7	10	3.0	10	3.0	10	4.9									
10	(250)	12	3.7	10	3.0	10	3.0	10	4.9									
12	(300)	12	3.7	10	3.0	10	3.0	10	4.9									
14	(350)	12	3.7	10	3.0													
16	(400)	12	3.7	10	3.0													
18	(450)	12	3.7	10	3.0													
20	(500)	12	3.7	10	3.0													
24	(600)	12	3.7	10	3.0													

30	(750)	12	3.7	10	3.0													
Vertical Spacing		25	7.6	Per Code		10	3.0	Per Code		Per Manufacturer	15' (4.5m)	15' (4.5m)	Each floor	Each floor	Each floor	Each floor	Each floor	Each floor

NOMINAL PIPE OR TUBING SIZE		COLUMNS(3) 1, 2, 6, 7 NOMINAL ROD DIA.		COLUMNS(3) 3, 4, 9, 10, 11, 12, 13 NOMINAL ROD DIA.	
in	mm	in	mm	in	mm
1/4	(6)			3/8	M10
3/8	(10)	3/8	M10	3/8	M10
1/2	(15)	3/8	M10	3/8	M10
3/4	(20)	3/8	M10	3/8	M10
1	(25)	3/8	M10	3/8	M10
1-1/4	(32)	3/8	M10	3/8	M10
1-1/2	(40)	3/8	M10	3/8	M10
2	(50)	3/8	M10	3/8	M10
2-1/2	(65)	1/2	M12	1/2	M12
3	(80)	1/2	M12	1/2	M12
3-1/2	(90)	1/2	M12	1/2	M12
4	(100)	5/8	M16	1/2	M12
5	(125)	5/8	M16	1/2	M12
6	(150)	3/4	M20	5/8	M16
8	(200)	3/4	M20	3/4	M20
10	(250)	7/8	M20	3/4	M20
12	(300)	7/8	M20	3/4	M20
14	(350)	1	M24		
16	(400)	1	M24		
18	(450)	1	M24		
20	(500)	1-1/4	M30		
24	(600)	1-1/4	M30		
30	(750)	1-1/4	M30		

NOTE:
(1) For calculated loads, rod diameters may be sized in accordance with MSS SP-58, Table 3 provided Table 1 and Section 7.3 of MSS SP-58 are satisfied.
(2) Rods may be reduced one size for double rod hangers. Minimum rod diameter shall be 3/8 in. (M10).
(3) Columns noted refer to Table 1, maximum horizontal pipe hanger and support spacing.

END OF SECTION

SECTION 220548 - VIBRATION CONTROLS FOR PLUMBING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. Certain requirements common to all the mechanical and electrical trades (Fire Suppression, Plumbing, HVAC, Electrical, and Tele/Data) are specified in Division 20. To avoid repetition, they are not repeated in each relevant Section. These requirements are applicable to the work of this Division, and are hereby incorporated by reference.

1.2 SUMMARY

A. Section Includes

1. Elastomeric isolation pads.
2. Elastomeric isolation mounts.
3. Restrained elastomeric isolation mounts.
4. Open-spring isolators.
5. Restrained-spring isolators.
6. Pipe-riser resilient supports.
7. Resilient pipe guides.
8. Elastomeric hangers.
9. Spring hangers.
10. Vibration isolation equipment bases.
11. Thrust restraints.
12. Snubbers.
13. Restraint channel bracings.
14. Restraint cables.
15. Restraint accessories.
16. Mechanical anchor bolts.
17. Adhesive anchor bolts.

B. Related Requirements

1. Division 21 for vibration isolation devices for fire-suppression equipment and systems.
2. Division 23 for vibration isolation devices for HVAC equipment and systems.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include rated load, rated deflection, and overload capacity for each vibration isolation device.
2. Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of vibration isolation device type required.
3. Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of restraint component required.

    a. Tabulate types and sizes of restraints, complete with report numbers and rated strength in tension and shear as evaluated by an agency acceptable to authorities having jurisdiction.
    b. Annotate to indicate application of each product submitted and compliance with requirements.

4. Interlocking Snubbers: Include ratings for horizontal, vertical, and combined loads.

B. Shop Drawings:

1. Detail fabrication and assembly of equipment bases. Detail fabrication including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.
2. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.

C. Delegated-Design Submittal:

1. For each vibration isolation device.

    a. Include design calculations and details for selecting vibration isolators and vibration isolation bases.
    b. Design Calculations: Calculate static and dynamic loading due to equipment weight and required to select vibration isolators and for designing vibration isolation bases.

        1) Coordinate design calculations with wind load calculations required for equipment mounted outdoors. Comply with requirements in other Sections for equipment mounted outdoors.

    c. Riser Supports: Include riser diagrams and calculations showing anticipated expansion and contraction at each support point, initial and final loads on building structure and spring deflection changes. Include certification that riser system was examined for excessive stress and that none exists.

2. Wind-Restraint Details:

    a. Design Analysis: To support selection and arrangement of wind restraints. Include calculations of combined tensile and shear loads.
    b. Details: Indicate fabrication and arrangement. Detail attachments of restraints to the restrained items and to the structure. Show attachment locations, methods, and spacing. Identify components, list their strengths, and indicate directions and values of forces transmitted to the structure during design wind speed. Indicate association with vibration isolation devices.
    c. Comply with requirements in other Sections for equipment mounted outdoors.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings:

1. Show coordination of vibration isolation device installation for PLUMBING piping and equipment with other systems and equipment in the vicinity, including other supports and restraints, if any.
2. Show coordination of bracing for PLUMBING piping and equipment with vibration isolation, other systems and equipment in the vicinity, including other supports and restraints, if any.

B. Qualification Data: For professional engineer and testing agency.

C. Welding certificates.

D. Field quality-control reports.

1.5 QUALITY ASSURANCE

A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is an NRTL as defined by OSHA in 29 CFR 1910.7 and that is acceptable to authorities having jurisdiction.

B. Comply with -restraint requirements in the applicable building code unless requirements in this Section are more stringent.

C. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Wind-Restraint Loading:

1. Basic Wind Speed: use requirment as established by the structural engineer.
2. Minimum 10 lb/sq. ft. multiplied by maximum area of PLUMBING component projected on vertical plane normal to wind direction, and 45 degrees either side of normal.

2.2 ELASTOMERIC ISOLATION PADS

A. Elastomeric Isolation Pads:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following :

a. Ace Mountings Co., Inc.
b. California Dynamics Corporation.
c. Isolation Technology, Inc.
d. Kinetics Noise Control, Inc.
e. Mason Industries, Inc.
f. Vibration Eliminator Co., Inc.
g. Vibration Isolation.
h. Vibration Mountings & Controls, Inc.

2. Fabrication: Single or multiple layers of sufficient durometer stiffness for uniform loading over pad area.
3. Size: Factory or field cut to match requirements of supported equipment.
4. Pad Material: Oil and water resistant with elastomeric properties.
5. Surface Pattern: Smooth, Ribbed or Waffle pattern.
6. Load-bearing metal plates adhered to pads.
7. Sandwich-Core Material: Resilient and elastomeric.

a. Surface Pattern: Smooth, Ribbed or Waffle pattern.

2.3 ELASTOMERIC ISOLATION MOUNTS

A. Double-Deflection, Elastomeric Isolation Mounts:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following :

a. Ace Mountings Co., Inc.
b. California Dynamics Corporation.
c. Isolation Technology, Inc.
d. Kinetics Noise Control, Inc.
e. Mason Industries, Inc.
f. Vibration Eliminator Co., Inc.
g. Vibration Isolation.
h. Vibration Mountings & Controls, Inc.

2. Mounting Plates:

a. Top Plate: Encapsulated steel load transfer top plates, factory drilled and threaded with threaded studs or bolts.
b. Baseplate: Encapsulated steel bottom plates with holes provided for anchoring to support structure.

3. Elastomeric Material: Molded, oil-resistant rubber, neoprene, or other elastomeric material.

2.4 RESTRAINED ELASTOMERIC ISOLATION MOUNTS

A. Restrained Elastomeric Isolation Mounts:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following :

    a. Ace Mountings Co., Inc.
    b. California Dynamics Corporation.
    c. Isolation Technology, Inc.
    d. Kinetics Noise Control, Inc.
    e. Mason Industries, Inc.
    f. Vibration Eliminator Co., Inc.
    g. Vibration Isolation.
    h. Vibration Mountings & Controls, Inc.

2. Description: All-directional isolator with restraints containing two separate and opposing elastomeric elements that prevent central threaded element and attachment hardware from contacting the housing during normal operation.

    a. Housing: Cast-ductile iron or welded steel.
    b. Elastomeric Material: Molded, oil-resistant rubber, neoprene, or other elastomeric material.

2.5 OPEN-SPRING ISOLATORS

A. Freestanding, Laterally Stable, Open-Spring Isolators:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following :

    a. Ace Mountings Co., Inc.
    b. California Dynamics Corporation.
    c. Isolation Technology, Inc.
    d. Kinetics Noise Control, Inc.
    e. Mason Industries, Inc.
    f. Vibration Eliminator Co., Inc.
    g. Vibration Isolation.
    h. Vibration Mountings & Controls, Inc.

2. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
6. Baseplates: Factory-drilled steel plate for bolting to structure with an elastomeric isolator pad attached to the underside. Baseplates shall limit floor load to 500 psig.
7. Top Plate and Adjustment Bolt: Threaded top plate with adjustment bolt and cap screw to fasten and level equipment.

2.6 RESTRAINED-SPRING ISOLATORS

A. Freestanding, Laterally Stable, Open-Spring Isolators with Vertical-Limit Stop Restraint:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following :

    a. Ace Mountings Co., Inc.
    b. California Dynamics Corporation.
    c. Isolation Technology, Inc.
    d. Kinetics Noise Control, Inc.
    e. Mason Industries, Inc.
    f. Vibration Eliminator Co., Inc.
    g. Vibration Isolation.
    h. Vibration Mountings & Controls, Inc.

2. Housing: Steel housing with vertical-limit stops to prevent spring extension due to weight being removed.

    a. Base with holes for bolting to structure with an elastomeric isolator pad attached to the underside. Bases shall limit floor load to 500 psig.
    b. Top plate with threaded mounting holes and elastomeric pad.
    c. Internal leveling bolt that acts as blocking during installation.

3. Restraint: Limit stop as required for equipment and authorities having jurisdiction.
4. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
5. Minimum Additional Travel: 50 percent of the required deflection at rated load.
6. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
7. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.

2.7 PIPE-RISER RESILIENT SUPPORT

A. Description: All-directional, acoustical pipe anchor consisting of two steel tubes separated by a minimum 1/2 inch- thick neoprene.

1. Vertical-Limit Stops: Steel and neoprene vertical-limit stops arranged to prevent vertical travel in both directions.
2. Maximum Load Per Support: 500 psig on isolation material providing equal isolation in all directions.

2.8 RESILIENT PIPE GUIDES

A. Description: Telescopic arrangement of two steel tubes or post and sleeve arrangement separated by a minimum 1/2 inch- thick neoprene.

1. Factory-Set Height Guide with Shear Pin: Shear pin shall be removable and reinsertable to allow for selection of pipe movement. Guides shall be capable of motion to meet location requirements.

2.9 ELASTOMERIC HANGERS

A. Elastomeric Mount in a Steel Frame with Upper and Lower Steel Hanger Rods:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following :

    a. Ace Mountings Co., Inc.
    b. California Dynamics Corporation.
    c. Isolation Technology, Inc.
    d. Kinetics Noise Control, Inc.
    e. Mason Industries, Inc.
    f. Vibration Eliminator Co., Inc.
    g. Vibration Mountings & Controls, Inc.

2. Frame: Steel, fabricated with a connection for an upper threaded hanger rod and an opening on the underside to allow for a maximum of 30 degrees of angular lower hanger-rod misalignment without binding or reducing isolation efficiency.
3. Dampening Element: Molded, oil-resistant rubber, neoprene, or other elastomeric material with a projecting bushing for the underside opening preventing steel to steel contact.

2.10 SPRING HANGERS

A. Combination Coil-Spring and Elastomeric-Insert Hanger with Spring and Insert in Compression:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Ace Mountings Co., Inc.
    b. California Dynamics Corporation.
    c. Kinetics Noise Control, Inc.
    d. Mason Industries, Inc.
    e. Vibration Eliminator Co., Inc.
    f. Vibration Isolation.
    g. Vibration Mountings & Controls, Inc.

2. Frame: Steel, fabricated for connection to threaded hanger rods and to allow for a maximum of 30 degrees of angular hanger-rod misalignment without binding or reducing isolation efficiency.
3. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
4. Minimum Additional Travel: 50 percent of the required deflection at rated load.
5. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
6. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
7. Elastomeric Element: Molded, oil-resistant rubber or neoprene. Steel-washer-reinforced cup to support spring and bushing projecting through bottom of frame.
8. Adjustable Vertical Stop: Steel washer with neoprene washer "up-stop" on lower threaded rod.

9. Self-centering hanger-rod cap to ensure concentricity between hanger rod and support spring coil.

2.11 VIBRATION ISOLATION EQUIPMENT BASES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. California Dynamics Corporation.
2. Kinetics Noise Control.
3. Mason Industries, Inc.
4. Vibration Eliminator Co., Inc.
5. Vibration Isolation.
6. Vibration Mountings & Controls, Inc.

B. Steel Rails: Factory-fabricated, welded, structural-steel rails.

1. Design Requirements: Lowest possible mounting height with not less than 1 inch clearance above the floor. Include equipment anchor bolts and auxiliary motor slide rails.

   a. Include supports for suction and discharge elbows for pumps.

2. Structural Steel: Steel shapes, plates, and bars complying with ASTM A 36/A 36M. Rails shall have shape to accommodate supported equipment.
3. Support Brackets: Factory-welded steel brackets on frame for outrigger isolation mountings and to provide for anchor bolts and equipment support.

C. Steel Bases: Factory-fabricated, welded, structural-steel bases and rails.

1. Design Requirements: Lowest possible mounting height with not less than 1 inch clearance above the floor. Include equipment anchor bolts and auxiliary motor slide bases or rails.

   a. Include supports for suction and discharge elbows for pumps.

2. Structural Steel: Steel shapes, plates, and bars complying with ASTM A 36/A 36M. Bases shall have shape to accommodate supported equipment.
3. Support Brackets: Factory-welded steel brackets on frame for outrigger isolation mountings and to provide for anchor bolts and equipment support.

D. Concrete Inertia Base: Factory-fabricated or field-fabricated, welded, structural-steel bases and rails ready for placement of cast-in-place concrete.

1. Design Requirements: Lowest possible mounting height with not less than 1 inch clearance above the floor. Include equipment anchor bolts and auxiliary motor slide bases or rails.

   a. Include supports for suction and discharge elbows for pumps.

2. Structural Steel: Steel shapes, plates, and bars complying with ASTM A 36/A 36M. Bases shall have shape to accommodate supported equipment.

3. Support Brackets: Factory-welded steel brackets on frame for outrigger isolation mountings and to provide for anchor bolts and equipment support.
4. Fabrication: Fabricate steel templates to hold equipment anchor-bolt sleeves and anchors in place during placement of concrete. Obtain anchor-bolt templates from supported equipment manufacturer.

2.12 THRUST RESTRAINTS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Ace Mountings Co., Inc.
2. California Dynamics Corporation.
3. Kinetics Noise Control.
4. Mason Industries, Inc.
5. Thybar Corporation.

B. Description: Spring element combined with steel angles, backup plates, threaded rod, washers and nuts to produce a pair of devices capable of limiting movement of air handling equipment to 0.25 inch.

C. Restraint shall be convertible in the field from compression type to tension type.

D. Unit shall be pre-compressed.

2.13 SNUBBERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Kinetics Noise Control, Inc.
2. Mason Industries, Inc.
3. Vibration Mountings & Controls, Inc.

B. Description: Factory fabricated using welded structural-steel shapes and plates, anchor bolts, and replaceable resilient isolation washers and bushings.

1. Anchor bolts for attaching to concrete shall be -rated, drill-in, and stud-wedge or female-wedge type.
2. Resilient Isolation Washers and Bushings: Oil- and water-resistant neoprene.
3. Maximum 1/4 inch air gap, and minimum 1/4 inch- thick resilient cushion.

2.14 RESTRAINT CHANNEL BRACINGS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Cooper B-Line, Inc.

2. Hilti, Inc.
3. Mason Industries, Inc.
4. Unistrut.

B. Description: MFMA-4, shop- or field-fabricated bracing assembly made of slotted steel channels with accessories for attachment to braced component at one end and to building structure at the other end and other matching components and with corrosion-resistant coating; rated in tension, compression, and torsion forces.

2.15 RESTRAINT CABLES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Kinetics Noise Control, Inc.
2. Loos & Co., Inc.
3. Vibration Mountings & Controls, Inc.

B. Restraint Cables: ASTM A 492 stainless-steel cables. End connections made of steel assemblies with thimbles, brackets, swivel, and bolts designed for restraining cable service; with a minimum of two clamping bolts for cable engagement.

2.16 MECHANICAL ANCHOR BOLTS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following :

1. Cooper B-Line, Inc.
2. Hilti, Inc.
3. Kinetics Noise Control, Inc.
4. Mason Industries, Inc.

B. Mechanical Anchor Bolts: Drilled-in and stud-wedge or female-wedge type in zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.

2.17 ADHESIVE ANCHOR BOLTS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following :

1. Hilti, Inc.
2. Kinetics Noise Control, Inc.
3. Mason Industries, Inc.

B. Adhesive Anchor Bolts: Drilled-in and capsule anchor system containing PVC or urethane methacrylate-based resin and accelerator, or injected polymer or hybrid mortar adhesive. Provide anchor bolts and hardware with zinc-coated steel for interior applications and stainless

steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and equipment to receive vibration isolation- and wind-control devices for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations before installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

D. Examine areas and equipment to receive restraint devices for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

3.2 APPLICATIONS

A. Multiple Pipe Supports: Secure pipes to trapeze member with clamps approved for application by an agency acceptable to authorities having jurisdiction.

B. Hanger-Rod Stiffeners: Install hanger-rod stiffeners to receive them and where required to prevent buckling of hanger rods due to forces.

C. Strength of Support Restraint Assemblies: Select sizes of components so strength is adequate to carry present and future static loads within loading limits.

3.3 VIBRATION CONTROL -RESTRAINT DEVICE INSTALLATION

A. Coordinate the location of embedded connection hardware with supported equipment attachment and mounting points and with requirements for concrete reinforcement and formwork specified in Division 03.

B. Installation of vibration isolators must not cause any change of position of equipment, piping, or ductwork resulting in stresses or misalignment.

C. Comply with requirements in Division 07 for installation of roof curbs, equipment supports, and roof penetrations.

D. Equipment Restraints:

1. Install snubbers on Plumbing equipment mounted on vibration isolators. Locate snubbers as close as possible to vibration isolators and bolt to equipment base and supporting structure.

2. Install resilient bolt isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inch.
3. Install -restraint devices using methods approved by an agency acceptable to authorities having jurisdiction that provides required submittals for component.

E. Piping Restraints:

1. Comply with requirements in MSS SP-127.

F. Install -restraint devices using methods approved by an agency acceptable to authorities having jurisdiction that provides required submittals for component.

G. Install bushing assemblies for anchor bolts for floor-mounted equipment, arranged to provide resilient media between anchor bolt and mounting hole in concrete base.

H. Install bushing assemblies for mounting bolts for wall-mounted equipment, arranged to provide resilient media where equipment or equipment-mounting channels are attached to wall.

I. Attachment to Structure: If specific attachment is not indicated, anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or at concrete members.

J. Drilled-in Anchors:

1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or drilling. Notify the structural engineer if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid pre-stressed tendons, electrical and telecommunications conduit, and gas lines.
2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
4. Adhesive Anchors: Clean holes to remove loose material and drilling dust prior to installation of adhesive. Place adhesive in holes proceeding from the bottom of the hole and progressing toward the surface in such a manner as to avoid introduction of air pockets in the adhesive.
5. Set anchors to manufacturer's recommended torque, using a torque wrench.
6. Install zinc-coated steel anchors for interior and stainless-steel anchors for exterior applications.

3.4 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Tests and Inspections:
1. Obtain Architect's approval before transmitting test loads to structure. Provide temporary load-spreading members.
2. Test at least four of each type and size of installed anchors and fasteners selected by Architect.
3. Test to 90 percent of rated proof load of device.
4. Measure isolator restraint clearance.

5. Measure isolator deflection.
6. Verify snubber minimum clearances.

C. Remove and replace malfunctioning units and retest as specified above.

3.5 ADJUSTING

A. Adjust isolators after piping system is at operating weight.

B. Adjust limit stops on restrained-spring isolators to mount equipment at normal operating height. After equipment installation is complete, adjust limit stops so they are out of contact during normal operation.

3.6 VIBRATION ISOLATION EQUIPMENT BASES INSTALLATION

A. Coordinate the location of embedded connection hardware with supported equipment attachment and mounting points and with requirements for concrete reinforcement and formwork specified in Division 03.

3.7 VIBRATION ISOLATION SCHEDULES

A. Provide vibration isolators and equipment bases for all rotating, piston driven or vibrating equipment in accordance with the following schedules. Selection of equipment isolators shall be based on approved equipment shop drawings.

Base & Isolator Types			
Base Types		Isolator Types	
A	No base, isolators attached directly to equipment.	1	Elastomeric pad.
B	Structural steel rails or base.	2	Elastomeric floor mount or hanger. Use restrained elastomeric mount where restraint is required.
C	Concrete inertia base.	3	Spring floor isolator or hanger.
D	Curb-mounted base.	4	Restrained spring isolator.
		5	Thrust restraint.

Vibration Isolation -RODI Skids and Vacuum Pumps															
r Type	Horsepower and Other	RPM	Slab on Grade			Up to 20 ft			20 to 30 ft			30 to 40 ft			Table Notes
			Base Type	Isolator Type	Min Defl., (in.)	Base Type	Isolator Type	Min Defl., (in.)	Base Type	Isolator Type	Min Defl., (in.)	Base Type	Isolator Type	Min Defl., (in.)	
RODI Filter Skids	All	All	A	2	0.25	A	4	0.75	A	4	1.5	A	4	2.5	1
RODI RO Skids	All	All	A	1	0.25	A	4	0.75	A	4	1.5	A	4	1.5	1,2
RODI Storage Tanks	All	All	A	1	0.25	A	4	0.75	A	4	1.5	A	4	1.5	1,2
Vacuum Pumps	All	All	A	1	0.25	A	4	0.75	A	4	1.5	A	4	1.5	

Notes:
1. Increase isolator deflection so isolator stiffness is less than one-tenth the stiffness of the supporting structure, as defined by the deflection due to load at the equipment support.
2. Where equipment manufacturer indicates component cannot be installed directly on individual isolators (type A), provide equipment manufacturer recommended supplemental support (base type).

Vibration Isolation - Air Compressors

Compressor Type	Horsepower and Other	RPM	Slab on Grade			Up to 20 ft			20 to 30 ft			30 to 40 ft			Table Notes
			Base Type	Isolator Type	Min Defl., (in.)	Base Type	Isolator Type	Min Defl., (in.)	Base Type	Isolator Type	Min Defl., (in.)	Base Type	Isolator Type	Min Defl., (in.)	
Tank-mounted horizontal	≤10	All	A	3	0.75	A	3	0.75	A	3	1.5	A	3	1.5	1
	≥15	All	C	3	0.75	C	3	0.75	C	3	1.5	C	3	1.5	1
Tank-mounted vertical	All	All	C	3	0.75	C	3	0.75	C	3	1.5	C	3	1.5	1
Base-Mounted	All	All	C	3	0.75	C	3	0.75	C	3	1.5	C	3	1.5	1
Large Reciprocating	All	All	C	3	0.75	C	3	0.75	C	3	1.5	C	3	1.5	1

Notes:
1. Compressors: Install base-mounted compressors through 5 hp and horizontal tank-type air compressors through 10 hp directly on spring isolators (type 3) with structural bases (type B), and compressors 15 to 100 hp on spring isolators (type 3) with inertia bases (type C) weighing 1 to 2 times the compressor weight.

Vibration Isolation - Pumps

Pump Type	Horsepower and Other	RPM	Slab on Grade			Up to 20 ft			20 to 30 ft			30 to 40 ft			Table Notes
			Base Type	Isolator Type	Min Defl., (in.)	Base Type	Isolator Type	Min Defl., (in.)	Base Type	Isolator Type	Min Defl., (in.)	Base Type	Isolator Type	Min Defl., (in.)	
Close Coupled	≤7.5	All	B	2	0.25	C	3	0.75	C	3	0.75	C	3	0.75	1
	≥10	All	C	3	0.75	C	3	0.75	C	3	1.5	C	3	1.5	1
Large Inline	5 to 25	All	A	3	0.75	A	3	1.5	A	3	1.5	A	2	1.5	
	≥30	All	A	3	1.5	A	3	1.5	A	3	1.5	A	3	2.5	
End suction and split case	≤40	All	C	3	0.75	C	3	0.75	C	3	1.5	C	3	1.5	1
	50 to 125	All	C	3	0.75	C	3	0.75	C	3	1.5	C	3	2.5	1
	≥150	All	C	3	0.75	C	3	0.75	C	3	2.5	C	3	3.5	1

Notes:
1. Pumps: Type C bases strength and shape shall accommodate base elbow supports. Concrete bases (type C) shall be designed for a thickness of one-tenth the longest dimension with minimum thickness as follows: (1) for up to 30 hp, 6 in.; (2) for 40 to 75 hp, 8 in.; and (3) for 100 hp and up, 12 in. Pumps over 75 hp and multistage pumps shall be provided with supplemental restraining devices.

Vibration Isolation - Water Heaters Generators

Type	Horsepower and Other	RPM	Slab on Grade			Up to 20 ft			20 to 30 ft			30 to 40 ft			Table Notes
			Base Type	Isolator Type	Min Defl., (in.)	Base Type	Isolator Type	Min Defl., (in.)	Base Type	Isolator Type	Min Defl., (in.)	Base Type	Isolator Type	Min Defl., (in.)	
Gas Fired	All	All	A	1	0.25	B	4	0.75	B	4	1.5	B	4	2.5	1
Electric	All	All	A	1	0.25	B	4	0.75	B	4	1.5	B	4	2.5	1
Steam Fired	All	All	A	1	0.25	B	4	0.75	B	4	1.5	B	4	2.5	1

Notes:
1. Where equipment manufacturer indicates component cannot be installed directly on individual isolators (type A) provide equipment manufacturer recommended supplemental support (base type).

3.8 PIPING SYSTEM VIBRATION ISOLATION

A. Vibration isolators for suspended piping:

1. Provide spring hangers for all piping in equipment rooms and up to 10 ft from vibration-isolated equipment and PRV stations. The first three hangers from the equipment shall be provided with the same deflection as the equipment isolators, with a maximum

limitation of 2 in. deflection. Remaining hangers shall be spring or combination spring and elastomeric with 0.75 in. deflection.

B. Vibration isolators for floor-supported piping:

1. Provide vibration isolators for floor supports for piping in equipment rooms to isolate equipment. Isolators shall be selected according to the guidelines for hangers. The first two adjacent floor supports shall be the restrained spring type, with a restraint/blocking feature to prevent load transfer to equipment flanges as the piping is filled or drained. Provide a slide plate where pipe is subjected to large thermal movement (PTFE, graphite, or steel) and shall be installed on top of the isolator. Provide a thermal barrier when rubber products are installed directly beneath steam or hot-water lines.

END OF SECTION

SECTION 220553 - IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Equipment labels.
2. Warning signs and labels.
3. Pipe labels.
4. Valve tags.
5. Warning tags.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Samples: For color, letter style, and graphic representation required for each identification material and device.

C. Equipment Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.

D. Valve numbering scheme.

E. Valve Schedules: For each piping system to include in maintenance manuals.

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

A. Metal Labels for Equipment:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Brady Corporation.
b. Marking Services, Inc.
c. Seton Identification Products.

2. Material and Thickness: Brass, 0.032-inch stainless steel, 0.025-inch aluminum, 0.032-inch or anodized aluminum, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
3. Letter Color: Black.
4. Background Color: White .
5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
6. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-quarters the size of principal lettering.
7. Fasteners: Stainless-steel rivets or self-tapping screws.
8. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

B. Plastic Labels for Equipment:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Brady Corporation.
b. Marking Services, Inc.
c. Seton Identification Products.

2. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.
3. Letter Color: Black.
4. Background Color: White.
5. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
6. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
7. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-quarters the size of principal lettering.
8. Fasteners: Stainless-steel rivets or self-tapping screws.
9. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

C. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), and the Specification Section number and title where equipment is specified.

D. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch bond paper. Tabulate equipment identification number, and identify Drawing numbers where equipment is indicated (plans, details, and schedules) and the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

2.2 WARNING SIGNS AND LABELS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. Brady Corporation.
2. Marking Services Inc.
3. Seton Identification Products.

B. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.

C. Letter Color: White.

D. Background Color: Red.

E. Maximum Temperature: Able to withstand temperatures up to 160 deg F.

F. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.

G. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-quarters the size of principal lettering.

H. Fasteners: Stainless-steel rivets or self-tapping screws.

I. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

J. Label Content: Include caution and warning information plus emergency notification instructions.

2.3 PIPE LABELS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. Brady Corporation.
2. Marking Services Inc.
3. Seton Identification Products.

B. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.

C. Pretensioned Pipe Labels: Precoiled, semi-rigid plastic formed to partially cover circumference of pipe and to attach to pipe without fasteners or adhesive.

D. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings; also include pipe size and an arrow indicating flow direction.

1. Flow-Direction Arrows: Integral with piping-system service lettering to accommodate both directions or as separate unit on each pipe label to indicate flow direction.
2. Lettering Size: Size letters according to ASME A13.1 for piping At least 1/2 inch for viewing distances up to 72 inches and proportionately larger lettering for greater viewing distances.

2.4 VALVE TAGS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. Brady Corporation.
2. Marking Services Inc.
3. Seton Identification Products.

B. Valve Tags: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch numbers.

1. Tag Material: Brass, 0.032-inch or stainless steel, 0.025-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
2. Fasteners: Brass wire-link chain or beaded chain or S-hook.

C. Valve Schedules: For each piping system, on 8-1/2-by-11-inch bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal-operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.

1. Valve-tag schedule shall be included in operation and maintenance data.

2.5 WARNING TAGS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. Brady Corporation.
2. Marking Services Inc.
3. Seton Identification Products.

B. Description: Preprinted or partially preprinted accident-prevention tags of plasticized card stock with matte finish suitable for writing.

1. Size: Approximately 4 by 7 inches.
2. Fasteners: Reinforced grommet and wire or string.
3. Nomenclature: Large-size primary caption such as "DANGER," "CAUTION," or "DO NOT OPERATE."
4. Color: Safety yellow background with black lettering.

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

3.2 GENERAL INSTALLATION REQUIREMENTS

A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

B. Coordinate installation of identifying devices with locations of access panels and doors.

C. Install identifying devices before installing acoustical ceilings and similar concealment.

3.3 EQUIPMENT LABEL INSTALLATION

A. Install or permanently fasten labels on each major item of mechanical equipment.

B. Locate equipment labels where accessible and visible.

3.4 PIPE LABEL INSTALLATION

A. Piping Color Coding: Painting of piping is specified in Division 09.

B. Pipe Label Locations: Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:

1. Near each valve and control device.
2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
3. Near penetrations through walls, floors, ceilings, and inaccessible enclosures.
4. At access doors, manholes, and similar access points that permit view of concealed piping.
5. Near major equipment items and other points of origination and termination.
6. Spaced at maximum intervals of 50 feet along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.
7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.
8. Mains shall be labeled at points of entrance and exit from mechanical room, adjacent to each valve, on each riser, at each tee fitting, at points of entrance and exit from building, at least once in each room, and at intervals no longer than 20 feet.

C. Directional Flow Arrows: Arrows shall be used to indicate direction of flow in pipes, including pipes where flow is allowed in both directions.

3.5 PIPE IDENTIFICATION

A. Provide color-coded pipe identification markers on piping installed under this Section. Pipe markers shall be snap-on laminated plastic protected by clear acrylic coating. Pipe markers shall be applied after Architectural painting where such is required.

B. Provide arrow marker with each pipe content marker to indicate direction of flow. If flow can be in either direction, use double-headed arrow marker.

C. In general, 2 inch high legend shall be used for pipe lines 4 inch dia. and larger, and 3/4 inches high legend shall be used for pipe lines 3 inches dia. and smaller.

D. Color banding shall meet ANSI latest and OSHA requirements.

E. Markers shall have legends and color coding per the tables below:

F. Markers are to be applied to all piping, regardless of under jacket colors per the following schedule. The following band colors and letter designations are USF standard a

PLUMBING PIPING

DESCRIPTION	ACRONYM	COLOR
Domestic Cold Water	DCW	Green
Domestic Hot Water	DHW	Yellow
Domestic Hot Water Return	DHWR	Yellow
Distilled Water	DIST.W	Green
Deionized Water	DEION.W	Green
Soft Water	SOFT W	Green
Sanitary Drain	SAN	Yellow
Storm Drain	ST	Yellow
Compressed Air	A	Yellow
Nitrogen	NIT	Yellow
Oxygen	OXY	Yellow
Carbon Dioxide	CO2	Yellow
Natural Gas	GAS	Yellow
Vacuum	VAC	Yellow
Fuel Oil	FUEL	Yellow

G. The Following Areas shall require all insulated piping to be protected along the entire pipe length with PVC jacketed covers (Ceel-Co or Zeston plastic jacket):

1. PAll areas on exposed piping installed 6 feet above finish floor or lower.
2. This plastic jacket shall include fitting covers and piping covers.
3. Piping to be covered with this plastic jacket shall be insulated and finished as herein specified and then the plastic jacket shall be applied.

3.6 VALVE-TAG INSTALLATION

A. Install tags on valves and control devices in piping systems, except check valves, valves within factory-fabricated equipment units, shutoff valves, faucets, convenience and lawn-watering hose connections, and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule.

B. Valve-Tag Application Schedule: Tag valves according to size, shape, and color scheme and with captions similar to those indicated in the following subparagraphs:

1. Tags, Valves, Equipment and Instruments

   a. Upon completion of work, attach engraved laminated plastic tags to all valves, and instrumentation. Equipment shall bear a stamped stainless tag. Tags shall have black characters on white face, consecutively numbered and prefixed with letter P for general valves. Tags shall bear the number used in the P&IDs for those items so marked.
   b. Embossed or engraved aluminum or brass tags may be substituted if desired. Tags shall be at least 1/8 inch thick.
   c. Tags shall be at least 1 inch diameter with numerals at least 3/8 inch high and attached by S hooks and chains.
   d. Nameplates, catalog numbers and rating identifications shall be securely attached to electrical and mechanical equipment with screws or rivets. Adhesives or cements will not be permitted.
   e. Non-potable water outlets shall be identified with permanently attached yellow color code or 4 inches high triangle tag reading, "water unsafe."
   f. Coordinate numbering system with existing piping tags as not to duplicate numbers.

2. Valve-Tag Size and Shape:

   a. All Plumbing and Piping Services that are part of this contract 1-1/2 inches round.

3. Valve-Tag Colors:

   a. Comply with the same colors as indicated for Pipe Labels

4. Letter Colors:

   a. White.

3.7 WARNING-TAG INSTALLATION

A. Write required message on, and attach warning tags to, equipment and other items where required.

END OF SECTION

SECTION 220716 - PLUMBING EQUIPMENT INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes insulating the following plumbing equipment:

1. Insulation materials
2. Insulating cements
3. Adhesives
4. Mastics
5. Sealants
6. Factory-applied jackets
7. Field-applied cloths
8. Field-applied jackets
9. Tapes
10. Securements
11. Corner angles

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory and field applied, if any).

B. LEED Submittals:

1. Product Data for Credit IEQ 4.1: For adhesives and sealants, documentation including printed statement of VOC content and chemical components.
2. Laboratory Test Reports for Credit IEQ 4: For adhesives and sealants, documentation indicating that product complies with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

C. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
2. Detail attachment and covering of heat tracing inside insulation.
3. Detail removable insulation at equipment connections and access panels.

4. Detail application of field-applied jackets.
5. Detail application at linkages of control devices.
6. Detail field application for each equipment type.

D. Samples: For each type of insulation and jacket indicated. Identify each Sample, describing product and intended use. Sample sizes are as follows:

1. Sheet Form Insulation Materials: 12 inches square.
2. Sheet Jacket Materials: 12 inches square.
3. Manufacturer's Color Charts: For products where color is specified, show the full range of colors available for each type of finish material.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified Installer.

B. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets, with requirements indicated. Include dates of tests and test methods employed.

C. Field quality-control reports.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.

B. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E 84 by a testing agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.

1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

C. Mockups: Before installing insulation, build mockups for each type of insulation and finish listed below to demonstrate quality of insulation application and finishes. Build mockups in the location indicated or, if not indicated, as directed by Architect. Use materials indicated for the completed Work.

1. Equipment Mockups: One tank, vessel, or pump.
2. For each mockup, fabricate cutaway sections to allow observation of application details for insulation materials, adhesives, mastics, attachments, and jackets.
3. Notify Architect seven days in advance of dates and times when mockups will be constructed.
4. Obtain Architect's approval of mockups before starting insulation application.

5. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
6. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
7. Demolish and remove mockups when directed.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

1.7 COORDINATION

A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Division 22.

B. Coordinate clearance requirements with equipment Installer for equipment insulation application.

C. Coordinate installation and testing of heat tracing.

1.8 SCHEDULING

A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.

B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

A. Comply with requirements in "Water Boiler Breeching Insulation Schedule" and "Equipment Insulation Schedule" articles for where insulating materials shall be applied.

B. Products shall not contain asbestos, lead, mercury, or mercury compounds.

C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.

D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.

E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.

F. Cellular Glass: Inorganic, incombustible, foamed or cellulated glass with annealed, rigid, hermetically sealed cells. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Johns Mansville.

b. Owens Corning.

c. Pittsburgh Corning Corporation.

2. Block Insulation: ASTM C 552, Type I.
3. Special-Shaped Insulation: ASTM C 552, Type III.
4. Board Insulation: ASTM C 552, Type IV.
5. Preformed Pipe Insulation without Jacket: Comply with ASTM C 552, Type II, Class 1.
6. Preformed Pipe Insulation with Factory-Applied ASJ-SSL: Comply with ASTM C 552, Type II, Class 2.
7. Factory fabricate shapes according to ASTM C 450 and ASTM C 585.

G. Flexible Elastomeric Insulation: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials and Type II for sheet materials.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Aeroflex USA, Inc.

b. Armacell LLC.

c. K-Flex USA.

H. Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type II and ASTM C 1290, Type I. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. CertainTeed Corporation.

b. Johns Manville; a Berkshire Hathaway company.

c. Knauf Insulation.

d. Manson Insulation Inc.

e. Owens Corning.

I. High-Temperature, Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type V, without factory-applied jacket.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Industrial Insulation Group, LLC (IIG-LLC).

b. Johns Manville; a Berkshire Hathaway company.

c. Knauf Insulation.

d. Roxul Inc.

J. Mineral-Fiber Board Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 612, Type IA or Type IB. For equipment applications, provide insulation with factory-applied ASJ. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. CertainTeed Corporation.

b. Johns Manville; a Berkshire Hathaway company.

c. Knauf Insulation.

d. Manson Insulation Inc.

e. Owens Corning.

K. High-Temperature, Mineral-Fiber Board Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 612, Type III, without factory-applied jacket.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Industrial Insulation Group, LLC (IIG-LLC).

b. Knauf Insulation.

c. Rock Wool.

d. Roxul Inc.

e. Thermafiber, Inc.; an Owens Corning company.

L. Mineral-Fiber, Preformed Pipe Insulation:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

   a. Johns Manville; a Berkshire Hathaway company.

   b. Knauf Insulation.

   c. Manson Insulation Inc.

   d. Owens Corning.

2. Type I, 850 Deg F Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type I, Grade A, with factory-applied ASJ-SSL. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

M. Mineral-Fiber, Pipe and Tank Insulation: Mineral or glass fibers bonded with a thermosetting resin. Semi rigid board material with factory-applied FSK jacket complying with ASTM C 1393, Type II or Type IIIA Category 2, or with properties similar to ASTM C 612, Type IB. Nominal density is 2.5 lb/cu. ft. or more. Thermal conductivity (k-value) at 100 deg F is 0.29 Btu x in./h x sq. ft. x deg F or less. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

   a. CertainTeed Corporation.

   b. Johns Manville; a Berkshire Hathaway company.

   c. Knauf Insulation.

   d. Manson Insulation Inc.

   e. Owens Corning.

N. Polyolefin: Unicellular, polyethylene thermal plastic insulation. Comply with ASTM C 534 or ASTM C 1427, Type I, Grade 1 for tubular materials and Type II, Grade 1 for sheet materials.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

   a. Armacell LLC.

   b. Nomaco Insulation.

2.2 INSULATING CEMENTS

A. Mineral-Fiber Insulating Cement: Comply with ASTM C 195.

B. Expanded or Exfoliated Vermiculite Insulating Cement: Comply with ASTM C 196.

C. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C 449.

2.3 ADHESIVES

A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to it and to surfaces to be insulated unless otherwise indicated.

B. Calcium Silicate Adhesive: Fibrous, sodium-silicate-based adhesive with a service temperature range of 50 to 800 deg F.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

   a. Childers Brand; H. B. Fuller Construction Products.

   b. Eagle Bridges - Marathon Industries.

   c. Foster Brand; H. B. Fuller Construction Products.

   d. Mon-Eco Industries, Inc.

   e. Vimasco Corporation.

2. For indoor applications, adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
3. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

C. Cellular-Glass Adhesive: Two-component, thermosetting urethane adhesive containing no flammable solvents, with a service temperature range of minus 100 to plus 200 deg F.

1. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
2. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

D. Flexible Elastomeric and Polyolefin Adhesive: Comply with MIL-A-24179A, Type II, Class I.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Aeroflex USA, Inc.

b. Armacell LLC.

c. Foster Brand; H. B. Fuller Construction Products.

d. K-Flex USA.

2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
3. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

E. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Childers Brand; H. B. Fuller Construction Products.

b. Eagle Bridges - Marathon Industries.

c. Foster Brand; H. B. Fuller Construction Products.

d. Mon-Eco Industries, Inc.

2. For indoor applications, adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
3. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

F. ASJ Adhesive, and FSK and PVDC Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Childers Brand; H. B. Fuller Construction Products.

b. Eagle Bridges - Marathon Industries.

c. Foster Brand; H. B. Fuller Construction Products.

d. Mon-Eco Industries, Inc.

2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

3. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

G. PVC Jacket Adhesive: Compatible with PVC jacket.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Dow Corning Corporation.

b. Johns Manville; a Berkshire Hathaway company.

c. PIC Plastics, Inc.

d. Speedline Corporation.

2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
3. Adhesive shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.4 MASTICS

A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-PRF-19565C, Type II.

1. For indoor applications, use mastics that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

B. Vapor-Barrier Mastic: Water based; suitable for indoor use on below ambient services.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Foster Brand; H. B. Fuller Construction Products.

b. Knauf Insulation.

c. Vimasco Corporation.

2. Water-Vapor Permeance: ASTM E 96/E 96M, Procedure B, 0.013 perm at 43-mil dry film thickness.
3. Service Temperature Range: Minus 20 to plus 180 deg F.
4. Solids Content: ASTM D 1644, 58 percent by volume and 70 percent by weight.
5. Color: White.

C. Breather Mastic: Water based; suitable for indoor and outdoor use on above ambient services.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

    a. Childers Brand; H. B. Fuller Construction Products.

    b. Eagle Bridges - Marathon Industries.

    c. Foster Brand; H. B. Fuller Construction Products.

    d. Knauf Insulation.

    e. Mon-Eco Industries, Inc.

    f. Vimasco Corporation.

2. Water-Vapor Permeance: ASTM F 1249, 1.8 perms at 0.0625-inch dry film thickness.
3. Service Temperature Range: Minus 20 to plus 180 deg F.
4. Solids Content: 60 percent by volume and 66 percent by weight.
5. Color: White.

2.5 SEALANTS

A. Joint Sealants:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

    a. Childers Brand; H. B. Fuller Construction Products.

    b. Eagle Bridges - Marathon Industries.

    c. Foster Brand; H. B. Fuller Construction Products.

    d. Mon-Eco Industries, Inc.

    e. Pittsburgh Corning Corporation.

2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Permanently flexible, elastomeric sealant.
4. Service Temperature Range: Minus 100 to plus 300 deg F.
5. Color: White or gray.
6. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
7. Sealants shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

B. FSK and Metal Jacket Flashing Sealants:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

   a. Childers Brand; H. B. Fuller Construction Products.

   b. Eagle Bridges - Marathon Industries.

   c. Foster Brand; H. B. Fuller Construction Products.

   d. Mon-Eco Industries, Inc.

2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Fire- and water-resistant, flexible, elastomeric sealant.
4. Service Temperature Range: Minus 40 to plus 250 deg F.
5. Color: Aluminum.
6. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
7. Sealants shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

C. ASJ Flashing Sealants, and Vinyl, PVDC, and PVC Jacket Flashing Sealants:

1. Materials shall be compatible with insulation materials, jackets, and substrates.
2. Fire- and water-resistant, flexible, elastomeric sealant.
3. Service Temperature Range: Minus 40 to plus 250 deg F.
4. Color: White.
5. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
6. Sealants shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.6 FACTORY-APPLIED JACKETS

A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:

1. ASJ: White, Kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.
2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.
3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with Kraft-paper backing; complying with ASTM C 1136, Type II.
4. PVDC Jacket for Indoor Applications: 4-mil- thick, white PVDC bi-axially oriented barrier film with a permeance at 0.02 perm when tested according to ASTM E 96/E 96M and with a flame-spread index of 5 and a smoke-developed index of 20 when tested according to ASTM E 84.

5. PVDC Jacket for Outdoor Applications: 6-mil- thick, white PVDC bi-axially oriented barrier film with a permeance at 0.01 perm when tested according to ASTM E 96/E 96M and with

a flame-spread index of 5 and a smoke-developed index of 25 when tested according to ASTM E 84.

6. PVDC-SSL Jacket: PVDC jacket with a self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip.

2.7 FIELD-APPLIED CLOTHS

A. Woven Glass-Fiber Fabric: Comply with MIL-C-20079H, Type I, plain weave, and pre-sized a minimum of 8 oz./sq. yd..

2.8 FIELD-APPLIED JACKETS

A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.

B. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

   a. Johns Manville; a Berkshire Hathaway company.

   b. PIC Plastics, Inc.

   c. Proto Corporation.

   d. Speedline Corporation.

2. Adhesive: As recommended by jacket material manufacturer.
3. Color: White.
4. Factory-fabricated tank heads and tank side panels.

C. Metal Jacket:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

   a. Childers Brand; H. B. Fuller Construction Products.

   b. ITW Insulation Systems; Illinois Tool Works, Inc.

   c. RPR Products, Inc.

2. Aluminum Jacket: Comply with ASTM B 209, Alloy 3003, 3005, 3105, or 5005, Temper H-14.

a. Finish and thickness are indicated in field-applied jacket schedules.
b. Moisture Barrier for Indoor Applications: 1-mil- thick, heat-bonded polyethylene and Kraft paper 3-mil- thick, heat-bonded polyethylene and Kraft paper 2.5-mil-thick polysurlyn.
c. Moisture Barrier for Outdoor Applications: 3-mil- thick, heat-bonded polyethylene and Kraft paper 2.5-mil- thick polysurlyn.

3. Stainless-Steel Jacket: ASTM A 167 or ASTM A 240/A 240M.

a. Sheet and roll stock ready for shop or field sizing Factory cut and rolled to size.
b. Material, finish, and thickness are indicated in field-applied jacket schedules.
c. Moisture Barrier for Indoor Applications: 1-mil- thick, heat-bonded polyethylene and Kraft paper 3-mil- thick, heat-bonded polyethylene and Kraft paper 2.5-mil-thick polysurlyn.
d. Moisture Barrier for Outdoor Applications: 3-mil- thick, heat-bonded polyethylene and Kraft paper 2.5-mil- thick polysurlyn.

2.9 TAPES

A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Avery Dennison Corporation, Specialty Tapes Division.

b. Compac Corporation.

c. Ideal Tape Co., Inc., an American Biltrite Company.

d. Knauf Insulation.

e. Venture Tape.

2. Width: 3 inches.
3. Thickness: 11.5 mils.
4. Adhesion: 90 ounces force/inch in width.
5. Elongation: 2 percent.
6. Tensile Strength: 40 lbf/inch in width.
7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.

B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Avery Dennison Corporation, Specialty Tapes Division.

b. Compac Corporation.

c. Ideal Tape Co., Inc., an American Biltrite Company.

d. Knauf Insulation.

e. Venture Tape.

2. Width: 3 inches.
3. Thickness: 6.5 mils.
4. Adhesion: 90 ounces force/inch in width.
5. Elongation: 2 percent.
6. Tensile Strength: 40 lbf/inch in width.
7. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.

C. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive; suitable for indoor and outdoor applications.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Compac Corporation.

b. Ideal Tape Co., Inc., an American Biltrite Company.

c. Venture Tape.

2. Width: 2 inches.
3. Thickness: 6 mils.
4. Adhesion: 64 ounces force/inch in width.
5. Elongation: 500 percent.
6. Tensile Strength: 18 lbf/inch in width.

D. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Avery Dennison Corporation, Specialty Tapes Division**.**

b. Compac Corporation**.**

c. Ideal Tape Co., Inc., an American Biltrite Company**.**

d. Knauf Insulation**.**

e. Venture Tape**.**

2. Width: 2 inches.
3. Thickness: 3.7 mils.
4. Adhesion: 100 ounces force/inch in width.

5. Elongation: 5 percent.
6. Tensile Strength: 34 lbf/inch in width.

E. PVDC Tape: White vapor-retarder PVDC tape with acrylic adhesive.

1. Width: 3 inches.
2. Film Thickness: 4 mils 6 mils.
3. Adhesive Thickness: 1.5 mils.
4. Elongation at Break: 145 percent.
5. Tensile Strength: 55 lbf/inch in width.

2.10 SECUREMENTS

A. Bands:

1. Stainless Steel: ASTM A 167 or ASTM A 240/A 240M, Type 304 or Type 316; 0.015 inch thick, 3/4 inch wide with wing seal or closed seal.
2. Aluminum: ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 3/4 inch wide with wing seal or closed seal.
3. Springs: Twin spring set constructed of stainless steel with ends flat and slotted to accept metal bands. Spring size determined by manufacturer for application.

B. Insulation Pins and Hangers:

1. Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.135-inch- diameter shank, length to suit depth of insulation indicated.

a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1) AGM Industries, Inc.

2) Gemco.

3) Midwest Fasteners, Inc.

4) Nelson Stud Welding.

2. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch- 0.135-inch- diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch galvanized carbon-steel washer.

a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1) AGM Industries, Inc.

2) CL WARD & Family Inc.

3) Gemco.

4) Midwest Fasteners, Inc.

5) Nelson Stud Welding.

3. Metal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place.

a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1) AGM Industries, Inc.

2) Gemco.

3) Midwest Fasteners, Inc.

b. Baseplate: Perforated, galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.
c. Spindle: Stainless steel, fully annealed, 0.106-inch- diameter shank, length to suit depth of insulation indicated.
d. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.

4. Nonmetal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate fastened to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place.

a. Baseplate: Perforated, nylon sheet, 0.030 inch thick by 1-1/2 inches in diameter.
b. Spindle: Nylon, 0.106-inch- diameter shank, length to suit depth of insulation indicated, up to 2-1/2 inches.
c. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.

5. Self-Sticking-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place.

a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1) AGM Industries, Inc.

2) Gemco.

3) Midwest Fasteners, Inc.

b. Baseplate: Galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.
c. Spindle: Stainless steel, fully annealed, 0.106-inch- diameter shank, length to suit depth of insulation indicated.
d. Adhesive-backed base with a peel-off protective cover.

6. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- thick, stainless-steel sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.

a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1) AGM Industries, Inc.

2) Gemco.

3) Midwest Fasteners, Inc.

4) Nelson Stud Welding.

b. Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap in exposed locations.

7. Nonmetal Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch-thick nylon sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.

C. Staples: Outward-clinching insulation staples, nominal 3/4-inch- wide, stainless steel or Monel.

D. Wire: 0.062-inch soft-annealed, stainless steel.

2.11 CORNER ANGLES

A. PVC Corner Angles: 30 mils thick, minimum 1 by 1 inch, PVC according to ASTM D 1784, Class 16354-C. White or color-coded to match adjacent surface.

B. Aluminum Corner Angles: 0.040 inch thick, minimum 1 by 1 inch, aluminum according to ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14.

C. Stainless-Steel Corner Angles: 0.024 inch thick, minimum 1 by 1 inch, stainless steel according to ASTM A 167 or ASTM A 240/A 240M, Type 304 or Type 316.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.

1. Verify that systems and equipment to be insulated have been tested and are free of defects.
2. Verify that surfaces to be insulated are clean and dry.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 GENERAL INSTALLATION REQUIREMENTS

A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of equipment.

B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item as specified in insulation system schedules.

C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.

D. Install insulation with longitudinal seams at top and bottom of horizontal runs.

E. Install multiple layers of insulation with longitudinal and end seams staggered.

F. Keep insulation materials dry during application and finishing.

G. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.

H. Install insulation with least number of joints practical.

I. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.

1. Install insulation continuously through hangers and around anchor attachments.
2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.

J. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.

K. Install insulation with factory-applied jackets as follows:

1. Draw jacket tight and smooth.
2. Cover circumferential joints with 3-inch- wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches OC.
3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at4 inches OC.

    a. For below ambient services, apply vapor-barrier mastic over staples.

4. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.
5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints.

L. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.

M. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

N. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

O. For above ambient services, do not install insulation to the following:

1. Vibration-control devices.
2. Testing agency labels and stamps.
3. Nameplates and data plates.
4. Manholes.
5. Handholes.
6. Cleanouts.

3.3 INSTALLATION OF EQUIPMENT, TANK, AND VESSEL INSULATION

A. Mineral-Fiber, Pipe, and Tank Insulation Installation for Tanks and Vessels: Secure insulation with adhesive and anchor pins and speed washers.

1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of tank and vessel surfaces.
2. Groove and score insulation materials to fit as closely as possible to equipment, including contours. Bevel insulation edges for cylindrical surfaces for tight joints. Stagger end joints.
3. Protect exposed corners with secured corner angles.
4. Install adhesively attached or self-sticking insulation hangers and speed washers on sides of tanks and vessels as follows:

a. Do not weld anchor pins to ASME-labeled pressure vessels.
b. Select insulation hangers and adhesive that are compatible with service temperature and with substrate.
c. On tanks and vessels, maximum anchor-pin spacing is 3 inches from insulation end joints, and 16 inches OC. in both directions.
d. Do not over compress insulation during installation.
e. Cut and miter insulation segments to fit curved sides and domed heads of tanks and vessels.
f. Impale insulation over anchor pins and attach speed washers.
g. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.

5. Secure each layer of insulation with stainless-steel or aluminum bands. Select band material compatible with insulation materials.
6. Where insulation hangers on equipment and vessels are not permitted or practical and where insulation support rings are not provided, install a girdle network for securing insulation. Stretch pre-stressed aircraft cable around the diameter of vessel and make taut with clamps, turnbuckles, or breather springs. Place one circumferential girdle around equipment approximately 6 inches from each end. Install wire or cable between two circumferential girdles 12 inches OC. Install a wire ring around each end and around outer periphery of center openings, and stretch pre-stressed aircraft cable radially from the wire ring to nearest circumferential girdle. Install additional circumferential girdles along the body of equipment or tank at a minimum spacing of 48 inches OC. Use this network for securing insulation with tie wire or bands.
7. Stagger joints between insulation layers at least 3 inches.
8. Install insulation in removable segments on equipment access doors, manholes, handholes, and other elements that require frequent removal for service and inspection.
9. Bevel and seal insulation ends around manholes, handholes, ASME stamps, and nameplates.
10. For equipment with surface temperatures below ambient, apply mastic to open ends, joints, seams, breaks, and punctures in insulation.

B. Flexible Elastomeric Thermal Insulation Installation for Tanks and Vessels: Install insulation over entire surface of tanks and vessels.

1. Apply 100 percent coverage of adhesive to surface with manufacturer's recommended adhesive.
2. Seal longitudinal seams and end joints.

C. Insulation Installation on Pumps:

1. Fabricate metal boxes lined with insulation. Fit boxes around pumps and coincide box joints with splits in pump casings. Fabricate joints with outward bolted flanges. Bolt flanges on 6-inch centers, starting at corners. Install 3/8-inch- diameter fasteners with wing nuts. Alternatively, secure the box sections together using a latching mechanism.
2. Fabricate boxes from stainless steel, at least 0.040 inch thick.
3. For below ambient services, install a vapor barrier at seams, joints, and penetrations. Seal between flanges with replaceable gasket material to form a vapor barrier.

3.4 INSTALLATION OF CALCIUM SILICATE INSULATION

A. Insulation Installation on Water Boiler Breechings:

1. Secure single-layer insulation with stainless-steel bands at 12-inch intervals and tighten bands without deforming insulation material.
2. Install two-layer insulation with joints tightly butted and staggered at least 3 inches. Secure inner layer with wire spaced at 12-inch intervals. Secure outer layer with stainless-steel bands at 12-inch intervals.
3. On exposed applications without metal jacket, finish insulation surface with a skim coat of mineral-fiber, hydraulic-setting cement. When cement is dry, apply flood coat of lagging adhesive and press on one layer of glass cloth. Overlap edges at least 1 inch. Apply finish coat of lagging adhesive over glass cloth. Thin finish coat to achieve smooth, uniform finish.

3.5 INSTALLATION OF FLEXIBLE ELASTOMERIC INSULATION

A. Seal longitudinal seams and end joints with manufacturers recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.6 FIELD-APPLIED JACKET INSTALLATION

A. Where glass-cloth jackets are indicated, install directly over bare insulation or insulation with factory-applied jackets.

1. Draw jacket smooth and tight to surface with 2-inch overlap at seams and joints.
2. Embed glass cloth between two 0.062-inch- thick coats of lagging adhesive.
3. Completely encapsulate insulation with coating, leaving no exposed insulation.

B. Where FSK jackets are indicated, install as follows:

1. Draw jacket material smooth and tight.
2. Install lap or joint strips with same material as jacket.
3. Secure jacket to insulation with manufacturer's recommended adhesive.
4. Install jacket with 1-1/2-inch laps at longitudinal seams and 3-inch- wide joint strips at end joints.
5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.

C. Where PVC jackets are indicated, install with 1-inch overlap at longitudinal seams and end joints; for horizontal applications, install with longitudinal seams along top and bottom of tanks and vessels. Seal with manufacturers recommended adhesive.

1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.

D. Where metal jackets are indicated, install with 2-inch overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches OC. and at end joints.

E. Where PVDC jackets are indicated, install as follows:

1. Jacket can be wrapped in cigarette fashion along length of roll for insulation systems with an outer circumference of 33-1/2 inches or less. 33-1/2-inch- circumference limit allows for 2-inch- overlap seal. Using the length of roll allows for longer sections of jacket to be installed at one time. Use adhesive on the lap seal. Visually inspect lap seal for "fish mouthing," and use PVDC tape along lap seal to secure joint.
2. Repair holes or tears in PVDC jacket by placing PVDC tape over the hole or tear and wrapping a minimum of 1-1/4 circumferences to avoid damage to tape edges.

3.7 FINISHES

A. Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Division 09.

1. Flat Acrylic Finish: Two finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.

a. Finish Coat Material: Interior, flat, latex-emulsion size.

B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.

C. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.

D. Do not field paint aluminum or stainless-steel jackets.

3.8 EQUIPMENT INSULATION SCHEDULE

A. Insulation materials and thicknesses are identified below. If more than one material is listed for a type of equipment, selection from materials listed is Contractor's option.

B. Insulate indoor and outdoor equipment that is not factory insulated.

C. Hot-water pump insulation shall be one of the following:

1. Cellular Glass: 2 inches thick.
2. Mineral-Fiber Blanket: 1 inch thick and 3-lb/cu. ft. nominal density.
3. Mineral-Fiber Board: 1 inch thick and 3-lb/cu. ft. nominal density.

D. Hot-water storage tank insulation shall be one of the following, of thickness to provide an R-value of 12.5:

1. Cellular glass.
2. Mineral-Fiber Blanket: 3-lb/cu. ft. nominal density.
3. Mineral-Fiber Board: 3-lb/cu. ft. nominal density.
4. Mineral-fiber pipe and tank.

E. Water storage tank (Domestic Only) insulation shall be one of the following:

1. Cellular Glass: thick.
2. Flexible Elastomeric: 1 inch thick.
3. Mineral-Fiber Blanket: 1 inch thick and 3-lb/cu. ft. nominal density.
4. Mineral-Fiber Board: 1 inch thick and 3-lb/cu. ft. nominal density.
5. Mineral-Fiber Pipe and Tank: 1 inch thick.
6. Polyolefin: 1 inch thick.

3.9 INDOOR, FIELD-APPLIED JACKET SCHEDULE

A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.

B. If more than one material is listed, selection from materials listed is Contractor's option.

END OF SECTION

SECTION 220719 - PLUMBING PIPING INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes insulating the following plumbing piping services:

1. Insulation materials
2. Accessory materials
3. Factory applied jackets
4. Tapes
5. Securements

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory- and field-applied, if any).

B. LEED Submittals:

1. Product Data for Credit IEQ 4.1: For adhesives and sealants, documentation including printed statement of VOC content and chemical components.
2. Laboratory Test Reports for Credit IEQ 4: For adhesives and sealants, documentation indicating that product complies with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

C. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
2. Detail attachment and covering of heat tracing inside insulation.
3. Detail insulation application at pipe expansion joints for each type of insulation.
4. Detail insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
5. Detail removable insulation at piping specialties, equipment connections, and access panels.
6. Detail application of field-applied jackets.
7. Detail application at linkages of control devices.

D. Samples: For each type of insulation and jacket indicated. Identify each Sample, describing product and intended use. Sample sizes are as follows:

1. Preformed Pipe Insulation Materials: 12 inches long by NPS 2.
2. Jacket Materials for Pipe: 12 inches long by NPS 2.
3. Sheet Jacket Materials: 12 inches square.
4. Manufacturer's Color Charts: For products where color is specified, show the full range of colors available for each type of finish material.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified Installer.

B. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets, with requirements indicated. Include dates of tests and test methods employed.

C. Field quality-control reports.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.

B. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E 84 by a testing agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.

1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

C. Comply with the following applicable standards and other requirements specified for miscellaneous components:

1. Supply and Drain Protective Shielding Guards: ICC A117.1.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

1.7 COORDINATION

A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Division 22.

B. Coordinate clearance requirements with piping Installer for piping insulation application. Before preparing piping Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

C. Coordinate installation and testing of heat tracing.

1.8 SCHEDULING

A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.

B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

A. Comply with requirements in "Piping Insulation Schedule, General," "Indoor Piping Insulation Schedule," "Outdoor, Aboveground Piping Insulation Schedule," and "Outdoor, Underground Piping Insulation Schedule" articles for where insulating materials shall be applied.

B. Products shall not contain asbestos, lead, mercury, or mercury compounds.

C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.

D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.

E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.

F. Type A: Cellular Glass: Inorganic, incombustible, foamed or cellulated glass with annealed, rigid, hermetically sealed cells. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Certain-Teed.

b. Johns Manville.

c. Owens Corning.

d. Pittsburgh Corning Corporation.

2. Molded Fibrous Glass Pipe Insulation: Comply with ASTM C 547, Type 1, Grade A, and ASTM C 585, for sizes required and of a type suitable for installation on piping systems as required. One of the following types shall be used:
3. For indoor systems operating at temperatures from 0°F (-18°C) to +850°F (454°C):

a. Owens Corning™ Fiberglas™ Insulation with SSL II® Positive Closure System.

4. For systems operating below ambient (32°F (0°C) to +65°F (18°C)) temperature:

a. Owens Corning™ VaporWick® Pipe Insulation. (see Plumbing Pipe Insulation – VaporWick® Pipe Insulation)

5. Block Insulation: ASTM C 552, Type I.
6. Special-Shaped Insulation: ASTM C 552, Type III.
7. Preformed Pipe Insulation with Factory-Applied ASJ-SSL: Comply with ASTM C 552, Type II, Class 2.
8. Factory fabricate shapes according to ASTM C 450 and ASTM C 585.

G. Type B: Flexible Elastomeric Insulation: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Aeroflex USA, Inc.

b. Armacell LLC.

c. K-Flex USA.

H. Type C: Mineral-Fiber, Preformed Pipe Insulation:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Johns Manville; a Berkshire Hathaway company.

b. Knauf Insulation.

c. Manson Insulation Inc.

d. Owens Corning.

2. Perpendicular Oriented Mineral Fiber Insulation: ASTM C1393, Type IIIB, Category 2:

a. For piping equal to or larger than 10 in (250 mm) diameter operating at temperatures up to +850°F (454°C):
b. Owens CorningTM FiberglasTM FLEXWRAP® Insulation.

3. Perpendicular Oriented Mineral Fiber Insulation: ASTM C1393, Type II, Category 1:

a. For piping equal to or larger than 10 in (250 mm) diameter operating at temperatures up to +650°F (343°C):
b. Owens CorningTM FiberglasTM Pipe and Tank Insulation.

4. Type I, 850 Deg F Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type I, Grade A, with factory-applied ASJ-SSL. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

I. Type G: Protective Shielding Pipe Covers,:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Engineered Brass Company.

b. Insul-Tect Products Co.

c. McGuire Manufacturing.

d. Plumberex Specialty Products, Inc.

e. Truebro.

f. Zurn Industries, LLC.

2. Description: Manufactured plastic wraps for covering plumbing fixture hot-water supply hot- and cold-water supplies and trap and drain piping. Comply with Americans with Disabilities Act (ADA) requirements.

2.2 ACCESSORY MATERIALS

A. Accessories: Provide accessories per insulating system manufacturer's recommendations, including the following:

1. Closure Materials: Butt strips, bands, wires, staples, mastics, adhesives, and pressure-sensitive tapes.

a. Mold resistant mastics are recommended for chilled water applications.

2. Field-Applied Jacketing Materials: Sheet metal, plastic, canvas, fiberglass cloth, insulating cement, PVC fitting covers.
3. Support Materials: Hanger straps, hanger rods, saddles, support rings, and high density inserts.

B. Adhesives for Indoor Applications: VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.3 FACTORY-APPLIED JACKETS

A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:

1. ASJ: White, Kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.
2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.
3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with Kraft-paper backing; complying with ASTM C 1136, Type II.

B. Jacket Types

TYPE	STYLE	MATERIALS
Type 1:	All Service Jacket	Vapor Barrier Jackets: Kraft reinforced foil vapor barrier with self-sealing adhesive joints. Jacket shall be heavy duty fire retardant material with glass fiber reinforcing and self-sealing lap. Jacket will be factory applied to the insulation. Jacket shall have neat, white Kraft finish or white vinyl suitable for painting, with bead puncture resistance of 50 units minimum. Vapor barrier shall be .001 inch aluminum foil adhered to the inner surface of the jacket. Permeance shall not exceed 0.02 perms. Jacket shall be Owens-Corning Fiberglass "ASJ-SSL" or Manville flamesafe "AP-T".
Type 2:	PVC Jackets:	Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket One piece, pre-molded type equal to Johns Manville Zeston 2000/300 Series PVC 20 or 30 mil jacketing and PVC fitting covers. All jackets shall follow manufacturers to comply with temperature of service piping. Jackets shall meet USDA compliance standard for all food handing
Type 3:	Color Coded PVC Jacket	Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket Same as type 2 above but color coded generally in rooms without ceilings. Color Jacket to be applied to all pipe, fittings and valves in the specified area in the schedule table below. See section 220553 Identification for specific colors, these colors are to be contiguous on the piping system in the areas scheduled.
Type 4:	Aluminum Jacket:	Aluminum roll stock ready for shop or field cutting. Comply with ASTM B 209/M 3003 alloy, H-14 temper. 0.016 inch thick smooth aluminum jacket with longitudinal ZEE style closures. Jacket shall be secured at both joints with 2 inch wide aluminum straps centered over butt joint of jacket. Provide 1/2 inch wide aluminum bands on 12 inch centers. Fitting covers shall be manufactured for purpose intended and shall be of same material. Acceptable for outdoor installation.

TYPE	STYLE	MATERIALS
Type 7	Protective Shielding Piping Enclosures for barrier free trap and water piping under fixture	Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following: Truebro. Zurn Industries, LLC. Description: Manufactured plastic enclosure for covering plumbing fixture hot- and cold-water supplies and trap and drain piping. Comply with ADA requirements. Furnish protective shielding to all Emergency Eyewash units where water waste and trap are exposed and are exclusively selected for Barrier Free Use.

2.4 TAPES

A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

   a. Avery Dennison Corporation, Specialty Tapes Division.

   b. Compac Corporation.

   c. Ideal Tape Co., Inc., an American Biltrite Company.

   d. Knauf Insulation.

   e. Venture Tape.

2. Width: 3 inches.
3. Thickness: 11.5 mils.
4. Adhesion: 90 ounces force/inch in width.
5. Elongation: 2 percent.
6. Tensile Strength: 40 lbf/inch in width.
7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.

B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

   a. Avery Dennison Corporation, Specialty Tapes Division.

   b. Compac Corporation.

   c. Ideal Tape Co., Inc., an American Biltrite Company.

d. Knauf Insulation.

e. Venture Tape.

2. Width: 3 inches.
3. Thickness: 6.5 mils.
4. Adhesion: 90 ounces force/inch in width.
5. Elongation: 2 percent.
6. Tensile Strength: 40 lbf/inch in width.
7. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.

C. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive; suitable for indoor and outdoor applications.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Compac Corporation.

b. Ideal Tape Co., Inc., an American Biltrite Company.

c. Venture Tape.

2. Width: 2 inches.
3. Thickness: 6 mils.
4. Adhesion: 64 ounces force/inch in width.
5. Elongation: 500 percent.
6. Tensile Strength: 18 lbf/inch in width.

D. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Avery Dennison Corporation, Specialty Tapes Division.

b. Compac Corporation.

c. Ideal Tape Co., Inc., an American Biltrite Company.

d. Knauf Insulation.

e. Venture Tape.

2. Width: 2 inches.
3. Thickness: 3.7 mils.
4. Adhesion: 100 ounces force/inch in width.
5. Elongation: 5 percent.
6. Tensile Strength: 34 lbf/inch in width.

2.5 SECUREMENTS

A. Bands:

1. Stainless Steel: ASTM A 167 or ASTM A 240/A 240M, Type 304 or Type 316; 0.015 inch thick, 1/2 inch 3/4 inch wide with wing seal or closed seal.
2. Aluminum: ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 3/4 inch wide with wing seal or closed seal.

B. Staples: Outward-clinching insulation staples, nominal 3/4-inch- wide, stainless steel or Monel.

C. Wire:

1. 0.062-inch soft-annealed, stainless steel.
2. 0.080 nickel-copper alloy
3. 0.062 soft annealed galvanized steel

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.

1. Verify that systems to be insulated have been tested and are free of defects.
2. Verify that surfaces to be insulated are clean and dry.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

B. Surface Preparation: Clean and prepare surfaces to be insulated. Before insulating, apply a corrosion coating to insulated surfaces as follows:

1. Stainless Steel: Coat 300 series stainless steel with an epoxy primer 5 mils thick and an epoxy finish 5 mils thick if operating in a temperature range between 140 and 300 deg F. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.
2. Carbon Steel: Coat carbon steel operating at a service temperature between 32 and 300 deg F with an epoxy coating. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.

C. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that applies to insulation.

D. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use de-mineralized water.

3.3 GENERAL INSTALLATION REQUIREMENTS

A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of piping including fittings, valves, and specialties.

B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of pipe system as specified in insulation system schedules.

C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.

D. Install insulation with longitudinal seams at top and bottom of horizontal runs.

E. Install multiple layers of insulation with longitudinal and end seams staggered.

F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.

G. Keep insulation materials dry during application and finishing.

H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.

I. Install insulation with least number of joints practical.

J. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.

1. Install insulation continuously through hangers and around anchor attachments.
2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.

K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.

L. Install insulation with factory-applied jackets as follows:

1. Draw jacket tight and smooth.
2. Cover circumferential joints with 3-inch- wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches OC.

3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 4 inches OC.

    a. For below-ambient services, apply vapor-barrier mastic over staples.

4. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.
5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to pipe flanges and fittings.

M. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.

N. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

O. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

P. For above-ambient services, do not install insulation to the following:

1. Vibration-control devices.
2. Testing agency labels and stamps.
3. Nameplates and data plates.
4. Cleanouts.

3.4 PENETRATIONS

A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.

1. Seal penetrations with flashing sealant.
2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches below top of roof flashing.
4. Seal jacket to roof flashing with flashing sealant.

B. Insulation Installation at Underground Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.

C. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.

1. Seal penetrations with flashing sealant.
2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install

insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.

3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches.
4. Seal jacket to wall flashing with flashing sealant.

D. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.

E. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions.

1. Comply with requirements in Division 07 for firestopping and fire-resistive joint sealers.

F. Insulation Installation at Floor Penetrations:

1. Pipe: Install insulation continuously through floor penetrations.
2. Seal penetrations through fire-rated assemblies. Comply with requirements in Division 07.

3.5 GENERAL PIPE INSULATION INSTALLATION

A. Requirements in this article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.

B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:

1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity unless otherwise indicated.
2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below-ambient services, provide a design that maintains vapor barrier.

6. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.
7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below-ambient services and a breather mastic for above-ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
8. For services not specified to receive a field-applied jacket except for flexible elastomeric and polyolefin, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.
9. Stencil or label the outside insulation jacket of each union with the word "union." Match size and color of pipe labels.

C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.

D. Install removable insulation covers at locations indicated. Installation shall conform to the following:

1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as adjoining pipe insulation.
2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union long at least two times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless-steel or aluminum bands. Select band material compatible with insulation and jacket.
3. Construct removable valve insulation covers in same manner as for flanges, except divide the two-part section on the vertical center line of valve body.
4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless-steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least 2 inches over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.
5. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.

3.6 INSTALLATION OF CELLULAR-GLASS INSULATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with factory-applied jackets on above-ambient services, secure laps with outward clinched staples at 6 inches OC.

4. For insulation with factory-applied jackets on below-ambient services, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of cellular-glass block insulation of same thickness as pipe insulation.
4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed sections of same material as straight segments of pipe insulation when available. Secure according to manufacturer's written instructions.
2. When preformed sections of insulation are not available, install mitered sections of cellular-glass insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed sections of cellular-glass insulation to valve body.
2. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.

3.7 INSTALLATION OF FLEXIBLE ELASTOMERIC INSULATION

A. Seal longitudinal seams and end joints with manufacturers recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

B. Insulation Installation on Pipe Flanges:

1. Install pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of same thickness as pipe insulation.
4. Secure insulation to flanges and seal seams with manufacturers recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install mitered sections of pipe insulation.
2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed valve covers manufactured of same material as pipe insulation when available.
2. When preformed valve covers are not available, install cut sections of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.
4. Secure insulation to valves and specialties and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.8 INSTALLATION OF MINERAL-FIBER INSULATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of preformed pipe insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with factory-applied jackets on above-ambient surfaces, secure laps with outward clinched staples at 6 inches OC.
4. For insulation with factory-applied jackets on below-ambient surfaces, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with mineral-fiber blanket insulation.
4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed sections are not available, install mitered sections of pipe insulation to valve body.
3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
4. Install insulation to flanges as specified for flange insulation application.

3.9 INSTALLATION OF POLYOLEFIN INSULATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Seal split-tube longitudinal seams and end joints with manufacturers recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

B. Insulation Installation on Pipe Flanges:

1. Install pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of polyolefin sheet insulation of same thickness as pipe insulation.
4. Secure insulation to flanges and seal seams with manufacturers recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install mitered sections of polyolefin pipe insulation.
2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install cut sections of polyolefin pipe and sheet insulation to valve body.
2. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.
4. Secure insulation to valves and specialties, and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.10 FIELD-APPLIED JACKET INSTALLATION

A. Where glass-cloth jackets are indicated, install directly over bare insulation or insulation with factory-applied jackets.

1. Draw jacket smooth and tight to surface with 2-inch overlap at seams and joints.
2. Embed glass cloth between two 0.062-inch- thick coats of lagging adhesive.
3. Completely encapsulate insulation with coating, leaving no exposed insulation.

B. Where FSK jackets are indicated, install as follows:

1. Draw jacket material smooth and tight.
2. Install lap or joint strips with same material as jacket.
3. Secure jacket to insulation with manufacturer's recommended adhesive.
4. Install jacket with 1-1/2-inch laps at longitudinal seams and 3-inch- wide joint strips at end joints.

5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.

C. Where PVC jackets are indicated, install with 1-inch overlap at longitudinal seams and end joints. Seal with manufacturers recommended adhesive.

1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.

D. Where metal jackets are indicated, install with 2-inch overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches OC. and at end joints.

3.11 FINISHES

A. Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Division 09.

1. Flat Acrylic Finish: Two finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.

a. Finish Coat Material: Interior, flat, latex-emulsion size.

B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.

C. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.

D. Do not field paint aluminum or stainless-steel jackets.

3.12 PIPING INSULATION SCHEDULE, GENERAL

A. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.

B. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:

1. Drainage piping located in crawl spaces.
2. Underground piping.
3. Chrome-plated pipes and fittings unless there is a potential for personnel injury.

3.13 PIPING INSULATION SCHEDULE

Piping System	Insulation Type	Thickness Inch	Jacket	Notes

Piping System	Insulation Type	Thickness Inch	Jacket	Notes
All Hot Water Supply And Return less than 2inches	A C	1½	Type 1	
All Hot Water Supply And Return greater than 2 inches	A C	2	Type 1	
Roof Drains And Horizontal Rainwater, Including Overflow Drainage System	A C	1½	Type 1	Note 3 Include Drain Bodies Note 5
Exterior Piping Exposed (Water)	A C	3/4	Type 5	
Exposed Sanitary Drains, Domestic Water, Domestic Hot Water, And Stops For Plumbing Fixtures For People With Disabilities	G	1/2	Type 7	Package System Only Includes EW&S Where Designated For Barrier Free Use.

Supplemental Notes

Note 1: Two layers of 1 inch with staggered joints. Provide stainless steel 1/2 inch steel bands, 12 inches on center, apply 1 foot hexagonal mesh over insulation and 1/2 inch thick coat of insulating cement troweled smooth. Apply glass cloth jacket and size with one brush coat of lagging adhesive.

Note 2: The contractor will furnish and install heat trace tape, prior to insulation installation. Raychem self-regulating Winter Guard Plus 8 watts per foot with failure alarm

Note 3: Insulation shall include drain sump body and all horizontal piping to, and including the elbow down to vertical.

Note 4: Unless noted otherwise this section pertains to ALL piping in a specified system, including in-chase or in-shaft piping

3.14 OUTDOOR, FIELD-APPLIED JACKET SCHEDULE

A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.

B. If more than one material is listed, selection from materials listed is Contractor's option.

C. Piping, Concealed:

1. None.
2. PVC, Color-Coded by System: 30 mils thick.
3. Stainless Steel, Type 304 Smooth 2B Finish: 0.010 inch thick.

D. Piping, Exposed:

1. PVC: 30 mils thick.
2. Stainless Steel, Type 304, Smooth 2B Finish with Z-Shaped Locking Seam: 0.020 inch thick.

3.15 UNDERGROUND, FIELD-INSTALLED INSULATION JACKET

A. For underground direct-buried piping applications, install underground direct-buried jacket over insulation material.

END OF SECTION

SECTION 220800 - COMMISSIONING OF PLUMBING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. The OPR and BOD documentation are included by reference for information only.

C. Division 01 section 'LEED Requirements' for additional LEED requirements.

1.2 SUMMARY

A. This section includes

1. Test equipment.

B. Related Sections:

1. Division 01 for general commissioning process requirements.

1.3 DESCRIPTION

A. Refer to Division 01 for the description of commissioning.

1.4 DEFINITIONS

A. Refer to Division 01 Section "General Commissioning Requirements" for definitions.

1.5 SUBMITTALS

A. Refer to Division 01 for CxA's role.

B. Refer to Division 01 for specific requirements. In addition, provide the following:

1. Certificates of readiness
2. Certificates of completion of installation, prestart, and startup activities.
3. O&M manuals
4. Test reports

1.6 QUALITY ASSURANCE

A. Test Equipment Calibration Requirements: Contractors will comply with test manufacturer's calibration procedures and intervals. Recalibrate test instruments immediately after instruments have been repaired resulting from being dropped or damaged. Affix calibration tags to test instruments. Furnish calibration records to CxA upon request.

1.7 COORDINATION

A. Refer to Division 01 for requirements pertaining to coordination during the commissioning process.

PART 2 - PRODUCTS

2.1 TEST EQUIPMENT

A. All standard testing equipment required to perform startup, initial checkout and functional performance testing shall be provided by the contractor for the equipment being tested. For example, the plumbing contractor of Division 22 shall ultimately be responsible for all standard testing equipment for the plumbing system in Division 22, except for equipment specific to and used by TAB in their commissioning responsibilities. A sufficient quantity of two-way radios shall be provided by each subcontractor.

B. Special equipment, tools and instruments (specific to a piece of equipment and only available from vendor) required for testing shall be included in the base bid price to the Owner and left on site, except for stand-alone data logging equipment that may be used by the CxA.

C. Proprietary test equipment and software required by any equipment manufacturer for programming and/or start-up, whether specified or not, shall be provided by the manufacturer of the equipment. Manufacturer shall provide the test equipment, demonstrate its use, and assist in the commissioning process as needed. Proprietary test equipment (and software) shall become the property of the Owner upon completion of the commissioning process.

D. Data logging equipment and software required to test equipment will be provided by the CxA, but shall not become the property of the Owner.

E. All testing equipment shall be of sufficient quality and accuracy to test and/or measure system performance with the tolerances specified in the Specifications. If not otherwise noted, the following minimum requirements apply: Temperature sensors and digital thermometers shall have a certified calibration within the past year to an accuracy of 0.5 deg F and a resolution of + or - 0.1 deg F. Pressure sensors shall have an accuracy of + or - 2.0 percent of the value range being measured (not full range of meter) and have been calibrated within the last year.

PART 3 - EXECUTION

3.1 GENERAL DOCUMENTATION REQUIREMENTS

A. With assistance from the installing contractors, the CxA will prepare Pre-Functional Checklists for all commissioned components, equipment, and systems

B. Red-lined Drawings:

1. The contractor will verify all equipment, systems, instrumentation, wiring and components are shown correctly on red-lined drawings.
2. Preliminary red-lined drawings must be made available to the Commissioning Team for use prior to the start of Functional Performance Testing.
3. Changes, as a result of Functional Testing, must be incorporated into the final as-built drawings, which will be created from the red-lined drawings.
4. The contracted party, as defined in the Contract Documents will create the as-built drawings.

C. Operation and Maintenance Data:

1. Contractor will provide a copy of O&M literature within 45 days of each submittal acceptance for use during the commissioning process for all commissioned equipment and systems.
2. The CxA will review the O&M literature once for conformance to project requirements.
3. The CxA will receive a copy of the final approved O&M literature once corrections have been mad by the contractor.

D. Demonstration and Training:

1. Contractor will provide demonstration and training as required by the specifications.
2. A complete training plan and schedule must be submitted by the contractor to the CxA four weeks (4) prior to any training.
3. A training agenda for each training session must be submitted to the CxA one (1) week prior the training session.
4. The CxA shall be notified at least 72 hours in advance of scheduled tests so that testing may be observed by the CxA and Owner's representative. A copy of the test record shall be provided to the CxA, Owner, and Architect.
5. Engage a Factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain specific equipment.
6. Train Owner's maintenance personnel on procedures and schedules for starting and stopping, trouble shooting, servicing, and maintaining equipment.
7. Review data in O&M Manuals.

E. Systems manual requirements

1. The Systems Manual is intended to be a usable information resource containing all of the information related to the systems, assemblies, and Commissioning Process in one place with indexes and cross references.
2. The GC shall include final approved versions of the following information for the Systems Manual:

a. As-Built System Schematics
b. Verified Record Drawings
c. Test Results (not otherwise included in Cx Record)
d. Periodic Maintenance Information for computer maintenance management system
e. Recommendations for recalibration frequency of sensors and actuators
f. A list of contractors, subcontractors, suppliers, architects, and engineers involved in the project along with their contact information
g. Training Records, Information on training provided, attendees list, and any on-going training

3. This information shall be organized and arranged by building system, such as fire alarm, chilled water, heating hot water, etc.
4. Information should be provided in an electronic version to the extent possible. Legible, scanned images are acceptable for non-electronic documentation to facilitate this deliverable.

3.2 CONTRACTOR'S RESPONSIBILITIES

A. Attend construction phase controls coordination meetings.

B. Attend domestic water balancing review and coordination meetings.

C. Participate in Plumbing systems, assemblies, equipment, and component maintenance orientation and inspection as directed by the CxA.

D. Provide information requested by the CxA for final commissioning documentation.

E. Include requirements for submittal data, operation and maintenance data, and training in each purchase order or sub-contract written.

F. Prepare preliminary schedule for Plumbing system orientations and inspections, operation and maintenance manual submissions, training sessions, pipe and duct system testing, flushing and cleaning, equipment start-up, testing and balancing and task completion for owner. Distribute preliminary schedule to commissioning team members.

G. Update schedule as required throughout the construction period.

H. During the startup and initial checkout process, execute the related portions of the prefunctional checklists for all commissioned equipment.

I. Assist the CxA in all verification and functional performance tests.

J. Provide measuring instruments and logging devices to record test data, and provide data acquisition equipment to record data for the complete range of testing for the required test period.

K. Gather operation and maintenance literature on all equipment, and assemble in binders as required by the specifications. Submit to CxA (45) days after submittal acceptance.

L. Coordinate with the CxA to provide (48) hour advance notice so that the witnessing of equipment and system start-up and testing can begin.

M. Notify the CxA a minimum of two (2) weeks in advance of the time for start of the balancing work. Attend the initial balancing meeting for review of the balancing procedures.

N. Participate in, and schedule vendors and contractors to participate in the training sessions.

O. Provide written notification to the CM/GC and CxA that the following work has been completed in accordance with the contract documents, and that the equipment, systems, and sub-system are operating as required.

1. Plumbing equipment including domestic water heaters, pumps, plumbing fixtures, and all other equipment furnished under this Division.
2. Gas piping, sanitary waste and vent piping, storm drainage piping, sump pumps and automatic sprinkler system.
3. Fire stopping in fire rated construction, including caulking, gasketing and sealing of smoke barriers.
4. Air compressors
5. Fuel delivery systems

P. The equipment supplier shall document the performance of his equipment.

Q. Provide a complete set of red-lined drawings to the CxA prior to the start of Functional Performance Testing.

R. Balance Contractor

1. Attend initial commissioning coordination meeting scheduled by the CxA.
2. Submit the site specific balancing plan to the CxA and Design Professional for review and acceptance.
3. Attend the balancing review meeting scheduled by the CxA. Be prepared to discuss the procedures that shall be followed in balancing the Plumbing system.
4. At the completion of the balancing work, and the submittal of the final balancing report, notify the Plumbing contractor and the CM/GC.
5. At the completion of balancing work, and the submittal of the final balancing report, notify the Plumbing Contractor and the CM/GC.
6. Participate in verification of the balancing report, which will consist of repeating measurements contained in the balancing reports. Assist in diagnostic purposes when directed.

S. Provide training of the Owner’s operating staff using expert qualified personnel, as specified.

T. Equipment Suppliers

1. Provide all requested submittal data, including detailed start-up procedures and specific responsibilities of the Owner, to keep warranties in force.
2. Assist in equipment testing per agreements with contractors.
3. Provide information requested by CxA regarding equipment sequence of operation and testing procedures.

U. Refer to Division 01 for additional contractor responsibilities.

3.3 OWNER'S RESPONSIBILITIES

A. Refer to Division 01 for Owner's Responsibilities.

3.4 DESIGN PROFESSIONAL'S RESPONSIBILITIES

A. Refer to Division 01 for Design Professional's Responsibilities.

3.5 CXA'S RESPONSIBILITIES

A. Refer to Division 01 for CxA's Responsibilities.

3.6 TESTING PREPARATION

A. Certify in writing to the CxA that Plumbing systems, subsystems, and equipment have been installed, calibrated, and started and are operating according to the Contract Documents.

B. Certify in writing to the CxA that Plumbing instrumentation and control systems have been completed and calibrated, that they are operating according to the Contract Documents, and that pretest set points have been recorded.

C. Certify in writing that balancing procedures have been completed and that testing, adjusting, and balancing reports have been submitted, discrepancies corrected, and corrective work approved.

D. Set systems, subsystems, and equipment into operating mode to be tested (e.g., normal shutdown, normal auto position, normal manual position, unoccupied cycle, emergency power, and alarm conditions).

E. Inspect and verify the position of each device and interlock identified on checklists.

F. Check safety cutouts, alarms, and interlocks with smoke control and life-safety systems during each mode of operation.

G. Testing Instrumentation: Install measuring instruments and logging devices to record test data as directed by the CxA.

3.7 DOMESTIC AND LABORATORY WATER BALANCING VERIFICATION

A. General Requirements
   1. Building Distribution System
      a. All circuits and sub circuits shall be flow and temperature balanced such that hot water positive flow is achieved in each branch circuit of the building hot water systems

b. See drawing detail sheets and specification section pipe table A10 for flow and balancing valve spec options. The specified products indicate either integral flow or flow/temperature balancing devices, assure the installed devices meet these specifications

c. Indicate on a riser diagram the type of balancing device use, method of calibration and proposed flow in each branch circuit of the hot water piping network for each hot water system

2. Building Main Hot Water Distribution Pumps

a. Balance flows to the main Thermostatic Hot Water Mixing Valves according to manufacturer's instructions

b. Provide plastic tags on each circuit indicating the flow and balancing valve position to the Mixing valves and then to the water heaters

3. Submissions

1) Submit a report indicating the actual flow and temperature in each circuit described in item C above. The report shall designate the following:

2) Time to achieve hot water at the remote hot water faucet in the circuit

3) Hot water temperature achieved

4) Setting on circuit setter

b. For the circuits at the outlets of hot water circulation pumps, indicate the following:

1) The actual flow and temperature into Temperature Mixing Valve

2) The actual flow and temperature back to the heaters and/or storage tanks

B. Prior to performance of Water Balancing work, provide copies of reports, sample forms, checklists, and certificates to the CxA.

C. Notify the CxA at least ten (10) days in advance of testing and balancing Work, and provide access for the CxA to witness balancing Work.

D. Provide technicians, instrumentation, and tools to verify testing and balancing of Plumbing systems at the direction of the CxA.

1. The CxA will notify testing and balancing subcontractor ten (10) days in advance of the date of field verification. Notice will not include data points to be verified.
2. The balancing subcontractor shall use the same instruments (by model and serial number) that were used when original data were collected.
3. Failure of an item includes a deviation of more than 10 percent. Failure of more than 10 percent of selected items shall result in rejection of final balancing report.
4. Remedy the deficiency and notify the CxA so verification of failed portions can be performed.

3.8 GENERAL TESTING REQUIREMENTS

A. Scope of Plumbing testing shall include entire Plumbing installation. Testing shall include measuring capacities and effectiveness of operational and control functions.

B. Test all operating modes, interlocks, control responses, and responses to abnormal or emergency conditions, and verify proper response of building automation system controllers and sensors.

C. The CxA along with the Plumbing contractor, balancing subcontractor shall prepare detailed testing plans, procedures, and checklists for Plumbing systems, subsystems, and equipment.

D. Tests will be performed using design conditions whenever possible.

E. Simulated conditions may need to be imposed using an artificial load when it is not practical to test under design conditions. Before simulating conditions, calibrate testing instruments. Provide equipment to simulate loads. Set simulated conditions as directed by the CxA and document simulated conditions and methods of simulation. After tests, return settings to normal operating conditions.

F. The CxA may direct that sensor values be altered with a signal generator when design or simulating conditions and altering set points are not practical.

G. If tests cannot be completed because of a deficiency outside the scope of the Plumbing system, document the deficiency and report it to the Owner. After deficiencies are resolved, reschedule tests.

H. If the testing plan indicates specific seasonal testing, complete appropriate initial performance tests and documentation and schedule seasonal tests.

3.9 PLUMBING SYSTEMS, SUBSYSTEMS, AND EQUIPMENT TESTING PROCEDURES

A. Equipment Testing and Acceptance Procedures: Testing requirements are specified in individual Division 22 sections. Provide submittals, test data, inspector record, and certifications to the CxA.

B. Plumbing Instrumentation and Control System Testing: Field testing plans and testing requirements are specified in Division 23 for HVAC Controls." Assist the CxA with preparation of testing plans.

C. Pipe system cleaning, flushing, hydrostatic tests and chemical treatment: Test requirements are specified in Division 22 piping sections. Plumbing Contractor shall prepare a pipe system cleaning, flushing, and hydrostatic testing plan. Provide cleaning, flushing, testing, and treating plan and final reports to the CxA. Plan shall include the following:

1. Sequence of testing and testing procedures for each section of pipe to be tested, identified by pipe zone or sector identification marker. Markers shall be keyed to Drawings for each pipe sector, showing the physical location of each designated pipe test section. Drawings keyed to pipe zones or sectors shall be formatted to allow each section of piping to be physically located and identified when referred to in pipe system cleaning, flushing, hydrostatic testing, and chemical treatment plan.
2. Description of equipment for flushing operations.
3. Minimum flushing water velocity.
4. Tracking checklist for managing and ensuring that all pipe sections have been cleaned, flushed, hydrostatically tested, and chemically treated.

D. Plumbing Distribution System Testing: Provide technicians, instrumentation, tools, and equipment to test performance of air, fuel gas, sanitary waste and vent piping, storm drainage piping, sprinkler and domestic water distribution systems.

E. Vibration and Sound Tests: Provide technicians, instrumentation, tools, and equipment to test performance of vibration isolation controls.

F. The work included in the commissioning process involves a complete and thorough evaluation of the operation and performance of all components, systems and sub-systems. The following equipment and systems shall be evaluated:

1. All Water Systems including hot and cold water systems and their related components and heaters.
2. All Compressed Air Systems
3. All Water Heaters and Heat Exchangers
4. All Condensing Equipment
5. All Vacuum Systems
6. Emergency Eyewash and Shower Equipment
7. All Backflow Devices
8. Antiflood Valve systems
9. Fuel Gas System
10. Gas System – Carbon Dioxide
11. Gas System – Central Cylinder
12. Gas System – Hydrogen
13. Gas System – Natural Gas
14. Gas System – Nitrogen
15. Hot Water Circulating Pumps
16. Hot Water Tempering Stations
17. Plumbing Fixtures
18. Rainwater Collection System
19. RODI Purified Water Systems
20. Vivarium bottle fill station system
21. Sanitary Waste and Venting System
22. Special Waste Systems
23. Grease Waste Interceptors
24. Wastewater Pumping Systems
25. Elevator Waste Pumping Systems
26. Storm Drainage System
27. Trap Primer
28. Water Booster Systems
29. Water Storage Systems

G. Refer to Division 01 for requirements pertaining to deficiencies/non-conformance, cost of retesting, or failure due to manufacturer defect.

H. Approval

1. Refer to Division 01 for approval procedures.

3.10 DEFERRED TESTING

A. Refer to Division 01 for requirements pertaining to deferred testing.

3.11 OPERATION AND MAINTENANCE MANUALS

A. The Operation and Maintenance Manuals shall conform to Contract Documents requirements as stated in Division 01.

B. Refer to Division 01 for the AE and CxA roles in the Operation and Maintenance Manual contribution, review and approval process.

3.12 TRAINING OF OWNER PERSONNEL

A. Refer to Division 01 for requirements pertaining to training.

B. Plumbing Contractor. The mechanical contractor shall have the following training responsibilities:

1. Provide the CxA with a training plan two weeks before the planned training.
2. Provide designated Owner personnel with comprehensive orientation and training in the understanding of the systems and the operation and maintenance of each piece of Plumbing equipment.
3. During any demonstration, should the system fail to perform in accordance with the requirements of the O&M manual or sequence of operations, the system will be repaired or adjusted as necessary and the demonstration repeated.
4. The appropriate trade or manufacturer's representative shall provide the instructions on each major piece of equipment. This person may be the start-up technician for the piece of equipment, the installing contractor or manufacturer’s representative. Practical building operating expertise as well as in-depth knowledge of all modes of operation of the specific piece of equipment is required. More than one party may be required to execute the training.
5. The training sessions shall follow the outline in the Table of Contents of the operation and maintenance manual and illustrate whenever possible the use of the O&M manuals for reference.
6. Hands-on training shall include start-up, operation in all modes possible, including manual, shut-down and any emergency procedures and preventative maintenance for all pieces of equipment.
7. The plumbing contractor shall fully explain and demonstrate the operation, function and overrides of any local packaged controls.
8. Training shall occur after functional testing is complete, unless approved otherwise by the Owner.

END OF SECTION

SECTION 221110 - COMMON PLUMBING PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
   1. Piping materials
   2. Encasement for piping.
   3. Dielectric fittings

1.3 ACTION SUBMITTALS

A. Product Data: For transition fittings and dielectric fittings.

B. All Pipe, Fittings, Valves and Sundries contained in this specification section. All piping systems shall be submitted as a single piping submittal package with labels tagged consistent with the pipe index found in Part 2 of this spec.

C. LEED Submittals:
   1. Product Data for Credit IEQ 4.1: For solvent cements and adhesive primers, documentation including printed statement of VOC content.
   2. Laboratory Test Reports for Credit IEQ 4: For solvent cements and adhesive primers, documentation indicating that products comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

1.4 INFORMATIONAL SUBMITTALS

A. All Product shop drawings and submittal sheets for all pipe, fittings, valves, equipment, appurtenances, and systems included in this section

B. System purging and disinfecting activities report.

C. Field quality-control reports.

1.5 FIELD CONDITIONS

A. Interruption of Existing Water Service: Do not interrupt water service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary water service according to requirements indicated:
   1. Notify Owner no fewer than two days in advance of proposed interruption of water service.
   2. Do not interrupt water service without Owner's written permission.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

A. Comply with requirements in "Piping Schedule Index and Pipe Tables." Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.

B. Potable-water piping and components shall comply with NSF 14 and NSF 61 Annex G. Plastic piping components shall be marked with "NSF-pw."

C. WATER PIPING
   1. All pipe, fittings, and valves used in this distribution system and installed after January 4, 2014 must comply with the new Federal Mandate known as the "Reduction of Lead in Drinking Water Act-2014". Therefore, after the enactment date of 1/4/14, all products installed must comply. Any product pipe, fittings or valve installed after the enactment date that does not comply, shall be removed and changed by this contractor at his/her own expense to comply with the Federal Law

   2. PIPE
      a. Seamless copper water tube, drawn temper, Type L. ASTM B-88.
   3. FITTINGS
      a. Wrought copper, solder-joint. ASME B16.22
      b. Ductile iron coupling with copper alkyd enamel paint coating, ASTM A-536. Grade “EHP” EPDM elastomer gasket rated -30F to 250F, ASTM D-2000. Equal to Victaulic Style 607 coupling. ASTM B-75 or ASTM B-152 copper alloy fittings or ASTM B-584 grooved end cast bronze fittings per UNS C89836 or C92200.
   4. JOINTS
      a. ASTM solder filler material shall be lead free to comply with the federal mandate of 2014.
      b. ASTM B-813 liquid or paste flux. Soldering procedures shall comply with ASTM B-828.
      c. Rolled groove prepared and assembled in accordance with manufacturer instructions.
      d. Pressed Jointing System similar to Viega Pro Press mechanical joint may be used in lieu of soldered joints
   5. VALVES

a. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following: Apollo, Watts, Milwaukee, Nibco, or Conbraco.

b. Gate Valve

1) Outside stem and yoke resilient wedge flanged gate valve, lead free model, Watts Series 408-OSYRW. This valve intended for main shutoff in compliance with local water department regulations.

c. Ball Valve

1) All bronze lead free, 2-piece, full port, PTFE seats, solder end connections. 200 psig WOG. Apollo 77BLF-100, Watts Milwaukee, Watts LF-B6081.
2) Class 125, cast iron body, FDA epoxy coated. Full port, flanged ends, stainless steel ball and stem. ANSI B16.1 flange dimensions. Watts G-4000-FDA series, Apollo IBV.

d. Butterfly Valve

1) Lead free design
2) Join to the piping system with Style 607 couplings.
3) Double-seal disc design with a resilient elastomeric coating bonded to the ductile iron disc core. Grade CHP flouro-elastomer rated -30 deg F to 250 deg F.
4) Double-seal disc design with a resilient elastomeric coating bonded to the ductile iron disc core.
5) The disc actuated by a manual lever, gear.
6) Dead end service provided to full working pressure in both directions.
7) Sealing and positive shut-off are accomplished by a double ring seal.

6. Check Valve

a. Lead Free Bronze body and clapper, solder ends, 200 WOG. Apollo 163 SLF Series, Watts LFWCV-CVS series, Milwaukee, Stockham.

b. Iron body, bronze mounted, flanged ends, 200 WOG. Nibco lead fee Class 125/250 silent check or Apollo 910F Series, Milwaukee F-2974-M, Stockham G-931.

7. Balancing Valve

a. 2 inches and Smaller. 300 psi threaded, soldered or Permalynx push-to-connect ends, non-ferrous Ametal® brass copper alloy body, EPDM o-ring seals. 4-turn digital readout hand wheel for balancing, hidden memory feature with locking tamper-proof setting.

b. Mandatory – Provide separate downstream temperature gauge in conformance with spec section 220519 “Meters and Gauges

c. 2-1/2 inches or Larger. 250 psi Flanged or 350 psi Grooved ends, ASTM A536 ductile iron body, all other metal parts of Ametal® brass copper alloy, EPDM o-ring seals. 8, 12, or 16 turn digital readout hand wheel for balancing, hidden memory feature with locking tamper-proof setting. Apollo 58B, Watts, or approved equal by Bell & Gossett or Armstrong.

D. GAS PIPING

1. PIPE Schedule 40 Galvanized Steel ASTM A53 Grade B, A106 Grade A, or ASTM A120. Schedule 40 Carbon Steel ASTM A53 Grade B, ASTM A106 Grade A, or ASTM A120.
2. FITTINGS Galvanized Malleable-Iron Threaded Fittings: ASME B16.3, Class 150, standard pattern Wrought-Steel Welding Fittings: ASTM A 234/A 234M for butt welding and socket welding
3. UNIONS Unions: ASME B16.39, Class 150, Galvanized malleable iron with brass-to-iron seat, ground joint, and threaded ends Use Flanges.
4. FLANGES Forged-Steel Galvanized Flanges and Galvanized Flanged Fittings: ASME B16.5, minimum Class 150, including bolts, nuts, and gaskets of the following material group, end connections, and facings:
5. Note: all cut treads used in the gas piping system shall be cold re-galvanized prior to assembly.

6. Valves

    a. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

        1) Watts Regulator, Apollo, Serd Audco, Resun, Nordstrom, AY McDonald
        2) Note: All valves used for gas shall be approved for use by the State Fuel Gas Code and/or the State Plumbing Board.

    b. Plug/Gas Cock Valves Bronze body and plug manually operated low pressure (2 psig or less) natural or propane gas valve for use indoors at ambient temperatures of 32 to 125 degrees Fahrenheit

    c. Ball Valves Bottom loaded pressure stem valve rated at 600 psi WOG.

        1) Basis of Design: Watts B-6000-UL-MassApollo 70-100-07 series, Watts FBV-3C Ball valves shall be of the floating-ball design providing bi-directional, tight shutoff in accordance with MSS SP-72. The valves shall be rated at 150# WSP/300# WOG.
        2) For sizes larger than 2 inch, bodies shall be ductile iron per ASTM A536, With ANSI Class 150 raised-face flanges. The interior and exterior of the body shall be UL certified polyester powder coated to meet NSF/ANSI 61 and NSF/ANSI 372. The ball shall be PFA infused stainless steel, with a stainless steel blowout-proof stem. The seats and body seals shall be PTFE. The stem seal shall be PTFE, externally adjustable chevron type. Valves shall be equipped with locking handles as standard. Valves shall be equipped with 2" manual gear operators.

    d. Check ValvesAll available sizes: 150# Class, bronze swing check valve. Aluminum disc, screwed cap, threaded or flanged ends, lifting lug for 3 – 8 inch valves. Basis of Design: Eclipse Inc. Series 1000.

    e. Pressure Regulating Devices

        1) Manufacturers: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

            a) American Meter Company.

            b) Eclipse Combustion, Inc.

            c) Fisher Control Valves and Regulators

d) Itron Valve

e) Sensus

f) Maxitrol Company.

g) Pietro Fiorentini Company

2) All regulators used to control gas pressures in association with Lochinvar equipment shall be first verified for style and location prior to installation.

7. Gas Shutoff emergency panel

   a. Where indicated on the drawings, furnish and install a surface mounted emergency gas shutoff panel

   b. Panel shall be Safety Technologies International Model SS-2230

   c. Furnish low voltage control wiring from control panel to emergency floor shutoff valves

8. Emergency Gas Shutoff Valve

   a. ASCO solenoid valve series 8223 low power shutoff valve. Power rated at 1.4W

9. Note: All valves used for gas shall be approved for use by the State Fuel Gas Code and/or the State Plumbing Board.

E. SLEEVE FOR NATURAL GAS PIPING

1. Pipe

   a. Schedule 40 Galvanized Steel. ASTM A53 Grade B, ASTM A106 Grade A or ASTM A120.

2. Fittings

   a. Screwed malleable iron 125 PSI galvanized.

   b. Grooved ductile iron 150 PSI galvanized.

3. Flanges
   a. 150# raised face, screwed, A105 galvanized.

4. Protection of Joints

   a. All piping used for sleeves on installation of underground gas piping, valves and fittings shall be protected and covered with Tapecoat H35 Gray corrosion protection tape with integral primer and adhesive. All fittings and joints shall be wrapped with similar protective tape.

   b. When steel comes in contact with dissimilar material, provide di-electric couplings or dielectric flanges. Contact between ferrous stud bolts and bronze flanges shall be electrically insulated with non-metallic washers. Provide union connections to all pneumatically operated equipment.

F. SANITARY WASTE AND STORM WATER ,CAST IRON PIPING (BELOW GRADE)

1. Pipe 2 inches And Larger: Hub And Spigot Cast Iron Soil Pipe, ASTM A-74 or Service Weight if Code Approved. Piping shall be Asphalt or Coal Tar Pitch Coated.
2. Fittings 2 inches and Larger: Hub and Spigot Cast Iron Fittings, Extra Heavy or service weight ASTM A-74. Asphalt or Coal Tar Pitch Coated. DWV Pattern.
3. Joints : Neoprene Compression Gaskets Conforming to ASTM C-564.

G. SANITARY WASTE AND STORM WATER ,CAST IRON PIPING (ABOVE GRADE)

1. Pipe

a. Hubless Cast Iron Soil Pipe, Service Weight. ASTM-A-888, CISPI 301.

b. Type L Copper Tubing. ASTM B8872. See Note 1.

2. Fittings

a. Hubless Cast Iron Fittings, Service Weight. ASTM-A-888, CISPI 801.

b. or Wrought Copper DWV Fittings. See Note 1

3. Cast Iron Sovent Fittings

a. For sanitary waste systems only,

b. Cast Iron Sovent system and fittings are acceptable. Cast Iron Sovent DWV system installed in accordance with approved construction plans and specifications in compliance with criteria set forth by "Cast Iron Sovent Design Manual #802" as published by Conine Manufacturing Co., Inc. The Cast Iron Sovent Aerator and De-aerator fittings shall be in compliance with ASME standard B16.45-1998.

4. Joints

a. Hubless Cast Iron: Heavy Duty Stainless Steel Band Coupling with Neoprene Gasket. Bank Torque of 80 Foot-Pounds. 15 PSIG Pressure Rating. Husky SD 4000 or Clamp-All Hi-Torq 80. See Note 2.

b. Copper: 95/5 Solder.

c. Neoprene Compression Gaskets Conforming to ASTM C-564.

d. Backwater Valve – Pit Style

e. Pit Style Backwater Valve: Duco Cast Iron Gravity with Bronze Backwater Valve and CI Secured Grate. Provide flashing clamp. Polished Bronze Face. J.R. Smith Co. 7000,, Zurn, Josam, Watts.

5. Backwater Valve – In Line

a. Cast Iron Gravity Flow Type, Bronze Mounted, Hub End. Exterior shall be Mastic Coated, Bolted or Extended Cover in Accordance with Installation Parameters. J.R. Smith Co. 7012 - 7022, Josam 67500, Zurn Industries Z-1095, Watts, BV-200.

b. Backwater – Manual Shutoff Gate

1) Duco Cast Iron Gravity Flow Type, Bronze Mounted with removable wheel handle. J.R. Smith Co. 7150, Josam, Zurn Industries, Watts.

H. SANITARY OR STORM FORCE MAIN PIPING

1. PIPE

a. Schedule 40 Galvanized Steel. ASTM A53 Grade B, A106 Grade A or A120. Schedule 40 Galvanized Steel. ASTM A53 Grade B, A106 Grade A or A120.

2. FITTINGS

a. Screwed Cast Iron 125 PSI Galvanized. Grooved Malleable Iron 125 PSI Galvanized.

3. UNIONS

a. Screwed 150# Malleable Iron A105 Grade Ii, Galvanized. Use Flanges.

4. FLANGES 1

a. 50# Raised Face, Screwed, A105 Galvanized.150# Raised Face Galvanized Uniflange, ASTM A181, Grade I. 150# Flat Face for Cast Iron Valve.

5. GASKETS

a. 1/16 inch Red Rubber, Wire Inserted. 150 Raised Face And 125 Flat Face Gasket.

6. GATE VALVE

a. 2-1/2 inches and Smaller: 125# Class, All Bronze, Rising Stem, Solid Disc, Solder Ends Screwed Bonnet, Solid Disc, Screw Ends Milwaukee 148, Apollo 101T, Stockham B-114.

b. 3 inches and Larger: 125# Class, Iron Body, Os&Y Bronze Mounted, Flanged Ends. Milwaukee F-2885-M, Apollo 611F, Stockham G-623, Watts 408 OSY-RW.

7. CHECK VALVE

a. 2 inch and smaller: Horizontal Swing, Composition Disc, All Bronze, Threaded Ends, 200 PSI Wp. Milwaukee 509, Apollo 161T, Stockham B319.Outside

b. 3" and larger: Lever And Weight Swing Check, Ibbm for Installation at no more than 45 degrees from horizontal, Flanged End, 200 PSI Wp. Jenkins 477-L, Stockham G931-L&W, Apollo 910 FLW.

I. KITCHEN WASTEWATER PIPING SYSTEM (GREASE LADEN WASTE)

1. PIPE

a. Same as Sanitary Waste Pipe spec

J. STAINLESS-STEEL WATER PIPING

1. Where Building and Plumbing codes allow, the contractor, at their option may substitute stainless steel piping for potable and non potable water services
2. Water piping and components shall comply with NSF 61 Annex G.
3. Pipe in "Stainless-Steel Pipe" Paragraph below is available in NPS 1/8 to NPS 30 (DN 6 to DN 750).

a. Stainless-Steel Pipe: ASTM A 312/A 312M, Schedule 10 and Schedule 40.

b. Stainless-Steel Pipe Fittings: ASTM A 815/A 815M.

c. Appurtenances for Grooved-End, Stainless-Steel Pipe:

4. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Anvil International.

b. Grinnell Mechanical Products.

c. Shurjoint Piping Products.

d. Victaulic Company.

5. Fittings for Grooved-End, Stainless-Steel Pipe: Stainless-steel casting with dimensions matching stainless-steel pipe.
6. Mechanical Couplings for Grooved-End, Stainless-Steel Pipe:

a. AWWA C606 for stainless-steel-pipe dimensions.

b. Stainless-steel housing sections.

c. Stainless-steel bolts and nuts.

d. EPDM-rubber gaskets suitable for hot and cold water.

e. Minimum Pressure Rating:

1) NPS 8 and Smaller: 600 psig.

2) NPS 10 and NPS 12: 400 psig.
3) NPS 14 to NPS 24: 250 psig.

2.2 ENCASEMENT FOR PIPING

A. Standard: ASTM A 674 or AWWA C105/A21.5.

B. Form: Sheet or tube.

C. Color: Black or natural.

2.3 DIELECTRIC FITTINGS

A. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.

B. Dielectric Unions:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   a. A. Y. McDonald Mfg. Co.
   b. Watts; a Watts Water Technologies company.
   c. Wilkins.
   d. Zurn Industries, LLC.
2. Standard: ASSE 1079.
3. Pressure Rating: 125 psig minimum at 180 deg F for low pressure piping and 150 psig 250 psig for high systems where the operating pressure exceeds 150 psig.
4. End Connections: Solder-joint copper alloy and threaded ferrous.

C. Dielectric Flanges:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   a. Watts; a Watts Water Technologies company.
   b. Wilkins.
   c. Zurn Industries, LLC.
2. Standard: ASSE 1079.
3. Factory-fabricated, bolted, companion-flange assembly.
4. Pressure Rating: 125 psig minimum at 180 deg F 150 psig 175 psig 300 psig match system working pressure.
5. End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.

D. Dielectric-Flange Insulating Kits:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Advance Products & Systems, Inc.

b. Calpico, Inc.

c. Central Plastics Company.

d. Pipeline Seal and Insulator, Inc.

2. Non-conducting materials for field assembly of companion flanges.
3. Pressure Rating: 150 psig.
4. Gasket: Neoprene or phenolic.
5. Bolt Sleeves: Phenolic or polyethylene.
6. Washers: Phenolic with steel backing washers.

E. Dielectric Nipples:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Elster Perfection Corporation.

b. Grinnell Mechanical Products.

c. Precision Plumbing Products.

d. Victaulic Company.

2. Standard: IAPMO PS 66.
3. Electroplated steel nipple complying with ASTM F 1545.
4. Pressure Rating and Temperature: 300 psig at 225 deg F.
5. End Connections: Male threaded or grooved.
6. Lining: Inert and noncorrosive, propylene.

PART 3 - EXECUTION

3.1 PIPE SCHEDULE INDEX

SERVICE	CODE	MAXIMUM SERVICE OPERATING LIMITS		PIPE CLASS	PIPE MATERIAL
		(psig)	Temp (°F)		
City or Service Water Entrance Piping	CW	100	250	Water Piping	Type K Copper or DICL
Domestic Cold Water	CW	100	250	Water Piping	Type L Copper
Domestic Hot Water	HW	100	250	Water Piping	Type L Copper
Domestic Hot Water Return	HWR	100	250	Water Piping	Type L Copper
Non-Potable Water	NPW	100	250	Water Piping	Type L Copper
Tepid Water	TW	100	250	Water Piping	Type L Copper
Tepid Water Return	TWR	100	250	Water Piping	Type L Copper
Trap Primer	TP	100	250	Water Piping	Type L Copper
Gas (Natural)	G	50	70	Gas Piping	C. Steel

SERVICE	CODE	MAXIMUM SERVICE OPERATING LIMITS		PIPE CLASS	PIPE MATERIAL
		(psig)	Temp (°F)		
Gas Vent	GV	50	70	Gas Piping	C. Steel
Indirect Waste (above ground)	IW	Gravity	80	Same as sanitary force main	G. Steel Copper
Sleeve for Interior Under-ground Natural Gas Piping	G-S	50	120	Same as sanitary force main	G. Steel
Natural Gas Exterior	G	30	73.4		Polyethylene Corrugated SS PE sleeve
Hot or Cold Potable or non -Potable Water piping for high rise mains	Service labeled	250	180	Water Piping	Stainless Steel with mechanical or weld joints
Rain Leader	RW	Gravity	80	San	Cast Iron
Sanitary Waste & Vent	S, W or V	Gravity	120	San	Cast Iron
Indirect Waste (below ground)	IW	Gravity	80	San	Cast Iron
Force Main (Sanitary Or Storm)	FM	50	120	Force Main	G. Steel Copper
Kitchen Grease Waste Piping	KW	Gravity	120		Cast Iron
Fuel Oil Piping					Refer to spec section 231113 for details

GENERAL PIPE SPEC NOTES:

1. Each valve type shall be the product of a single manufacturer. Each system shall be provided with valves as required by code and shown on the drawings and shall be installed to facilitate operation, replacement and repair.
2. Provide access panels for concealed valves behind non-removable ceilings or walls.
3. Provide shut-off valves on supply piping to individual pieces of equipment.
4. Provide pipe dope, Teflon tape, wax rings, neoprene gaskets and other jointing compounds as required by best standard practice and only on service as recommended by manufacturer.
5. Apply putties and jointing compounds for plumbing fixtures and trim as recommended by manufacturers.
6. Valves on insulated piping systems shall be equipped with extended handles to accommodate insulation thickness.
7. All piping insulation and materials installed in return air plenums shall be plenum rated. Thermoplastic piping systems are hereby prohibited in return air plenums.
8. Piping routed through metal stud or wood stud partitions: provide centering such that piping does not come in contact with metal studs and also protection of piping systems routed horizontally through metal stud or wood stud partitions where the piping crosses a stud. Sleeve type protection shall be used to prevent damage to the lateral piping by the use of screws/nails/fasteners. Provide pre-manufactured products equal to puncture solution, or on site sleeves.

3.2 EARTHWORK

A. Comply with requirements in Division 31 for excavating, trenching, and backfilling.

3.3 GENERAL INSTALLATION REQUIREMENTS

A. Piping Installation

1. Install piping approximately as shown on the drawings and as directed during installation by the General Contractor or the Architect.
2. Piping shall be installed as straight and direct as possible forming right angles or parallel lines with building walls, other piping and neatly spaced.
3. The horizontal runs of piping, except where concealed in partitions, shall be installed as high as possible.

B. Piping or other apparatus shall not be installed in such a manner so as to interfere with the full swing of the doors and access to other equipment.

C. The arrangement, positions and connections of pipes, fixtures, drains, valves, and the like, indicated on the drawings shall be followed as closely as possible, but the right is reserved by the General Contractor or the Architect to change locations and elevations to accommodate the work, without additional compensation for such change.

D. It shall be possible to drain the water from all sections of each cold, and hot water piping system. Pitch piping back to drain valves.

E. Screwed piping of brass or chrome plated brass shall be made up with special care to avoid marring or damaging pipe and fitting exterior and interior surfaces.

F. Screwed pipe and copper tubing shall be reamed smooth before installation.

G. Remove and replace with new materials, any copper or brass piping (chrome plated or unplated) and valves showing visible tool marks.

H. Vertical risers shall be firmly supported by riser clamps, properly installed to relieve all weight from the fittings.

3.4 GRAVITY PIPING INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on coordination drawings.

B. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.

C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

E. Install piping free of sags and bends.

F. Install piping to allow application of insulation.

G. Lay buried building drainage piping beginning at low point of each system. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream. Install required gaskets according to manufacturer's written instructions for use of lubricants,

cements, and other installation requirements. Maintain swab in piping and pull past each joint as completed.

H. Install cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."

I. Install steel piping according to applicable plumbing code.

J. Install stainless-steel piping according to ASME A112.3.1 and applicable plumbing code.

K. Install aboveground copper tubing according to CDA's "Copper Tube Handbook."

L. Install aboveground PVC piping according to ASTM D 2665.

M. Install Underground PVC piping according to ASTM D 2321.

N. Be responsible for checking each pipe for alignment, centerline elevation and invert grade for underground installations.

O. At times when work is not in progress, open ends of pipe and fittings shall be securely closed so that no trench water, earth or other substance will enter the pipe or fittings. Pipe laid through rock excavation shall rest on a six-inch layer of well-compacted sand.

P. The Sanitary (waste and vent), and storm drainage piping three inches and smaller in diameter shall pitch a minimum of 1/4 inch per foot, and piping four inches and larger in diameter shall pitch a minimum of 1/8 inch per foot.

Q. The vent stacks shall be connected as shown and extended through the roof a minimum of 18 inches. Waste and vent pipes shall be concealed unless otherwise noted.

R. Every fixture shall be separately trapped and the traps must be vented unless an approved battery or wet vented system is being installed. Floor drains shall be considered as a fixture.

S. Vents shall be connected to the discharge of each trap in the sanitary system, thence carried individually to a point above the flood level of the fixture before connecting with any other vent pipes. Pitch the branch vents back to the fixtures.

T. The vents passing through the roof shall be a minimum size of four inches in diameter.

U. Cleanouts shall be provided in drainage piping at changes in directions, at foot of stacks or other required points so that all portions of the lines will be readily accessible for cleaning or rodding out.

V. The maximum horizontal distance between cleanouts; in piping four inches in diameter and smaller shall not be more than 50 feet apart; in piping five inches in diameter and larger shall not be more than 100 feet apart.

W. Traps on sanitary piping not integral with fixtures and in accessible locations shall be provided with a brass trap screw protected by the water seal, and will be regarded as a cleanout.

X. Test tees with brass cleanout plugs shall be provided at the foot of all vertical waste and storm drainage stacks and at each floor. Wherever cleanouts on vertical lines occur concealed behind finished walls, they shall be extended to back of finished wall and a wall plate shall be provided.

3.5 SPECIALTY PIPING INSTALLATION

A. Install engineered soil and waste drainage and vent piping systems as follows:
   1. Combination Waste and Vent: Comply with standards of authorities having jurisdiction.
   2. Solvent Drainage System: Comply with ASSE 1043 and solvent fitting manufacturer's written installation instructions.
   3. Reduced-Size Venting: Comply with standards of authorities having jurisdiction.

B. Anchorage shall be provided to restrain drainage piping from axial movement.
   1. For plastic pipe sizes greater than 6 inches, and other pipes sizes greater than 4 inches (102 mm), restraints shall be provided for drain pipes at all changes in direction and at all changes in diameter greater than two pipe sizes. Braces, blocks, rodding, backfill and other methods specified as suitable by the coupling manufacturer shall be utilized
   2. Bases of stacks shall be supported by the building structure, virgin or compacted earth or other material suitable to support the weight of the piping.

C. Expansion joint fittings in drainage pipe.
   1. Expansion joint fittings shall be used only where necessary to provide for expansion and contraction of the pipes. The expansion joint fittings shall be of the typical material suitable for the use with the type of piping which such fittings are installed

D. Install underground, ductile-iron, force-main piping according to AWWA C600. Install buried piping inside building between wall and floor penetrations and connection to sanitary sewer piping outside building with restrained joints. Anchor pipe to wall or floor. Install thrust-block supports at vertical and horizontal offsets.
   1. In all areas with corrosive soil environments, install encasement on piping according to ASTM A 674 or AWWA C105/A 21.5.

E. Install underground, copper, force-main tubing according to CDA's "Copper Tube Handbook."

F. Plumbing Specialties:
   1. Install backwater valves in sanitary waster gravity-flow piping where indicated on the drawings. Comply with requirements for backwater valves specified in Division 22.
   2. Install cleanouts at grade and extend to where building sanitary drains connect to building sanitary sewers in sanitary drainage gravity-flow piping. Install cleanout fitting with closure plug inside the building in sanitary drainage force-main piping. Comply with requirements for cleanouts specified in Division 22.
   3. Install drains in sanitary drainage gravity-flow piping. Comply with requirements for drains specified in Division 22.

G. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

H. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Division 22.

I. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Division 22.

J. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Division 22.

3.6 JOINT CONSTRUCTION (GRAVITY DRAIN STORM AND VENT SYSTEMS)

A. Join hub-and-spigot, cast-iron soil piping with gasket joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for compression joints.

B. Join hub-and-spigot, cast-iron soil piping with calked joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for lead-and-oakum calked joints.

C. Join hubless, cast-iron soil piping according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-piping coupling joints.

D. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
   1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
   2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

E. Join stainless-steel pipe and fittings with gaskets according to ASME A112.3.1.

F. Join copper tube and fittings with soldered joints according to ASTM B 828. Use ASTM B 813, water-flushable, lead-free flux and ASTM B 32, lead-free-alloy solder.

G. Grooved Joints: Cut groove ends of pipe according to AWWA C606. Lubricate and install gasket over ends of pipes or pipe and fitting. Install coupling housing sections, over gasket, with keys seated in piping grooves. Install and tighten housing bolts.

H. Flanged Joints: Align bolt holes. Select appropriate gasket material, size, type, and thickness. Install gasket concentrically positioned. Use suitable lubricants on bolt threads. Torque bolts in cross pattern.

I. Plastic, Non-pressure-Piping, Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:
   1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
   2. ABS Piping: Join according to ASTM D 2235 and ASTM D 2661 Appendixes.
   3. PVC Piping: Join according to ASTM D 2855 and ASTM D 2665 Appendixes.

3.7 PRESSURE PIPING INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of domestic water piping. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on coordination drawings.

B. Install copper tubing under building slab according to CDA's "Copper Tube Handbook."

C. Install ductile-iron piping under building slab with restrained joints according to AWWA C600 and AWWA M41.

D. Install underground copper tube and ductile iron pipe in PE encasement according to ASTM A 674 or AWWA C105/A21.5 when soil is of corrosive nature.

E. Install shutoff valve, hose-end drain valve, strainer, pressure gage, and test tee with valve inside the building at each domestic water-service entrance. Comply with requirements for pressure gages in Division 22 and with requirements for drain valves and strainers in this section for water piping specialties."

F. Install shutoff valve immediately upstream of each dielectric fitting.

G. When water pressure exceeds 80 psig, install water-pressure-reducing valves downstream from shutoff valves.

H. Rough-in domestic water piping for water-meter installation according to utility company's requirements.

I. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.

J. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

K. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal, and coordinate with other services occupying that space.

L. Install piping to permit valve servicing.

M. Install nipples, unions, special fittings, and valves with pressure ratings the same as or higher than the system pressure rating used in applications below unless otherwise indicated.

N. Install piping free of sags and bends.

O. Install fittings for changes in direction and branch connections.

P. Install unions in copper tubing at final connection to each piece of equipment, machine, and specialty.

Q. Install pressure gages on suction and discharge piping for each plumbing pump and packaged booster pump. Comply with requirements for pressure gages in Division 22.

R. Install thermostats in hot-water circulation piping. Comply with requirements for thermostats in Division 22.

S. Install thermometers on inlet and outlet piping from each water heater. Comply with requirements for thermometers in Division 22.

T. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Division 22.

U. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Division 22.

3.8 JOINT CONSTRUCTION (PRESSURE PIPING SYSTEMS)

A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

B. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.

C. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
   1. Apply appropriate tape or thread compound to external pipe threads.
   2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.

D. Brazed Joints for Copper Tubing: Comply with CDA's "Copper Tube Handbook," "Brazed Joints" chapter.

E. Soldered Joints for Copper Tubing: Apply ASTM B 813, water-flushable flux to end of tube. Join copper tube and fittings according to ASTM B 828 or CDA's "Copper Tube Handbook."

F. Pressure-Sealed Joints for Copper Tubing: Join copper tube and pressure-seal fittings with tools recommended by fitting manufacturer.

G. Push-on Joints for Copper Tubing: Clean end of tube. Measure insertion depth with manufacturer's depth gage. Join copper tube and push-on-joint fittings by inserting tube to measured depth.

H. Joint Construction for Grooved-End Copper Tubing: Make joints according to AWWA C606. Roll groove ends of tubes. Lubricate and install gasket over ends of tubes or tube and fitting. Install coupling housing sections over gasket with keys seated in tubing grooves. Install and tighten housing bolts.

I. Joint Construction for Grooved-End, Ductile-Iron Piping: Make joints according to AWWA C606. Cut round-bottom grooves in ends of pipe at gasket-seat dimension required for specified (flexible or rigid) joint. Lubricate and install gasket over ends of pipes or pipe and fitting. Install coupling housing sections over gasket with keys seated in piping grooves. Install and tighten housing bolts.

J. Joint Construction for Grooved-End Steel Piping: Make joints according to AWWA C606. Roll groove ends of pipe as specified. Lubricate and install gasket over ends of pipes or pipe and fitting. Install coupling housing sections over gasket with keys seated in piping grooves. Install and tighten housing bolts.

K. Flanged Joints: Select appropriate asbestos-free, nonmetallic gasket material in size, type, and thickness suitable for domestic water service. Join flanges with gasket and bolts according to ASME B31.9.

L. Joint Construction for Solvent-Cemented Plastic Piping: Clean and dry joining surfaces. Join pipe and fittings according to the following:
   1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements. Apply primer.
   2. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.
   3. PVC Piping: Join according to ASTM D 2855.

M. Joints for Dissimilar-Material Piping: Make joints using adapters compatible with materials of both piping systems.

3.9 NATURAL GAS SYSTEMS

A. All piping shall be cut accurately to measurements obtained at the site and shall be installed without springing or forcing due to inaccurate measurements or improper hanger installation

B. Piping shall be done by licensed gas fitter (as required by Code).

C. Gas piping shall pitch to drain and shall have drip pockets at least 6 inches long with removable caps at low points.

D. Gas Isolation Valves
1. Provide a gas cock valve at each branch run out from main or riser serving gas outlets. This shall include all branches from the gas main and further branches from gas sub-mains. These requirements will be strictly enforced by the local plumbing inspector. This requirement shall take precedent over general arrangement drawings. Therefore the following is called for:
2. Provide a gas shutoff valve at each Tee on both outlets of the Tee in a run of piping
3. Provide a gas shutoff valve at each piece of equipment
4. Gas valves or cocks shall not be concealed and shall be readily accessible for inspection and repair
5. Every branch line from a main shall be furnished with a branch valve (no exceptions) and shall be taken off the top of main using such fittings as may be required by structural obstructions or other installation conditions. All service pipes, fittings, and valves shall be kept at sufficient distance from other work to permit not less than 1 inch between finished coverings on other service piping.

E. Provide union connection between shut-off cock and equipment to permit disconnection of equipment

F. Piping shall be securely fastened, separately hung and shall not support any other weight or piping. Piping dropping in concrete block walls shall be factory wrapped for corrosion protection.

G. Welded piping shall conform to the latest requirements of the STATE Fuel Gas Code.

H. All piping shall be supported independently and securely fastened to the building structure with appropriate anchors and pipe hangers. In general, all lines shall be installed above ceilings in finished spaces.

I. All piping shall be cut true and threaded or welded. Cap all open ends of piping to prevent the entrance of debris when work on this system is complete or the work day has ended.

J. Provide individual vents from regulators, pressure switches and reliefs on factory packaged equipment gas trains at all equipment located on this system. It is this contractor's responsibility to extend all vents to atmosphere terminal at a safe location in conjunction with the fuel gas code.

K. Gas piping and safety devices shall meet requirements of NFPA No. 54 and shall be subject to inspection and approval of State Gas Regulatory Board.

L. Special Note: Provide aluminum check valves on all gas pipes that enter rooms where compressed air is installed or when both compressed air and gas piping connect to the same piece of equipment. This is required in all areas where gas and air are present.

M. All pipes shall be run parallel and graded evenly to low points. A serviceable drip leg of at least six inches in length shall be provided at each low point, at every connection to a piece of equipment, and at the base of each riser.

N. Provide valved pressure gauge assemblies at each main gas service entrance, at each water heater, boiler, emergency or standby generator, incinerators, HVAC rooftop units and all other major pieces of equipment utilizing gas. Each pressure gauge assembly shall be individually valved, include a snubber and shall have a dial range that would locate the system pressure as close to the approximate mid-point on the dial range as possible. Assembly shall be similar to TRERICE Model 760B, 2-1/2 inch diameter gauge, 735-2 valve and 872-1 snubber.

O. Piping system shall be purged with 100 psi compressed air to remove dirt and debris.

P. Pressure test gas piping system with air, carbon dioxide or nitrogen pressure test at not less than 10 psi gage for a period of 24 hours with no decrease in pressure. For welded piping and for piping carrying gas at pressures exceeding 14-inches of water column pressure, the test pressure shall be at least 60 psig for a period of 24 hours with no decrease in pressure. If a decrease in pressure is detected, soap or bubble test joints for leaks, repair or replace as required, and retest.

Q. Gas piping connections to all equipment shall include a gas shutoff valve, drip leg, union fitting and pressure gauge as well as a swing joint consisting of at least two 90 degree elbows at all HVAC equipment

3.10 GAS SERVICE, METER, VENTS AND PIPING

A. Gas meter and piping to meter from gas main will be provided by Gas Company. Pay charges associated with Gas Company installation. Gas piping provided under this Section; shall begin at building side of gas meter.

B. Provide pressure reducing valve between meter and building piping, as required by Gas Company, piped and vented to outside of building.

C. Provide full size isolation valve at the gas meter outlet.

D. Provide an aluminum or plastic valve tag stating the gas pressure downstream of the gas meter.

3.11 TRANSITION FITTING INSTALLATION

A. Install transition couplings at joints of dissimilar piping.

B. Transition Fittings in Underground Domestic Water Piping:
   1. Fittings for NPS 1-1/2 and Smaller: Fitting-type coupling.
   2. Fittings for NPS 2 and Larger: Sleeve-type coupling.

C. Transition Fittings in Aboveground Domestic Water Piping NPS 2 and Smaller: per manufacturers recommendations

3.12 DIELECTRIC FITTING INSTALLATION

A. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.

B. Dielectric Fittings for NPS 2 and Smaller: Use dielectric couplings couplings or nipples nipples unions.

C. Dielectric Fittings for NPS 2-1/2 to NPS 4: Use dielectric flanges flange kits nipples.

D. Dielectric Fittings for NPS 5 and Larger: Use dielectric flange kits.

3.13 EXAMINATION OF VALVES

A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.

B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.

C. Examine threads on valve and mating pipe for form and cleanliness.

D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.

E. Do not attempt to repair defective valves; replace with new valves.

3.14 VALVE INSTALLATION

A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.

B. Locate valves for easy access and provide separate support where necessary.

C. Install valves in horizontal piping with stem at or above center of pipe.

D. Install valves in position to allow full stem movement.

E. Install chainwheels on operators for butterfly and gate valves NPS 4 and larger and more than 96 inches above floor. Extend chains to 60 inches above finished floor.

F. Install check valves for proper direction of flow and as follows:
   1. Swing Check Valves: In horizontal position with hinge pin level.

2. Center-Guided and Plate-Type Check Valves: In horizontal or vertical position, between flanges.
3. Lift Check Valves: With stem upright and plumb.

G. Install valve tags. Comply with requirements in Division 22 for valve tags and schedules.

3.15 FOOD SERVICE EQUIPMENT

A. Provide roughing and final connections for water, waste, kitchen waste, vent and gas systems.

B. Include all necessary appurnatures such as traps, tailpieces, strainers, wheel handle stops, valves, drain cocks, etc. to fixtures and equipment so required

C. Each fixture, appliance or piece of equipment, including work in, under or through tables, cabinets and equipment chases shall be fit with valves and traps

D. Provide miscellaneous equipment connections and indirect drains from service units and similar equipment. Unions or flanged means of disconnect shall be installed at kitchen equipment and at all places where disconnect of piping allows for repair or removal of the equipment.

E. Roughing shall not begin until Architect has approved equipment and fixture shop drawings and a kitchen template is furnished by the pertinent manufacturer.

F. Verify all connection requirements with the architect and kitchen consultant. Each location of service connection shall be obtained prior to roughing such that all work may be installed in a neat and professional manner.

G. Water Hammer Arrestors: an isolation valve shall be installed beneath each absorber. Absorbers shall be sized in accordance with the Plumbing and Drainage Institute Standard PDI-WH-201. Furnish and install shock absorbers at each piece of equipment with quick closing valves including but not limited to:
1. Dishwashers
2. Booster heaters
3. Cold or hot water fill stations with spring loaded manual valves.
4. At all equipment with solenoid shutoff valves

H. Provide isolation or stop valves at all fixture and equipment connections. Valves shall be provided at the equipment. Valves shall be 1/4 turn isolation type stop valves.

I. Provide vacuum breakers on water service lines to booster heaters, garbage disposer, dishwashers, pot washers, as well as at all equipment that has means for a hose connection at the outlet faucet.

J. Provide a backflow device comparable to a Watts SD-3 conforming to ASSE-1022 on the cold water connection to carbonators, beverage dispensers and coffee machines.

K. Provide adjustable pressure reducing valves (PRV's) at all hot water connections to glassware washers, dishwashers, pot washers and other automatic kitchenware wash equipment.

L. Furnish and install approved backflow preventers for all food service equipment including dishwashers, combi-ovens, pot washers, garbage disposers that are not equipped with approved integral backflow devices.

3.16 HANGER AND SUPPORT INSTALLATION

A. Comply with requirements for pipe hanger, support products, and installation in Division 22.
   1. Vertical Piping: MSS Type 8 or 42, clamps.
   2. Individual, Straight, Horizontal Piping Runs:
   3. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
   4. Longer than 100 Feet: MSS Type 43, adjustable roller hangers.
   5. Longer than 100 Feet if Indicated: MSS Type 49, spring cushion rolls.
   6. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
   7. Base of Vertical Piping: MSS Type 52, spring hangers.

B. Support vertical piping and tubing at base and at each floor.

C. Rod diameter may be reduced one size for double-rod hangers, to a minimum of 3/8 inch.

D. Install hangers for cast-iron soil piping per requirements set forth by the Cast Iron Soil Pipe Institute w

E. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:
   1. NPS 3/4 and Smaller: 60 inches with 3/8-inch rod.
   2. NPS 1 and NPS 1-1/4: 72 inches with 3/8-inch rod.
   3. NPS 1-1/2 and NPS 2: 96 inches with 3/8-inch rod.
   4. NPS 2-1/2: 108 inches with 1/2-inch rod.
   5. NPS 3 to NPS 5: 10 feet with 1/2-inch rod.
   6. NPS 6: 10 feet with 5/8-inch rod.
   7. NPS 8: 10 feet with 3/4-inch rod.

F. Install supports for vertical copper tubing every 10 feet.

G. Install hangers for steel piping with the following maximum horizontal spacing and minimum rod diameters:
   1. NPS 1-1/4 and Smaller: 84 inches with 3/8-inch rod.
   2. NPS 1-1/2: 108 inches with 3/8-inch rod.
   3. NPS 2: 10 feet with 3/8-inch rod.
   4. NPS 2-1/2: 11 feet with 1/2-inch rod.
   5. NPS 3 and NPS 3-1/2: 12 feet with 1/2-inch rod.
   6. NPS 4 and NPS 5: 12 feet with 5/8-inch rod.
   7. NPS 6: 12 feet with 3/4-inch rod.
   8. NPS 8 to NPS 12: 12 feet with 7/8-inch rod.

H. Install supports for vertical steel piping every 15 feet.

I. Install hangers for stainless-steel piping with the following maximum horizontal spacing and minimum rod diameters:
   1. NPS 1-1/4 and Smaller: 84 inches with 3/8-inch rod.
   2. NPS 1-1/2: 108 inches with 3/8-inch rod.
   3. NPS 2: 10 feet with 3/8-inch rod.
   4. NPS 2-1/2: 11 feet with 1/2-inch rod.
   5. NPS 3 and NPS 3-1/2: 12 feet with 1/2-inch rod.
   6. NPS 4 and NPS 5: 12 feet with 5/8-inch rod.
   7. NPS 6: 12 feet with 3/4-inch rod.

8. NPS 8 to NPS 12: 12 feet with 7/8-inch rod.

J. Install supports for vertical stainless-steel piping every 15 feet.

K. Install vinyl-coated hangers for CPVC piping with the following maximum horizontal spacing and minimum rod diameters:
1. NPS 1 and Smaller: 36 inches with 3/8-inch rod.
2. NPS 1-1/4 to NPS 2: 48 inches with 3/8-inch rod.
3. NPS 2-1/2 to NPS 3-1/2: 48 inches with 1/2-inch rod.
4. NPS 4 and NPS 5: 48 inches with 5/8-inch rod.
5. NPS 6: 48 inches with 3/4-inch rod.
6. NPS 8: 48 inches with 7/8-inch rod.

L. Install supports for vertical CPVC piping every 60 inches for NPS 1 and smaller, and every 72 inches for NPS 1-1/4 and larger.

M. Install vinyl-coated hangers for PVC piping with the following maximum horizontal spacing and minimum rod diameters:
1. NPS 2 and Smaller: 48 inches with 3/8-inch rod.
2. NPS 2-1/2 to NPS 3-1/2: 48 inches with 1/2-inch rod.
3. NPS 4 and NPS 5: 48 inches with 5/8-inch rod.
4. NPS 6: 48 inches with 3/4-inch rod.
5. NPS 8: 48 inches with 7/8-inch rod.

N. Install supports for vertical PVC piping per manufacturers recommendations.

O. Support piping and tubing not listed in this article according to MSS SP-69 and manufacturer's written instructions.

3.17 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. When installing piping adjacent to equipment and machines, allow space for service and maintenance.

C. Connect domestic water piping to exterior water-service piping. Use transition fitting to join dissimilar piping materials.

D. Connect water piping to water-service piping with shutoff valve; extend and connect to the following:
1. Domestic Water Booster Pumps: Cold-water suction and discharge piping.
2. Water Heaters: Cold-water inlet and hot-water outlet piping in sizes indicated, but not smaller than sizes of water heater connections.
3. Plumbing Fixtures: Cold- and hot-water-supply piping in sizes indicated, but not smaller than that required by plumbing code.
4. Equipment: Cold- and hot-water-supply piping as indicated, but not smaller than equipment connections. Provide shutoff valve and union for each connection. Use flanges instead of unions for NPS 2-1/2 and larger.

3.18 IDENTIFICATION

A. Identify system components. Comply with requirements for identification materials and installation in Division 22.

B. Label pressure piping with system operating pressure.

3.19 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:
   1. Piping Inspections:
      a. Do not enclose, cover, or put piping into operation until it has been inspected and approved by authorities having jurisdiction.
      b. During installation, notify authorities having jurisdiction at least one day before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction:
         1) Roughing-in Inspection: Arrange for inspection of piping before concealing or closing in after roughing in and before setting fixtures.
         2) Final Inspection: Arrange for authorities having jurisdiction to observe tests specified in "Piping Tests" Subparagraph below and to ensure compliance with requirements.
   2. Reinspection: If authorities having jurisdiction find that piping will not pass tests or inspections, make required corrections and arrange for reinspection.
   3. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
   4. Piping Tests:
      a. Fill water piping. Check components to determine that they are not air bound and that piping is full of water.
      b. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit a separate report for each test, complete with diagram of portion of piping tested.
      c. Leave new, altered, extended, or replaced domestic water piping uncovered and unconcealed until it has been tested and approved. Expose work that was covered or concealed before it was tested.
      d. Cap and subject piping to static water pressure of 50 psig above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow it to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
      e. Repair leaks and defects with new materials, and retest piping or portion thereof until satisfactory results are obtained.
      f. Prepare reports for tests and for corrective action required.

B. Domestic water piping will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.

3.20 TESTING AND ADJUSTING - GENERAL

A. Scope
   1. Test and adjust plumbing systems as specified and as required by authorities that have jurisdiction. Perform tests recommended by manufacturers of materials and equipment. This requirement may be waived by Architect.
   2. Testing, balancing, and adjusting shall in no way relieve guarantee requirements.
   3. Furnish instruments, equipment, material, and labor necessary to conduct tests.
   4. All systems shall be thoroughly adjusted for perfect intended operation. All mechanical equipment shall be adjusted for flow, temperature, etc. of fluid. The entire hot water circulation system shall be thoroughly balanced so hot water draw from fixtures shall be as quickly available as possible. Pumps, relief valves and pressure reducing valves shall be adjusted as required by the Engineer. Submit in writing to the Engineer upon completion of this work that it is completed and ready for use.

B. Before date of acceptance, furnish Architect with certificates of testing and inspection indicating approval of authorities having jurisdiction and conformance with requirements of Contract Documents.

C. General
   1. Submit proposed test procedures, recording forms, and test equipment for review before testing.
   2. Notify Architect and authorities involved at least 48 hours before testing and inspection.
   3. Do not paint, cover or conceal work before testing, inspecting and obtaining approval; this includes backfilling and application of insulation.
   4. Costs of repairs and restoration of work of other trades and of existing building surfaces or material damaged during cleaning or testing shall be borne by trade performing cleaning or testing.

D. No tests shall be started until systems have been cleaned as described under Cleaning paragraph. Provide temporary piping and connections for testing, flushing, or draining systems to be tested.
   1. Repair or replace leaks, damage and defects that result from tests to like-new condition. Remove and replace defective materials with acceptable materials.
   2. Piping and joints shall be made tight without caulking. Continue tests until systems operate without adjustments and repair to equipment or piping.
   3. Provide testing instruments, force pumps, gauges, equipment and labor necessary to conduct tests. Instruments used for testing and balancing shall have been calibrated within six months before balancing. Instrument calibration shall be certified.
   4. Submit six copies of complete testing and balancing report to Architect for review.

E. Final test shall be made after vertical and horizontal pipes and roughing-in have been run and before sewer or fixture connection is made.
   1. After soils, wastes, and storm lines, etc. have been installed, outlets shall be temporarily plugged up.
   2. Test piping and check for leakage.
   3. Retesting after leaks are repaired shall be at no additional cost.

F. Pressurized Piping Systems
   1. Leak tests shall be conducted in accordance with ANSI applicable codes and as specified herein.
   2. Test piping of various systems before covered or furred in.

3. Tests shall be witnessed by Architect and pronounced satisfactory before pressure is removed or any water drained off.
4. Equipment shall be valved off or removed during test if equipment pressure rating is less than test pressure.
5. Retest systems after leaks are repaired within Contract Price.

G. Potable Water System Test
1. Certification of the potable water system integrity shall be required where separate systems of potable and non-potable water are provided to supply plumbing fixtures.
2. Fill potable water system to capacity with clean clear water. Introduce water at top of piping system (hot and cold). During filling, introduce green food coloring dye into piping system. A floor-by-floor survey shall be conducted. Operate each outlet (hot and cold) connected to potable water system until coloring has been observed. A method of maintaining the level of water and coloring shall be employed in order to make-up the drawn off amounts. A survey sheet shall indicate each floor and the room number sequentially.
3. This survey is required to be performed after all pressure testing and flushing of the piping system but before sterilization, further it is required that all fixtures connected to the potable water system be installed prior to the test.

H. Examine Part 2 for supplemental testing requirements.

3.21 TESTING: PIPING SYSTEMS

A. General
1. Piping systems shall be subjected to testing water or air as noted and shall hold tight at the pressure head stated for the time interval required without adding air or water. While any system is being tested, required head or pressure shall be maintained until joints are inspected.
2. Tests shall be witnessed by inspector having jurisdiction and the Architect with 48-hour notice given these authorities.
3. Equipment, material and labor required for testing of various systems or part thereof shall be provided by Plumbing Contractor.

B. Sanitary, Other Waste, Vent and Roof Water Conductor Systems
1. Water test shall be applied to drainage systems either in their entirety or in sections as required, after rough piping has been installed.
2. If applied to entire system, openings in piping system shall be tightly closed, except the highest opening, and system filled with water to point of overflow.
3. If system is tested in sections, each opening shall be tightly closed except highest opening in the section under test, and each section shall be filled with water but no section shall be tested with less than a 10 foot head of water.
4. In testing successive sections, at least upper 10 feet of next preceding section shall be tested so that no joint of piping in building, except the uppermost 10 feet of the system shall be submitted to a test of less than a 10 foot head of water.
5. Water shall be kept in system for at least 30 minutes before inspection starts; the system shall then be made tight at all points.
6. Points of drainage systems tested with air instead of water shall be tested by attaching an air compressor testing apparatus to suitable opening and, after closing all other inlets or outlets, forcing air into systems until a uniform gauge pressure of 5 psi or sufficient pressure to balance a column of mercury 10 inches high. Pressure shall be held without introduction of additional air for a period of at least 15 minutes.

C. Water Piping Systems
1. Upon completion of water supply systems or section thereof, as required, system shall be tested and proved tight under 1.5 times the operating system pressure and a minimum of 150 psi. Gauge shall be located on lowest new floor and pressure shall hold for a period of one hour without introducing additional water. Water used for testing shall be from a potable source of supply.
2. Filtered water piping system shall be tested with filtered or distilled water to a pressure of 100 psi for one hour.

D. Natural Gas Piping Systems
1. Upon completion of gas piping system or section thereof, as required, test by attaching an air compressor testing apparatus to any suitable opening and, after closing all other inlets or outlets, force air into the system until a uniform pressure of at least 10 inches mercury or 3 lb. gauge for a period of no less than 60 minutes for each 500 cubic feet of pipe volume without showing any drop in pressure. Pressure shall be measured with a mercury manometer, slope gauge, or an equivalent device calibrated to read in increments of no greater than 1/10 lbs.
2. Test all elevated pressure gas piping at 15 psi for 24 hours. Pressure shall be measured with a mercury manometer, slope gauge, or an equivalent device calibrated to read in increments of no greater than 1/10 lbs.

E. Testing Summary

System	Test Medium	Test Pressure	Test Duration
Drainage and Vent (All Systems)	Water	10 feet	30 minutes
Water (All Systems)	Water	150 psig min or 1.5 operating pressure	1 hour
Natural Gas (High Pressure)	Air	15 psig min or 1.5 operating pressure	24 hours
Natural Gas (Low Pressure)	Air	10 inch mercury minimum for each 500 cubic feet of pipe volume	1 hour
Thermoplastic Piping	Water No air	1.5 operating pressure and manufacturers recommendation	1 hour
Ejector Discharge/Pumped Piping System	Water	50 psig min. or 1.5 times system pressure	1 hour

F. Defective Work: If inspection or tests show defects, such defective work or material shall be replaced and inspection and tests shall be repeated. Repairs to piping shall be made with new material. No caulking of screwed joints or holes shall be acceptable.

G. Additional Tests
1. Provide additional tests such as smoke pressure tests as required by regulations or as directed by authorities making the inspection.
2. Provide for any repeated test as directed by the Architect, to make all systems tight as required.
3. Visual inspections of joints and valves shall be made as directed by the Architect.

3.22 ADJUSTING

A. Perform the following adjustments before operation:
1. Close drain valves, hydrants, and hose bibbs.
2. Open shutoff valves to fully open position.
3. Open throttling valves to proper setting.
4. Adjust balancing valves in hot-water-circulation return piping to provide adequate flow.
5. Manually adjust ball-type balancing valves in hot-water-circulation return piping to provide hot-water flow in each branch.
6. Adjust calibrated balancing valves to flows indicated.
7. Remove plugs used during testing of piping and for temporary sealing of piping during installation.
8. Remove and clean strainer screens. Close drain valves and replace drain plugs.
9. Remove filter cartridges from housings and verify that cartridges are as specified for application where used and are clean and ready for use.
10. Check plumbing specialties and verify proper settings, adjustments, and operation.

3.23 BALANCING OF HOT WATER SYSTEMS

A. Building Distribution System
1. Al circuits and sub circuits shall be flow and temperature balanced such that hot water positive flow is achieved in each branch circuit of the building hot water systems
2. See drawing detail sheets and specification section pipe table A10 for flow and balancing valve spec options. The specified products indicate either integral flow or flow/temperature balancing devices, assure the installed devices meet these specifications
3. Indicate on a riser diagram the type of balancing device use, method of calibration and proposed flow in each branch circuit of the hot water piping network for each hot water system

B. Building Main Hot Water Distribution Pumps
1. Balance flows to the main Thermostatic Hot Water Mixing Valves according to manufacturer’s instructions
2. Provide plastic tags on each circuit indicating the flow and balancing valve position to the Mixing valves and then to the water heaters

C. Submissions
1. Submit a report indicating the actual flow and temperature in each circuit described in item C above. The report shall designate the following:
2. Time to achieve hot water at the remote hot water faucet in the circuit
3. Hot water temperature achieved
4. Setting on circuit setter
5. For the circuits at the outlets of hot water circulation pumps, indicate the following:
6. The actual flow and temperature into Temperature Mixing Valve
7. The actual flow and temperature back to the heaters and/or storage tanks

3.24 CLEANING

A. Clean and disinfect potable domestic water piping as follows:

1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.
2. Use purging and disinfecting procedures prescribed by authorities having jurisdiction; if methods are not prescribed, use procedures described in either AWWA C651 or AWWA C652 or follow procedures described below:
3. Flush piping system with clean, potable water until dirty water does not appear at outlets.
4. Fill and isolate system according to either of the following:
    a. Fill system or part thereof with water/chlorine solution with at least 50 ppm of chlorine. Isolate with valves and allow to stand for 24 hours.
    b. Fill system or part thereof with water/chlorine solution with at least 200 ppm of chlorine. Isolate and allow to stand for three hours.
5. Flush system with clean, potable water until no chlorine is in water coming from system after the standing time.
6. Repeat procedures if biological examination shows contamination.
7. Submit water samples in sterile bottles to authorities having jurisdiction.

B. Clean non-potable domestic water piping as follows:
1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.
2. Use purging procedures prescribed by authorities having jurisdiction or; if methods are not prescribed, follow procedures described below:
3. Flush piping system with clean, potable water until dirty water does not appear at outlets.
4. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedures if biological examination shows contamination.

C. Prepare and submit reports of purging and disinfecting activities. Include copies of water-sample approvals from authorities having jurisdiction.

D. Clean interior of domestic water piping system. Remove dirt and debris as work progresses.

END OF SECTION

SECTION 221113 - FACILITY WATER DISTRIBUTION PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes:

1. Copper tube and fittings
2. Ductile iron pipe and fittings
3. Special pipe fittings
4. Joining materials
5. Piping specialties
6. Gate valves
7. Gate valve accessories and specialties

1.3 DEFINITIONS

A. EPDM: Ethylene propylene diene terpolymer rubber.

B. LLDPE: Linear, low-density polyethylene plastic.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: For piping and specialties including relation to other services in same area, drawn to scale. Show piping and specialty sizes and valves, meter and specialty locations, and elevations.

B. Field quality-control test reports.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For water valves and specialties to include in emergency, operation, and maintenance manuals.

1.7 QUALITY ASSURANCE

A. Regulatory Requirements:

1. Comply with requirements of utility company supplying water.
2. Comply with standards of authorities having jurisdiction for potable-water-service piping, including materials, installation, testing, and disinfection.

B. Piping materials shall bear label, stamp, or other markings of specified testing agency.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

D. NSF Compliance:

1. Comply with NSF 61 Annex G for materials for water-service piping and specialties for domestic water.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Preparation for Transport: Prepare valves, , according to the following:

1. Ensure that valves are dry and internally protected against rust and corrosion.
2. Protect valves against damage to threaded ends and flange faces.
3. Set valves in best position for handling. Set valves closed to prevent rattling.

B. During Storage: Use precautions for valves, including fire hydrants, according to the following:

1. Do not remove end protectors unless necessary for inspection; then reinstall for storage.
2. Protect from weather. Store indoors and maintain temperature higher than ambient dew-point temperature. Support off the ground or pavement in watertight enclosures when outdoor storage is necessary.

C. Handling: Use sling to handle valves if size requires handling by crane or lift. Rig valves to avoid damage to exposed parts. Do not use hand wheels or stems as lifting or rigging points.

D. Deliver piping with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe-end damage and to prevent entrance of dirt, debris, and moisture.

E. Protect stored piping from moisture and dirt. Elevate above grade. Do not exceed structural capacity of floor when storing inside.

F. Protect flanges, fittings, and specialties from moisture and dirt.

1.9 PROJECT CONDITIONS

A. Interruption of Existing Water-Distribution Service: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary water-distribution service according to requirements indicated:

1. Notify Owner no fewer than five business days in advance of proposed interruption of service.
2. Do not proceed with interruption of water-distribution service without Owner's written permission.

1.10 COORDINATION

A. Coordinate connection to water main with utility company.

PART 2 - PRODUCTS

2.1 COPPER TUBE AND FITTINGS

A. Soft Copper Tube: ASTM B 88, Type K, water tube, annealed temper.

B. Hard Copper Tube: ASTM B 88, Type K, water tube, drawn temper.

1. Copper, Solder-Joint Fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought-copper, solder-joint pressure type. Furnish only wrought-copper fittings if indicated.
2. Copper: Silver brazed joints
3. Copper: Ground joint
4. No mechanical joints allowed

C. Bronze Flanges: ASME B16.24, Class 150, with solder-joint end. Furnish Class 300 flanges if required to match piping.

D. Copper Unions: MSS SP-123, cast-copper-alloy, hexagonal-stock body with ball-and-socket, metal-to-metal seating surfaces, and solder-joint or threaded ends.

2.2 DUCTILE-IRON PIPE AND FITTINGS

A. Mechanical-Joint, Ductile-Iron Pipe: AWWA C151, with mechanical-joint bell and plain spigot end unless grooved or flanged ends are indicated.

B. The pipe or fitting exterior shall be coated with a bituminous coating in accordance with AWWA standard C151. The pipe and fitting interior shall be cement-mortar lined and seal coated in compliance with the latest revision of AWWA standard C104.

1. Mechanical-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.
2. Glands, Gaskets, and Bolts: AWWA C111, ductile- or gray-iron glands, rubber gaskets, and steel bolts.

C. Push-on-Joint, Ductile-Iron Pipe: AWWA C151, with push-on-joint bell and plain spigot end unless grooved or flanged ends are indicated.

1. Push-on-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.
2. Gaskets: AWWA C111, rubber.

D. Grooved-Joint, Ductile-Iron Pipe: AWWA C151, with cut, rounded-grooved ends.

1. Grooved-End, Ductile-Iron Pipe Appurtenances:

a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1) Anvil International.

2) Smith-Cooper International.

3) Victaulic Company.

b. Grooved-End, Ductile-Iron Fittings: ASTM A 47/A 47M, malleable-iron castings or ASTM A 536, ductile-iron castings with dimensions matching pipe.
c. Grooved-End, Ductile-Iron-Piping Couplings: AWWA C606, for ductile-iron-pipe dimensions. Include ferrous housing sections, gasket suitable for water, and bolts and nuts.

E. Flanges: ASME 16.1, Class 125, cast iron.

2.3 SPECIAL PIPE FITTINGS

A. Ductile-Iron Deflection Fittings:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Dresser Mfg.

b. EBAA Iron, Inc.

c. Anvil International

2. Description: Compound, ductile-iron coupling fitting with sleeve and one or two flexing sections for up to 15-degree deflection, gaskets, and restrained-joint ends complying with AWWA C110 or AWWA C153. Include AWWA C111, ductile-iron glands, rubber gaskets, and steel bolts.

    a. Pressure Rating: 250 psig minimum.

2.4 JOINING MATERIALS

A. Refer to Division 33 for commonly used joining materials.

B. Brazing Filler Metals: AWS A5.8, BCuP Series.

2.5 PIPING SPECIALTIES

A. Transition Fittings: Manufactured fitting or coupling same size as, with pressure rating at least equal to and ends compatible with, piping to be joined.

B. Tubular-Sleeve Pipe Couplings:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

    a. Cascade Waterworks Mfg. Co.

    b. Dresser, Inc.

    c. Hays Fluid Controls.

    d. JCM Industries, Inc.

    e. Smith-Blair, Inc.

2. Description: Metal, bolted, sleeve-type, reducing or transition coupling, with center sleeve, gaskets, end rings, and bolt fasteners and with ends of same sizes as piping to be joined.

    a. Standard: AWWA C219.
    b. Center-Sleeve Material: Manufacturer's standard.
    c. Gasket Material: Natural or synthetic rubber.
    d. Pressure Rating: 200 psig minimum.
    e. Metal Component Finish: Corrosion-resistant coating or material.

C. Split-Sleeve Pipe Couplings:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

    a. Victaulic Company.

2. Description: Metal, bolted, split-sleeve-type, reducing or transition coupling with sealing pad and closure plates, O-ring gaskets, and bolt fasteners.

    a. Standard: AWWA C219.
    b. Sleeve Material: Manufacturer's standard.
    c. Sleeve Dimensions: Of thickness and width required to provide pressure rating.
    d. Gasket Material: O-rings made of EPDM rubber, unless otherwise indicated.
    e. Pressure Rating: 200 psig minimum.
    f. Metal Component Finish: Corrosion-resistant coating or material.

D. Flexible Connectors:

1. Nonferrous-Metal Piping: Bronze hose covered with bronze wire braid; with copper-tube, pressure-type, solder-joint ends or bronze flanged ends brazed to hose.
2. Ferrous-Metal Piping: Stainless-steel hose covered with stainless-steel wire braid; with ASME B1.20.1, threaded steel pipe nipples or ASME B16.5, steel pipe flanges welded to hose.

E. Dielectric Fittings:

1. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.
2. Dielectric Unions:

    a. Description:

        1) Standard: ASSE 1079.
        2) Pressure Rating: 250 psig.
        3) End Connections: Solder-joint copper alloy and threaded ferrous.

3. Dielectric Flanges:

    a. Description:

        1) Standard: ASSE 1079.
        2) Factory-fabricated, bolted, companion-flange assembly.
        3) Pressure Rating: 300 psig.
        4) End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.

4. Dielectric-Flange Insulating Kits:

    a. Description:

        1) Non-conducting materials for field assembly of companion flanges.
        2) Pressure Rating: 150 psig.
        3) Gasket: Neoprene or phenolic.
        4) Bolt Sleeves: Phenolic or polyethylene.
        5) Washers: Phenolic with steel backing washers.

5. Dielectric Nipples:

a. Description:

1) Standard: IAPMO PS 66
2) Electroplated steel nipple, complying with ASTM F 1545.
3) Pressure Rating: 300 psig at 225 deg F.
4) End Connections: Male threaded or grooved.
5) Lining: Inert and noncorrosive, propylene.

2.6 GATE VALVES

A. AWWA, Cast-Iron Gate Valves:

1. Manufacturers: Subject to compliance with requirements, **available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following**:

a. Clow Valve Company; a subsidiary of McWane, Inc.
b. Kennedy Valve Company; a division of McWane, Inc.
c. Mueller Co.
d. NIBCO INC.
e. Zurn Industries, LLC.

2. Non-rising Stem, Resilient-Seated Gate Valves:

a. Description: Gray- or ductile-iron body and bonnet; with bronze or gray- or ductile-iron gate, resilient seats, bronze stem, and stem nut.

1) Standard: AWWA C509.
2) Minimum Pressure Rating: 200 psig.
3) End Connections: Mechanical joint.
4) Interior Coating: Complying with AWWA C550.

3. Non-rising Stem, High-Pressure, Resilient-Seated Gate Valves:

a. Description: Ductile-iron body and bonnet; with bronze or ductile-iron gate, resilient seats, bronze stem, and stem nut.

1) Standard: AWWA C509.
2) Minimum Pressure Rating: 250 psig.
3) End Connections: Push on or mechanical joint.
4) Interior Coating: Complying with AWWA C550.

4. OS&Y, Rising-Stem, Resilient-Seated Gate Valves:

a. Description: Cast- or ductile-iron body and bonnet, with bronze or gray- or ductile-iron gate, resilient seats, and bronze stem.

1) Standard: AWWA C509.
2) Minimum Pressure Rating: 200 psig.
3) End Connections: Flanged.

2.7 GATE VALVE ACCESSORIES AND SPECIALTIES

A. Valve Boxes: Comply with AWWA M44 for cast-iron valve boxes. Include top section, adjustable extension of length required for depth of burial of valve, plug with lettering "WATER," and bottom section with base that fits over valve and with a barrel approximately 5 inches in diameter.

1. Operating Wrenches: Steel, tee-handle with one pointed end, stem of length to operate deepest buried valve, and socket matching valve operating nut.

B. Indicator Posts: UL 789, FMG-approved, vertical-type, cast-iron body with operating wrench, extension rod, and adjustable cast-iron barrel of length required for depth of burial of valve.

PART 3 - EXECUTION

3.1 EARTHWORK

A. Refer to Division 31 for excavating, trenching, and backfilling.

3.2 PIPING APPLICATIONS

A. General: Use pipe, fittings, and joining methods for piping systems according to the following applications.

B. Transition couplings and special fittings with pressure ratings at least equal to piping pressure rating may be used, unless otherwise indicated.

C. Do not use flanges or unions for underground piping.

D. Underground water-service piping NPS 3/4 to NPS 3 shall be any of the following:

1. Soft copper tube, ASTM B 88, Type K; wrought-copper, solder-joint fittings; and brazed copper, pressure-seal fittings; and pressure-sealed joints.

E. Underground water-service piping NPS 4 to NPS 8 shall be any of the following:

1. Ductile-iron, push-on-joint pipe; ductile-iron, push-on-joint fittings; and gasketed joints.

F. Underground Combined Water-Service NPS 6 to NPS 12 shall be any of the following:

1. Ductile-iron, push-on-joint pipe; ductile-iron, push-on-joint fittings; and gasketed mechanical-joint pipe; ductile-iron, mechanical-joint fittings; and mechanical joints.

3.3 PIPING SYSTEMS - COMMON REQUIREMENTS

A. See Division 33 for piping-system common requirements.

3.4 PIPING INSTALLATION

A. Water-Main Connection: Arrange with utility company for tap of size and in location indicated in water main.

B. Water-Main Connection: Connect to the Site Utility Piping according to requirements of water utility company and of size and in location indicated.

C. Install ductile-iron, water-service piping according to AWWA C600 and AWWA M41.

D. Bury piping with depth of cover over top, with top at least 12 inches below level of maximum frost penetration, and according to the following:

1. Under Driveways: With at least 36 inches cover over top.
2. In Loose Gravelly Soil and Rock: With at least 12 inches additional cover.

E. Extend water-service piping and connect to water-supply source and building-water-piping systems at outside face of building wall where Site Utility Water Service ends.

1. Terminate water-service piping from the point where site utility piping ends to a point inside the building wall until building-water-piping systems are installed. Terminate piping with caps, plugs, or flanges as required for piping material. Make connections to building-water-piping systems when those systems are installed.

F. Sleeves are specified in Division 22.

G. Mechanical sleeve seals are specified in Division 22.

H. Install underground piping with restrained joints at horizontal and vertical changes in direction. Use restrained-joint piping, thrust blocks, anchors, tie-rods and clamps, and other supports.

3.5 JOINT CONSTRUCTION

A. See Division 33 for basic piping joint construction.

B. Make pipe joints according to the following:

1. Copper-Tubing, Pressure-Sealed Joints: Use proprietary crimping tool and procedure recommended by copper, pressure-seal-fitting manufacturer.
2. Ductile-Iron Piping, Gasketed Joints for Water-Service Piping: AWWA C600 and AWWA M41.
3. Ductile-Iron Piping, Gasketed Joints for Fire-Service-Main Piping: UL 194.
4. Ductile-Iron Piping, Grooved Joints: Cut-groove pipe. Assemble joints with grooved-end, ductile-iron-piping couplings, gaskets, lubricant, and bolts according to coupling manufacturer's written instructions.
5. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.

a. Dielectric Fittings for NPS 2 and Smaller: Use dielectric nipples unions.
b. Dielectric Fittings for NPS 2-1/2 to NPS 4: Use dielectric flanges flange kits nipples.
c. Dielectric Fittings for NPS 5 and Larger: Use dielectric flange kits.

3.6 ANCHORAGE INSTALLATION

A. Anchorage, General: Install water-distribution piping with restrained joints. Anchorages and restrained-joint types that may be used include the following:

1. Locking mechanical joints.
2. Set-screw mechanical retainer glands.
3. Bolted flanged joints.
4. Heat-fused joints.
5. Pipe clamps and tie rods.
6. Concrete thrust blocks are to be used in addition to mechanical restrained joints where 90 degree offsets are made and at back of tees.

B. Install anchorages for tees, plugs and caps, bends, crosses, valves, and hydrant branches. Include anchorages for the following piping systems:

1. Gasketed-Joint, Ductile-Iron, Water-Service Piping: According to AWWA C600.

C. Apply full coat of asphalt or other acceptable corrosion-resistant material to surfaces of installed ferrous anchorage devices.

3.7 CONNECTIONS

A. See Division 33 for piping connections to valves and equipment.

B. Connect water-distribution piping to interior domestic water piping.

C. Ground equipment according to Division 26.

D. Connect wiring according to Division 26.

3.8 FIELD QUALITY CONTROL

A. Piping Tests: Conduct piping tests before joints are covered and after concrete thrust blocks have hardened sufficiently. Fill pipeline 24 hours before testing and apply test pressure to stabilize system. Use only potable water.

B. Hydrostatic Tests: Test at not less than one-and-one-half times working pressure for two hours.

1. Increase pressure in 50-psig increments and inspect each joint between increments. Hold at test pressure for 1 hour; decrease to 0 psig. Slowly increase again to test pressure and hold for 1 more hour. Maximum allowable leakage is 2 quarts per hour per 100 joints. Remake leaking joints with new materials and repeat test until leakage is within allowed limits.

C. Prepare reports of testing activities.

3.9 IDENTIFICATION

A. Install continuous underground detectable warning tape during backfilling of trench for underground water-distribution piping. Locate below finished grade, directly over piping. Underground warning tapes are specified in Division 31.

B. Permanently attach equipment nameplate or marker indicating plastic water-service piping, on main electrical meter panel. See Division 33 for identifying devices.

3.10 CLEANING

1. Use purging and disinfecting procedure prescribed by authorities having jurisdiction or, if method is not prescribed by authorities having jurisdiction, use procedure described in AWWA C651 or do as follows:

    a. Fill system or part of system with water/chlorine solution containing at least 50 ppm of chlorine; isolate and allow to stand for 24 hours.

    ****** OR ******

    b. Drain system or part of system of previous solution and refill with water/chlorine solution containing at least 200 ppm of chlorine; isolate and allow to stand for 3 hours.
    c. After standing time, flush system with clean, potable water until no chlorine remains in water coming from system.
    d. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedure if biological examination shows evidence of contamination.

B. Prepare reports of purging and disinfecting activities.

END OF SECTION

SECTION 221119 - WATER PIPING SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. General Requirements
2. Performance Requirements
3. Vacuum breakers.
4. Backflow preventers.
5. Water pressure-reducing valves.
6. Central digital thermostatic water mixing valves
7. Strainers.
8. Hose stations.
9. Hose bibbs.
10. Wall hydrants.
11. Drain valves.
12. Water-hammer arresters.
13. Air vents.
14. Trap-seal primer valves.
15. Trap-seal primer systems.
16. Flexible connectors.

B. All pipe, fittings, and valves used in this distribution system and installed after January 4, 2014 must comply with the new Federal Mandate known as the “Reduction of Lead in Drinking Water Act-2014”. Any product pipe, fittings or valve installed after the enactment date that does not comply, shall be removed and changed by this contractor at Contractor expense to comply with the Federal Law

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For domestic water piping specialties.
1. Include diagrams for power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For domestic water piping specialties to include in emergency, operation, and maintenance manuals.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR PIPING SPECIALTIES

A. All pipe, fittings, and valves used in this distribution system and installed after January 4, 2014 must comply with the new Federal Mandate known as the “Reduction of Lead in Drinking Water Act-2014”. Therefore, after the enactment date of 1/4/14, all products installed must comply. Any product pipe, fittings, valve, or specialty item installed after the enactment date that does not comply, shall be removed and changed by this contractor at his/her own expense to comply with the Federal Law

B. Potable-water piping and components shall comply with NSF 61 Annex G and NSF 14.

2.2 PERFORMANCE REQUIREMENTS

A. Minimum Working Pressure for Water Piping Specialties: 150 psig unless otherwise indicated.
1. Note: in all areas where pressures exceed 150 psig, use class 250 pipe, fittings and valves.

2.3 VACUUM BREAKERS

A. Pipe-Applied, Atmospheric-Type Vacuum Breakers: TAG # AVB
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    a. Ames Co.
    b. Cash Acme.
    c. Conbraco Industries, Inc.
    d. FEBCO.
    e. Watts; a Watts Water Technologies company.

f. Zurn Industries, LLC.

2. Standard: ASSE 1001.
3. Size: NPS 1/4 to NPS 3, as required to match connected piping.
4. Body: Bronze.
5. Inlet and Outlet Connections: Threaded.
6. Finish: Rough bronze.
7. Basis of Design for Cold Water: Watts LF288A, Cash Acme V101.
8. Basis of Design for Hot Water: Cash Acme V101.

B. Hose-Connection Vacuum Breakers : TAG # HCVB

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

   a. Cash Acme.

   b. Conbraco Industries, Inc.

   c. Watts; a Watts Water Technologies company.

   d. Woodford Manufacturing Company.

   e. Zurn Industries, LLC.
2. Standard: ASSE 1011.
3. Body: Bronze, non-removable, with manual drain.
4. Outlet Connection: Garden-hose threaded complying with ASME B1.20.7.
5. Finish: Chrome or nickel plated Rough bronze. Match finish of HB
6. Basis of Design: Cash Acme VB-222.

C. Pressure Vacuum Breakers: TAG # PVB

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

   a. Ames Co.

   b. Conbraco Industries, Inc.

   c. FEBCO.

   d. Watts; a Watts Water Technologies company.

   e. Zurn Industries, LLC.
2. Standard: ASSE 1020.
3. Operation: Continuous-pressure applications.
4. Pressure Loss: 5 psig maximum, through middle third of flow range.
5. Accessories:

   a. Valves: Ball type, on inlet
6. Basis of Design Cold Water: Watts series LF800M4QT
7. Basis of Design Hot Water: Cash Acme PVB
8. Basis of Design Freeze Proof Cold Water: Watts series 800M4FR

D. Laboratory-Faucet Vacuum Breakers :
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   a. Conbraco Industries, Inc.
   b. Watts; a Watts Water Technologies company.
   c. Woodford Manufacturing Company.
   d. Zurn Industries, LLC.
2. Standard: ASSE 1035.
3. Size: NPS 1/4 or NPS 3/8 matching faucet size.
4. Body: Bronze.
5. End Connections: Threaded.
6. Finish: Chrome plated.
7. Basis of Design: Zurn model 730 and 735, Watts LFNLF-9

E. Spill-Resistant Vacuum Breakers :
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   a. Conbraco Industries, Inc.
   b. Watts; a Watts Water Technologies company.
   c. Zurn Industries, LLC.
2. Standard: ASSE 1056.
3. Operation: Continuous-pressure applications.
4. Size: NPS 1/4 NPS 3/8 NPS 1/2 NPS 3/4 NPS 1.
5. Accessories:
   a. Valves: Ball type, on inlet and outlet.
6. Basis of Design: Zurn Model 460, Watts LF008PCQT

2.4 BACKFLOW PREVENTERS

A. Reduced-Pressure-Principle Backflow Preventers:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Ames Co.
   b. Conbraco Industries, Inc.
   c. FEBCO.
   d. Watts; a Watts Water Technologies company.

e. Zurn Industries, LLC.

2. Standard: ASSE 1013.
3. Operation: Continuous-pressure applications.
4. Pressure Loss: 8 PSIG maximum, through middle third of flow range.
5. Body: Bronze for NPS 2 and smaller; steel with interior lining that complies with AWWA C550 or that is FDA approved or stainless steel for NPS 2-1/2 and larger.
6. End Connections: Threaded for NPS 2 and smaller; flanged or mechanical for NPS 2-1/2 and larger.
7. Configuration: Designed for horizontal, straight-through flow.
8. Accessories:

   a. Valves NPS 2 and Smaller: Ball type with threaded ends on inlet and outlet.
   b. Valves NPS 2-1/2 and Larger: Outside-screw and yoke-gate type with flanged ends on inlet and outlet.
   c. Air-Gap Fitting: ASME A112.1.2, matching backflow-preventer connection.
9. Basis of Design: Watts 957, Watts 009-QT-S
10. Basis of Design: Special Flow Patterns: Febco 825YA, Febco 880V

B. Backflow Preventer Anti-flood Device
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

      a. FEBCO.

      b. Watts; a Watts Water Technologies company.

      c. Cla-Val.
   2. The Flood Protection Shutdown Valve shall be a normally open Diaphragm Valve installed upstream of the Reduced Pressure Zone Backflow Assembly, and automatically close if the RPZ relief valve begins to discharge. A Time Delay supplied in the JB113 Junction Box shall prevent the valve from closing on intermittent discharges from the RPZ relief valve. If continuous Relief Valve discharge occurs, the FS99 Flow Sensor installed horizontally in the RPZ Relief Valve discharge piping shall send a signal to the JB113 Junction Box energizing Solenoid to close the main valve. Once closed the Flood Protection Shutdown Valve must be manually reset.
   3. The JB113 Junction Box shall be valve mounted with the Solenoid pre-wired. The FS99 Flow Sensor shall be provided with the valve package and shall be field installed in a horizontal position in the RPZ Relief Valve discharge piping. Vertical installation of the Flow Sensor shall not be acceptable. The valve shall be equipped with a Limit Switch to provide local visual and remote electrical indication of valve closure.
   4. The Reduced Pressure Zone Backflow Assembly, Flood Protection Shutdown Valve, JB113 Junction Box and FS99 Flow Sensor shall be provided by the same manufacturer and be covered by a single warranty policy.
   5. The main valve shall be a hydraulically operated, single diaphragm actuated, globe or angle pattern valve. Y-pattern valves shall not be permitted. The valve shall contain a disc and diaphragm assembly that forms a sealed chamber below the valve cover, separating operating pressure from line pressure. The diaphragm shall be constructed of nylon reinforced Buna-N, and shall not seal directly against the valve seat and shall be fully supported by the valve body and cover. Rolling diaphragm construction will not be allowed and there shall be no pistons operating the main valve or any pilot controls.
   6. The main valve body and cover shall be Ductile Iron ASTM A536, and all internal cast components shall be Ductile Iron or CF8M (316) Stainless Steel. All Ductile Iron components, including the body and cover, shall be lined and coated with an NSF 61 Certified Epoxy Coating applied by the electrostatic heat fusion process. All main valve

throttling components (valve seat and disc guide) shall be Stainless Steel. The valve body and cover must be machined with a 360-degree locating lip to assure proper alignment.

7. The disc and diaphragm assembly shall contain a Buna-N synthetic rubber “Quad Seal” that is securely retained on 3-1/2 sides by a disc retainer and disc guide. Diaphragm assemblies utilizing bolts or cap screws for component retention will not be permitted. Direction of flow through the valve shall be the over-the-disc design, causing the valve to close upon diaphragm failure.
8. The exposed portion of the Quad Seal shall contact the valve seat and seal drip-tight. The disc and diaphragm assembly must be guided by two separate bearings, one installed in the valve cover and one concentrically located within the valve seat, to avoid deflection and assure positive disc-to-seat contact. Center guided valves will not be permitted. The main valve stem shall be Xylan coated to avoid the effects of mineral or hard water build-up. The main valve spring shall be the manufacturer’s heavy or extra heavy spring design. All necessary repairs shall be made from the top of the valve while the body remains in line.
9. The Pilot Control System shall contain a Flo-Clean Strainer, 3-Way Accelerator, NEMA 4, 120 VAC 60HZ 3-Way Solenoid with Manual Operator, Manual Reset Ball Valve, Pressure Gauge, separate Adjustable Opening and Closing Speed Controls, Single Limit Switch, JB113 Junction Box and Isolation Ball Valves on all body connections. The JB113 Junction Box shall be valve mounted and the FS99 Flow Sensor shall be field installed.
10. Accessories:

    a. Valves NPS 2 and Smaller: Ball type with threaded ends on inlet and outlet.
    b. Valves NPS 2-1/2 and Larger: Flanged ends on inlet and outlet.
11. Basis of design: Watts Model 113-6RFP (globe) or 1113-6RFP (angle) Flood

C. Double-Check, Backflow-Prevention Assemblies: TAG# DCVA
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

    a. Ames Co.

    b. Conbraco Industries, Inc.

    c. FEBCO.

    d. Watts; a Watts Water Technologies company.

    e. Zurn Industries, LLC.
2. Standard: ASSE 1015.
3. Operation: Continuous-pressure applications unless otherwise indicated.
4. Pressure Loss: 5 psig maximum, through middle third of flow range.
5. Body: Bronze for NPS 2 and smaller; steel with interior lining that complies with AWWA C550 or that is FDA approved or stainless steel for NPS 2-1/2 and larger.
6. End Connections: Threaded for NPS 2 and smaller; flanged or mechanical for NPS 2-1/2 and larger.
7. Configuration: Designed for horizontal, straight-through flow.
8. Accessories:

    a. Valves NPS 2 and Smaller: Ball type with threaded ends on inlet and outlet.

b. Valves NPS 2-1/2 and Larger: Outside-screw and yoke-gate type with flanged ends on inlet and outlet.

9. Basis of Design: Watts 757. Watts LF007

D. Hose-Connection Backflow Preventers:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

   a. Conbraco Industries, Inc.

   b. Watts; a Watts Water Technologies company.

   c. Woodford Manufacturing Company.

2. Standard: ASSE 1052.
3. Operation: Up to 10-foot head of water back pressure.
4. Inlet Size: NPS 1/2 or NPS 3/4.
5. Outlet Size: Garden-hose thread complying with ASME B1.20.7.
6. Capacity: At least 3-gpm flow.

E. Backflow-Preventer Test Kits :

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

   a. Conbraco Industries, Inc.

   b. FEBCO.

   c. Watts; a Watts Water Technologies company.

   d. Zurn Industries, LLC.

2. Description: Factory calibrated, with gages, fittings, hoses, and carrying case with test-procedure instructions.

2.5 WATER PRESSURE-REDUCING VALVES

A. Water Regulators : See drawings for sizes, pressures and flow rates

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

   a. Cash Acme.

   b. Conbraco Industries, Inc.

   c. Watts; a Watts Water Technologies company.

   d. Zurn Industries, LLC.

2. Standard: ASSE 1003.
3. Pressure Rating: Initial working pressure of 150 psig.
4. Size: See drawings.

5. Body: Bronze for NPS 2 and smaller; cast iron with interior lining that complies with AWWA C550 or that is FDA approved for NPS 2-1/2 and NPS 3.
6. Valves for Booster Heater Water Supply: Include integral bypass.
7. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and NPS 3.

B. Water-Control Valves: See drawings for sizes, pressures and flow rates
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. CLA-VAL Automatic Control Valves.

b. OCV Control Valves.

c. Watts; a Watts Water Technologies company.

d. Zurn Industries, LLC.
2. Description: Pilot-operated, diaphragm-type, single-seated, main water-control valve.
3. Pressure Rating: Initial working pressure of 150 psig 1035 kPa minimum with AWWA C550 or FDA-approved, interior epoxy coating. Include small pilot-control valve, restrictor device, specialty fittings, and sensor piping.
4. Main Valve Body: Cast- or ductile-iron body with AWWA C550 or FDA-approved, interior epoxy coating; or stainless-steel body.
5. End Connections: Threaded for NPS 2 DN 50 and smaller; flanged for NPS 2-1/2 DN 65 and larger.

2.6 TEMPERATURE-ACTUATED, WATER MIXING VALVES

A. For electric water heaters – TMV-1

B. Manifold, Thermostatic, Water Mixing-Valve Assemblies: See drawing schedule sheet for valve duty.

a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

b. Lawler Industries.

c. Leonard Valve Company.

d. Powers.

e. Symmons Industries, Inc.

C. Description: Factory-fabricated, exposed-mounted, thermostatically controlled, water mixing-valve assembly in two-valve parallel arrangement.

D. Large-Flow Parallel: Thermostatic, water mixing valve and downstream-pressure regulator with pressure gages on inlet and outlet.

E. Intermediate-Flow Parallel: Thermostatic, water mixing valve and downstream-pressure regulator with pressure gages on inlet and outlet.

F. Small-Flow Parallel: Thermostatic, water mixing valve.

G. Thermostatic Mixing Valves: Comply with ASSE 1017. Include check stops on hot- and cold-water inlets and shutoff valve on outlet.

H. Water Regulator(s): Comply with ASSE 1003. Include pressure gage on inlet and outlet.

I. Pressure Rating: 150 psig minimum unless otherwise indicated.

J. Thermostatic Mixing Valve and Water Regulator Finish: Rough bronze.

K. Piping Finish: Copper.

L. Factory pre-assembled and tested as a complete system

M. Contractor to obtain proper inter-piping arrangement detail from the manufacturer prior to installation, failure to do so, or piping arrangements not approved and sanctioned by the manufacturer shall result in removal and reinstall of the valves in accordance with manufacturers instruction.

N. Aquastat with temperature differential of 5 to 30°F (3 to 17°C) • GFCI* switch. The GFCI switch will be used to turn the circulator on or off for setup. *Ground Fault Interrupter

O. System mounted on strut, galvanized. Strut shall be assembled with three hole flat angle plate on corners, four hole tee plates or two hole flat plate connectors on all other support pieces using 3/8” grip lock nuts and 3/8”x 1” hex head cap screws, washers and lock washers.

P. Factory pre-assembled and tested as a complete system •

Q. All electrical connections to be completed by division 26 Electrical Contractor

R. Basis of Design: Leonard Megatron Lead Free Model 8NB-LF-BSMI

S. See Drawing Schedule Sheet for sizes

T. Accessories – furnish and install Leonard model LMS-188-4P digital monitoring system with the following components
1. Four (4) Temperature Probes - Range: -148ºF to 212ºF Resolution: 1ºF • Audio & visual alarms
2. User adjustable high & low temperature alarm set points
3. Alarm delay period to prevent nuisance alarms
4. Remote alarm contacts (SPDT) with adjustable relay period
5. 10/100 Ethernet Connection
6. Web Server Interface for Setup & Commissioning
7. Unit can send an E-mail transmission of alarms for up to 8 contacts
8. Unit can send an E-mail report daily with temperatures readings over the previous day
9. LMS-188-4P option replaces analog dial thermometers with a single digital display for all 4 temperatures, incoming hot, incoming cold, outlet and return

2.7 STRAINERS FOR WATER PIPING

A. Y-Pattern Strainers:
1. Pressure Rating: 125 psig minimum unless otherwise indicated.
2. Body: Bronze for NPS 2 and smaller; cast iron with interior lining that complies with AWWA C550 or that is FDA approved, epoxy coated and for NPS 2-1/2 and larger.
3. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
4. Screen: Stainless steel with round perforations unless otherwise indicated.
5. Perforation Size:
    a. Strainers NPS 2 and Smaller: 0.020 inch.
    b. Strainers NPS 2-1/2 to NPS 4: 0.045 inch.
    c. Strainers NPS 5 and Larger: 0.125 inch.
6. Drain: 1/2 to 2 inch pipe plug 2-1/2 inches and larger - Factory-installed, hose-end drain valve.

2.8 HOSE BIBBS

A. Hose Bibbs :
1. Standard: ASME A112.18.1 for sediment faucets.
2. Body Material: Bronze.
3. Seat: Bronze, replaceable.
4. Supply Connections: NPS 1/2 or NPS 3/4 threaded or solder-joint inlet.
5. Outlet Connection: Garden-hose thread complying with ASME B1.20.7.
6. Pressure Rating: 125 psig.
7. Vacuum Breaker: Integral non-removable, drainable, hose-connection vacuum breaker complying with ASSE 1011.
8. Finish for Mechanical Rooms: Bronze.
    a. Basis of Design: Watts HB-1 3/4 inch
9. Finish for Equipment Rooms: Chrome or nickel plated.
    a. Basis of Design: Chicago 952-CP
10. Finish for Service Areas: Chrome or nickel plated.
    a. Basis of Design: Chicago 998-633RCF
11. Finish for Finished Rooms, including toilet rooms: . verify finish with architect
    a. Basis of Design: Chicago 952-CP, handle to be turned over to owner
12. Operation for Finished Rooms: key handle, furnish a key for each device installed
13. Include operating key with each operating-key hose bibb.
14. Include integral wall flange with each chrome- or nickel-plated hose bibb.

2.9 WALL HYDRANTS

A. Vacuum Breaker Wall Hydrants: Tag # WH-3
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Smith, Jay R. Mfg. Co.

b. Watts; a Watts Water Technologies company.

c. Woodford Manufacturing Company.

d. Zurn Industries, LLC.

2. Standard: ASSE 1019, Type A or Type B.
3. Type: Freeze-resistant, automatic draining with integral air-inlet valve.
4. Classification: Type B, for automatic draining with hose removed or with hose attached and nozzle closed.
5. Pressure Rating: 125 psig.
6. Operation: Loose key or wheel handle.
7. Casing and Operating Rod: Of length required to match wall thickness. Include wall clamp.
8. Inlet: NPS 1/2 or NPS 3/4.
9. Outlet: Exposed with garden-hose thread complying with ASME B1.20.7.

2.10 BASIS OF DESIGN: DRAIN VALVES

A. Ball-Valve-Type, Hose-End Drain Valves:
1. Standard: MSS SP-110 for standard-port, two-piece ball valves.
2. Pressure Rating: 400-psig minimum CWP.
3. Size: NPS 3/4.
4. Body: Copper alloy.
5. Ball: Chrome-plated brass.
6. Seats and Seals: Replaceable.
7. Handle: Vinyl-covered steel.
8. Inlet: Threaded or solder joint.
9. Outlet: Threaded, short nipple with garden-hose thread complying with ASME B1.20.7 and cap with brass chain.

B. Stop-and-Waste Drain Valves:
1. Standard: MSS SP-110 for ball valves or MSS SP-80 for gate valves.
2. Pressure Rating: 200-psig minimum CWP or Class 125.
3. Size: NPS 3/4.
4. Body: Copper alloy or ASTM B 62 bronze.
5. Drain: NPS 1/8 side outlet with cap.

2.11 WATER-HAMMER ARRESTERS

A. Water-Hammer Arresters:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. AMTROL, Inc.

b. MIFAB, Inc.

c. Precision Plumbing Products.

d. Sioux Chief Manufacturing Company, Inc.

e. Smith, Jay R. Mfg. Co.

f. Watts; a Watts Water Technologies company.

g. Zurn Industries, LLC.

2. Standard: ASSE 1010 or PDI-WH 201.
3. Type: Metal bellows or Copper tube with piston.
4. Size: ASSE 1010, Sizes AA and A through F, or PDI-WH 201, Sizes A through F.

2.12 AIR VENTS

A. Bolted-Construction Automatic Air Vents:
1. Body: Bronze.
2. Pressure Rating and Temperature: 125-psig minimum pressure rating at 140 deg F.
3. Float: Replaceable, corrosion-resistant metal.
4. Mechanism and Seat: Stainless steel.
5. Size: NPS 1/2 minimum inlet.
6. Inlet and Vent Outlet End Connections: Threaded.

B. Welded-Construction Automatic Air Vents :
1. Body: Stainless steel.
2. Pressure Rating: 150-psig minimum pressure rating.
3. Float: Replaceable, corrosion-resistant metal.
4. Mechanism and Seat: Stainless steel.
5. Size: NPS 3/8 minimum inlet.
6. Inlet and Vent Outlet End Connections: Threaded.

2.13 TRAP-SEAL PRIMER DEVICE

A. Supply-Type, Trap-Seal Primer Device : Tag # TP-1
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. MIFAB, Inc.

b. Precision Plumbing Products.

c. Sioux Chief Manufacturing Company, Inc.

d. Smith, Jay R. Mfg. Co.

e. Watts; a Watts Water Technologies company.

f. Zurn Industries, LLC.

2. Standard: ASSE 1018.

3. Pressure Rating: 125 psig minimum.
4. Body: Bronze.
5. Inlet and Outlet Connections: NPS 1/2 threaded, union, or solder joint.
6. Gravity Drain Outlet Connection: NPS 1/2 threaded or solder joint.
7. Finish: Chrome plated, or rough bronze for units used with pipe or tube that is not chrome finished.
8. Basis of Design: Precision Plumbing model PRO1-500 Brass
9. Precision Plumbing model PRO1-ULP500 chrome

2.14 TRAP-SEAL PRIMER SYSTEMS

A. Trap-Seal Primer Systems : Tag # TP-2
   1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
      a. Precision Plumbing Products.
      b. Zurn Industries, LLC.
   2. Standard: ASSE 1044.
   3. Piping: NPS 3/4, ASTM B 88, Type L; copper, water tubing.
   4. Cabinet: Recessed or Surface-mounted steel box with stainless-steel cover.
   5. Electric Controls: 24-hour timer, solenoid valve, and manual switch for 120-V ac power.
      a. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
   6. Vacuum Breaker: ASSE 1001.
   7. Number Outlets: Insert number.
   8. Size Outlets: NPS 1/2.
   9. Basis of Design: Zurn Z-1020

2.15 FLEXIBLE CONNECTORS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
   1. Flexicraft Industries.
   2. Metraflex Company (The).
   3. Universal Metal Hose.

B. Bronze-Hose Flexible Connectors: Corrugated-bronze tubing with bronze wire-braid covering and ends brazed to inner tubing.
   1. Working-Pressure Rating: Minimum 250 psig.
   2. End Connections NPS 2 and Smaller: Threaded copper pipe or plain-end copper tube.
   3. End Connections NPS 2-1/2 and Larger: Flanged copper alloy.

C. Stainless-Steel-Hose Flexible Connectors: Corrugated-stainless-steel tubing with stainless-steel wire-braid covering and ends welded to inner tubing.
   1. Working-Pressure Rating: Minimum 250 psig.
   2. End Connections NPS 2 and Smaller: Threaded steel-pipe nipple.

3. End Connections NPS 2-1/2 and Larger: Flanged steel nipple.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install backflow preventers in each water supply to mechanical equipment and systems and to other equipment and water systems that may be sources of contamination. Comply with authorities having jurisdiction.
   1. Locate backflow preventers in same room as connected equipment or system.
   2. Install drain for backflow preventers with atmospheric-vent drain connection with air-gap fitting, fixed air-gap fitting, or equivalent positive pipe separation of at least two pipe diameters in drain piping and pipe-to-floor drain. Locate air-gap device attached to or under backflow preventer. Simple air breaks are unacceptable for this application.
   3. Do not install bypass piping around backflow preventers.

B. Install water regulators with inlet and outlet shutoff valves and bypass with memory-stop balancing valve. Install pressure gages on inlet and outlet.

C. Install water-control valves with inlet and outlet shutoff valves and bypass with globe valve. Install pressure gages on inlet and outlet.

D. Install balancing valves in locations where they can easily be adjusted.

E. Install temperature-actuated, water mixing valves with check stops or shutoff valves on inlets and with shutoff valve on outlet.
   1. Install cabinet-type units recessed in or surface mounted on wall as specified.

F. Install Y-pattern strainers for water on supply side of each control valve water pressure-reducing valve solenoid valve and pump.

G. Install outlet boxes recessed in wall or surface mounted on wall. Install 2-by-4-inch fire-retardant-treated-wood blocking, wall reinforcement between studs. Comply with requirements for fire-retardant-treated-wood blocking in Division 06.

H. Install hose stations with check stops or shutoff valves on inlets and with thermometer on outlet.
   1. Install cabinet-type units recessed in or surface mounted on wall as specified. Install 2-by-4-inch fire-retardant-treated-wood blocking, wall reinforcement between studs. Comply with requirements for fire-retardant-treated-wood blocking in Division 06.

I. Install ground hydrants with 1 cubic yard of crushed gravel around drain hole. Set ground hydrants with box flush with grade.

J. Install draining-type post hydrants with 1 cubic yard of crushed gravel around drain hole. Set post hydrants in concrete paving or in 1 cubic foot of concrete block at grade.

K. Set non-freeze, non-draining-type post hydrants in concrete or pavement.

L. Set freeze-resistant yard hydrants with riser pipe in concrete or pavement. Do not encase canister in concrete.

M. Install water-hammer arresters in water piping according to PDI-WH 201.

N. Install air vents at high points of water piping. Install drain piping and discharge onto floor drain.

O. Install supply-type, trap-seal primer valves with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting. Adjust valve for proper flow.

P. Install drainage-type, trap-seal primer valves as lavatory trap with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting.

Q. Install trap-seal primer systems with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting. Adjust system for proper flow.

3.2 CONNECTIONS

A. Comply with requirements for ground equipment in Division 26.

B. Fire-retardant-treated-wood blocking is specified in Division 26 for electrical connections.

3.3 LABELING AND IDENTIFYING

A. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplate or sign on or near each of the following:
1. Pressure vacuum breakers.
2. Intermediate atmospheric-vent backflow preventers.
3. Reduced-pressure-principle backflow preventers.
4. Double-check, backflow-prevention assemblies.
5. Carbonated-beverage-machine backflow preventers.
6. Dual-check-valve backflow preventers.
7. Reduced-pressure-detector, fire-protection, backflow-preventer assemblies.
8. Double-check, detector-assembly backflow preventers.
9. Water pressure-reducing valves.
10. Calibrated balancing valves.
11. Primary, thermostatic, water mixing valves.
12. Manifold, thermostatic, water mixing-valve assemblies.
13. Photographic-process, thermostatic, water mixing-valve assemblies.
14. Primary water tempering valves.

B. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit. Nameplates and signs are specified in Division 22.

3.4 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:
1. Test each pressure vacuum breaker reduced-pressure-principle backflow preventer double-check, backflow-prevention assembly and double-check, detector-assembly

backflow preventer Insert type according to authorities having jurisdiction and the device's reference standard.

B. Water piping specialties will be considered defective if they do not pass tests and inspections.

C. Prepare test and inspection reports.

3.5 ADJUSTING

A. Set field-adjustable pressure set points of water pressure-reducing valves.

B. Set field-adjustable flow set points of balancing valves.

C. Set field-adjustable temperature set points of temperature-actuated, water mixing valves.

END OF SECTION

SECTION 221123 - WATER PUMPS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Packaged In-line, wet rotor centrifugal pumps.
2. Horizontally or vertically mounted, in-line, close-coupled centrifugal pumps.

1.3 DEFINITIONS

A. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control, signaling power-limited circuits.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include materials of construction, rated capacities, certified performance curves with operating points plotted on curves, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. LEED Submittals:

1. Product Data for Prerequisite EA 2: Documentation indicating that units comply with applicable requirements in ASHRAE/IESNA 90.1, without amendments, Section 7 - "Service Water Heating."

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For water pumps to include in operation and maintenance manuals.

1.6 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. UL Compliance: Comply with UL 778 for motor-operated water pumps.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Retain shipping flange protective covers and protective coatings during storage.

B. Protect bearings and couplings against damage.

C. Comply with pump manufacturer's written rigging instructions for handling.

1.8 COORDINATION

A. Coordinate sizes and locations of concrete bases with actual equipment provided.

PART 2 - PRODUCTS

2.1 HORIZONTALLY OR VERTICALLY MOUNTED, IN-LINE, CLOSE-COUPLED CENTRIFUGAL PUMPS INSERT TAG # HERE FOR EACH PUMP

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. Armstrong Pumps, Inc.
2. Bell & Gossett; a Xylem brand.
3. PACO Pumps; Grundfos Pumps Corporation, USA.
4. TACO Incorporated.
5. Grunfos Pumps

B. Application: Hot water return points for remote slave heaters or riser locations not returned to main package pump station’

C. Description: Factory-assembled and -tested, in-line, single-stage, close-coupled, overhung-impeller centrifugal pumps designed for installation with pump and motor shaft mounted horizontal.

D. Close Coupled Pumps.

1. The pumps shall be single stage horizontal in-line design. The seal shall be serviceable without disturbing the piping connections. The capacities and characteristics shall be as called for in the plans/schedules.
2. Pump shall be constructed of ASTM A48 class 30 cast iron. The pump casing shall be drilled and tapped for gauge ports on both the suction and discharge connections.
3. All casings shall be flanged connections.
4. Pumps shall be rated for domestic water service
5. The impeller shall be ASTM C87500 or C89833 bronze and hydraulically balanced. The impeller shall be dynamically balanced to ANSI Grade G6.3 and shall be fitted with a holding taper and left handed 431 series stainless steel bolt. The impeller shall be cast by the hydraulically efficient lost foam technique to ensure repeatability of high quality.
6. The pump shall incorporate a dry shaft design to prevent the circulating fluid from contacting the shaft. The pump shaft shall be AISI 1045 carbon steel with field replaceable copper nickel 90-10 shaft sleeve. In order to improve serviceability and reduce the cost of ownership the shaft sleeve must be slip on (press on not allowable) and must be easily replaced in the field.
7. The pump shall be fitted with a single mechanical seal, with EPT elastomers and Carbon/Ceramic faces, rated up to 250 deg F. The pump shall be coupled to a NEMA 56C face motor with threaded on shaft extension.
8. The manufacturer shall standardize on one mechanical seal throughout the entire range of the family of pumps. The manufacturer shall not use multiple part numbers for the same part.

E. Motor: Single speed, with grease-lubricated ball bearings; and resiliently or rigidly mounted to pump casing.

F. Capacities and Characteristics: see drawing schedule sheet

G. Motors

1. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Division 22.

    a. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.

H. Controls

1. Control Panel – furnish control panels for in-line duplex circulating how water pumps only, panel shall house all control operations with HOA switches for the pumps. Starters may be provided in the panel or integral to the pump, however, means of pump disconnect shall be in the control panel.

    a. Control Panels shall be factory mounted and wired and shall include the following:

        1) Magnetic Starters must be used on all 3 phase motors and single phase motors 3 HP and larger
        2) Provide fuses or a circuit breaker ahead of the starters to protect against short circuits.

3) Selector Switches – “Auto-Off-Hand” selector switches provide a means of shutting off pumps and a means of testing in the “Hand” position. “Off-Hand Lead-Lag” selector switches shall be furnished on duplex units
4) Electrical Alternator on duplex units to provide automatic sequencing of lead pump. Use only when magnetic starters are provided.
5) Transformer is required by the National Electrical Code to reduce control voltage when power supply exceeds 250 volts.
6) Pilot Lights – Pump running pilots to indicate pump operation.
7) NEMA 4 enclosures in non corrosive enviounments and NEMA 4x enclosures in corrosive enviounments UL listed unless otherwise specified.
8) For manual shut down. In the inlet and outlet piping of the pump, shutoff valves shall be installed to permit service to the pump, strainer, and check valve without draining the system

2. Timers: Electric, for control of hot-water circulation pump.

   a. Type: Programmable, seven-day clock with manual override on-off switch.
   b. Enclosure: NEMA 250, Type 1, suitable for wall mounting.
   c. Operation of Pump: On or off.
   d. Transformer: Provide if required.
   e. Power Requirement: 24-V ac.
   f. Programmable Sequence of Operation: Up to two on-off cycles each day for seven days.

3. Time-Delay Relays: Electric, for control of hot-water circulation pump between water heater and connected hot-water storage tank.

   a. Type: Adjustable time-delay relay.
   b. Range: Up to five minutes.
   c. Setting: Five minutes.
   d. Enclosure: NEMA 250, Type 4X.
   e. Operation of Pump: On or off.
   f. Transformer: Provide if required.
   g. Power Requirement: 24-V ac.
   h. Programmable Sequence of Operation: Limit pump operation to periods of burner operation plus maximum five minutes after the burner stops.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in of -water-piping system to verify actual locations of connections before pump installation.

3.2 PUMP INSTALLATION

A. Comply with HI 1.4.

B. Install in-line, seal-less centrifugal pumps with shaft horizontal unless otherwise indicated.

C. Install horizontally mounted, in-line, separately coupled and close-coupled centrifugal pumps with shaft(s) horizontal.

D. Install vertically mounted, in-line, close-coupled centrifugal pumps with shaft vertical.

E. Pump Mounting: Install vertically mounted, in-line, close-coupled centrifugal pumps with cast-iron base mounted on concrete base using elastomeric mounts OR restrained spring isolators. Comply with requirements for concrete base specified in Division 03.

1. Minimum Deflection: 1/4 inch .
2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of concrete base.
3. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
4. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
5. Install anchor bolts to elevations required for proper attachment to supported equipment.

F. Install continuous-thread hanger rods and spring hangers with vertical-limit stop of size required to support pump weight.

1. Comply with requirements for vibration isolation devices specified in Division 22. Fabricate brackets or supports as required.
2. Comply with requirements for hangers and supports specified in Division 22.

G. Install pressure switches in water supply piping.

H. Install thermostats in hot-water return piping.

I. Install timers Insert location.

J. Install time-delay relays in piping between water heaters and hot-water storage tanks.

3.3 CONNECTIONS

A. Comply with requirements for piping specified in Piping Sections of this specification. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to pumps to allow service and maintenance.

C. Connect water piping to pumps. Install suction and discharge piping equal to or greater than size of pump nozzles.

1. Install flexible connectors adjacent to pumps in suction and discharge piping of the following pumps:

    a. Horizontally mounted, in-line, separately coupled centrifugal pumps.
    b. Horizontally mounted, in-line, close-coupled centrifugal pumps.
    c. Vertically mounted, in-line, close-coupled centrifugal pumps.
    d. Comply with requirements for flexible connectors specified in Division 22.

D. Install shutoff valve and strainer on suction side of each pump, and check, shutoff, and throttling valves on discharge side of each pump. Install valves same size as connected piping. Comply with requirements for valves specified in Division 22 and comply with requirements for strainers specified in Division 22.

1. Install pressure gage and snubber at suction of each pump and pressure gage and snubber at discharge of each pump. Install at integral pressure-gage tappings where provided or install pressure-gage connectors in suction and discharge piping around pumps. Comply with requirements for pressure gages and snubbers specified in Division 22.

E. Connect pressure switches, thermostats, time-delay relays, and timers to pumps that they control.

F. Interlock pump between water heater and hot-water storage tank with water heater burner and time-delay relay.

3.4 IDENTIFICATION

A. Comply with requirements for identification specified in Division 22 for identification of pumps.

3.5 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.
2. Check piping connections for tightness.
3. Clean strainers on suction piping.
4. Set pressure switches, thermostats, timers, and time-delay relays for automatic starting and stopping operation of pumps.
5. Perform the following startup checks for each pump before starting:

    a. Verify bearing lubrication.
    b. Verify that pump is free to rotate by hand and that pump for handling hot liquid is free to rotate with pump hot and cold. If pump is bound or drags, do not operate until cause of trouble is determined and corrected.
    c. Verify that pump is rotating in the correct direction.

6. Prime pump by opening suction valves and closing drains, and prepare pump for operation.
7. Start motor.
8. Open discharge valve slowly.
9. Adjust temperature settings on thermostats.
10. Adjust timer settings.

3.6 ADJUSTING

A. Adjust water pumps to function smoothly, and lubricate as recommended by manufacturer.

B. Adjust initial temperature set points.

C. Set field-adjustable switches and circuit-breaker trip ranges as indicated.

END OF SECTION

SECTION 221124 - WATER PACKAGED BOOSTER PUMPS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Multiplex, variable speed booster pumps general requirements
2. Vertical multistage water booster pumps
3. Vertical turbine water booster pumps
4. Motors

1.3 DEFINITIONS

A. VFC: Variable-frequency controller(s).

1.4 PERFORMANCE REQUIREMENTS

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, material descriptions, and dimensions of individual components and profiles. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Shop Drawings: For booster pumps. Include plans, elevations, sections, details, and attachments to other work.

1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
2. Wiring Diagrams: For power, signal, and control wiring.

1.6 INFORMATIONAL SUBMITTALS

1.7 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For booster pumps to include in emergency, operation, and maintenance manuals.

1.8 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. ASME Compliance: Comply with ASME B31.9 for piping.

C. UL Compliance for Packaged Pumping Systems:

1. UL 508, "Industrial Control Equipment."
2. UL 508A, "Industrial Control Panels."
3. UL 778, "Motor-Operated Water Pumps."
4. UL 1995, "Heating and Cooling Equipment."
5. All Equipment as well as pipe, fittings, and valves used in this distribution system and installed after January 4, 2014 must comply with the new Federal Mandate known as the " Reduction of Lead in Drinking Water Act-2014".

D. Booster pumps shall be listed and labeled as packaged pumping systems by testing agency acceptable to authorities having jurisdiction.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Retain protective coatings and flange's protective covers during storage.

1.10 COORDINATION

A. Coordinate sizes and locations of concrete bases with actual equipment provided.

PART 2 - PRODUCTS

2.1 MULTIPLEX, VARIABLE-SPEED BOOSTER PUMPS - GENERAL REQUIREMENTS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Armstrong Pumps, Inc.

2. Bell & Gossett; a Xylem brand.
3. Goulds Water Technology; a Xylem brand.
4. Grundfos Pumps Corporation U.S.A.
5. Patterson Pump Company; a Gorman-Rupp company.
6. SyncroFlo, Inc.

2.2 VERTICAL MULTI-STAGE WATER PRESSURE BOOSTER PUMPS

ITEM	VERTICAL VARIABLE SPEED MULTISTAGE PUMP STATION
DESCRIPTION	Furnish and install a pre-fabricated and tested variable speed packaged pumping system to maintain constant water delivery pressure. The entire pump system including pumps and pump logic controller, shall be designed, built, and tested by the same manufacturer. The complete packaged pumping system shall be NSF61 Annex G Listed for drinking water and low lead requirements. The pumps shall be of the in-line vertical multi-stage design.
NUMBER OF PUMPS	see drawings
OPERATION AND SEQUENCE	The system controller shall operate equal capacity variable speed pumps to maintain a constant discharge pressure (system set-point). The system controller shall receive an analog signal (-20mA) from the factory installed pressure transducer on the discharge manifold, indicating the actual system pressure. As flow demand increases the pump speed shall be increased to maintain the system set-point pressure. When the operating pump(s) reach 96% of full speed (adjustable), an additional pump will be started and will increase speed until the system set-point is achieved. When the system pressure is equal to the system set-point all pumps in operation shall reach equal operating speeds. As flow demand decreases the pump speed shall be reduced while system set-point pressure is maintained. When all pumps in operation are running at low speed the system controller shall switch off pumps when fewer pumps are able to maintain system demand. The system controller shall be capable of switching pumps on and off to satisfy system demand without the use of flow switches, motor current monitors or temperature measuring devices. All pumps in the system shall alternate automatically based on demand, time and fault. If flow demand is continuous (no flow shut-down does not occur), the system controller shall have the capability to alternate the pumps every 24 hours, every 48 hours or once per week. The interval and actual time of the pump change-over shall be field adjustable. The system controller shall be able to control a pressure maintenance pump, (jockey pump), in the system. The set point of the pressure maintenance pump shall be able to be any value above or below the pump system's set point. The pressure maintenance pump shall be able to be staged on as back-up pump when capacity of pump system is exceeded.
PUMPS (Nominal flow from 3 to 125 gallons per minute)	The pump impellers shall be secured directly to the pump shaft by means of a splined shaft arrangement. The suction/discharge base shall have ANSI Class 250 flange or internal pipe thread (NPT) connections as determined by the pump station manufacturer. Pump Construction: Materials for the suction/discharge base and pump head shall be cast 316 stainless steel (ASTM CF-8M) resulting in all wetted parts of stainless steel. Impellers, diffuser chambers, outer sleeve: 304 Stainless Steel Shaft 316 or 431 Stainless Steel Impeller wear rings: 304 Stainless Steel Shaft journals and chamber bearings: Silicon Carbide O-rings: EPDM Shaft couplings for motor flange sizes 184TC and smaller shall be made of cast iron or sintered steel. Shaft couplings for motor flange sizes larger than 184TC shall be made of ductile iron (ASTM 60-40-18). The shaft seal shall be a balanced o-ring cartridge type with the following features: Collar, Drivers, Spring: 316 Stainless Steel Shaft Sleeve, Gland Plate: 316 Stainless Steel Stationary Ring: Silicon Carbide

ITEM	VERTICAL VARIABLE SPEED MULTISTAGE PUMP STATION
	Rotating Ring: Silicon Carbide O-rings: EPDM The Silicon Carbide shall be imbedded with graphite.
PUMPS (Nominal flows from 130 to 500 gallons per minute)	The pump impellers shall be secured directly to the smooth pump shaft by means of a split cone and nut design. The suction/discharge base shall have ANSI Class 125 or Class 250 flange connections in a slip ring (rotating flange) design as indicated in the drawings or pump schedule. Pump Construction. Suction/discharge base, pump head: Ductile Iron (ASTM 65-45-12) Shaft couplings, flange rings: Ductile Iron (ASTM 65-45-12) Shaft: 431 Stainless Steel Motor Stool: Cast Iron (ASTM Class 30) Impellers, diffuser chambers, outer sleeve: 304 Stainless Steel Impeller wear rings: 304 Stainless Steel Intermediate Bearing Journals: Tungsten Carbide Intermediate Chamber Bearings: Leadless Tin Bronze Chamber Bushings: Graphite Filled PTFE O-rings: EPDM The shaft seal shall be a single balanced metal bellows cartridge with the following construction: Bellows: 904L Stainless Steel Shaft Sleeve, Gland Plate, Drive Collar: 316 Stainless Steel Stationary Ring: Carbon Rotating Ring: Tungsten Carbide O-rings: EPDM
SHAFT SEAL REPLACEMENT	Shaft seal replacement shall be possible without removal of any pump components other than the coupling guard, motor couplings, motor and seal cover. The entire cartridge shaft seal shall be removable as a one piece component. Pumps with motors equal to or larger than 15 hp (fifteen horsepower) shall have adequate space within the motor stool so that shaft seal replacement is possible without motor removal
FACTORY ASSEMBLY - SYSTEM CONSTRUCTION	Manifold construction shall be such that water stagnation cannot exist in manifold during operation to prevent bacteria growth inside manifold. The suction and discharge manifolds shall be constructed of 316 stainless steel. Pump Isolation valves shall be provided on the suction and discharge of each pump. A spring-loaded non-slam type check valve shall be installed on the discharge of each pump. The head loss through the check valve shall not exceed 5 psi at the pump design capacity. A bourdon tube pressure gauge, 2.5 inch diameter, shall be placed on the suction and discharge manifolds. Systems with a flooded suction inlet or suction lift configuration shall have a factory installed water shortage protection device on the suction manifold.
DRIVES	Each motor shall be of the Integrated Variable Frequency Drive design consisting of a motor and a Variable Frequency Drive (VFD) built and tested as one unit by the same manufacturer. The VFD shall be of the PWM (Pulse Width Modulation) design using current IGBT (Insulated Gate Bipolar Transistor) technology. The VFD shall convert incoming fixed frequency three-phase AC power into a variable frequency and voltage for controlling the speed of motor. The VFD shall utilize an energy optimization algorithm to minimize energy consumption. The output voltage shall be adjusted in response to the load, independent of speed. The VFD shall automatically reduce the switching frequency and/or the output voltage and frequency to the motor during periods of sustained ambient temperatures that are higher

ITEM	VERTICAL VARIABLE SPEED MULTISTAGE PUMP STATION
	than the normal operating range. The switching frequency shall be reduced before motor speed is reduced. An integral RFI filter shall be standard in the VFD. The VFD shall have a minimum of two skip frequency bands which can be field adjustable. The VFD shall have internal solid-state overload protection designed to trip within the range of 125-150% of rated current. The integrated VFD motor shall include protection against input transients, phase imbalance, loss of AC line phase, over-voltage, under-voltage, VFD over-temperature, and motor over-temperature. Three-phase integrated VFD motors shall be capable of providing full output voltage and frequency with a voltage imbalance of up to 10%. The integrated VFD motor shall have, as a minimum, the following input/output capabilities: Speed Reference Signal: 0-10 VDC, 4-20mA Digital remote on/off Fault Signal Relay (NC or NO) Fieldbus communication port (RS485) The motor shall be Totally Enclosed Fan Cooled (TEFC) with a standard NEMA C-Face, Class F insulation with a temperature rise no higher than Class B. The cooling design of the motor and VFD shall be such that a Class B motor temperature rise is not exceeded at full rated load and speed at a minimum switching frequency of 9.0 kHz.
PRESSURE TRANSDUCER	A pressure transducer shall be factory installed on the discharge manifold . Systems with positive inlet gauge pressure shall have a factory installed pressure transducer on the suction manifold for water shortage protection. Pressure transducers shall be made of 316 stainless steel. Transducer accuracy shall be +/- 1.0% full scale with hysteresis and repeatability of no greater than 0.1% full scale. The output signal shall be 4-20 mA with a supply voltage range of 9-32 VDC.
CONTROL AND CONTROL PANEL	The control panel shall be mounted on a 304 stainless steel fabricated control cabinet stand attached to the system skid. The controller shall be microprocessor based capable of having software changes and updates via personal computer (notebook). The controller user interface shall have a color display with a minimum screen size of 3-1/2” x 4-5/8” for easy viewing of system status parameters and for field programming. The display shall have a back light with contrast adjustment. Password protection of system settings shall be standard. The controller shall provide internal galvanic isolation to all digital and analog inputs as well as all fieldbus connections. The controller shall have the ability to be connected to a battery to maintain power on controller during periods of loss of supply power. The controller shall have built in data logging capability. Logged vales shall be graphically displayed on the controller and able to be exported to computer via standard connection. Estimated flow-rate Speed of pumps Inlet pressure Discharge pressure Power consumption Controlling parameter (process value) The controller shall display the following as status readings from a single display on the controller (this display shall be the default): Current value of the control parameter, (typically discharge pressure) Most recent existing alarm (if any) System status with current operating mode Status of each pump with current operating mode and rotational speed as a percentage (%)

ITEM	VERTICAL VARIABLE SPEED MULTISTAGE PUMP STATION
	Estimated flow-rate, (not requiring flow meter connection) The controller shall have as a minimum the following hardware inputs and outputs: Three analog inputs (4-20mA or 0-10VDC) Three digital inputs Two digital outputs Ethernet connection Field Service connection to PC for advanced programming and data logging Pump system programming (field adjustable) shall include as a minimum the following: Water shortage protection (analog or digital) Transducer Settings (Suction and Discharge Analog supply/range) PI Controller (Proportional gain and Integral time) settings High system pressure indication and shut-down Low system pressure indication and shut-down Low suction pressure/level shutdown (via digital contact) Low suction pressure/level warning (via analog signal) Low suction pressure/level shutdown (via analog signal) Flow meter settings (if used, analog signal) The controller shall be capable of receiving a remote analog set-point (4-20mA or 0-10 VDC) as well as a remote system on/off (digital) signal. The controller shall be able to adjust the ramp time of a change in set point on both an increase or decrease change in set point. The pump system controller shall store up to 24 warning and alarms in memory. The time, date and duration of each alarm shall be recorded. A potential-free relay shall be provided for alarm notification to the building management system (BMS). The controller shall display the following alarm conditions: High System Pressure — Low system pressure Low suction pressure (warning and alarm) — Individual pump failure VFD trip/failure — Loss of sensor signal (4-20 mA) Loss of remote set-point signal (4-20mA) — System power loss The pump system controller shall be mounted in a UL Type 3R rated enclosure. A self-certified NEMA enclosure rating shall not be considered equal. The entire control panel shall be UL 508 listed as an assembly. The control panel shall include a main disconnect, circuit breakers for each pump and the control circuit and control relays for alarm functions. Control panel options shall include, Pump Run Lights, System Fault Light, Audible Alarm (80 db(A), Surge Arrestor, Emergency/Normal Operation Switches, Service Disconnect Switches, Qty (9) Configurable Digital Outputs available for monitoring The controller shall be capable of receiving a redundant sensor input to function as a backup to the primary sensor (typically discharge pressure). The controller shall have a pump “Test Run” feature such that pumps are switched on during periods of inactivity (system is switched to the “off” position but with electricity supply still connected). The inoperative pumps shall be switched on for a period of two to three (3-4) seconds every 24 hours, 48 hours or once per week and at specific time of day (user selectable). The controller shall be capable of changing the number of pumps available to operate or have the ability limit the maximum power consumption by activation of a digital input for purposes of limited generator supplied power. The controller shall be capable of displaying instantaneous power consumption (Watts or kilowatts) and cumulative energy consumption (kilowatt-hours). The controller shall be capable of displaying an estimated flow-rate on the default status screen. The controller shall have the ability to compensate for pipe friction loss by decreasing pressure set-point at lower flow-rates and increasing pressure set-point at higher flow-rates without the requirement of a flow meter. The controller shall have the ability to communicate common field-bus protocols, (BACnet,

ITEM	VERTICAL VARIABLE SPEED MULTISTAGE PUMP STATION
	Modbus, Profibus, and LON), via optional communication expansion card installed inside controller. The controller shall have a built in Ethernet connection allowing controller to connected to network and access of controller via web browser and internet any where around the world where internet communication is available. The controller shall have a programmable Service Contact Field that can be populated with service contact information including: contact name, address, phone number(s) and website.
HYDRO-ACCUMULATOR	Furnish a diaphragm tank, a connection of no smaller than ¾" shall be provided on the discharge manifold. <u>Low Flow Stop and Energy Saving Mode</u> The pump system controller shall be capable receiving a digital signal from a flow switch or an analog signal from a flow meter to indicate a low flow condition. A bladder type diaphragm tank shall be installed with a pre-charge pressure of 70% of system set-point. The tank shall be piped to the discharge manifold or system piping downstream of the pump system. When low flow is detected (signal from flow switch or meter), the system controller shall increase pump speed until the discharge pressure reaches the stop pressure (system set-point plus 50% of programmed on/off band). The pump shall remain off until the discharge pressure reaches the start pressure (system set-point minus 50% of programmed on/off band). The pump shall remain in the energy saving on/off mode during low flow indication. When low flow is no longer present (low flow indication ceases), the pump(s) shall resume constant pressure operation. It shall be possible to change from the standard low flow stop to the optional low flow stop (and vice-versa) via the user interface.
FACTORY TEST	The entire pump station shall be factory tested for functionality. Functionality testing shall include the following parameters: Dry Run Protection, Minimum Pressure and Maximum Pressure alarms (where applicable), Setpoint Operation, and Motor Rotation. The system shall undergo a factory hydrostatic test at the end of the production cycle. The system shall be filled with water and pressurized to 1.5 times the nameplate maximum pressure. Systems with 150# flange connections shall be tested at 350 psig, and systems with 300# flange connections shall be tested at 450 psig. The pressure shall be maintained for a minimum of 15 minutes with no leakage (slight leakage around pump(s) mechanical seal is acceptable) prior to shipment.
START-UP & WARRANTY	See part 1
VIBRATION ISOLATION	The base frame shall be constructed of corrosion resistant 304 stainless steel. Rubber vibration dampers shall be fitted between each pumps and baseframe to minimize vibration. Provide vibration isolators between skid and housekeeping pad.
CAPACITY AND DUTY	See Plumbing Schedule Sheet
ELECTRICAL SUPPLY	480 VAC, phase , 60 Hz
BASIS OF DESIGN	Grunfos System Series Hydro MPC-E BoosterpaQ (Integrated VFD/Motor)] or Packaged HPS VTVFD-620

2.3 MOTORS

A. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors.

1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
2. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in NFPA 70.
3. Provide shaft grounding for all variable speed drives and motors

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in for booster pumps to verify actual locations of piping connections before booster-pump installation.

3.2 INSTALLATION

A. Equipment Mounting:

1. Install booster pumps on cast-in-place concrete equipment base(s). Comply with requirements for equipment bases and foundations specified in Division 03.
2. Comply with requirements for vibration isolation devices specified in Division 22.

B. Support connected -water piping so weight of piping is not supported by booster pumps.

3.3 CONNECTIONS

A. Comply with requirements for piping specified in Division 22. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Connect -water or other appropriate system water piping to booster pumps. Install suction and discharge pipe equal to or greater than size of system suction and discharge headers piping.

1. Install shutoff valves on piping connections to booster-pump suction and discharge headers. Install ball, butterfly, or gate valves same size as suction and discharge headers. Comply with requirements for general-duty valves specified in Division 22.
2. Install union, flanged, or grooved-joint connections on suction and discharge headers at connection to -water piping. Comply with requirements for unions and flanges specified in Division 22.
3. Install valved bypass, same size as and between piping, at connections to booster-pump suction and discharge headers. Comply with requirements for -water piping specified in Division 22.
4. Install flexible connectors, same size as piping, on piping connections to booster-pump suction and discharge piping. Comply with requirements for flexible connectors specified in Division 22.
5. Install piping adjacent to booster pumps to allow service and maintenance.

3.4 IDENTIFICATION

A. Identify system components. Comply with requirements for identification specified in Division 22.

3.5 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

B. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

C. Tests and Inspections:

1. Perform visual and mechanical inspection.
2. Leak Test: After installation, charge booster pump and test for leaks. Repair leaks and retest until no leaks exist.
3. Operational Test: After electrical circuitry has been energized, start booster pumps to confirm proper motor rotation and booster-pump operation.
4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

D. Pumps and controls will be considered defective if they do not pass tests and inspections.

E. Prepare test and inspection reports.

3.6 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.

3.7 ADJUSTING

A. Adjust booster pumps to function smoothly, and lubricate as recommended by manufacturer.

B. Adjust pressure set points.

C. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting booster pump to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

3.8 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain booster pumps.

END OF SECTION

SECTION 221313 - FACILITY SANITARY SEWERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This spec section includes sanitary pipe lead-ins to the interior plumbing wastewater piping systems. The spec covers the pipe from the inside of the foundation wall to the exterior10 feet. For site sanitary service beyond the 10 foot interface, see the civil utility plans and specifications for the project

1. Make connection to the Utility service with a compatable flexible fitting approved by the local authority having jurisdiction.

B. Section Includes:

1. Hub and spigot, cast-iron soil pipe and fittings
2. Ductile iron, gravity sewer pipe and fittings
3. Ductile iron, pressure pipe and fittings
4. Non-pressure type transition couplings
5. Pressure type pipe couplings
6. Expansion joints and deflection fittings
7. Encasement for piping

1.3 DEFINITIONS

A. FRP: Fiberglass-reinforced plastic.

1.4 ACTION SUBMITTALS

A. Product Data: For the following:

1. Expansion joints and deflection fittings.
2. Backwater valves.

B. Shop Drawings: For manholes. Include plans, elevations, sections, details, and frames and covers.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Show pipe sizes, locations, and elevations. Show other piping in same trench and clearances from sewer system piping. Indicate interface and spatial relationship between manholes, piping, and proximate structures.

B. Product Certificates: For each type of cast-iron soil pipe and fitting, from manufacturer.

C. Field quality-control reports.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Do not store plastic manholes, pipe, and fittings in direct sunlight.

B. Protect pipe, pipe fittings, and seals from dirt and damage.

C. Handle manholes according to manufacturer's written rigging instructions.

1.7 PROJECT CONDITIONS

A. Interruption of Existing Sanitary Sewerage Service: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary service according to requirements indicated:

1. Notify Architect Construction Manager Owner no fewer than five (5) business days in advance of proposed interruption of service.
2. Do not proceed with interruption of service without Architect's Construction Manager's Owner's written permission.

PART 2 - PRODUCTS

2.1 HUB-AND-SPIGOT, CAST-IRON SOIL PIPE AND FITTINGS

A. Pipe and Fittings: ASTM A 74, Service class .

B. Gaskets: ASTM C 564, rubber.

C. Calking Materials: ASTM B 29, pure lead and oakum or hemp fiber.

2.2 DUCTILE-IRON, GRAVITY SEWER PIPE AND FITTINGS

A. Pipe: ASTM A 746, for push-on joints.

B. Standard Fittings: AWWA C110, ductile or gray iron, for push-on joints.

C. Compact Fittings: AWWA C153, ductile iron, for push-on joints.

D. Gaskets: AWWA C111, rubber.

2.3 DUCTILE-IRON, PRESSURE PIPE AND FITTINGS

A. Push-on-Joint Piping:

1. Pipe: AWWA C151.
2. Standard Fittings: AWWA C110, ductile or gray iron.
3. Compact Fittings: AWWA C153.
4. Gaskets: AWWA C111, rubber, of shape matching pipe and fittings.

B. Mechanical-Joint Piping:

1. Pipe: AWWA C151, with bolt holes in bell.
2. Standard Fittings: AWWA C110, ductile or gray iron, with bolt holes in bell.
3. Compact Fittings: AWWA C153, with bolt holes in bells.
4. Glands: Cast or ductile iron; with bolt holes and high-strength, cast-iron or high-strength, low-alloy steel bolts and nuts.
5. Gaskets: AWWA C111, rubber, of shape matching pipe, fittings, and glands.

2.4 NON-PRESSURE-TYPE TRANSITION COUPLINGS

A. Comply with ASTM C 1173, elastomeric, sleeve-type, reducing or transition coupling, for joining different underground non-pressure piping. Include ends of same sizes as piping to be joined and corrosion-resistant-metal tension band and tightening mechanism on each end.

B. Connect to site sewer or drainage piping 10 feet outside of the building with proper transition coupling.

C. Sleeve Materials:

1. For Cast-Iron Soil Pipes: ASTM C 564, rubber.
2. For Concrete Pipes: ASTM C 443, rubber.
3. For Fiberglass Pipes: ASTM F 477, elastomeric seal or ASTM D 5926, PVC.
4. For Plastic Pipes: ASTM F 477, elastomeric seal or ASTM D 5926, PVC.
5. For Dissimilar Pipes: ASTM D 5926, PVC or other material compatible with pipe materials being joined.

D. Unshielded, Flexible Couplings:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Dallas Specialty & Mfg. Co.
b. Fernco Inc.
c. Logan Clay Pipe.
d. Mission Rubber Company, LLC; a division of MCP Industries.

e. NDS Inc.
f. Plastic Oddities.

2. Description: Elastomeric sleeve with stainless-steel shear ring and corrosion-resistant-metal tension band and tightening mechanism on each end.

E. Shielded, Flexible Couplings:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Cascade Waterworks Mfg. Co.
b. Dallas Specialty & Mfg. Co.
c. Mission Rubber Company, LLC; a division of MCP Industries.

2. Description: ASTM C 1460, elastomeric or rubber sleeve with full-length, corrosion-resistant outer shield and corrosion-resistant-metal tension band and tightening mechanism on each end.

F. Ring-Type, Flexible Couplings:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Fernco Inc.
b. Logan Clay Pipe.
c. Mission Rubber Company, LLC; a division of MCP Industries.

2. Description: Elastomeric compression seal with dimensions to fit inside bell of larger pipe and for spigot of smaller pipe to fit inside ring.

G. Non-pressure-Type, Rigid Couplings:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:

a. ANACO-Husky.

2. Description: ASTM C 1461, sleeve-type, reducing- or transition-type mechanical coupling, molded from ASTM C 1440, TPE material; with corrosion-resistant-metal tension band and tightening mechanism on each end.

2.5 PRESSURE-TYPE PIPE COUPLINGS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. Cascade Waterworks Mfg. Co.
2. Dresser, Inc.

3. Smith, Jay R. Mfg. Co.
4. Victaulic Company.
5. Viking Johnson.

B. Tubular-Sleeve Couplings: AWWA C219, with center sleeve, gaskets, end rings, and bolt fasteners.

C. Metal, bolted, sleeve-type, reducing or transition coupling, for joining underground pressure piping. Include 150-psig minimum pressure rating and ends of same sizes as piping to be joined.

D. Center-Sleeve Material: Manufacturer's standard .

E. Gasket Material: Natural or synthetic rubber.

F. Metal Component Finish: Corrosion-resistant coating or material.

2.6 EXPANSION JOINTS AND DEFLECTION FITTINGS

A. Ductile-Iron, Flexible Expansion Joints:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

   a. EBAA Iron, Inc.
   b. Romac Industries, Inc.
   c. Star Pipe Products.

2. Description: Compound fitting with combination of flanged and mechanical-joint ends complying with AWWA C110 or AWWA C153. Include two gasketed ball-joint sections and one or more gasketed sleeve sections, rated for 250-psig minimum working pressure and for offset and expansion indicated.

2.7 ENCASEMENT FOR PIPING

A. Standard: ASTM A 674 or AWWA C105.

B. Material: high-density, cross-laminated polyethylene film of 0.004-inch minimum thickness.

C. Form: Sheet or tube.

D. Color: Black or natural.

PART 3 - EXECUTION

3.1 EARTHWORK

A. Excavating, trenching, and backfilling are specified in Division 31.

3.2 PIPING INSTALLATION

A. General Locations and Arrangements: Drawing plans and details indicate general location and arrangement of underground sanitary sewer piping. Location and arrangement of piping layout take into account design considerations. Install piping as indicated, to extent practical. Where specific installation is not indicated, follow piping manufacturer's written instructions.

B. Install piping beginning at low point, true to grades and alignment indicated with unbroken continuity of invert. Place bell ends of piping facing upstream. Install gaskets, seals, sleeves, and couplings according to manufacturer's written instructions for using lubricants, cements, and other installation requirements.

C. Install manholes for changes in direction unless fittings are indicated. Use fittings for branch connections unless direct tap into existing sewer is indicated.

D. Install proper size increasers, reducers, and couplings where different sizes or materials of pipes and fittings are connected. Reducing size of piping in direction of flow is prohibited.

E. When installing pipe under streets or other obstructions that cannot be disturbed, use pipe-jacking process of micro tunneling.

F. Install gravity-flow, non-pressure, drainage piping according to the following:

1. Install piping pitched down in direction of flow, at minimum slope of 1 percent unless otherwise indicated.
2. Install piping NPS 6 and larger with restrained joints at tee fittings and at changes in direction. Use corrosion-resistant rods, pipe or fitting manufacturer's proprietary restraint system, or cast-in-place-concrete supports or anchors.
3. Install piping with 48-inch minimum cover.
4. Install hub-and-spigot, cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook."
5. Install ductile-iron, gravity sewer piping according to ASTM A 746.
6. Install PVC cellular-core sewer piping according to ASTM D 2321 and ASTM F 1668.
7. Install PVC corrugated sewer piping according to ASTM D 2321 and ASTM F 1668.
8. Install PVC profile sewer piping according to ASTM D 2321 and ASTM F 1668.
9. Install PVC Type PSM sewer piping according to ASTM D 2321 and ASTM F 1668.
10. Install PVC gravity sewer piping according to ASTM D 2321 and ASTM F 1668.
11. Install fiberglass sewer piping according to ASTM D 3839 and ASTM F 1668.
12. Install non-reinforced-concrete sewer piping according to ASTM C 1479 and ACPA's "Concrete Pipe Installation Manual."
13. Install reinforced-concrete sewer piping according to ASTM C 1479 and ACPA's "Concrete Pipe Installation Manual."

G. Install force-main, pressure piping according to the following:

1. Install piping with restrained joints at tee fittings and at horizontal and vertical changes in direction. Use corrosion-resistant rods, pipe or fitting manufacturer's proprietary restraint system, or cast-in-place-concrete supports or anchors.
2. Install piping with 48-inch minimum cover.
3. Install ductile-iron pressure piping according to AWWA C600 or AWWA M41.
4. Install ductile-iron special fittings according to AWWA C600.
5. Install PVC pressure piping according to AWWA M23 or to ASTM D 2774 and ASTM F 1668.
6. Install PVC water-service piping according to ASTM D 2774 and ASTM F 1668.

3.3 PIPE JOINT CONSTRUCTION

A. Join gravity-flow, non-pressure, drainage piping according to the following:

1. Join hub-and-spigot, cast-iron soil piping with gasket joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for compression joints.
2. Join ductile-iron, gravity sewer piping according to AWWA C600 for push-on joints.
3. Join PVC cellular-core sewer piping according to ASTM D 2321 and ASTM F 891 for solvent-cemented joints.
4. Join PVC corrugated sewer piping according to ASTM D 2321.
5. Join PVC profile sewer piping according to ASTM D 2321 for elastomeric-seal joints or ASTM F 794 for gasketed joints.
6. Join PVC Type PSM sewer piping according to ASTM D 2321 and ASTM D 3034 for elastomeric-seal joints or ASTM D 3034 for elastomeric-gasket joints.
7. Join PVC gravity sewer piping according to ASTM D 2321 and ASTM D 3034 for elastomeric-seal joints or ASTM D 3034 for elastomeric-gasket joints.
8. Join fiberglass sewer piping according to ASTM D 4161 for elastomeric-seal joints.
9. Join non-reinforced-concrete sewer piping according to ASTM C 14 and ACPA's "Concrete Pipe Installation Manual" for rubber-gasket joints.
10. Join reinforced-concrete sewer piping according to ACPA's "Concrete Pipe Installation Manual" for rubber-gasket joints.
11. Join dissimilar pipe materials with non-pressure-type, flexible or rigid couplings.

B. Join force-main, pressure piping according to the following:

1. Join ductile-iron pressure piping according to AWWA C600 or AWWA M41 for push-on joints.
2. Join ductile-iron special fittings according to AWWA C600 or AWWA M41 for push-on joints.
3. Join PVC pressure piping according to AWWA M23 for gasketed joints.
4. Join PVC water-service piping according to ASTM D 2855.
5. Join dissimilar pipe materials with pressure-type couplings.

C. Pipe couplings, expansion joints, and deflection fittings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.

1. Use non-pressure flexible couplings where required to join gravity-flow, non-pressure sewer piping unless otherwise indicated.

    a. Shielded flexible or rigid couplings for pipes of same or slightly different OD.
    b. Unshielded, increaser/reducer-pattern, flexible or rigid couplings for pipes with different OD.

c. Ring-type flexible couplings for piping of different sizes where annular space between smaller piping's OD and larger piping's ID permits installation.

2. Use pressure pipe couplings for force-main joints.

3.4 CONNECTIONS

A. Connect non-pressure, gravity-flow drainage piping to building's sanitary building drains specified in Division 22.

B. Connect force-main piping to building's sanitary force mains specified in Division 22. Terminate piping where indicated.

C. Make connections to existing piping and underground manholes.

1. Use commercially manufactured wye fittings for piping branch connections. Remove section of existing pipe, install wye fitting into existing piping, and encase entire wye fitting plus 6-inch overlap with not less than 6 inches of concrete with 28-day compressive strength of 3000 psi.
2. Make branch connections from side into existing piping, NPS 4 to NPS 20. Remove section of existing pipe, install wye fitting into existing piping, and encase entire wye with not less than 6 inches of concrete with 28-day compressive strength of 3000 psi.
3. Make branch connections from side into existing piping, NPS 21 or larger, or to underground manholes by cutting opening into existing unit large enough to allow 3 inches of concrete to be packed around entering connection. Cut end of connection pipe passing through pipe or structure wall to conform to shape of and be flush with inside wall unless otherwise indicated. On outside of pipe or manhole wall, encase entering connection in 6 inches of concrete for minimum length of 12 inches to provide additional support of collar from connection to undisturbed ground.

    a. Use concrete that will attain a minimum 28-day compressive strength of 3000 psi unless otherwise indicated.
    b. Use epoxy-bonding compound as interface between new and existing concrete and piping materials.

4. Protect existing piping and manholes to prevent concrete or debris from entering while making tap connections. Remove debris or other extraneous material that may accumulate.

D. Connect to grease oil and sand interceptors specified in Division 22.

3.5 IDENTIFICATION

A. Comply with requirements in Division 31 for underground utility identification devices. Arrange for installation of green warning tapes directly over piping and at outside edges of underground manholes.

1. Use detectable warning tape over ferrous piping.
2. Use detectable warning tape over nonferrous piping and over edges of underground manholes.

3.6 FIELD QUALITY CONTROL

A. Inspect interior of piping to determine whether line displacement or other damage has occurred. Inspect after approximately 24 inches of backfill is in place, and again at completion of Project.

1. Submit separate report for each system inspection.
2. Defects requiring correction include the following:

    a. Alignment: Less than full diameter of inside of pipe is visible between structures.
    b. Damage: Crushed, broken, cracked, or otherwise damaged piping.
    c. Infiltration: Water leakage into piping.
    d. Exfiltration: Water leakage from or around piping.

3. Replace defective piping using new materials, and repeat inspections until defects are within allowances specified.
4. Reinspect and repeat procedure until results are satisfactory.

B. Test new piping systems, and parts of existing systems that have been altered, extended, or repaired, for leaks and defects.

1. Do not enclose, cover, or put into service before inspection and approval.
2. Test completed piping systems according to requirements of authorities having jurisdiction.
3. Schedule tests and inspections by authorities having jurisdiction with at least 24 hours advance notice.
4. Submit separate report for each test.
5. Hydrostatic Tests: Test sanitary sewerage according to requirements of authorities having jurisdiction and the following:

    a. Fill sewer piping with water. Test with pressure of at least 10-foot head of water, and maintain such pressure without leakage for at least 15 minutes.
    b. Close openings in system and fill with water.
    c. Purge air and refill with water.
    d. Disconnect water supply.
    e. Test and inspect joints for leaks.

6. Force Main: Perform hydrostatic test after thrust blocks, supports, and anchors have hardened. Test at pressure not less than 1-1/2 times the maximum system operating pressure, but not less than 150 psig .

    a. Ductile-Iron Piping: Test according to AWWA C600, "Hydraulic Testing" Section.
    b. PVC Piping: Test according to AWWA M23, "Testing and Maintenance" Chapter.

C. Leaks and loss in test pressure constitute defects that must be repaired.

D. Replace leaking piping using new materials, and repeat testing until leakage is within allowances specified.

3.7 CLEANING

A. Clean dirt and superfluous material from interior of piping. Flush with potable water.

END OF SECTION

SECTION 221319 - SANITARY WASTE PIPING SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Backwater valves.
2. Cleanouts.
3. Floor drains.
4. Trench drains.
5. Channel drainage systems.
6. Roof flashing assemblies.
7. Through-penetration firestop assemblies.
8. Miscellaneous sanitary drainage piping specialties.
9. Flashing materials.

B. Related Requirements:

1. Division 33 for storm draining piping and piping specialties outside the building.

1.3 DEFINITIONS

A. ABS: Acrylonitrile-butadiene-styrene plastic.

B. FOG: Fats, oils, and greases.

C. FRP: Fiberglass-reinforced plastic.

D. PE: Polyethylene plastic.

E. PP: Polypropylene plastic.

F. HDPE: High-density polyethylene plastic.

G. PVC: Polyvinyl chloride plastic.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, and accessories for the following:

1. FOG disposal systems.
2. Grease interceptors.
3. Grease removal devices.
4. Oil interceptors.

A. Shop Drawings: Show fabrication and installation details for frost-resistant vent terminals.

1. Wiring Diagrams: Power, signal, and control wiring.

1.5 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For drainage piping specialties to include in emergency, operation, and maintenance manuals.

1.7 QUALITY ASSURANCE

A. Drainage piping specialties shall bear label, stamp, or other markings of specified testing agency.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. Comply with NSF 14, "Plastics Piping Components and Related Materials," for plastic sanitary piping specialty components.

1.8 COORDINATION

A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

B. Coordinate size and location of roof penetrations.

1.9 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Cultures: Provide 1-gal. bottles of bacteria culture recommended by manufacturer of FOG disposal systems equal to 200 percent of amount installed, but no fewer than two 1-gal. bottles.

PART 2 - PRODUCTS

2.1 BACKWATER VALVES

A. General

1. Finish for all cleanouts and drain tops exposed to view shall be Brushed Chrome

B. Horizontal, Cast-Iron Backwater Valves:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. MIFAB, Inc.

b. Smith, Jay R. Mfg. Co.

c. Watts; a Watts Water Technologies company.

d. Zurn Industries, LLC.

2. Standard: ASME A112.14.1.
3. Size: Same as connected piping.
4. Body: Cast iron.
5. Cover: Cast iron with bolted or threaded access check valve.
6. End Connections: Hub and spigot or hubless.
7. Type Check Valve: Removable, bronze, swing check, factory assembled or field modified to hang open for airflow unless subject to backflow condition.
8. Extension: ASTM A 74, Service class; full-size, cast-iron, soil-pipe extension to field-installed cleanout at floor; replaces backwater valve cover.

C. Drain-Outlet Backwater Valves:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Josam Company.

b. Smith, Jay R. Mfg. Co.

c. Watts; a Watts Water Technologies company.

d. Zurn Industries, LLC.

2. Size: Same as floor drain outlet.
3. Body: Cast iron or bronze made for vertical installation in bottom outlet of floor drain.
4. Check Valve: Removable ball float.
5. Inlet: Threaded.
6. Outlet: Threaded or spigot.

2.2 CLEANOUTS

A. Exposed Metal Cleanouts :

1. ASME A112.36.2M, Cast-Iron Cleanouts:

a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1) Smith, Jay R. Mfg. Co.

2) Watts; a Watts Water Technologies company.

3) Zurn Industries, LLC.

2. ASME A112.3.1, Stainless-Steel Cleanouts:

a. Use Stainless Steel cleanouts for all stainless piping systems installed.

b. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1) Blucher Corp.

2) Josam Company.

3) JR Smith.

4) Zurn.

3. Standard: ASME A112.36.2M for cast iron ASME A112.3.1 for stainless steel for cleanout test tee.
4. Size: Same as connected drainage piping
5. Body Material: as required to match connected piping.
6. Closure: Countersunk or raised-head, brass plug.
7. Closure Plug Size: Same as or not more than one size smaller than cleanout size.
8. Closure: Stainless-steel plug with seal.

B. Metal Floor Cleanouts :

1. ASME A112.36.2M, Cast-Iron Cleanouts:

   a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

      1) Sioux Chief Manufacturing Company, Inc.

      2) Smith, Jay R. Mfg. Co.

      3) Watts; a Watts Water Technologies company.

      4) Zurn Industries, LLC.

2. ASME A112.36.2M, Stainless-Steel Cleanouts:

   a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

      1) Blucher Corp.

      2) Josam Company.

      3) Smith, Jay R. Mfg. Co.

      4) Zurn Industries, LLC.

3. Standard: ASME A112.36.2M for heavy-duty, adjustable housing cleanout Size: Same as connected branch**.**
4. **Type:** Threaded, adjustable housing.
5. Body or Ferrule: Stainless steel.
6. Closure: Brass plug with straight threads and gasket Brass plug with tapered threads.
7. Adjustable Housing Material: Cast iron with threads set-screws or other device. Frame and Cover Material and Finish: Nickel-bronze, copper alloy for all finished areas Painted Caste Iron or Rough bronze for Utility areas and Stainless steel in areas subject to corrosion Frame and Cover Shape: Square .
8. Top Loading Classification: Extra Heavy Heavy Duty.
9. Riser: ASTM A 74, Extra-Heavy Service class, cast-iron drainage pipe fitting and riser to clean out.
10. Standard: ASME A112.3.1.
11. Size: Same as connected branch.
12. Housing: Stainless steel.
13. Closure: Stainless steel with seal.
14. Riser: Stainless-steel drainage pipe fitting to clean out.

C. Cast-Iron Wall Cleanouts :

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

   a. MIFAB, Inc.

b. Smith, Jay R. Mfg. Co.

c. Watts; a Watts Water Technologies company.

d. Zurn Industries, LLC.

2. Standard: ASME A112.36.2M. Include wall access.
3. Size: Same as connected drainage piping.
4. Body: as required to match connected piping.
5. Closure: Countersunk or raised-head, drilled-and-threaded brass plug.
6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.
7. Wall Access: Square, wall-installation frame and cover.

D. Plastic Floor Cleanouts :

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. IPS Corporation.

b. Plastic Oddities.

c. Sioux Chief Manufacturing Company, Inc.

d. Zurn Industries, LLC.

2. Size: Same as connected branch.
3. Body: PVC.
4. Closure Plug: PVC.
5. Riser: Drainage pipe fitting and riser to clean out of same material as drainage piping.

2.3 FLOOR DRAINS

A. Cast-Iron Floor Drains :

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. MIFAB, Inc.

b. Smith, Jay R. Mfg. Co.

c. Watts; a Watts Water Technologies company.

d. Zurn Industries, LLC.

B. Stainless-Steel Floor Drains :

1. ASME A112.6.3, Stainless-Steel Floor Drains:

a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1) Josam Company.

2) Smith, Jay R. Mfg. Co.

3) Watts; a Watts Water Technologies company.

4) Zurn Industries, LLC.

2.4 TRENCH DRAINS

A. Trench Drains :

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Josam Company.

b. MIFAB, Inc.

c. Smith, Jay R. Mfg. Co.

d. Tyler Pipe; a subsidiary of McWane Inc.

e. Watts; a Watts Water Technologies company.

f. Zurn Industries, LLC.

2. Standard: ASME A112.6.3 for trench drains.
3. Material: Ductile or gray iron.
4. Flange:
5. Clamping Device:
6. Outlet:Side
7. Grate Material: Stainless steel .
8. Grate Finish: **cast iron in mechanical rooms or brushed chrome in exposed to view areas**
9. Top Loading Classification: Extra Heavy-Duty .
10. Trap Material: **match piping system**
11. Trap Pattern: Standard P-trap.

2.5 ROOF FLASHING ASSEMBLIES

A. Roof Flashing Assemblies :

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

   a. Acorn Engineering Company.

   b. Thaler Metal Industries Ltd.

   c. Zurn Industries, LLC.

2. Description: Manufactured assembly made of 4.0-lb/sq. ft., 0.0625-inch- OR 6.0-lb/sq. ft., 0.0938-inch- thick, lead flashing collar and skirt extending at least 10 inches from pipe, with galvanized-steel boot reinforcement and counter flashing fitting.

   a. Extended Vent Cap: With field-installed, vandal-proof vent cap.

2.6 THROUGH-PENETRATION FIRESTOP ASSEMBLIES

A. Through-Penetration Firestop Assemblies :

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

   a. ProSet Systems Inc.

   b. Hilti

   c. 3M

2. Standard: UL 1479 assembly of sleeve and stack fitting with firestopping plug.
3. Size: Same as connected soil, waste, or vent stack.
4. Sleeve: Molded PVC plastic, of length to match slab thickness and with integral nailing flange on one end for installation in cast-in-place concrete slabs.
5. Stack Fitting: ASTM A 48/A 48M, gray-iron, hubless-pattern, wye branch with neoprene O-ring at base and gray-iron plug in thermal-release harness. Include PVC protective cap for plug.
6. Special Coating: Corrosion resistant on interior of fittings.

2.7 MISCELLANEOUS SANITARY DRAINAGE PIPING SPECIALTIES

A. Open Drains :

1. Description: Shop or field fabricate from ASTM A 74, Service class, hub-and-spigot, cast-iron, soil-pipe fittings. Include P-trap, hub-and-spigot riser section; and where required, increaser fitting joined with ASTM C 564, rubber gaskets.
2. Size: Same as connected waste piping with increaser fitting two sizes larger than connected pipe.

B. Deep-Seal Traps :

1. Description: Cast-iron or bronze casting, with inlet and outlet matching connected piping and cleanout trap-seal primer valve connection.
2. Size: Same as connected waste piping.

    a. NPS 2: 4-inch- minimum water seal.
    b. NPS 2-1/2 and Larger: 5-inch- minimum water seal.

C. Floor-Drain, Trap-Seal Primer Fittings :

1. Description: Cast iron, with threaded inlet and threaded or spigot outlet, and trap-seal primer valve connection.
2. Size: Same as floor drain outlet with NPS 1/2 side inlet.

D. Air-Gap Fittings :

1. Standard: ASME A112.1.2, for fitting designed to ensure fixed, positive air gap between installed inlet and outlet piping.
2. Body: Bronze or cast iron.
3. Inlet: Opening in top of body.
4. Outlet: Larger than inlet.
5. Size: Same as connected waste piping and with inlet large enough for associated indirect waste piping.

E. Sleeve Flashing Device :

1. Description: Manufactured, cast-iron fitting, with clamping device that forms sleeve for pipe floor penetrations of floor membrane. Include galvanized-steel pipe extension in top of fitting that will extend 1 inch above finished floor and galvanized-steel pipe extension in bottom of fitting that will extend through floor slab.
2. Size: As required for close fit to riser or stack piping.

F. Stack Flashing Fittings :

1. Description: Counter flashing-type, cast-iron fitting, with bottom recess for terminating roof membrane, and with threaded or hub top for extending vent pipe.
2. Size: Same as connected stack vent or vent stack.

G. Vent Caps :

1. Description: Cast-iron body with threaded or hub inlet and vandal-proof design. Include vented hood and setscrews to secure to vent pipe.
2. Size: Same as connected stack vent or vent stack.

H. Expansion Joints :

1. Standard: ASME A112.21.2M.
2. Body: Cast iron with bronze sleeve, packing, and gland.
3. End Connections: Matching connected piping.
4. Size: Same as connected soil, waste, or vent piping.

2.8 FLASHING MATERIALS

A. Copper Sheet: ASTM B 152/B 152M, of the following minimum weights and thicknesses, unless otherwise indicated:

1. General Applications: 12 oz. /sq. ft..
2. Vent Pipe Flashing: 8 oz. /sq. ft..

B. Zinc-Coated Steel Sheet: ASTM A 653/A 653M, with 0.20 percent copper content and 0.04-inch minimum thickness, unless otherwise indicated. Include G90 hot-dip galvanized, mill-phosphatized finish for painting if indicated.

C. Elastic Membrane Sheet: ASTM D 4068, flexible, chlorinated polyethylene, 40-mil minimum thickness.

D. Fasteners: Metal compatible with material and substrate being fastened.

E. Metal Accessories: Sheet metal strips, clamps, anchoring devices, and similar accessory units required for installation; matching or compatible with material being installed.

F. Solder: ASTM B 32, lead-free alloy.

G. Bituminous Coating: SSPC-Paint 12, solvent-type, bituminous mastic.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Equipment Mounting:

1. Install FOG disposal systems grease interceptors grease removal devices and solids interceptors on cast-in-place concrete equipment bases. Comply with requirements for equipment bases and foundations specified in Division 03.
2. Comply with requirements for vibration isolation control devices specified in Division 22.

B. Install backwater valves in building drain piping. For interior installation, provide cleanout deck plate flush with floor and centered over backwater valve cover, and of adequate size to remove valve cover for servicing.

C. Install cleanouts in aboveground piping and building drain piping according to the following, unless otherwise indicated:

1. Size same as drainage piping up to NPS 4. Use NPS 4 for larger drainage piping unless larger cleanout is indicated.
2. Locate at each change in direction of piping greater than 45 degrees.
3. Locate at minimum intervals of 50 feet for piping NPS 4 and smaller and 100 feet for larger piping.
4. Locate at base of each vertical soil and waste stack.

D. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.

E. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.

F. Install floor drains at low points of surface areas to be drained. Set grates of drains flush with finished floor, unless otherwise indicated.

1. Position floor drains for easy access and maintenance.
2. Set floor drains below elevation of surrounding finished floor to allow floor drainage. Set with grates depressed according to the following drainage area radii:

    a. Radius, 30 Inches or Less: Equivalent to 1 percent slope, but not less than 1/4-inch total depression.
    b. Radius, 30 to 60 Inches: Equivalent to 1 percent slope.
    c. Radius, 60 Inches or Larger: Equivalent to 1 percent slope, but not greater than 1-inch total depression.

3. Install floor-drain flashing collar or flange so no leakage occurs between drain and adjoining flooring. Maintain integrity of waterproof membranes where penetrated.
4. Install individual traps for floor drains connected to sanitary building drain, unless otherwise indicated.

G. Install trench drains at low points of surface areas to be drained. Set grates of drains flush with finished surface, unless otherwise indicated.

H. Install roof flashing assemblies on sanitary stack vents and vent stacks that extend through roof.

I. Install through-penetration firestop assemblies in plastic conductors and stacks at floor penetrations.

J. Assemble open drain fittings and install with top of hub 2 inches above floor.

K. Install deep-seal traps on floor drains and other waste outlets, if indicated.

L. Install floor-drain, trap-seal primer fittings on inlet to floor drains that require trap-seal primer connection.

1. Exception: Fitting may be omitted if trap has trap-seal primer connection.
2. Size: Same as floor drain inlet.

M. Install air-gap fittings on draining-type backflow preventers and on indirect-waste piping discharge into sanitary drainage system.

N. Install sleeve flashing device with each riser and stack passing through floors with waterproof membrane.

O. Install vent caps on each vent pipe passing through roof.

P. Install expansion joints on vertical stacks and conductors. Position expansion joints for easy access and maintenance.

Q. Install wood-blocking reinforcement for wall-mounting-type specialties.

R. Install traps on plumbing specialty drain outlets. Omit traps on indirect wastes unless trap is indicated.

3.2 CONNECTIONS

A. Install piping adjacent to equipment to allow service and maintenance.

B. FOG Disposal Systems: Connect inlet and outlet to unit, connect flow-control fitting and fresh-air inlet piping to unit inlet piping, and connect vent piping between trap and media chamber. Connect electrical power.

C. Ground equipment according to Division 26.

D. Connect wiring according to Division 26.

3.3 RUBBER TRAP SLEEVE INSTALLATION:

A. Product shall be installed in accordance with the Manufacturer's instructions and the requirements of the applicable codes. Device can be installed inside other manufacturer's drain tail pieces or optionally inside 2", 3" or 4" pipe that connects the various types of floor or hub drains. If a T&P relief valve is discharged into the Trap Guard device, it must be discharged into the center opening of the device. A strainer with a center hole is available for that purpose.

B. Protect the elastomeric device materials from being touched with solvent cement or primers during installation. Protect material from being distorted or damaged during storage, handling and installation.

C. Test Methods And Performance Requirements:

1. The Elastomeric membrane material shall be field pressure tested to determine the back pressure of the device to hold back compressed air from 1 inch WC and then increased to 2 inch WC with no leakage.
2. Testing shall be performed to verify that a plumbing snake can be effectively used with the Trap Guard device installed. For a typical 4" diameter floor drain, a 1-1/2" PVC pipe shall be inserted the entire length of the device with lubrication to provide an adequate pathway for a plumbing snake.
3. Testing shall be performed to determine the maximum water flow the device could accommodate using an electric sump pump and a portable water reservoir. The pump discharge shall be into the Trap Guard device installed into a simulated drain assembly. Test acceptance is 30 GPM.

D. Commission the device by flushing out thoroughly with clear warm water.

3.4 FLASHING INSTALLATION

A. Fabricate flashing from single piece unless large pans, sumps, or other drainage shapes are required. Join flashing according to the following if required:

1. Copper Sheets: Solder joints of copper sheets.

B. Install sheet flashing on pipes, sleeves, and specialties passing through or embedded in floors and roofs with waterproof membrane.

1. Pipe Flashing: Sleeve type, matching pipe size, with minimum length of 10 inches, and skirt or flange extending at least 8 inches around pipe.
2. Sleeve Flashing: Flat sheet, with skirt or flange extending at least 8 inches around sleeve.
3. Embedded Specialty Flashing: Flat sheet, with skirt or flange extending at least 8 inches around specialty.

C. Set flashing on floors and roofs in solid coating of bituminous cement.

D. Secure flashing into sleeve and specialty clamping ring or device.

E. Install flashing for piping passing through roofs with counter flashing or commercially made flashing fittings, according to Division 07.

F. Fabricate and install flashing and pans, sumps, and other drainage shapes.

G. \Penthouse and containment floor drains

1. Provide waterproofing membrane extending a minimum of 12 inches from drain in all directions
2. Extend waterproofing membrane into seepage pan and secure with clamping collar
3. Provide underdeck clamp on thin slab installations of 5 inches or less, above grade installations only. Secure clamp to drain.

3.5 LABELING AND IDENTIFYING

A. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplate or sign on or near each of the following:

1. Backwater valves.

B. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit. Nameplates and signs are specified in Division 22.

3.6 FIELD QUALITY CONTROL

A. Perform tests and inspections and prepare test reports.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect field-assembled FOG disposal systems and their installation, including piping and electrical connections, and to assist in testing.

B. Tests and Inspections:

1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

3.7 PROTECTION

A. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.

B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

3.8 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain FOG disposal systems. Refer to Division 01.

END OF SECTION

SECTION 221323 - SANITARY WASTE INTERCEPTORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Interior or exterior plastic tank grease interceptor
2. Oil Interceptors

1.3 DEFINITIONS

A. FRP: Fiberglass-reinforced plastic.

B. PP: Polypropylene plastic.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of metal and plastic interceptor indicated. Include materials of fabrication, dimensions, rated capacities, retention capacities, operating characteristics, size and location of each pipe connection, furnished specialties, and accessories.

B. Shop Drawings: For each type and size of precast-concrete interceptor indicated.

1. Include materials of construction, dimensions, rated capacities, retention capacities, location and size of each pipe connection, furnished specialties, and accessories.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Interceptors, drawn to scale, on which the following items are shown and coordinated with each other, based on input from Installers of the items involved:

1. Interceptors.
2. Piping connections. Include size, location, and elevation of each.
3. Interface with underground structures and utility services.

1.6 PROJECT CONDITIONS

A. Interruption of Existing Sewer Services: Do not interrupt services to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary sewer services according to requirements indicated:

1. Notify Architect Construction Manager Owner no fewer than five business days in advance of proposed interruption of service.
2. Do not proceed with interruption of sewer services without Architect's Construction Manager's Owner's written permission.

PART 2 - PRODUCTS

2.1 INTERIOR OR EXTERIOR PLASTIC TANK GREASE INTERCEPTOR

A. Interior Thermoplastic Tank Grease Intercepting System

1. Manufacturers: Subject to compliance with requirements, Provide products by the following:
   a. Schier Products Company.
2. Basis-of-Design Product: Subject to compliance with requirements, provide Schier model GB-250. Eight units as piped on drawings required

B. Capacities and Characteristics:

1. Number of Units: .eight
2. Retention Capacity: .
3. Inlet and Outlet Pipe Size: see drawings
4.
5. Installation Position: Above Ground.

2.2 INTERIOR OIL INTERCEPTOR

A. General

1. Highland Tank Model HTC-350 Series-G - Oil/Water Separator with Integral Sand Interceptor Compartment UL-SU2215 Approved with Corella® Coalescer, Single-wall Construction with the HighGuard Protection System for underground installation
2. The separator shall be designed for gravity separation of sand, grit, settleable solids, or semisolids, and free oils (hydrocarbons and other petroleum products) from wastewater associated with in place operations. Separator shall be installed belowground with top access at or above grade level. The source of the influent to the separator shall be gravity flow from storm water runoff, hydrocarbon spills, and/or cleaning/maintenance operations

B. Performance

1. Provide Separator designed for intermittent and variable flows of water, oil, or any combination of non-emulsified oil-water mixtures ranging from zero to 35 gal/min. Minimum separator retention time shall be 10 minutes. Operating temperatures of the influent oil in water mixture shall range from 40 degrees F. to 80 degrees F. The specific gravity of the oils at operating temperatures shall range from 0.71 to 0.92. The specific gravity of the fresh water at operating temperatures shall range from 1.00 to 1.03.l
2. The free oil and grease concentration in the effluent from the separator shall not exceed 10 mg/l (10 PPM) to satisfy requirements of the NPDES stormwater discharge permit. To achieve this goal, it will be necessary to remove all free oil droplets equal to and greater than 20 microns

C. Design Criteria

1. The separator shall be listed to Underwriter's Laboratories UL-SU2215. Construction and performance of the oil/water separators must be in accordance with UL-SU2215. Provide certification documentation detailing criteria under which the system was tested. UL-SU2215 label shall be prominently displayed on manway covers.
2. Separator shall be designed in accordance with Stokes Law and the American Petroleum Institute Publication 421, "Monographs on Refinery Environmental Control - Management of Water Discharges; Design and Operation of Oil/Water Separators." Effective surface area calculations, signed and stamped by a Registered Professional Engineer shall be submitted to document specified effluent quality based on complete removal of the specified oil globule at design flow. A separator with lower effective surface area than required is not permissible.
3. Separator capacities, dimensions, construction, and thickness shall be in strict accordance with Underwriters Laboratories, Subject UL-58 Standard for Safety, Steel Underground Tanks for Flammable and Combustible Liquids, September 30, 1997, Single Wall construction.
4. Separator Corrosion Control System shall be in strict accordance with Underwriters Laboratories Inc. Subject UL-1746 Standard for External Corrosion Protection Systems for Steel Underground Storage Tanks and HighGuard® External Corrosion Protection Specifications.
5. Oil/water separator shall comply with National Fire Protection Association NFPA 30 Flammable and Combustible Liquids Code, 2003 Edition.
6. Separator vessel volume shall allow for a hydraulic retention time of ten (10) minutes to ensue laminar flow conditions which result in hydraulic uniformity and high effluent quality. Volume reduction will adversely affect separator performance by increasing horizontal velocity and turbulence, therefore a separator of smaller volume is not permissible.
7. Separator shall be the standard patented product of a steel tank manufacturer regularly engaged in the production of such equipment. Manufacturer shall have at least 15 years experience in manufacturing similar units for identical applications. No subcontracting of tank fabrication shall be permitted.
8. Separator shall be fabricated, inspected, and tested for leakage before shipment from the factory by manufacturer as a completely assembled vessel ready for installation.
9. Separator shall be cylindrical, horizontal, atmospheric-type steel vessel intended for the separation and storage of flammable and combustible liquids. The separator shall have the structural strength to withstand static and dynamic hydraulic loading while empty and during operating conditions. The Oil/Water Separator's dimensions and thickness shall

be in strict compliance with Roark's Formulas for Stress and Strain as presented in UL 58, September 30, 1997. Calculations, signed and stamped by a Registered Professional Engineer shall be submitted to document structural strength under specified overbearing or external pressure. A separator with a reduced shell thickness is not permissible.

10. Separator shall have an oil storage capacity equal to about 43% of the total vessel volume and an emergency oil spill capacity equal to 80% of the total vessel volume.

11. To prevent extensive shutdown and maintenance, the separator design must allow solids to fall unhindered by turbulence, and oil droplets to rise without risk of re-emulsifying due to collisions with interfering solids. The use of plastic perforated tubes, spherical balls, or irregular shaped media will increase the facility's maintenance costs and shall not be permitted.

12. Separator shall consist of inlet and outlet connections, integral sand interceptor compartment, non-clogging flow distributor and energy dissipater device, stationary under flow baffle, presettling chamber for solids, sludge baffle, oil coalescing chamber with removable parallel flat/corrugated plate coalescer, with removable plates, and sectionalized removable polypropylene impingement coalescers to optimize separation of free oil from water, effluent downcomer positioned to prevent discharge of free oil that has been separated from the water, access ways for coalescers and each chamber, fittings for vent, oil pump-out, sampling, gauging, and lifting lugs.

D. Description

1. Separator shall be standard prefabricated inclined parallel flat/corrugated plate, gravity displacement type unit.

2. Separator shall be cylindrical with capacities, dimensions, construction, and thickness in strict accordance with Underwriters Laboratories Subject 58, Single Wall construction using flat-flanged heads. Separator shall comply with National Fire Protection Association NFPA 30 Flammable and Combustible Liquids Code, 2003 Edition.

3. The separator shall be a pre-packaged, pre-engineered, ready to install unit consisting of:

4. An influent connection 4" inch, flanged. An internal influent nozzle at the inlet end of the separator. Nozzle discharge to be located at the furthest diagonal point from the effluent discharge opening.

5. A 216 gallon integral sand interceptor compartment containing one (1) manhole, UL approved, complete with extension, cover, gasket, and bolts. A heavy-duty bulkhead shall retain sand, grit, settleable solids or semisolids and prevent them from entering the separation chamber. Bulkhead shall have inch transfer pipe.

6. A velocity head diffusion baffle at the inlet to:

   a. reduce horizontal velocity and flow turbulence.

   b. distribute the flow equally over the separators cross sectional area.

   c. direct the flow in a serpentine path in order to enhance hydraulic characteristics and fully utilize all separator volume.

   d. completely isolate all inlet turbulence from the separation chamber.

7. A sediment chamber to disperse flow and collect oily solids and sediments.

8. A sludge baffle to retain settleable solids and sediment and prevent them from entering the separation chamber.

An Oil/Water Separation Chamber containing a removable Corella® inclined parallel flat/corrugated plate coalescer. The coalescer shall have individual removable plates, sloped towards the sediment chamber. Each coalescing plate shall be flat on the top and corrugated on the bottom. The flat top plate shall resist clogging and clotting with solids. The corrugations of each of the plate bottoms shall be shaped and positioned to enhance collisions between the rising oil droplets and coalescence between them thereby improving separator efficiency. The coalescer shall:

9. effect separation of oil and solids from all strata of the wastewater stream.
10. shorten the vertical distance that an oil globule or solid particle has to raise or sink, respectively, for effective removal. The minimum plate gap to be ¾.
11. enhance coalescence and agglomeration by causing the smaller globules and particles (those possessing smaller rising/settling rates) to coalesce and collect on the plates thereby forming larger globules and particles that separate rapidly in water.
12. direct the flow paths of the separated oil to the surface of the separator and separated solids to the bottom of the separator.
13. allow solids to fall unhindered by turbulence, and oil droplets to rise without risk of re-emulsifying due to collisions with interfering solids.
14. The Oil/Water Separation Chamber shall also contain a sectionalized removable "Petro-Screen" polypropylene impingement coalescer designed to intercept oil globules of less than 20 microns in diameter. Heavy, one-piece impingement coalescers are not permissible.
15. An internal effluent downcomer at the outlet end of the separator, to allow for discharge from the bottom of the separation chamber only.
16. An effluent connection 4” inch, flanged.
17. Fittings for vent, interface/level sensor, and waste oil pump-out, sampling, and gauge.
18. Two (2) manholes, UL approved, complete with extension, cover, gasket, and bolts. One manway shall be placed between the inlet and the parallel flat/corrugated plate coalescer to facilitate access into sediment chamber for solids removal. One manway shall be placed between the parallel flat/corrugated plate coalescer and outlet to facilitate access into the oil water separation chamber for oil removal.
19. Lifting lugs at balancing points for handling and installation.
20. Identification plates: Plates to be affixed in prominent location and be durable and legible throughout equipment life.
21. Highguard® Corrosion Protection System :
22. Isolation Spool Pieces
23. Dielectric Isolation Gaskets and Bushings
24. External surfaces commercial grit blast, coated 75 mils DFT Self-Reinforcing Polyurethane.
25. Internal surfaces commercial grit blast and coated with 10 mils DFT heavy duty Polyurethane.

E. Accessories

1. Separator shall be supplied with an audible and visual alarm system that indicates hi oil level (visual only) and hi hi oil level (audible and visual) of oil storage in the oil/water

separator will be provided. A silence control shall be provided for the audible alarms. Level sensor(s) to be intrinsically safe. Level sensor floats to be made of stainless steel. The control panel shall be NEMA 4. Power to the control panel – see schedule sheet.

2. Separator shall be supplied with Polyester Hold-down straps.

PART 3 - EXECUTION

3.1 EARTHWORK

A. Excavating, trenching, and backfilling are specified in Division 31.

3.2 INSTALLATION

A. Set tops of manhole frames and covers flush with finished surface in pavements. Set tops 3 inches above finish surface elsewhere, unless otherwise indicated.

B. Set tops of grating frames and grates flush with finished surface.

C. Set metal and plastic interceptors level and plumb.

D. Set tops of metal interceptor covers flush with finished surface in pavements. Set tops 3 inches above finish surface elsewhere, unless otherwise indicated.

E. Install piping and oil storage tanks according to Division 22.

3.3 CONNECTIONS

A. Piping installation requirements are specified in Division 22, drawings indicate general arrangement of piping, fittings, and specialties.

B. Make piping connections between interceptors and piping systems.

C. Grease Interceptors: Connect inlet and outlet to unit, and connect flow-control fitting and vent to unit inlet piping. Install valve on outlet of automatic draw off-type unit.

D. Grease Removal Devices: Connect controls, electrical power, factory-furnished accessories, and inlet, outlet, and vent piping to unit.

E. Oil Interceptors: Connect inlet, outlet, vent, and gravity draw off piping to unit; flow-control fitting and vent to unit inlet piping; and gravity draw off and suction piping to oil storage tank.

F. Ground equipment according to Division 26.

G. Connect wiring according to Division 26.

3.4 IDENTIFICATION

A. Identification materials and installation are specified in Section 312000 "Earth Moving." Arrange for installation of green warning tapes directly over piping and at outside edges of underground interceptors.

1. Use warning tapes or detectable warning tape over ferrous piping.
2. Use detectable warning tape over nonferrous piping and over edges of underground structures.

END OF SECTION

SECTION 221423 - STORM DRAINAGE PIPING SPECIALTIES

PART 1 - GENERAL

1.1 GENERAL

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

1.2 SUMMARY

A. Section Includes:

1. Metal roof drains.
2. Miscellaneous storm drainage piping specialties.
3. Cleanouts.
4. Backwater valves.
5. Trench drains.
6. Channel drainage systems.
7. Through-penetration firestop assemblies.
8. Flashing materials.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

1.4 QUALITY ASSURANCE

A. Drainage piping specialties shall bear label, stamp, or other markings of specified testing agency.

PART 2 - PRODUCTS

2.1 METAL ROOF DRAINS

A. Cast-Iron, Large-Sump, General-Purpose Roof Drains :

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Josam Company.

b. MIFAB, Inc.

c. Smith, Jay R. Mfg. Co.

d. Watts; a Watts Water Technologies company.

e. Zurn Industries, LLC.

2. Standard: ASME A112.6.4, for general-purpose roof drains.
3. Body Material: Cast iron.
4. Combination Flashing Ring and Gravel Stop: .
5. Under deck Clamp: .
6. Expansion Joint:
7. Basis of Design: Watts Model RD-300

B. Cast-Iron, Large-Sump, Dual Outlet Roof Drain/Overflow:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Josam Company.

b. MIFAB, Inc.

c. Smith, Jay R. Mfg. Co.

d. Watts; a Watts Water Technologies company.

e. Zurn Industries, LLC.

2. Standard: ASME A112.6.4, for general-purpose roof drains.
3. Body Material: Cast iron.
4. Combination Flashing Ring and Gravel Stop: .
5. Under deck Clamp: .
6. Expansion Joint:
7. 4 inch High Overflow
8. Basis of Design: Watts Model RD-700

C. Cast-Iron, Medium-Sump, Small Area Roof Drains

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Josam Company.

b. MIFAB, Inc.

c. Smith, Jay R. Mfg. Co.

d. Watts; a Watts Water Technologies company.

e. Zurn Industries, LLC.

2. Standard: ASME A112.6.4, for general-purpose roof drains.
3. Body Material: Cast iron.
4. Dimension of Body: 8- to 12-inch diameter.
5. Combination Flashing Ring and Gravel Stop: Required.
6. Under deck Clamp: .
7. Basis of Design: Watts Model RD-100

D. Cast-Iron, Small-Sump, General-Purpose Roof Drains

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Josam Company.

b. MIFAB, Inc.

c. Smith, Jay R. Mfg. Co.

d. Watts; a Watts Water Technologies company.

e. Zurn Industries, LLC.

2. Standard: ASME A112.6.4, for general-purpose roof drains.
3. Body Material: Cast iron.
4. Dimension of Body: Nominal 8-inch diameter.
5. Combination Flashing Ring and Gravel Stop.
6. Under deck Clamp:
7. Expansion Joint:
8. Basis of Design: Watts Model 200

2.2 CLEANOUTS

A. General

1. All exposed cleanouts in finish spaces shall comply with the finish as specified by the architect

B. Floor Cleanouts :

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Josam Company.

b. Sioux Chief Manufacturing Company, Inc.

c. Smith, Jay R. Mfg. Co.

d. Watts; a Watts Water Technologies company.

e. Zurn Industries, LLC.

2. Standard: ASME A112.36.2M, for adjustable housing cleanouts.
3. Size: Same as connected branch.
4. Body or Ferrule Material: Cast iron
5. Clamping Device: match pipe material
6. Closure: Brass plug with tapered threads.
7. Adjustable Housing Material: Cast iron with threads set-screws or other device.
8. Frame and Cover Material and Finish: brushed chrome.
9. Frame and Cover Shape: Square.
10. Top-Loading Classification: Heavy Duty.
11. Basis of Design: Watts Model CO-200S

C. Test Tees :

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Josam Company.

b. MIFAB, Inc.

c. Smith, Jay R. Mfg. Co.

d. Watts; a Watts Water Technologies company.

e. Zurn Industries, LLC.

2. Standard: ASME A112.36.2M and ASTM A 74, ASTM A 888, or CISPI 301, for cleanout test tees.
3. Size: Same as connected drainage piping.
4. Body Material: Hub-and-spigot, cast-iron soil-pipe T-branch or hubless, cast-iron soil-pipe test tee as required to match connected piping.
5. Closure Plug: Countersunk.
6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.
7. Basis of Design: Watts Model CO-460

D. Wall Cleanouts :

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Josam Company.

b. MIFAB, Inc.

c. Smith, Jay R. Mfg. Co.

d. Watts; a Watts Water Technologies company.

e. Zurn Industries, LLC.

2. Standard: ASME A112.36.2M, for cleanouts. Include wall access.
3. Size: Same as connected drainage piping.
4. Body Material: T-branch as required to match connected piping.
5. Closure: Drilled and threaded brass plug.
6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.
7. Wall Access: Square, brushed chrome wall-installation frame and cover.
8. Basis of Design: Watts Model CO-460-RD

2.3 BACKWATER VALVES

A. Cast-Iron, Horizontal Backwater Valves

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Josam Company.

b. MIFAB, Inc.

c. Smith, Jay R. Mfg. Co.

d. Watts; a Watts Water Technologies company.

e. Zurn Industries, LLC.

2. Standard: ASME A112.14.1, for backwater valves.
3. Size: Same as connected piping.
4. Body Material: Cast iron.
5. Cover: Cast iron with bolted or threaded access check valve.
6. End Connections: hub and spigot or hubless.
7. Check Valve: Removable, bronze, swing check, factory assembled or field modified to hang open for airflow unless subject to backflow condition.
8. Extension: ASTM A 74, Service class; full-size, cast-iron soil-pipe extension to field-installed cleanout at floor; replaces backwater valve cover.
9. Basis of Design: Watts Model BV-200

B. Cast-Iron, Drain-Outlet Backwater Valves

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Josam Company.

b. Smith, Jay R. Mfg. Co.

c. Watts; a Watts Water Technologies company.

d. Zurn Industries, LLC.

2. Size: Same as floor drain outlet.
3. Body Material: Cast iron or bronze made for vertical installation in bottom outlet of floor drain.
4. Check Valve: Removable ball float.
5. Inlet: Threaded.
6. Outlet: Threaded or spigot.
7. Basis of Design: Watts Model BV-300

2.4 THROUGH-PENETRATION FIRESTOP ASSEMBLIES

A. Through-Penetration Firestop Assemblies for PVC or other thermoplastic piped system conductors :

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. 3M Corporation.

b. Hilti, Inc.

c. ProSet Systems Inc.

2. Standard: ASTM E 814, for through-penetration firestop assemblies.
3. Certification and Listing: Insert testing agency acceptable to authorities having jurisdiction for through-penetration firestop assemblies.
4. Size: Same as connected pipe.
5. Sleeve: Molded PVC plastic, of length to match slab thickness and with integral nailing flange on one end for installation in cast-in-place concrete slabs.
6. Stack Fitting: ASTM A 48/A 48M, gray-iron, hubless-pattern, wye branch with neoprene O-ring at base and gray-iron plug in thermal-release harness. Include PVC protective cap for plug.
7. Special Coating: Corrosion resistant on interior of fittings.

2.5 FLASHING MATERIALS

A. Copper Sheet: ASTM B 152/B 152M, 12 oz. /sf.

B. Zinc-Coated Steel Sheet: ASTM A 653/A 653M, with 0.20 percent copper content and 0.04-inch minimum thickness unless otherwise indicated. Include G90 hot-dip galvanized, mill-phosphatized finish for painting if indicated.

C. Elastic Membrane Sheet: ASTM D 4068, flexible, chlorinated polyethylene, 40-mil minimum thickness.

D. Fasteners: Metal compatible with material and substrate being fastened.

E. Metal Accessories: Sheet metal strips, clamps, anchoring devices, and similar accessory units required for installation; matching or compatible with material being installed.

F. Solder: ASTM B 32, lead-free alloy.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install roof drains at low points of roof areas according to roof membrane manufacturer's written installation instructions.

1. Install flashing collar or flange of roof drain to prevent leakage between drain and adjoining roofing. Maintain integrity of waterproof membranes where penetrated.
2. Install expansion joints, if indicated, in roof drain outlets.
3. Position roof drains for easy access and maintenance.

B. Install downspout adapters on outlet of back-outlet parapet roof drains and connect to sheet metal downspouts.

C. Install downspout boots at grade with top 12 inches above grade. Secure to building wall.

D. Install conductor nozzles at exposed bottom of conductors where they spill onto grade.

E. Install cleanouts in aboveground piping and building drain piping according to the following instructions unless otherwise indicated:

1. Use cleanouts the same size as drainage piping up to NPS 4. Use NPS 4 for larger drainage piping unless larger cleanout is indicated.
2. Locate cleanouts at each change in direction of piping greater than 45 degrees.
3. Locate cleanouts at minimum intervals of 50 feet for piping NPS 4 and smaller and 100 feet for larger piping.
4. Locate cleanouts at base of each vertical soil and waste stack.

F. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.

G. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.

H. Install horizontal backwater valves in floor with cover flush with floor.

I. Install drain-outlet backwater valves in outlet of drains.

J. Install test tees in vertical conductors and near floor.

K. Install wall cleanouts in vertical conductors. Install access door in wall if indicated.

L. Install trench drains at low points of surface areas to be drained. Set grates of drains flush with finished surface unless otherwise indicated.

M. Assemble channel drainage system components according to manufacturer's written instructions. Install on support devices so that top will be flush with adjacent surface.

N. Install through-penetration firestop assemblies in plastic conductors at concrete floor penetrations.

O. Install sleeve flashing device with each conductor passing through floors with waterproof membrane.

3.2 CONNECTIONS

A. Comply with requirements for piping specified in Division 22. Drawings indicate general arrangement of piping, fittings, and specialties.

3.3 FLASHING INSTALLATION

A. Fabricate flashing from single piece of metal unless large pans, sumps, or other drainage shapes are required. Join flashing according to the following if required:

1. Copper Sheets: Solder joints of copper sheets.

B. Install sheet flashing on pipes, sleeves, and specialties passing through or embedded in floors and roofs with waterproof membrane.

1. Pipe Flashing: Sleeve type, matching the pipe size, with a minimum length of 10 inches and with skirt or flange extending at least 8 inches around pipe.
2. Sleeve Flashing: Flat sheet, with skirt or flange extending at least 8 inches around sleeve.
3. Embedded Specialty Flashing: Flat sheet, with skirt or flange extending at least 8 inches around specialty.

C. Set flashing on floors and roofs in solid coating of bituminous cement.

D. Secure flashing into sleeve and specialty clamping ring or device.

E. Fabricate and install flashing and pans, sumps, and other drainage shapes.

3.4 PROTECTION

A. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.

B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

END OF SECTION

SECTION 221429 - SUMP PUMPS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Packaged point of use sump drainage-pump units
2. Motors

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Wiring Diagrams: For power, signal, and control wiring.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For pumps and controls, to include in operation and maintenance manuals.

1.5 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. UL Compliance: Comply with UL 778 for motor-operated water pumps.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Retain shipping flange protective covers and protective coatings during storage.

B. Protect bearings and couplings against damage.

C. Comply with pump manufacturer's written rigging instructions for handling.

PART 2 - PRODUCTS

A. PACKAGED POINT OF USE Elevator SUMP DRAINAGE-PUMP UNITS Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
1. Standcore Oil Minder
2. Grundfos Pumps Corp.
3. Liberty Pumps.
4. Zoeller Company.
5. Stancor Inc.

B. Description: Factory-assembled and -tested, automatic-operation, simplex oil mizer Elevator pack pump assembly-mounted, sump-pump unit.

ELEVATOR SUMP AND DRAINAGE UNIT	
Equipment Tag	**see schedule sheet**
Description	The system shall be capable of pumping water while containing oil. The pump and oil sensor technology control system shall comply with ASME 17.1 standards. The system shall function automatically without human intervention. In addition, the system shall provide separate alarms in the event of an oil spill, high liquid level condition, or overcurrent condition due to a pump fault. All controls shall be UL 508a approved. All components of system shall be UL approved. Pump shall be approved to UL 778 and/or CSA C22.2
Number of units	Per elevator sump – see drawings for quantities
Design	The pump shall be designed to handle without clogging clean water, contaminated water, wastewater effluent, storm water, and other similar liquids that may contain small solids. The pump shall have integrated feet allowing it to stand on a hard bottom wet well. The power cable shall be sized according to NEC and CSA standards. The outer jacket of the cable shall be oil and water resistant thermoplastic elastomer. The power cable shall be fitted to the motor using an epoxy potted water tight cable entry system with a rubber grommet as the secondary seal and strain relief
Bearings	The pump shaft shall rotate on permanently lubricated, greased bearings. B-10 bearing life shall be a minimum of 30,000 hours at BEP. Pump designs utilizing components other than ball bearings, or those requiring supplemental guide bushings for the shaft or impeller, shall not be considered acceptable.
Construction:	Major pump components shall be made from Stainless Steel 304 and FC-20 Cast Iron, with smooth surfaces devoid of porosity or other irregularities. All exposed fasteners shall be AISI type 316 stainless steel. Critical mating surfaces, where a watertight seal is required, shall be machined and fitted with Nitrile (Buna N) O-rings.
Shaft and Rotating Assembly	The common motor/pump shaft shall be of Stainless Steel (410) material that is in contact with pump's mechanical seals and shall have a polished finish and accurately machined shoulders to accommodate the bearings, seals and impeller.
Motors	The motor shall be capable of continuous submerged operation under water to a depth of 30 feet. The motor shall be capable of operating continuously, submerged in liquid of 40°C (104° F) without overheating. The motor shall be capable of handling up to 10 evenly spaced starts per hour. All motors shall have a voltage tolerance of +/- 10% from nominal name plate rating
Seals	Each pump shall be equipped with a tandem mechanical shaft seal system consisting of two independent seal assemblies with a common spring between them and a

ELEVATOR SUMP AND DRAINAGE UNIT	
Equipment Tag	**see schedule sheet**
	radial lip seal; providing three complete levels of sealing between the pump wet end and the motor. The mechanical seals shall operate in an oil filled chamber which is completely separate from the motor chamber. The seal faces shall be Silicon Carbide/ Silicon Carbide for the lower seal and Carbon/Ceramic for the upper seal. Metallic components of the mechanical seal shall be constructed of 300 series stainless steel.
Impeller	The impeller shall be a non-clogging, dynamically balanced, vortex design, capable of passing a 35 mm diameter spherical solid.
Controls	Approved to UL508 standards and housed in a gasketed NEMA 4X enclosure made up of polycarbonate and ABS. The dimensions of the box shall be approximately 14”x12”x6”. The enclosure shall have an opaque hinged cover, with a transparent window made up of polycarbonate and a silicone gasket for sealing. The control panel shall include a field adjustable switch with variable sensitivity settings for oil with a separate over-current relay and field adjustable motor overload heater with an optional automatic or manual reset button. The control panel shall have an adjustable high decibel warning horn with illuminated red light and alarm silencing switch. Separate LED indicator lights allow users to monitor: 1) oil alert, 2) high water, 3) high motor amps, 4) power to system and 5) pump activation High-Level Alarm/Redundant Run Float The high-level liquid alarm shall be enabled by an additional float placed at a level in the pit above normal acceptable liquid levels. The rising of this float (closing) shall cause the controller to energize the audible alarm (where applicable), remote alarm relay (dry contacts), and the high-level LED. The high-level alarm shall only be de-energized after the high-level float drops to its normal state (open). The high-level liquid alarm shall not disable the pump motor from normal operation. In addition, the activation of the high-level float will also attempt to run the pump should the normal start float have become incapacitated. Silence Button An external control mounted silence alarm button shall be provided to de-energize the audible alarm for the convenience of maintenance personnel. Depressing this button shall not clear any fault, but shall silence the alarm for 5 minutes. If a fault is removed and returns, the audible alarm shall reenergize as expected. Self Diagnostic The control shall include a “push to test” feature for all pump and control diagnostic functions. This test helps ensure the system is installed properly and remains in working order.
Oil Detection	The oil sensor probe voltage shall not exceed 15 millivolts DC until it comes in contact with water, at which point the oil sensor returns to 5VDC.
Installation	The pump system shall be supplied as a factory assembled system. The system shall physically fit and be fully functional with all on-off and oil detection features along with all alarms within a 24” X 24” X 24” deep sump, allowing adequate operational space for a required grate or pit cover.
Pump Floats and Probe	Submersible pump shall be pump factory fitted with an Vertical float(s) and probe. The probe and floats shall be an integral unit constructed of 304 stainless steel. Each float shall activate an internal reed switch capable of handling the Oil Minder circuit

ELEVATOR SUMP AND DRAINAGE UNIT	
Equipment Tag	**see schedule sheet**
	sensing voltages. Float switches shall be in the normally open position. Rising liquid shall cause each float ball (pump run and high level) to rise ½" and close the respective circuit. The integral probe shall sense for conductivity through the media being pumped. Wire shall be 18-4 AWG with SJOOW insulation. Standard length shall be 16'.
Electrical	See schedule sheet
Capacity	See drawing schedule sheet
Warranty	See part 1
Basis of Design	Stancor Model SE-50-ELV complete pump package Oil-Minder® control system for each elevator pit, where shown on the drawings

2.2 MOTORS

A. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Division 22.

1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven loads will not require motor to operate in service factor range above 1.0.

B. Motors for submersible pumps shall be hermetically sealed.

PART 3 - EXECUTION

3.1 EARTHWORK

A. Excavation and filling are specified in Division 31.

3.2 EXAMINATION

A. Examine roughing-in for plumbing piping to verify actual locations of storm drainage piping connections before sump pump installation.

3.3 INSTALLATION

A. Pump Installation Standards: Comply with HI 1.4 for installation of sump pumps.

3.4 CONNECTIONS

A. Comply with requirements for piping specified in Division 22. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to equipment to allow service and maintenance.

3.5 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

B. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

C. Tests and Inspections:

1. Perform each visual and mechanical inspection.
2. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
3. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

D. Pumps and controls will be considered defective if they do not pass tests and inspections.

E. Prepare test and inspection reports.

3.6 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.
2. Assure all wiring and plumbing systems are fully connected and functional prior to all testing
3. <**Insert startup steps if any**>.

3.7 ADJUSTING

A. Adjust pumps to function smoothly, and lubricate as recommended by manufacturer.

B. Adjust control set points.

3.8 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain controls and pumps.

END OF SECTION

SECTION 223200 - GENERAL PURPOSE WATER FILTRATION EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. General
2. Central Water Softeners for laboratory hot and cold water service
3. Floor Autoclave Filters
4. Central Or Bulk Sterilizer Filters
5. Glasswasher Filters
6. Icemaker Filter
7. Pantry Filter
8. Source Quality Control

1.3 PERFORMANCE REQUIREMENTS

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for filters and separators. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Shop Drawings: For water filtration equipment. Include plans, elevations, sections, details, and attachments to other work.

1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
2. Wiring Diagrams: For power, signal, and control wiring.

1.5 INFORMATIONAL SUBMITTALS

A. Certificates of Shop Inspections and Data Reports: For products required to have ASME label, signed by product manufacturer.

B. Welding certificates.

C. Source quality-control reports.

D. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For water filtration equipment to include in emergency, operation, and maintenance manuals.

1.7 MATERIALS MAINTENANCE SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Bag-Type Filter Bags: Bags for bag-type filters equal to 200 percent of amount installed for each size and media indicated.
2. Cartridge-Filter Elements: Elements for cartridge filters equal to 200 percent of amount installed for each size and media indicated.

1.8 QUALITY ASSURANCE

A. Source Limitations: Obtain each type of water filtration equipment through one source from a single manufacturer.

B. Welding Qualifications: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

D. Comply with NSF 61 Annex, "Drinking Water System Components - Health Effects," for all components that will be in contact with potable water.

1.9 COORDINATION

A. Coordinate size and location of concrete bases with actual equipment provided.

1.10 WARRANTY

A. General: periods are stipulated here for this specification section. Generally manufacturers standard warranty applies, however, longer warranty periods, if required, are stipulated in part 2 where each product is specified. The warranty periods stipulated in part 2 take priority over standard manufacturer's warranty periods specified in part 1.

B. Warranty: Manufacturer's standard warranty – submit a form in which manufacturer agrees to repair or replace components that fail in materials or workmanship within manufacturers standard specified warranty period. Manufacturers standard warranty must include minimum durations below

C. Minimum Durations and Special Warrantees: Manufacturer's standard form in which manufacturer agrees to repair or replace components that fail in materials or workmanship within specified warranty period.

1. Structural failures including shell.
2. Warranty period shall begin on the date of project substantial completion stipulated by the Architect and/or the Construction Manager

PART 2 - PRODUCTS

2.1 GENERAL

A. Fabricate supports and base, feet, or skirt and attachment to housing with reinforcement strong enough to resist filter movement when filter base is anchored to building structure

B. On Floor Housings: Corrosion resistant; designed to separate feedwater from filtrate and to direct feedwater through water filter element(s); with element support(s) and base, feet, or skirt

C. Off Floor Housings: Corrosion resistant; designed to separate feedwater from filtrate and to direct feedwater through water filter element; with element support.

1. Pipe Connections: Threaded according to ASME B1.20.1.
2. Support: Wall bracket.

2.2 CENTRAL WATER SOFTENING EQUIPMENT FOR LABORATORY HOT AND COLD WATER

WATER SOFTENERS – Lab Water	
Description	Automatic commercial grade water softeners FRP vessels, internal distributors, brine maker, top mounted multiport valve, pressure gauges, sample valves, media and a control panel. Furnish all Media, Media shall be shipped separately. The unit shall have down flow re-generation and downflow service
Water Flow Rate	125 GPM
Number of units	2 installed in parallel Diameter = 48 inches
Performance Conditions	A top mounted, motorized control valve shall provide for quiet, efficient and dependable automatic operation of the units. One softener shall be on line while the other is in standby. The units shall alternate automatically.
Operating Parameters (each)	Normal flow rate 108 gpm Peak flow rate: 216 gpm Backwash 95 gpm
Media	Cation resin in sodium form – 36 cubic feet per vessel.
Materials of Construction	Material: FRP lined with Polyethylene Diameter: 48" Shell Straightside: 72" Hydrostatic test pressure: 150 psi ASME code stamped: No Influent distributor (top): Basket diffuser Underdrain distributor : PVC basket strainer.
Controls and Instrumentation	Pressure gauges Type: 316SS, liquid filled, 2½" face psi. Locations: Feed water, product Flow Meter: Fleck or equal Electrical and Controls Enclosure rating: NEMA Type 1 Enclosure material: Steel Enclosure finish: Epoxy paint
Valves and Connectors	Isolation Valves: Quantity: Two (2), by others Type: Ball Material: PVC Sample Valves: Quantity: Two (2), by others Type: 1/4" ball valve Locations: Influent, effluent

WATER SOFTENERS – Lab Water	
Face Piping	Pipe material: Schedule 80 PVC Connections PVC Sch 80 - solvent welded (by Contractor): Connections (on control valve): Feed water: 1½" female pipe thread Product: 1½" female pipe thread Waste: 3/4"female pipe thread
Regeneration and Brine	Deluxe - The control is performed by an NXT programmable controller. The softener will regenerate based on either volume of water treated, an external initiation (i.e. differential a PLC) or time. The time option can be set with an operation of up to 99 days. The operator can manually initiate regeneration at any timeRegeneration dosage Brine Maker 540 lbs/regen Construction: Polyethylene Size: 50 "dia. x 60" tallt.
Basis of Design	Evoqua Vantage Water Softener Model PTC D-48 x 72
WATER SOFTENERS – Vivarium	
Description	Automatic commercial grade water softeners FRP vessels, internal distributors, brine maker, top mounted multiport valve, pressure gauges, sample valves, media and a control panel. Furnish all Media, Media shall be shipped separately. The unit shall have down flow re-generation and downflow service
Water Flow Rate	125 GPM
Number of units	2 installed in parallel Diameter = 48 inches
Performance Conditions	A top mounted, motorized control valve shall provide for quiet, efficient and dependable automatic operation of the units. One softener shall be on line while the other is in standby. The units shall alternate automatically.
Operating Parameters (each)	Normal flow rate 78 gpm Peak flow rate: 156 gpm Backwash 70 gpm
Media	Cation resin in sodium form – 26 cubic feet per vessel.
Materials of Construction	Material: FRP lined with Polyethylene Diameter: 42" Shell Straightside: 72" Hydrostatic test pressure: 150 psi ASME code stamped: No Influent distributor (top): Basket diffuser Underdrain distributor : PVC basket strainer.

WATER SOFTENERS – Lab Water	
Controls and Instrumentation	Pressure gauges Type: 316SS, liquid filled, 2½" face psi. Locations: Feed water, product Flow Meter: Fleck or equal Electrical and Controls Enclosure rating: NEMA Type 1 Enclosure material: Steel Enclosure finish: Epoxy paint
Valves and Connectors	Isolation Valves: Quantity: Two (2), by others Type: Ball Material: PVC Sample Valves: Quantity: Two (2), by others Type: 1/4" ball valve Locations: Influent, effluent
Face Piping	Pipe material: Schedule 80 PVC Connections PVC Sch 80 - solvent welded (by Contractor): Connections (on control valve):
Regeneration and Brine	Deluxe - The control is performed by an NXT programmable controller. The softener will regenerate based on either volume of water treated, an external initiation (i.e. differential a PLC) or time. The time option can be set with an operation of up to 99 days. The operator can manually initiate regeneration at any timeRegeneration dosage Brine Maker 390 lbs/regen Construction: Polyethylene Size: 42 “dia. x 60" tall.
Basis of Design	Evoqua Vantage Water Softener Model PTC D-42 x 72

2.3 AUTOCLAVE FILTER

A. Water Filter Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. 3M AquaPure.
2. Hayward Flow Control.
3. Pennair.
4. Pentek.
5. Culligan
6. CUNO
7. PEP Filters
8. Shelco Filters.
9. Hamscro Filtration Products

AUTOCLAVE FILTER		
Description	Cartridge Filter assembly for removal of suspended solids and turbidity.	
Number Required	See drawings	
Performance Conditions	Provide 5-micron particulate removal from water supply.	
Operating Arrangement	Refer to drawings and schedules for arrangement of equipment. Pipe headers and controls for simplex operation with valve isolation.	
Materials of Construction	Housing	AISI 304 stainless steel with 316 stainless steel head
	Media	Cartridge particulate to 5 µ
Controls and Instrumentation	Inlet/outlet pressure indicators.	
Filter Media		
Valves and Connectors	Same as pipe class.	
Filter Housing	Top or side inlet. Bottom outlet. BUNA-N cover gasketing. 150 psig maximum operating pressure at 250°F.	
Surface Finish	N/A.	
Housing drain/vent	No drain. 1/4inch NPT vent ports.	
Electrical	None.	
Capacity	See drawings	
Basis of Design	Aqua Pure SST series with 5 micron cartridge Note: for hot water applications use AP2005 cartridge	

2.4 CENTRAL OR BULK STERILIZER FILTER\

A. Water Filter Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. 3M AquaPure.
2. Hayward Flow Control.
3. Pennair.
4. Pentek.
5. Culligan
6. CUNO
7. PEP Filters
8. Shelco Filters.
9. Hamscro Filtration Products

BULK STERILIZER FILTER		
Description	Cartridge Filter assembly for removal of suspended solids and turbidity.	
Number Required	See drawings	
Performance Conditions	Provide 5-micron particulate removal from water supply.	
Operating Arrangement	Refer to drawings and schedules for arrangement of equipment. Pipe headers and controls for simplex operation with valve isolation.	
Materials of Construction	Housing	AISI 304 stainless steel with 316 stainless steel or brass head
	Media	Cartridge particulate to 5 µ.
Controls and Instrumentation	Inlet/outlet pressure indicators.	
Filter Media		
Valves and Connectors	Same as pipe class.	
Filter Housing	Top or side inlet. Bottom outlet. BUNA-N cover gasketing. 150 psig maximum operating pressure at 250°F.	
Surface Finish	N/A.	
Housing drain/vent	drain. 1/8inch NPT vent ports.	
Electrical	None.	
Capacity	See drawings	
Basis of Design	Aqua Pure SST series with 5 micron cartridge Shelco RH 80	

2.5 GLASSWASHER FILTER

A. Water Filter Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. 3M AquaPure.
2. Hayward Flow Control.
3. Pennair.
4. Pentek.
5. Culligan
6. CUNO
7. PEP Filters
8. Shelco Filters.
9. Hamscro Filtration Products

GLASSWASHER FILTER		
Description	Cartridge Filter assembly for removal of suspended solids and turbidity.	
Number Required	See drawings	
Performance Conditions	Provide 5-micron particulate removal from water supply.	
Operating Arrangement	Refer to drawings and schedules for arrangement of equipment. Pipe headers and controls for simplex operation with valve isolation.	
Materials of Construction	Housing	For hot water supply line - AISI 304 stainless steel with brass head and nickel plated brass ring nut and brass petcock Housing for cold water supply line – lexan polycarbonate clear plastic
	Media	Cartridge particulate to 5 µ, appropriate for hot water applications up to 170 deg F.
Controls and Instrumentation	Inlet/outlet pressure indicators.	
Valves and Connectors	Same as pipe class.	
Filter Housing	Hot side: Top or side inlet. Bottom outlet. BUNA-N cover gasketing. 150 psig maximum operating pressure at 250°F. Cold Side: 100°F (38°C) temperature maximum and 100 psig maximum pressure, blue polypropylene cap with relief button.	
Surface Finish	N/A.	
Housing drain/vent	1/8 drain. 1/4 inch NPT gauge ports.	
Electrical	None.	
Capacity	See drawings	
Basis of Design	Hot side: Shelco RH-90 Cold side: Shelco RH-90	

2.6 ICEMAKER FILTER

A. Water Filter Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. 3M AquaPure.
2. Hayward Flow Control.
3. Pennair.
4. Pentek.
5. Culligan
6. CUNO
7. PEP Filters
8. Shelco Filters.
9. Hamscro Filtration Products

ICEMAKER FILTER		
Description	Cartridge Filter assembly for removal of taste and odor as well as suspended solids and turbidity.	
Number Required	See drawings	
Performance Conditions	Taste and odor cartridge carbon filter and particulate removal from water supply.	
Operating Arrangement	Refer to drawings and schedules for arrangement of equipment.	
Materials of Construction	Housing	10 inch clear reinforced polypropylene housing and cap
	O-ring	Buna-N
	Max Temp	125 F
	Max Press	125 psi
Controls and Instrumentation	Inlet/outlet pressure indicators.	
Filter Media	Cartridge: carbon block taste and odor" 5µ	
Valves and Connectors	Same as pipe class.	
Filter Housing	Top or side inlet. Bottom outlet. BUNA-N cover gasketing. 1	
Surface Finish	N/A.	
Housing drain/vent	No drain. Button relief.	
Electrical	None.	
Capacity	See drawings	
Basis of Design	Pentak Clear 10" Filter With taste and odor cartridge	

2.7 PANTRY FILTER

A. Water Filter Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. 3M AquaPure.
2. Hayward Flow Control.
3. Pennair.
4. Pentek.
5. Culligan
6. CUNO
7. PEP Filters
8. Shelco Filters.
9. Hamscro Filtration Products

PANTRY FILTER		
Description	Cartridge Filter assembly for removal of taste and odor as well as suspended solids and turbidity.	
Number Required	See drawings	
Performance Conditions	Taste and odor cartridge carbon filter and particulate removal from water supply.	
Operating Arrangement	Refer to drawings and schedules for arrangement of equipment.	
Materials of Construction	Housing	10 inch blue polypropylene housing and cap
	O-ring	Buna-N
Controls and Instrumentation	Inlet/outlet pressure indicators.	
Filter Media	Cartridge: taste and odor" 5µ	
Valves and Connectors	Same as pipe class.	
Filter Housing	Top or side inlet. Bottom outlet. BUNA-N cover gasketing. 125 psig maximum operating pressure at 125°F.	
Surface Finish	N/A.	
Housing drain/vent	No drain. Button relief.	
Electrical	None.	
Capacity	See drawings	
Basis of Design	Pentak Little Blue With Pentek C1 taste and odor cartridge	

2.8 DUPLEX MANUAL IN-LINE STRAINERS

A. Manual Operation, In Line, Manual Flush Duplex Strainers

B. Strainers

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

    a. Hayward
    b. Hellan
    c. HyperJet Fluids Engineering
    d. Lakos
    e. PEP Filters
    f. Eaton
    g. SurFlo Automatic Equipment
    h. Tekleen Filtration
    i. Watts

DUPLEX BASKET STRAINER – MANUAL OPERATION

Description	duplex basket strainer continuous operation When the first basket is full, the parallel strainer handles the flow (manually diverted to a second basket), to permit removal and cleaning with no interruption to operations Blowdown and flush is manual
Number of units	Duplex unit
Performance Conditions	In line dual device shall have the ability for continuous operation. The strainer shall separate solids from the waste stream via dual mesh baskets. The device shall include a manual valve to select primary and secondary strainer baskets or shall be employ individual hand wheels that may be manually rotated.
Basket and screen	See drawings
Materials of Construction	Bronze and stainless diverter ball 200 psi @ 150 deg F maximum rating
Sizes	2 inch to 8 inch . ANSI threaded or flange connections
Capacities	See drawings
Face Piping	Manufacturer Standard
Warranty	See part 1
Electrical	none
Basis of Design	Eaton model 53 ball type Hellan series DH Staples and Pfeiffer Duplex model 123

2.9 SOURCE QUALITY CONTROL

A. Before shipping, hydrostatically test carbon filters, circulating sand filters, multimedia sand filters, greensand filters, and separators to minimum of one and one-half times pressure rating.

B. Prepare test reports.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of filters and separators.

B. Examine roughing-in for piping systems to verify actual locations of piping connections before equipment installation.

C. Examine walls and floors for suitable conditions where filters and separators will be installed.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION - GENERAL

A. Install skidded components and other equipment in accordance with manufacturers' written instructions and recommendations.

B. Install equipment on concrete bases. Set and connect units and major accessories according to manufacturers' written instructions. Install units plumb, level, and firmly anchored in locations indicated. Maintain manufacturers' recommended clearances. Orient so equipment, controls, and devices needing service are accessible.

C. Affix instrument identification numbers, date of calibration, and next date of calibration. Labels shall be clearly visible.

D. Tag all equipment, valves, and instruments with permanent stainless steel tags bearing Drawings tag number.

3.3 EQUIPMENT MOUNTING

A. Equipment Mounting: Install filters, except wall-mounted cartridge filters, and separators on concrete bases. Comply with requirements for concrete bases specified in Section 033000 "Cast-in-Place Concrete." Section 033053 "Miscellaneous Cast-in-Place Concrete."

1. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around full perimeter of concrete base.
2. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
4. Install anchor bolts to elevations required for proper attachment to supported equipment.

3.4 CARTRIDGE-FILTER INSTALLATION

A. Install cartridge filters level and plumb, according to layout drawings, original design, and referenced standards. Maintain manufacturer's recommended clearances. Arrange units so controls and devices needing service are accessible.

B. Equipment Mounting: attach to floors with manufacturer recommended support stands

C. Attach wall brackets for off-floor, wall-mounted, cartridge filter to vertical surface. Attach housing(s), and base if any, to wall bracket.

D. Install housings for off-floor, in-line, cartridge filters in piping.

E. Install filter elements in cartridges.

3.5 CONNECTIONS

A. Comply with requirements for piping specified in Section 221116 "Domestic Water Piping." Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to equipment to allow service and maintenance.

C. Make piping connections between water filtration equipment and dissimilar-metal water piping with dielectric fittings. Comply with requirements for dielectric fittings specified in Division 22.

D. Install shutoff valves on feedwater-inlet and filtrate-outlet piping of each water filtration equipment filter and separator and on inlet and outlet headers.

1. Comply with requirements for metal general-duty valves specified in Division 22.
2. Comply with requirements for plastic valves specified in Division 22.
3. Exception: Water filtration equipment with factory-installed shutoff valves at locations indicated.

E. Install pressure gages on feedwater-inlet and filtrate-outlet piping of each water filtration equipment filter and separator. Comply with requirements for pressure gages specified in Division 22.

1. Exception: Water filtration equipment with factory-installed pressure gages at locations indicated.
2. Exception: Cartridge water filters.

F. Install valved bypass water piping around each water filtration equipment filter and separator.

1. Comply with requirements for metal general-duty valves specified in Division 22
2. Comply with requirements for plastic valves specified in Division 22.
3. Comply with requirements for water piping specified in Division 22.
4. Exception: Bag-type water filtration equipment.
5. Exception: Cartridge water filtration equipment.

G. Install drains as indirect wastes to spill into open drains or over floor drains.

3.6 IDENTIFICATION

A. Identify system components. Comply with requirements for identification specified in Division 22.

3.7 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

B. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

C. Tests and Inspections:

1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
2. Operational Test: After electrical circuitry has been energized, start units to confirm proper unit operation.
3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

D. Water piping filtration equipment will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports.

3.8 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform Perform startup service for circulating sand filters, multimedia sand filters, greensand filters, and separators.

1. Complete installation and startup checks according to manufacturer's written instructions.
2. Exception – small point of use filters with flows less than 15 gpm.

B. Sample filter and separator filtrate after startup and at three consecutive seven-day intervals (total of four samples), and prepare certified test reports for required water performance characteristics.

3.9 DEMONSTRATION

A. Engage a factory-authorized service representative to train Train Owner's maintenance personnel to adjust, operate, and maintain circulating sand filters, multimedia sand filters, water softeners, carbon filters, UV filters, bsag filters, greensand filters, and separators.

B. Assure all instrumentation called for in the spec to report to the BMS, functions properly and BMS vendor acknowledges these instruments are registering proper information at the BMS head end.

END OF SECTION

SECTION 223300 - ELECTRIC, WATER HEATERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Commercial, electric, water booster heaters.
2. Commercial, electric, small to mid capacity water heaters
3. Commercial electric instantaneous water heaters
4. Water heater accessories.
5. Floor Leak Detection
6. Source Quality Control

1.3 PERFORMANCE REQUIREMENTS

1.4 ACTION SUBMITTALS

A. Product Data: For each type and size of water heater indicated. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. LEED Submittals:

1. Product Data for Prerequisite EA 2: Documentation indicating that units comply with applicable requirements in ASHRAE/IESNA 90.1, Section 7, "Service Water Heating."

C. Shop Drawings:

1. Wiring Diagrams: For power, signal, and control wiring.

1.5 INFORMATIONAL SUBMITTALS

A. Product Certificates: For each type of commercial residential and tankless, electric, water heater, from manufacturer.

B. Water Heater Labeling: Certified and labeled by testing agency acceptable to authorities having jurisdiction.

C. Source quality-control reports.

D. Field quality-control reports.

E. Warranty: Sample of special warranty.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For electric, water heaters to include in emergency, operation, and maintenance manuals.

1.7 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1.

C. ASME Compliance: Where ASME-code construction is indicated, fabricate and label commercial, water heater storage tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.

D. NSF Compliance: Fabricate and label equipment components that will be in contact with potable water to comply with NSF 61 Annex G, "Drinking Water System Components - Health Effects."

1.8 COORDINATION

A. Coordinate sizes and locations of concrete bases with actual equipment provided.

1.9 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of electric, water heaters that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

    a. Structural failures including storage tank and supports.
    b. Faulty operation of controls.
    c. Deterioration of metals, metal finishes, and other materials beyond normal use.

2. Warranty Periods: From date of Substantial Completion.

    a. Commercial, Electric, water Booster Heaters:

1) Controls and Other Components: Three years.

b. Commercial, Electric, Storage, water Heaters:

1) Storage Tank: Five years.
2) Controls and Other Components: Five years.

c. Compression Tanks: Five years.

PART 2 - PRODUCTS

2.1 COMMERCIAL, ELECTRIC, MID CAPACITY WATER HEATERS: EWH-1, EWH-2

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. Hubbell Water Heater Equipment

2. Lochinvar, LLC.

3. Rheem Manufacturing Company.

4. Standard: UL 174.
5. Storage-Tank Construction: Corrosion-resistant steel with corrosion-resistant coating.

a. Tappings: ASME B1.20.1 pipe thread.
b. Pressure Rating: 150 psig.
c. Interior Finish: Comply with NSF 61 Annex G barrier materials for potable water tank linings, including extending lining material into tappings.
d. The outer jacket shall be of backed enamel finish and shall enclose the tank with foam insulation.

6. Models shall meet the standby loss requirements of the U.S. Department of energy and current edition of ASHRAE/IESNA 90.1.
7. Factory-Installed Storage-Tank Appurtenances:

a. Drain Valve: ASSE 1005 if tank has drain outlet. Provide hose-end drain valve in piping for water heaters without drain outlet. Comply with requirements for hose-end drain valves specified in Division 22.
b. Insulation: Comply with ASHRAE 90.2.
c. Jacket: Steel with enameled finish.
d. Heating Element: electric, screw-in immersion type.
e. Electric heating elements shall be medium watt density with zinc plated copper sheath. Each element shall be controlled by an individually mounted thermostat and high temperature cutoff switch.
f. Safety Control: High-temperature-limit cutoff device or system.
g. Relief Valve: ASME rated and stamped for combination temperature-and-pressure relief valves. Include relieving capacity at least as great as heat input, and include pressure setting less than water heater working-pressure rating. Select relief valve with sensing element that extends into storage tank.

h. Electrical junction box with heavy duty terminal block shall be provided (except on 120V and 277V (no junction box on DEL-6 thru 20).
i. The drain value shall be located in the front for ease of servicing.
j. Heater tank shall have a ten year limited warranty as outlined in the written warranty. Fully illustrated instruction manual to be included.

8. Basis of Design: Lochinvar CHX18 100A

9. Bassi of Design: Hubbell Model E

a. Tank shall be 100 gallon capacity. Heater(s) shall have 150 psi working pressure. See schedule sheet for duty.

B. Point of Use, Under Sink Heater

Manufacturer/series	**Hubbell Series**				
Heater Model Number	R003-2S	240V	3KW	12.5A	48 deg F T rise at .4 GPM
Heater Model Number	R005-2S	240	5 KW	19	31 deg F T rise at.7GPM
Heater Model Number	R007-2S	240	7 KW	29	44 deg F T rise at 1.1GPM
Heater Model Number	R009-3W	277	9 KW	32A	55 deg F T rise at 1.1GPM
Heater Model Number	R011-3W	277	11 KW	39A	68 deg F T rise at 1.1GPM
Accessories	Integrated ASSE 1070 mixing valve, Factory temp not to exceed 105 degrees. .3 gpm activation				
Manufacturer/series	Eemax Accumix Series				
Heater Model Number	MT004120T	120V	3.5KW	29A	48 ºF T rise @ .5 GPM
Heater Model Number	MT005240T	240	4.8	20	31 ºF T rise @1.GPM
Heater Model Number	MT007240T	240	6.5	27	44º F T rise @1.GPM
Heater Model Number	MT008277T	277	8.0	29A	55º F T rise @1.GPM
Heater Model Number	MT010277T	277	10.0	40A	68 ºF T rise @1.GPM
Accessories	Integrated ASSE 1070 mixing valve, Factory temp not to exceed 105 degrees. .3 gpm activation				

2.2 WATER HEATER ACCESSORIES

A. Water Compression Tanks

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. AMTROL, Inc.

b. Smith, A. O. Corporation.

c. State Industries.

d. Taco, Inc.

2. Description: Steel pressure-rated tank constructed with welded joints and factory-installed butyl-rubber diaphragm. Include air pre-charge to minimum system-operating pressure at tank.

3. Furnish and install expansion tanks for both zone 1 electric water heaters and zone 2 plate and frame water heat exchangers
4. Construction:

    a. Tappings: Factory-fabricated steel, welded to tank before testing and labeling. Include ASME B1.20.1 pipe thread.
    b. Interior Finish: Comply with NSF 61 Annex G barrier materials for potable water tank linings, including extending finish into and through tank fittings and outlets.
    c. Air-Charging Valve: Factory installed.

B. Drain Pans: Corrosion-resistant metal with raised edge. Comply with ANSI/CSA LC 3. Include dimensions not less than base of water heater, and include drain outlet not less than NPS 3/4 with ASME B1.20.1 pipe threads or with ASME B1.20.7 garden-hose threads.

C. Piping-Type Heat Traps: Field-fabricated piping arrangement according to ASHRAE/IESNA 90.1 or ASHRAE 90.2.

D. Heat-Trap Fittings: ASHRAE 90.2.

E. Manifold Kits: water heater manufacturer's factory-fabricated inlet and outlet piping for field installation, for multiple water heater installation. Include ball-, butterfly-, or gate-type shutoff valves to isolate each water heater and calibrated memory-stop balancing valves with integral flow meters to provide balanced flow through each water heater.

F. Comply with requirements for ball, butterfly, or gate type shutoff valves specified in for Plumbing Piping," Pressure-Reducing Valves: ASSE 1003 for water. Set at 25 psig maximum outlet pressure unless otherwise indicated.

G. Combination Temperature-and-Pressure Relief Valves: ASME rated and stamped. Include relieving capacity at least as great as heat input, and include pressure setting less than water heater working-pressure rating. Select relief valves with sensing element that extends into storage tank.

H. Pressure Relief Valves: ASME rated and stamped. Include pressure setting less than water heater working-pressure rating.

I. Vacuum Relief Valves: ANSI Z21.22/CSA 4.4.

J. Shock Absorbers: ASSE 1010 or PDI-WH 201, Size A water hammer arrester.

K. Water Heater Stands: Manufacturer's factory-fabricated steel stand for floor mounting, capable of supporting water heater and water. Include dimension that will support bottom of water heater a minimum of 18 inches above the floor.

L. Water Heater Mounting Brackets: Manufacturer's factory-fabricated steel bracket for wall mounting, capable of supporting water heater and water.

2.3 SOURCE QUALITY CONTROL

A. Factory Tests: Test and inspect water heaters specified

B. Retain option in first paragraph below if testing of only commercial -water heaters is required.

C. Hydrostatically test commercial water heaters to minimum of one and one-half times pressure rating before shipment.

D. Electric, water heaters will be considered defective if they do not pass tests and inspections. Comply with requirements in Division 01 for retesting and re-inspecting requirements and Division 01 for requirements for correcting the Work.

E. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 WATER HEATER INSTALLATION

A. Commercial, Electric, water Heater Mounting: Install commercial, electric, water heaters on concrete base. Comply with requirements for concrete bases specified in Division 03.

1. Exception: Omit concrete bases for commercial, electric, water heaters if installation on stand, bracket, suspended platform, or directly on floor is indicated.
2. Maintain manufacturer's recommended clearances.
3. Arrange units so controls and devices that require servicing are accessible.
4. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of concrete base.
5. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
6. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
7. Install anchor bolts to elevations required for proper attachment to supported equipment.
8. Anchor water heaters to substrate.

3.2 CONNECTIONS

A. Comply with requirements for piping specified in water piping sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Where installing piping adjacent to electric, water heaters, allow space for service and maintenance of water heaters. Arrange piping for easy removal of water heaters.

3.3 IDENTIFICATION

A. Identify system components. Comply with requirements for identification specified in Division 22.

3.4 FIELD QUALITY CONTROL

A. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
2. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
3. Operational Test: After electrical circuitry has been energized, start units to confirm proper operation.
4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

B. Electric, water heaters will be considered defective if they do not pass tests and inspections. Comply with requirements in Division 01 for retesting and re-inspecting requirements and Division 01 for requirements for correcting the Work.

C. Prepare test and inspection reports.

3.5 DEMONSTRATION

A. Engage a factory-authorized service representative to train. Owner's maintenance personnel to adjust, operate, and maintain commercial, electric, water heaters.

END OF SECTION

SECTION 224200 - COMMERCIAL PLUMBING FIXTURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Plumbing fixtures
2. Toilet seats
3. Supply fittings
4. Risers
5. Water tempering equipment
6. Source quality control
7. Grout

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for water closets.
2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For flushometer valves and electronic sensors to include in operation and maintenance manuals.

1.5 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that are packaged with protective covering for storage and identified with labels describing contents.

1. Flushometer-Valve Repair Kits: Equal to 10 percent of amount of each type installed, but no less than one of each type.

PART 2 - PRODUCTS

2.1 PLUMBING FIXTURES

A. Finish of all trim, faucets, supplies, traps and other sundries exposed on walls, floors or as part of plumbing fixtures shall be BRUSHED CHROME.

1. The above includes the finish of floor cleanouts, exposed drains, wall cleanouts access doors, and other appurnatures

B. Plumbing Fixtures Are Scheduled On The Drawings, specifically on the plumbing drawing schedule sheet. Below are requirements that establish the level of quality as a minimum to meet the standards of this installation

C. See Drawings for Exact Models and Types.

D. General – only grade 1, type 1 plumbing fixtures are acceptable

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. American Standard.

b. Briggs Plumbing Products, Inc.

c. Crane Plumbing, L.L.C.

d. Acorn

e. Bradley

f. Eljer

g. Haws

h. Halsey Taylor

i. Oasis

j. Kohler Co.

k. Sloan Valve Company.

l. TOTO USA, INC.

m. Zurn Industries, LLC.

2. All plumbing fixtures shall be furnished from the same manufacturer

3. All fixtures shall comply with the latest water conservation standards

4. Refer to Architectural and Plumbing Drawings for quantities, locations and mounting heights of fixtures provided under this Section.

5. Fixture trim, traps, faucets, escutcheons and waste pipes exposed to view in finished spaces shall be IPS brass plated to match the finish stipulated by the architect.

6. Vitreous china fixtures shall be regular selection fused and vitrified to produce homogeneous material with close grain without pores. Surfaces that contact walls, floors and other fixtures shall be set true.

7. Enameled surfaces on cast iron fixtures shall be of suitable thickness to provide the highest commercial grade. Exterior exposed surfaces not enameled shall be treated at factory with one coat of filler.
8. Affix manufacturer's guarantee label or trademark to fixture to indicate first quality. Acid-resisting enameled fixture shall bear manufacturer's symbol signifying resistance to acid.
9. Set fixtures with wall outlet flanges at proper distance from floors and walls with closet setting compound or gasket.
10. Vitreous china and enameled cast-iron fixtures shall be scheduled on the drawings unless specified otherwise.
    a. For fixture colors: White as a general rule unless scheduled otherwise

E. Plumbing Fixtures And Trim

1. Refer to Architectural and Plumbing Drawings for quantities, locations and mounting heights of fixtures provided under this Section.
2. Fixture trim, traps, faucets, escutcheons and waste pipes exposed to view in finished spaces shall be IPS brass with polished chromium plating (CP) over nickel finish.
3. Vitreous china fixtures shall be regular selection fused and vitrified to produce homogeneous material with close grain without pores. Surfaces that contact walls, floors and other fixtures shall be set true.
4. Enameled surfaces on cast iron fixtures shall be of suitable thickness to provide the highest commercial grade. Exterior exposed surfaces not enameled shall be treated at factory with one coat of filler.
5. Affix manufacturer's guarantee label or trademark to fixture to indicate first quality. Acid-resisting enameled fixture shall bear manufacturer's symbol signifying resistance to acid.
6. Set fixtures with wall outlet flanges at proper distance from floors and walls with closet setting compound or gasket.
7. Vitreous china and enameled cast-iron fixtures shall be white throughout unless specified otherwise. Closet seats shall match closet fixture color.

2.2 TOILET SEATS

A. Toilet Seats :

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
    a. American Standard America.
    b. Bemis Manufacturing Company.
    c. Church Seats; Bemis Manufacturing Company.
    d. Kohler Co.
    e. Olsonite Seat Co.
    f. TOTO USA, INC.

g. Zurn Industries, LLC.

2. Standard: IAPMO/ANSI Z124.5.
3. Material: Plastic.
4. Type: Commercial (Heavy duty).
5. Shape: Elongated rim, open front].
6. Hinge: Check.
7. Hinge Material: Non-corroding metal.
8. Seat Cover: Not required.
9. Color: White.

2.3 SUPPLY FITTINGS

A. NSF Standard: Comply with NSF 61 Annex G, "Drinking Water System Components - Health Effects," for supply-fitting materials that will be in contact with potable water.

B. Standard: ASME A112.18.1/CSA B125.1.

C. Supply Piping: Chrome-plated brass pipe or chrome-plated copper tube matching water-supply piping size. Include chrome-plated brass or stainless-steel wall flange.

D. Supply Stops: Chrome-plated brass, one-quarter-turn, ball-type or compression valve with inlet connection matching supply piping.

E. Operation: Loose key.

2.4 RISERS

A. NPS 1/2 chrome-plated, soft-copper flexible tube or ASME A112.18.6, braided or corrugated stainless-steel, flexible hose waste fittings

B. Standard: ASME A112.18.2/CSA B125.2.

C. Drain: Grid with NPS 1-1/2 DN 40 tailpiece.

D. Trap:

1. Size: NPS 1-1/2.
2. Note: All trap trim is to match the finish selected by the Architect. See architectural requirements for finish material
3. Material: two-piece, cast-brass trap and swivel elbow with 0.032-inch- thick brass tube to wall; and finish -plated brass or steel wall flange.
4. Material: Stainless-steel, two-piece trap and swivel elbow with 0.012-inch- thick stainless-steel tube to wall; and stainless-steel wall flange.

a. Supply Connections: For hot and cold water.

2.5 WATER-TEMPERING EQUIPMENT

2.6 GROUT

A. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.

B. Characteristics: Non-shrink; recommended for interior and exterior applications.

C. Design Mix: 5000-psi, 28-day compressive strength.

D. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in of water supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before plumbing fixture installation.

B. Examine walls and floors for suitable conditions where closet plumbing fixtures will be installed.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Water-Closet Installation:

1. Install level and plumb according to roughing-in drawings.
2. Install floor-mounted water closets on bowl-to-drain connecting fitting attachments to piping or building substrate. Install accessible, wall-mounted water closets at mounting height for handicapped/elderly, according to ICC/ANSI A117.1.
3. Install toilet seats on water closets.

B. Urinal Installation:

1. Install urinals level and plumb according to roughing-in drawings.
2. Install wall-hung, back-outlet urinals onto waste fitting seals and attached to supports.
3. Install Wall-hung, bottom-outlet urinals with tubular waste piping attached to supports.
4. Install accessible, wall-mounted urinals at mounting height for the handicapped/elderly, according to ICC/ANSI A117.1.
5. Install trap-seal liquid in waterless urinals.

C. Lavatory Installation

1. Install lavatories level and plumb according to roughing-in drawings.

2. Install supports, affixed to building substrate, for wall-mounted lavatories.

D. Sink Installation

1. Install sinks level and plumb according to roughing-in drawings.
2. Install supports, affixed to building substrate, for wall-hung sinks.
3. Install accessible wall-mounted sinks at handicapped/elderly mounting height according to ICC/ANSI A117.1.
4. Set floor-mounted sinks in leveling bed of cement grout.

E. Seal joints between sinks and counters, floors, and walls using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color. Comply with sealant requirements specified in Division 07.

F. Shower Installation

1. Assemble shower components according to manufacturers' written instructions.
2. Install showers level and plumb according to roughing-in drawings.
3. Install water-supply piping with stop on each supply to each shower faucet.

    a. Exception: Use ball or gate valves if supply stops are not specified with shower.
    b. Install stops in locations where they can be easily reached for operation.

4. Install shower flow-control fittings with specified maximum flow rates in shower arms.
5. Set shower receptors and shower basins in leveling bed of cement grout.

G. Wash-Fountain Installation

1. Install wash fountains level and plumb according to roughing-in drawings.
2. Set freestanding wash fountains on floor.
3. Install off-floor carrier supports, affixed to building substrate, for wall-mounted wash fountains.
4. Install accessible, wall-mounted wash fountains at mounting height for handicapped/elderly according to ICC A117.1.
5. Install water-supply piping with shutoff valve on each supply to each wash fountain to be connected to domestic-water distribution piping.
6. Use ball or gate valve. Install valves in locations where they can be easily reached for operation.
7. Install trap and waste piping on each drain outlet of each wash fountain to be connected to sanitary drainage system.
8. Seal joints between fixtures and walls using sanitary-type, one-part, mildew-resistant, silicone sealant. Match sealant color to fixture color. Comply with sealant requirements specified in Division 07.

H. Flushometer-Valve Installation:

1. Install flushometer-valve water-supply fitting on each supply to each urinal.
2. Attach supply piping to supports or substrate within pipe spaces behind fixtures.
3. Install lever-handle flushometer valves for accessible urinals with handle mounted on open side of compartment.
4. Install fresh batteries in battery-powered, electronic-sensor mechanisms.

I. Support Installation:

1. Install supports, affixed to building substrate, for wall-hung urinals.
2. Use off-floor carriers with waste fitting and seal for back-outlet urinals.
3. Use carriers without waste fitting for urinals with tubular waste piping.
4. Use chair-type carrier supports with rectangular steel uprights for accessible urinals.
5. Install supports, affixed to building substrate, for floor-mounted, back-outlet water closets.
6. Use carrier supports with waste-fitting assembly and seal.
7. Install floor-mounted, back-outlet water closets attached to building floor substrate, onto waste-fitting seals; and attach to support.

J. Install wall-mounted, back-outlet water-closet supports with waste-fitting assembly and waste-fitting seals; and affix to building substrate. Water Cooler Installation

1. Install fixtures level and plumb according to roughing-in drawings. For fixtures indicated for children, install at height required by authorities having jurisdiction.
2. Set freestanding pressure water coolers on floor.
3. Install off-the-floor carrier supports, affixed to building substrate, for wall-mounted fixtures.
4. Install mounting frames, affixed to building construction, and attach recessed, pressure water coolers to mounting frames.
5. Install water-supply piping with shutoff valve on supply to each fixture to be connected to domestic-water distribution piping. Use ball or gate valve. Install valves in locations where they can be easily reached for operation.
6. Install trap and waste piping on drain outlet of each fixture to be connected to sanitary drainage system.

K. Drinking Fountain Installation

1. Install fixtures level and plumb according to roughing-in drawings. For fixtures indicated for children, install at height required by authorities having jurisdiction.
2. Set pedestal drinking fountains on floor.
3. Install recessed drinking fountains secured to wood blocking in wall construction.
4. Install off-the-floor carrier supports, affixed to building substrate, for wall-mounted fixtures.
5. Install water-supply piping with shutoff valve on supply to each fixture to be connected to domestic-water distribution piping. Use ball or gate valve. Install valves in locations where they can be easily reached for operation.

L. Flushometer-Valve Installation:

1. Install flushometer-valve, water-supply fitting on each supply to each water closet.
2. Attach supply piping to supports or substrate within pipe spaces behind fixtures.
3. Install lever-handle flushometer valves for accessible water closets with handle mounted on open side of water closet.
4. Install actuators in locations that are easy for people with disabilities to reach.
5. Install fresh batteries in battery-powered, electronic-sensor mechanisms.

M. Wall Flange and Escutcheon Installation:

1. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations and within cabinets and millwork.

2. Install deep-pattern escutcheons if required to conceal protruding fittings.
3. Comply with escutcheon requirements specified in Division 22.

N. Joint Sealing:

1. Seal joints between water closets and walls and floors using sanitary-type, one-part, mildew-resistant silicone sealant.
2. Match sealant color to water-closet color.
3. Comply with sealant requirements specified in Division 07.

3.3 EMERGENCY PLUMBING FIXTURE INSTALLATION

A. Assemble emergency plumbing fixture piping, fittings, control valves, and other components. See specification section 224500

3.4 CONNECTIONS

A. Connect water closets with water supplies and soil, waste, and vent piping. Use size fittings required to match water closets.

B. Where installing piping adjacent to water closets, allow space for service and maintenance.

3.5 ADJUSTING

A. Operate and adjust water closets and controls. Replace damaged and malfunctioning water closets, fittings, and controls.

B. Operate and adjust urinals and controls. Replace damaged and malfunctioning urinals, fittings, and controls.

C. Adjust water pressure at flushometer valves to produce proper flow.

D. Install fresh batteries in battery-powered, electronic-sensor mechanisms.

3.6 CLEANING AND PROTECTION

A. Clean all plumbing fixtures and fittings with manufacturers' recommended cleaning methods and materials.

B. Install protective covering for fixtures and fittings.

C. Do not allow use of plumbing fixtures for temporary facilities unless approved in writing by Owner

END OF SECTION

SECTION 224500 - EMERGENCY PLUMBING FIXTURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Emergency showers.
2. Eye/face wash equipment.
3. Combination units.
4. Supplemental equipment.
5. Water-tempering equipment.
6. Source quality control.

1.3 DEFINITIONS

A. Accessible Fixture: Emergency plumbing fixture that can be approached, entered, and used by people with disabilities.

B. Plumbed Emergency Plumbing Fixture: Fixture with fixed, potable-water supply.

C. Self-Contained Emergency Plumbing Fixture: Fixture with flushing-fluid-solution supply.

D. Tepid: Moderately warm.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include flow rates and capacities, furnished specialties, and accessories.

B. Shop Drawings: Diagram power, signal, and control wiring.

1.5 INFORMATIONAL SUBMITTALS

A. Product Certificates: Submit certificates of performance testing specified in "Source Quality Control" Article.

B. Field quality-control test reports.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For emergency plumbing fixtures to include in operation and maintenance manuals.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Flushing-Fluid Solution: Separate lot and equal to at least 200 percent of amount of solution installed for each self-contained unit.

1.8 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. ANSI Standard: Comply with ANSI Z358.1, "Emergency Eyewash and Shower Equipment."

C. NSF Standard: Comply with NSF 61 Annex G, "Drinking Water System Components - Health Effects," for fixture materials that will be in contact with potable water.

D. Regulatory Requirements: Comply with requirements in ICC/ANSI A117.1, "Accessible and Usable Buildings and Facilities"; Public Law 90-480, "Architectural Barriers Act"; and Public Law 101-336, "Americans with Disabilities Act"; for plumbing fixtures for people with disabilities.

PART 2 - PRODUCTS

2.1 EMERGENCY SHOWERS

A. Freestanding, Plumbed Emergency Showers,:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Acorn Safety.

b. Guardian Equipment Co.

c. Haws Corporation.

d. Speakman Company.

e. WaterSaver Faucet Co.

2. Capacity: Not less than 20 gpm. Provide flow restrictor on each shower head, Guardian FC-20
3. Supply Piping: **NPS 1-1/4** galvanized steel stainless steel or PVC with flow regulator and stay-open control valve.
4. Control-Valve Actuator: Pull rod.
5. Shower Head: 8-inch- minimum diameter, stainless steel, or plastic
6. Mounting: Pedestal.
7. Basis of Design

a. Stainless Steel Guardian G-1696
b. PVC Guardian G-1662

B. Off-Floor, Plumbed Emergency Showers,:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Acorn Safety.

b. Guardian Equipment Co.

c. Haws Corporation.

d. Speakman Company.

e. WaterSaver Faucet Co.

2. Capacity: Not less than 20 gpm. Provide flow restrictor on each shower head, Guardian FC-20
3. Supply Piping: NPS 1 stainless steel with flow regulator and stay-open control valve.
4. Control-Valve Actuator: Pull rod.
5. Shower Head: 8-inch- minimum diameter, stainless steel.
6. Mounting: Horizontal from wall or Vertical from ceiling and supported from piping.
7. Basis of Design

a. Vertical recessed: Guardian G-1629
b. Vertical semi- recessed: Guardian G-1658
c. Horizontal: Guardian G-1691

2.2 EYE/FACE WASH EQUIPMENT

A. Standard, Wall-Mounted, Plumbed, Eye/Face Wash Units,:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Acorn Safety.

b. Guardian Equipment Co.

c. Haws Corporation.

d. Speakman Company.

e. WaterSaver Faucet Co.

2. Capacity: Not less than 3.0 gpm for at least 15 minutes.
3. Supply Piping: NPS 1/2 chrome-plated brass or stainless steel with flow regulator and stay-open control valve.
4. Furnish flip top dust cover, internal flow controls and filter.
5. Control-Valve Actuator: **Paddle**
6. Spray-Head Assembly: Two or four receptor-mounted spray heads.
7. Receptor: stainless-steel bowl.
8. Drain Piping: NPS 1-1/4 minimum, chrome-plated brass, receptor drain, P-trap, waste to wall, and wall flange complying with ASME A112.18.2/CSA B125.2.
9. Mounting: Wall bracket.
10. Basis of Design

a. Stainless Steel: Guardian G-1724

B. Accessible, Wall-Mounted, Plumbed, Eye/Face Wash Units,:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Guardian Equipment Co.

b. Haws Corporation.

c. WaterSaver Faucet Co.

2. Capacity: Not less than 3.0 gpm for at least 15 minutes.
3. Supply Piping: NPS 1/2 chrome-plated brass or stainless steel with flow regulator and stay-open control valve.
4. Control-Valve Actuator: **Paddle**
5. Spray-Head Assembly: Four receptor-mounted spray heads.
6. Furnish flip top dust cover, internal flow controls and filter.
7. Receptor: stainless-steel bowl.
8. Mounting: Wall bracket.
9. Special Construction: Comply with ICC/ANSI A117.1.
10. Basis of Design

a. Stainless Steel: Guardian

C. Sink, Fixed-Position, Plumbed, Eye/Face Wash Unit,:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Acorn Safety.

b. Guardian Equipment Co.

c. Haws Corporation.

d. WaterSaver Faucet Co.

2. Capacity: Not less than 3 gpm for at least 15 minutes.
3. Supply Piping: NPS 1/2 chrome-plated brass or stainless steel with flow regulator and stay-open control valve.
4. Control-Valve Actuator:
5. Spray-Head Assembly: Two or four spray heads positioned over sink.
6. Receptor: stainless-steel bowl.
7. Mounting: Attached to sink receptor.
8. Basis of Design

a. Stainless Steel: Guardian G-1822

D. Sink, Swivel-Type, Plumbed Eyewash Unit,:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Acorn Safety; a division of Acorn Engineering Company.
b. Guardian Equipment Co.
c. Haws Corporation.
d. Speakman Company.
e. WaterSaver Faucet Co.

2. Capacity: Not less than 0.4 gpm for at least 15 minutes.
3. Supply Piping: stainless steel with flow regulator and stay-open control valve.
4. Control-Valve Actuator: Movement of spray-head assembly to position over sink.
5. Spray-Head Assembly: Two spray heads with offset piping.
6. Mounting: Deck next to sink.
7. Basis of Design

a. 90° Swivel Stainless Steel" Guardian G-1774 MOD
b. Left 90° Swivel Stainless Steel: Guardian G-1774 LH MOD

2.3 COMBINATION UNITS

A. Barrier Free, Plumbed Emergency Shower with Eye/Face Wash Combination Units,:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Acorn Safety.

b. Guardian Equipment Co.

c. Haws Corporation.

d. Speakman Company.

e. WaterSaver Faucet Co.

2. Piping:

a. Material: stainless steel Unit Supply**:** NPS 1-1/4 minimum**.**
b. Unit Drain: Outlet at back or side **near bottom.**

3. **Shower:**

a. **Capacity: Not less than** 20 gpm
b. Supply Piping: NPS 1 with flow regulator and stay-open control valve.
c. Provide flow restrictor on each shower head, Guardian FC-20
d. Control-Valve Actuator: .
e. Shower Head: 8-inch- minimum diameter, stainless steel plastic.
f. Mounting: Pedestal.

4. Eye/Face Wash Unit:

a. Capacity: Not less than 3 gpm for at least 15 minutes.
b. Supply Piping: NPS 1/2 with flow regulator and stay-open control valve.
c. Control-Valve Actuator: Paddle.
d. Spray-Head Assembly: Two or four receptor-mounted spray heads.
e. Receptor: stainless-steel bowl.
f. Mounting: Attached shower pedestal.
g. Basis of Design

1) Galvanized Steel Pipe with Plastic Head: Guardian GBF-1909
2) Galvanized Steel Pipe with Stainless Steel: Guardian GBF-1909SSH
3) All Stainless Steel: Guardian GBF-1994

2.4 WATER-TEMPERING EQUIPMENT

A. It is our understanding that USF does not require a tempered water system for safety showers and eyewashes due to available water temperature in that part of the country. Therefore, water tempering equipment shall not be provided. Local mixing valves will be provided at emergency plumbing fixtures for temperature flexibility

2.5 SOURCE QUALITY CONTROL

A. Certify performance of emergency plumbing fixtures by independent testing organization acceptable to authorities having jurisdiction.

1. Exception: .

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in for water and waste piping systems to verify actual locations of piping connections before plumbed emergency plumbing fixture installation.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 EMERGENCY PLUMBING FIXTURE INSTALLATION

A. Assemble emergency plumbing fixture piping, fittings, control valves, and other components.

B. Install fixtures level and plumb.

C. Fasten fixtures to substrate.

D. Install shutoff valves in water-supply piping to fixtures. Use ball or gate valve if specific type valve is not indicated. Install valves chained or locked in open position if permitted. Install valves in locations where they can easily be reached for operation. Comply with requirements for valves specified in Division 22.

1. Exception: Omit shutoff valve on supply to group of plumbing fixtures that includes emergency equipment.
2. Exception: Omit shutoff valve on supply to emergency equipment if prohibited by authorities having jurisdiction.
3. If authorities require shutoff valves, provide locable valves with limit switches that report a closed position. This for the valves in quesiton used for emergency plumbing life safety equipment. Coordinate limit switch points such that valve status is reported to the BMS.

E. Install dielectric fitting in supply piping to emergency equipment if piping and equipment connections are made of different metals. Comply with requirements for dielectric fittings specified in Division 22.

F. Install thermometers in supply and outlet piping connections to water-tempering equipment. Comply with requirements for thermometers specified in Division 22.

G. Install trap and waste piping on drain outlet of emergency equipment receptors that are indicated to be directly connected to drainage system. Comply with requirements for waste piping specified in Division 22.

H. Install indirect waste piping on drain outlet of emergency equipment receptors that are indicated to be indirectly connected to drainage system. Comply with requirements for waste piping specified in Division 22.

I. Install escutcheons on piping wall and ceiling penetrations in exposed, finished locations. Comply with requirements for escutcheons specified in Division 22.

J. Fill self-contained fixtures with flushing fluid.

3.3 CONNECTIONS

A. Connect cold-water-supply piping to plumbed emergency plumbing fixtures not having water-tempering equipment. Comply with requirements for cold-water piping specified in Division 22 for domestic water piping."

B. Directly connect emergency plumbing fixture receptors with trapped drain outlet to sanitary waste and vent piping. Comply with requirements for waste piping specified in Division 22.

C. Indirectly connect emergency plumbing fixture receptors without trapped drain outlet to sanitary waste or storm drainage piping.

D. Where installing piping adjacent to emergency plumbing fixtures, allow space for service and maintenance of fixtures.

3.4 IDENTIFICATION

A. Install equipment nameplates or equipment markers on emergency plumbing fixtures and equipment and equipment signs on water-tempering equipment. Comply with requirements for identification materials specified in Division 22.

3.5 FIELD QUALITY CONTROL

A. Mechanical-Component Testing: After plumbing connections have been made, test for compliance with requirements. Verify ability to achieve indicated capacities.

B. Tests and Inspections:

1. Perform each visual and mechanical inspection.
2. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
3. Operational Test: After electrical circuitry has been energized, start units to confirm proper unit operation.
4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

C. Emergency plumbing fixtures will be considered defective if they do not pass tests and inspections.

D. Prepare test and inspection reports.

3.6 ADJUSTING

A. Adjust or replace fixture flow regulators for proper flow.

B. Adjust equipment temperature settings.

END OF SECTION

SECTION 226113 - PIPING FOR LABORATORY FACILITIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Performance requirements
2. Laboratory pipe, tubes and fittings
3. Laboratory waste pipe, tubes and fittings
4. Piping specialties
5. Jointing materials
6. Laboratory compressed gas cylinder gas racks
7. Laboratory compressed gas manifolds and outlets
8. Nitrogen.

1.3 DEFINITIONS

A. Non-laboratory laboratory vacuum piping systems include laboratory low-vacuum and laboratory high-vacuum piping systems.

B. Laboratory compressed-air piping systems include laboratory air, dental air, instrument air, and laboratory air.

C. Non-laboratory compressed-air piping systems include laboratory air piping systems.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer and testing agency.

B. Material Certificates: Signed by Installer certifying that laboratory compressed air piping materials comply with requirements in NFPA 99 for positive-pressure laboratory gas systems.

C. Brazing certificates.

D. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For compressed-air piping specialties to include in emergency, operation, and maintenance manuals.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Laboratory all laboratory piping systems :

   a. Extra valves of each type (one of each)
   b. Extra full cylinders of each type of lab gas furnished (one of each)

2. Laboratory Quick-Coupler Service Connections: Furnish complete non-interchangeable laboratory vacuum suction inlets.

1.8 QUALITY ASSURANCE

A. Installer Qualifications:

1. Laboratory Air Piping Systems for Healthcare Facilities: According to ASSE Standard #6010 for laboratory-gas-system installers.
2. Shape-Memory-Metal Coupling Joints: An authorized representative who is trained and approved by manufacturer.

B. Testing Agency Qualifications: An independent testing agency, with the experience and capability to conduct compressed gases and vacuum piping testing indicated, that is a member of the Laboratory Gas Professional Healthcare Organization or is an NRTL, and that is acceptable to authorities having jurisdiction.

1. Qualify testing personnel according to ASSE Standard #6020 for laboratory-gas-system inspectors and ASSE Standard #6030 for laboratory-gas-system verifiers.

C. Brazing: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code, Section IX, "Welding and Brazing Qualifications"; or AWS B2.2, "Standard for Brazing Procedure and Performance Qualification."

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Laboratory Lab bench air operating at 20 to 30 psig.

B. Laboratory central air system operating at 80 to 120 psig.

C. Instrument air operating at 175 psig.

D. Laboratory Natural Gas air operating at 10 inch WC.

E. Laboratory Central Nitrogen gas operating at 50 psig.

1. Bench delivery pressure: 25 psig

F. Laboratory Central CO_2 gas operating at 50 psig.

1. Bench delivery pressure: 25 psig

G. Laboratory Central O_2 gas operating at 50 psig

1. Bench delivery pressure: 25 psig

H. Laboratory Central Vacuum System operating at 20 inches Hg 560 torr at the remote bench outlet

2.2 PIPES, TUBES, AND FITTINGS – LABORATORY PIPING

A. Laboratory Compressed Gas Piping, **Air, CO2, Oxygen and Nitrogen**

1. PIPE

   a. Seamless copper tube, laboratory gas, drawn temper, Type L. ASTM B-819. See Note a.
   b. Seamless copper tube, laboratory gas, drawn temper, Type L. ASTM B-819.

2. FITTINGS

   a. Wrought copper, solder-joint. ASME B16.22. .
   b. Wrought copper, solder-joint. ASME B16.22. .

3. JOINTS

   a. ANSI/AWS A5.8 brazing filler material, BcuP series. No flux. See Note b ANSI/AWS A5.8 brazing filler material, BCuP series. No flux. See Note b.

4. MECHANICAL JOINTS

a. Cast copper alloy unions, hexagonal stock with ball-and-socket joint, solder joint ends. ASME B16.18. See Note a.
b. ANSI Class 150 flange, ASME B16.24. ANSI B16.1 flange dimensions. See Note a

5. BALL VALVES

a. All bronze, 3 piece, full port, PTFE seats, chrome plated bronze ball, solder end connections. 600 PSIG WOG. Apollo 82-200-57, Ohmeda 6802, Watts B-6801.

6. CHECK VALVES

a. Class 125, bronze body, bronze disc, solder end connections. See Note b Milwaukee 1509, Jenkins 4093, Stockham B-309.
b. Class 125, cast iron body, bronze disc, flanged end connections. ANSI B16.1 flange dimensions. See Note b. Milwaukee F-2974.

7. Notes:

a. Valves, fittings, components, and each length of tube shall be factory cleaned and suitable for laboratory oxygen service in accordance with CGA Pamphlet G-4.1. They shall be permanently labeled and delivered plugged, capped, bagged or otherwise sealed. Plug caps or other seals shall remain in place until final assembly.
b. Brazers shall be qualified in accordance with the requirements of NFPA 99. Joints and piping shall be continuously purged with a positive flow of Grade M, CGA Pamphlet G-10.1 oil free, dry nitrogen per ANSI/AWS B2.2 and NFPA 99 procedures.
c. Valves shall be by a single manufacturer.
d. Provide mechanical joint connections to all equipment such as pumps, compressors, manifolds, etc.

B. LABORATORY VACUUM PIPING

1. Pipe

a. Seamless copper tube, drawn temper, Type L. ASTM B-88.
b. Seamless copper tube, drawn temper, Type L. ASTM B-88.

2. Fittings

a. Wrought copper, solder-joint, DWV pattern. ASME B16.29.
b. Wrought copper, solder-joint. ASME B16.29.

3. Joints

a. ANSI/AWS A5.8 brazing filler material, BcuP series
b. ANSI/AWS A5.8 brazing filler material, BCuP series.

4. Mechanical Joints

a. Cast copper alloy unions, hexagonal stock with ball-and-socket joint, solder joint ends. ASME B16.18.

b. ANSI Class 150 flange, ASME B16.24. ANSI B16.1 flange dimensions.

5. Ball Valve

a. All bronze, 3 piece, full port, PTFE seats, chrome plated bronze ball, solder end connections. 600 PSIg WOG. Apollo 82-200, Ohmeda 6802, Watts B-6801.
b. All bronze, 3 piece, full port, PTFE seats, chrome plated bronze ball, solder end connections. 600 PSIg WOG. Apollo 82-200-57, Ohmeda 6802, Watts B-6801.

6. Check

a. Class 125, bronze body, bronze disc, solder end connections. Milwaukee 1509, Jenkins 4093, Stockham B-309.
b. Class 125, cast iron body, bronze disc, flanged end connections. ANSI B16.1 flange dimensions. Milwaukee F-2974.

2.3 PIPES, TUBES, AND FITTINGS – LABORATORY WASTEWATER

A. GRAVITY LAB WASTE AND VENT

1. CPVC Pipe and fittings will be used from a lab fixture to a point 8 feet downstream from said lab fixture where a transition to cast iron soil pipe shall be used. From that point route cast iron lab wastewater piping to sanitary waste stacks

2. PP Drainage Pipe and Fittings: may be used as an alternative to CPVC ASTM F 1412, pipe extruded and drainage-pattern fittings molded, with Schedule 40 dimensions, from PP resin with fire-retardant additive complying with ASTM D 4101; with fusion-joint ends.

3. Adhere to manufacturers recommendations for backfill and compaction.

4. Waste Pipe And Fittings Above Slab (Under Bench).....Flame-Retardant Polypropylene fittings shall be manufactured to Schedule 40 dimensions. Fittings shall be joined to the polypropylene pipe by means of mechanical joint connection. Fittings shall meet the same flammability requirements as described for pipe above.

5. Mechanical joints are <u>not permitted</u> for drainage of hot water appliances (autoclaves, sterilizers, dishwashers, etc.)

B. CPVC Spec Data

1. GENERAL CPVC Drainage Pipe and Fittings: ASTM F 1412, pipe extruded and drainage-pattern fittings molded, with Schedule 40 dimensions

2. . All pipe shall be marked with manufacturer's name, pipe size, schedule, type, quality control mark and ASTM information. All fittings shall be legibly marked showing manufacturer's trademark, fitting size, manufacturer's part number, and symbol indicating the material.

3. PIPE Schedule 40CPVC to meet schedule 40 iron pipe size dimensional standards ASTM. Pipe shall be produced to the requirements of ASTM F2614 .....
4. FITTINGS DWV pattern Schedule 40-fittings in conformance with ASTM D1784 and ASTM F2618

5. JOINTS Solvent weld. Joints to be prepared and cleaned in accordance with manufacturer's guidelines

6. EXPANSION AND CONTRACTION Mechanical expansion joints are not permitted. The pipe expansion and contraction is to be compensated with proper piped expansion provisions. All support hangers and friction clamps are to allow movement. Pipe and fittings shall not bear against building structure. Use only approved floor to floor spring support clamps as manufactured by Mason Industries or approved equal

7. ACCEPTABLE MANUFACTURERS Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the work include but are not limited to:

   a. Charlotte Pipe

   b. Spears

   c. US Plastics

   d. Harvel Plastics

8. NOTES:

   a. Installation, including support spacing, compensation for expansion and contraction, and joining shall be in compliance with manufacturer's recommendations

   b. Underground installations (in accordance with manufacturer's recommendations) – the trench for the pipe installation to be free of loose stones, building materials or outcroppings and must provide minimum clearance around pipe of half the diameter on each side and one pipe diameter above and below the pipe.

   c. The trench shall be backfilled over the unexcavated base to a depth of one pipe diameter with clean backfill.

   d. Backfill material shall be free of stones and foreign matter and shall be capable of passing a #10 screen.

   e. After testing, initial backfilling must be completed using #10 screen material until fill surrounds the pipe. When the selected backfill meets a depth of one diameter over the pipe, then backfilling can proceed with normal fill until complete.

   f. Buried Piping - Fill shall be compacted using hand held compacting equipment when fill is midway up the pipe and again when the fill is over one diameter over the pipe. Heavy duty compacting equipment can be used after the initial backfill is complete.

   g. For underground piping and piping in contact with concrete/masonry: Provide protection around exterior surface of piping system in accordance with the pipe manufacturers' instructions.

   h. Coating system design basis: schedule 40 galvanized pipe sleeve

C. LABORATORY FORCE MAIN

1. General

a. PP Pressure Pipe and Fittings: ASTM F 1412, pipe extruded and drainage-pattern fittings molded, with Schedule 80 dimensions, from PP resin with fire-retardant additive complying with ASTM D 4101; with hot fusion joints - no coils

2. Pipe

a. Acid Waste Flame Retardant Polypropylene (NFRPP) Schedule 80 Pipe complying with ASTM F1412 and the material requirements of ASTM D4101.

3. Fittings

a. Polypropylene Drainage Fittings complying with ASTM F1412 and the material requirements of ASTM D4101. Fittings ready for heat fusion, no coils.

4. Joints

a. Connections between polypropylene pipe and fittings to be made using butt weld heat fusion joints. Joints shall be rated for 150% of working pressure of the system but not less than 100 psi at 73 deg F
b. In Accordance With The Manufacturer's Recommendations. Joints Made Between PP Pipe And Dissimilar Materials Shall Be Joined With Proper Adapters and Transition Fittings According To Manufacturer's Recommendations.

5. Butterfly Valve

a. Butterfly valves shall be PP body with either PP, disc and FKM seat and seals. The liner shall be full seat design fully molded around the body where as only the Disc and Seat are wetted parts and feature raised convex rings on the face and be utilized as the mating flange gaskets.
b. Valves shall accept flat faced flanges in accordance with ANSI B16.5 bolt pattern for 150 lb flanges. Valve stem shall be either 316 SS.
c. The valve lever handle (sizes 1-1/2" – 8") shall have a molded provision for a padlock.
d. Operators: Lever Type (standard sizes 1-1/2" – 8").

6. CHECK VALVE

a. All sizes Class 150, ball type PP body with EPDM/FPM seats and seals. 150 PSI @ 68 deg C for sizes 3/8" (15mm) through 4" (110mm). Valves shall be equal to GF Piping systems LLC Type 561 (no spring) or Type 562 (with spring).

7. Acceptable Manufacturers And Notes

a. Asahi of America - Pressurized and Fittings.
b. Orion - Orion Fittings Inc.
c. Enfield/Labline - IPEX USA LLC.
d. GF – George Fischer Corp.
e. Notes:

1) Underground installations (in accordance with manufacturer's recommendations) – the trench for the pipe installation to be free of loose stones, building materials or outcroppings and must provide minimum

clearance around pipe of half the diameter on each side and one pipe diameter above and below the pipe.

2) The trench shall be backfilled over the unexcavated base to a depth of one pipe diameter with clean backfill.
3) Backfill material shall be free of stones and foreign matter and shall be capable of passing a #10 screen.
4) After testing, initial backfilling must be completed using #10 screen material until fill surrounds the pipe. When the selected backfill meets a depth of one diameter over the pipe, then backfilling can proceed with normal fill until complete.
5) Fill shall be compacted using hand held compacting equipment when fill is midway up the pipe and again when the fill is over one diameter over the pipe. Heavy-duty compacting equipment can be used after the initial backfill is complete.

2.4 PIPING SPECIALTIES

A. Comply with ASME B31.1, "Power Piping," for piping systems operating at more than 150 psig.

B. Comply with ASME B31.9, "Building Services Piping," for piping systems operating at 150 psig or less.

C. Flexible Pipe Connectors:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Flex-Hose Co., Inc.

b. Flexicraft Industries.

c. Metraflex Company (The).

d. Universal Metal Hose.

2. Description: Corrugated- stainless steel with stainless braid and cover and ends brazed to inner tubing.

a. Working-Pressure Rating: 250 psig minimum.
b. End Connections: . match the piping material to which it is connected

2.5 PIPING SPECIALTIES – LABORATORY WASTE

A. Plastic Dilution Traps:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Georg Fischer Inc.
b. IPEX USA LLC.
c. Orion Fittings; a Watts Water Technologies company.
d. Town & Country Plastics, Inc.
e. Zurn Industries, LLC.

2. Material: Corrosion-resistant PP, with removable base.
3. End Connections: Mechanical joint.
4. Dilution Tanks: 1-gal. capacity, with clear base unless colored base is indicated; with two NPS 1-1/2 top inlets and one NPS 1-1/2 side outlet.
5. Small Dilution Jars: 1-pint capacity, with clear base unless colored base is indicated; with NPS 1-1/2 top inlet and NPS 1-1/2 side outlet.
6. Large Dilution Jars: 1-quart capacity; with NPS 1-1/2 top inlet and NPS 1-1/2 side outlet.

B. Corrosion-Resistant Traps:

1. Type: P-trap or drum trap.
2. Size: NPS 1-1/2 or NPS 2, as required to match connected piping.
3. High-Silicon Iron: ASTM A 861, with horizontal outlet and hub-and-plain or plain ends to match connecting piping.
4. PP: ASTM D 4101, with mechanical-joint pipe connections.
5. PVDF: ASTM D 3222, with mechanical-joint pipe connections.
6. Glass: ASTM C 1053, with coupling pipe connections.

C. Stainless-Steel Cleanouts:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

a. Blucher Co. Division of Watts Technology Group.
b. Josam Company.
c. Zurn Corporation
d. Smith Company

2. Standard: ASME A112.3.1, ASTM A 666, Type 316L, stainless steel.
3. Aboveground Piping: Cleanout tee of size matching piping.
4. Underground and Underslab Piping: Floor access cleanout of size matching piping.

D. Plastic Backwater Valves:

1. Description: Full-port NPS 3 check valve, PP or PVDF, matching or compatible with system piping and compatible with system liquid, with EPDM seals and flanged ends.

E. PP Sink Outlets:

1. Description: NPS 1-1/2, with clamping device, stopper, and 7-inch- high overflow fitting.

2.6 JOINING MATERIALS

A. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys.

B. Threaded-Joint Tape: PTFE.

C. Lead: the use of lead joints, lead solder, and/or caulking material is prohibited

D. Note: specific jointing materials are listed in each pipe spec table

2.7 NITROGEN

A. Comply with USP 32 - NF 27 for oil-free dry nitrogen.

PART 3 - EXECUTION

3.1 PIPING SYSTEMS SCHEDULE

SERVICE	CODE	MAXIMUM SERVICE OPERATING LIMITS		PIPE CLASS	PIPE MATERIAL
		(psig)	Temp (°F)		
Lab 140° Hot Water	L140°	100	250	See 221100 Water	Copper, Press Fit
Lab 140° Hot Water Return	L140°R	100	250	See 221100 Water	Copper, Press Fit
Laboratory Cold Water	LCW	100	250	See 221100 Water	Copper, Press Fit
Laboratory Hot Water	LHW	100	250	See 221100 Water	Copper, Press Fit
Laboratory Hot Water Return	LHWR	100	250	See 221100 Water	Copper, Press Fit
Non-Potable Water	NPW	100	250	See 221100 Water	Copper, Press Fit
Vivarium 140° Hot Water	V140°	100	250	See 221100 Water	Copper, Press Fit
Vivarium 140° Hot Water Return	V140°R	100	250	See 221100 Water	Copper, Press Fit
Vivarium Cold Water	VCW	100	250	See 221100 Water	Copper, Press Fit
Vivarium Hot Water	VHW	100	250	See 221100 Water	Copper, Press Fit
Vivarium Hot Water Return	VHWR	100	250	See 221100 Water	Copper, Press Fit
Laboratory Compressed Air	CA	200	120		Copper
Laboratory Carbon Dioxide	CO2	125	120		Copper
Laboratory Nitrogen	N2	250	120		Copper
Laboratory Oxygen	OX	125	120		Copper
Laboratory Vacuum	VAC	29 inches HG	120		Copper
General Pipe Spec Notes:					
1. Each valve type shall be the product of a single manufacturer. Each system shall be provided					

Commented [rjr1]: vanderwiel engineers stipulates copper a better selection here, of cource. we need USF to accept or reject for galv steel (their standard)

SERVICE	CODE	MAXIMUM SERVICE OPERATING LIMITS		PIPE CLASS	PIPE MATERIAL
		(psig)	Temp (°F)		

with valves as required by code and shown on the drawings. And shall be installed to facilitate operation, replacement and repair.

2. Provide access panels for concealed valves behind non-removable ceilings or walls.
3. Provide shut-off valves on supply piping to individual pieces of equipment.
4. Provide pipe dope, Teflon tape, wax rings, neoprene gaskets and other jointing compounds as required by best standard practice and only on service as recommended by manufacturer.
5. Apply putties and jointing compounds for plumbing fixtures and trim as recommended by manufacturers.
6. Valves on insulated piping systems shall be equipped with extended handles to accommodate insulation thickness.
7. Piping routed through metal stud or wood stud partitions: provide centering such that piping does not come in contact with metal studs and also protection of piping systems routed horizontally through metal stud or wood stud partitions where the piping crosses a stud. Sleeve type protection shall be used to prevent damage to the lateral piping by the use of screws/nails/fasteners. Provide pre-manufactured products equal to puncture solution, or on site sleeves.

3.2 SCHEDULE OF PIPING – LABORATORY WASTEWATER

SERVICE	CODE	MAXIMUM SERVICE OPERATING LIMITS		PIPE CLASS Chemical Drain	PIPE MATERIAL
		(psig)	(°F)		
Force Main (Lab Waste)	LW-FM	50	120		Schedule 80 PP – pressure joint
Lab Vent (non plenum rated)	LV	Gravity	100		cast iron see 221110
Lab Waste inside casework and run-out to cast iron stack	LW	Gravity	120		CPVC from lab sink to cast iron stack
Lab Waste general piping	LW	Gravity	120		Cast iron – see 221110

General Pipe Spec Notes:

1. Adapters and Transition Fittings: Assemblies with combination of clamps, couplings, adapters, and gaskets; compatible with piping and system liquid; made for joining different piping materials.
2. Each Valve Type Shall Be The Product Of A Single Manufacturer. Each System Shall Be Provided with Valves as Required by Code and Shown On the drawings And Shall Be Installed to Facilitate Operation, Replacement and Repair.
3. Provide Access Panels For Concealed Valves Behind Non-Removable Ceilings Or Walls.
4. Provide Shut-Off Valves On Supply Piping To Individual Pieces Of Equipment.
5. Blucher gasket material for chemical waste piping used for this section
6. Piping Routed through Metal Stud or Wood Stud Partitions: provide centering such that piping does not come in contact with metal studs and also protection of piping systems routed horizontally through metal stud or wood stud partitions where the piping crosses a stud. Sleeve type protection shall be used to prevent damage to the lateral piping by the use of screws/nails/fasteners. Provide pre-manufactured products equal to Puncture Solution, or on site sleeves.

3.3 PREPARATION

A. Cleaning of Laboratory Gas Tubing: If manufacturer-cleaned and -capped fittings or tubing is not available or if pre-cleaned fittings or tubing must be re-cleaned because of exposure, have supplier or separate agency acceptable to authorities having jurisdiction perform the following procedures:

   1. If the above criteria in paragraph A applies, see the cleaning specification in this section, table 3 for details.

3.4 PIPING INSTALLATION – LABORATORY SERVICE PIPING

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping. Indicated locations and arrangements were used to size pipe and calculate friction loss,

expansion, air-compressor sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on coordination drawings.

B. Comply with NFPA 99 for installation of compressed-air and compressed gas piping.

C. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.

D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal and coordinate with other services occupying that space.

F. Install piping adjacent to equipment and specialties to allow service and maintenance.

G. Install compressed-air piping with 1 percent slope downward in direction of flow.

H. Install nipples, unions, special fittings, and valves with pressure ratings same as or higher than system pressure rating used in applications specified in "Piping Schedule" Article unless otherwise indicated.

I. Install eccentric reducers, if available, where compressed-air piping is reduced in direction of flow, with bottoms of both pipes and reducer fitting flush.

J. Install branch connections to compressed-air mains from top of main. Provide drain leg and drain trap at end of each main and branch and at low points.

K. Install thermometer and pressure gage on discharge piping from each air compressor and on each receiver. Comply with requirements in Division 22.

L. Install piping to permit valve servicing.

M. Install piping free of sags and bends.

N. Install fittings for changes in direction and for branch connections.

O. Install laboratory air piping to laboratory air service connections specified in this Section, to laboratory air service connections in equipment specified in Division 22, and to equipment specified in other Sections requiring laboratory air service.

P. Install compressed-air service connections recessed in walls. Attach roughing-in assembly to substrate; attach finishing assembly to roughing-in assembly.

Q. Connect compressed-air piping to air compressors and to compressed-air outlets and equipment requiring compressed-air service.

R. Install unions in copper compressed-air tubing adjacent to each valve and at final connection to each machine, specialty, and piece of equipment.

S. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Division 22.

T. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Division 22.

3.5 PIPING INSTALLATION – LABORATORY WASTEWATER PIPING

A. Chemical-Waste Sewerage Outside the Building:

1. Locations and Arrangements: Drawing plans and details indicate general location and arrangement of underground chemical-waste sewerage piping. Location and arrangement of piping layout take design considerations into account. Install piping as indicated, to extent practical. Where specific installation is not indicated, follow piping manufacturer's written instructions.
2. Install piping beginning at low point, true to grades and alignment indicated with unbroken continuity of invert. Place bell ends of piping facing upstream. Install gaskets, seals, sleeves, and couplings according to manufacturer's written instructions for using lubricants, cements, and other installation requirements.
3. Install manholes for changes in direction, unless fittings are indicated. Use fittings for branch connections unless direct tap into existing sewer is indicated.
4. Install proper size increasers, reducers, and couplings where different sizes or materials of pipes and fittings are connected. Reducing size of piping in direction of flow is prohibited.
5. Tunneling: Install pipe under streets or other obstructions that cannot be disturbed by tunneling, jacking, or combination of both.
6. Install drainage piping pitched down in direction of flow, at minimum slope of 1/8 inch per foot, unless otherwise indicated.
7. Install drainage piping with 60-inch minimum cover.
8. Install PVDF drainage piping according to ASTM D 2321 and ASTM F 1668.
9. Install fiberglass piping according to ASTM D 3839 and ASTM F 1668.
10. Install field-fabrication containment piping over existing carrier piping. Use containment piping manufacturer's fastening system.
11. Clear interior of piping and structures of dirt and superfluous material as work progresses. Maintain swab or drag in piping, and pull past each joint as it is completed. Place plug in end of incomplete piping at end of day and when work stops.

B. Chemical-Waste Piping Inside the Building:

1. Install piping next to equipment, accessories, and specialties to allow service and maintenance.
2. Transition and special fittings with pressure ratings at least equal to piping pressure rating may be used unless otherwise indicated.
3. Flanges may be used only if all alternative fusion solutions are impossible, on aboveground piping unless otherwise indicated.
4. Install underground fiberglass piping according to ASTM D 3839.
5. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.
6. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
7. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
8. Install piping at indicated slopes.
9. Install piping free of sags and bends.
10. Install fittings for changes in direction and branch connections.

11. Verify final equipment locations for roughing-in.
12. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Division 22.
13. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Division 22.
14. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Division 22.

3.6 PIPING SPECIALTY INSTALLATION - WASTEWATER

A. Embed floor drains in 4-inch minimum depth of concrete around bottom and sides. Comply with requirements in Division 03 for concrete.

B. Fasten grates to drains if indicated.

C. Set floor drains with tops flush with pavement surface.

D. Install cleanouts and riser extension from sewer pipe to clean out at grade. Use fittings of same material as sewer pipe at branches for cleanouts and riser extensions to cleanouts. Install piping so cleanouts open in direction of flow in pipe.

1. Set cleanout bodies in earth in cast-in-place concrete block, 18 by 18 by 12 inches deep. Set with tops 1 inch above surrounding grade. Set cleanout plugs in concrete pavement with tops flush with pavement surface. Comply with requirements in Division 03 for formwork, reinforcement, and concrete requirements.

E. Install backwater valves in horizontal position. Include riser to clean out at grade.

3.7 JOINT CONSTRUCTION - WASTEWATER

A. Chemical-Waste Sewerage Outside the Building:

1. Plastic-Piping, Electro fusion Joints: Make polyolefin drainage-piping joints according to ASTM F 1290.
2. Join dissimilar pipe materials with adapters compatible with pipe materials being joined.
3. Join high-silicon-iron, hub-and-plain-end piping with calked joints using acid-resistant packing and lead.
4. PVC Non-pressure Piping Joints: Join piping according to ASTM D 2665.

B. Chemical-Waste Piping Inside the Building:

1. Plastic-Piping Electro fusion Joints: Make polyolefin drainage-piping joints according to ASTM F 1290.
2. Dissimilar-Material Piping Joints: Make joints using adapters compatible with both system materials.
3. PVC Non-pressure Piping Joints: Join piping according to ASTM D 2665.
4. See individual pipe tables for specific jointing materials

3.8 VACUUM SYSTEM

A. Vacuum system shall run as indicated to outlets and equipment. Provide necessary fittings, valves and adapters to vacuum fittings, outlets and laboratory equipment.

B. Vacuum piping and component valves and fittings shall be capable of full vacuum. Threaded joints shall not be used.

C. Support all piping from the building structure with hangers or trapeze hangers with other laboratory piping where piping is positioned on racks. In suspended ceiling areas, conceal all lines above ceilings

D. Configure piping to run with building lines and in accordance with the drawings. do not cross building lines above ceilings in diagonal patterns, Keep piping neat and rectilinear with the building structure

E. Provide branch valves on every branch from the air main in addition to valves shown on the drawings

3.9 VALVE INSTALLATION

A. Install shutoff valve at each connection to and from compressed-air equipment and specialties.

B. Install check valves to maintain correct direction of compressed-air flow from compressed-air equipment.

C. Install valve boxes recessed in wall and anchored to substrate. Single boxes may be used for multiple valves that serve same area or function.

D. Install zone valves and gages in valve boxes. Rotate valves to angle that prevents closure of cover when valve is in closed position.

E. Install pressure regulators on compressed-air piping where reduced pressure is required.

F. Install flexible pipe connectors in discharge piping and in inlet air piping from remote air-inlet filter of each air compressor.

3.10 JOINT CONSTRUCTION

A. Remove scale, slag, dirt, and debris from outside of cleaned tubing and fittings before assembly.

B. Threaded Joints: Apply appropriate tape to external pipe threads.

C. Brazed Joints: Join copper tube and fittings according to CDA's "Copper Tube Handbook," "Brazed Joints" chapter. Continuously purge joint with oil-free dry nitrogen during brazing.

D. Flanged Joints: Install flange on copper tubes. Use pipe-flange gasket between flanges. Join flanges with gasket and bolts according to ASME B31.9 for bolting procedure.

E. Shape-Memory-Metal Coupling Joints: Join new copper tube to existing tube according to procedures developed by fitting manufacturer for installation of shape-memory-metal coupling joints.

3.11 CONNECTIONS - WASTEWATER

A. Coordinate piping installations and specialty arrangements with schematics on Drawings and with requirements specified. If Drawings are explicit enough, these requirements may be reduced or omitted.

B. Drawings indicate general arrangement of piping, fittings, and specialties.

C. Make connections to existing piping so finished Work complies as nearly as practical with requirements specified for new Work.

D. Use commercially manufactured wye fittings for sewerage piping branch connections. Remove section of existing pipe; install wye fitting into existing piping; and encase entire wye fitting plus 6-inch 150-mm overlap, with not less than 6 inches 150 mm of concrete with 28-day compressive strength of 3000 psi 20.7 MPa.

E. Protect existing piping to prevent concrete or debris from entering while making connections. Remove debris or other extraneous material that may accumulate.

F. Install piping adjacent to equipment to allow service and maintenance.

3.12 LABORATORY BENCHES, EQUIPMENT AND HOODS

A. Provide roughing and final connections for protected hot and cold water, laboratory waste and vent, laboratory vacuum, laboratory compressed air, carbon dioxide, RODI systems, natural gas and special gases, and including traps, tailpiece and strainers, wheel handle stops, valves, cocks and appurtenances to hoods and laboratory equipment requiring same. Each hood and piece of equipment, including work in, under or through benches, cabinets and equipment chases, shall be valved and trapped.

B. Laboratory Natural or Propane gas piping system:

1. Install safety valves at each lab per the drawings
2. Install a gas shutoff valve in an accessible location for all appliances, this includes a gas valve for each gas bench turret.

C. As laboratory equipment purchased may vary slightly from that indicated and therefore require some rearrangement of piping different from that indicated on Drawings, make connections to such rearranged equipment without additional cost to Owner. Unpack, assemble and install trim for benches, equipment and hoods, furnished under other Sections.

D. Provide miscellaneous laboratory equipment connections and indirect drains from similar equipment. Unions shall be installed at laboratory equipment and at other such places as may be necessary to disconnect piping so as to make repairs.

E. Roughing shall not be undertaken until Architect has approved laboratory equipment and hood shop drawings. Exact location of service connections shall be obtained prior to roughing.

F. Hook-up between glass washers and distilled water branch shall be made with a 3 foot piece of stainless steel pipe and shall include installation of a shutoff valve and vacuum breaker.

G. Shock absorbers shall be installed in conjunction with quick closing valves including glass washers and autoclaves. Shut-off valve shall be installed beneath each absorber. Absorber shall be sized in accordance with Plumbing and Drainage Institute Standard PDI-WH 201.

H. Provide ball valves on all fixtures, hoods, and equipment supplies.

I. Provide pressure vacuum breakers to glass washers, and cage washers where required to prevent back siphonage.

J. Provide RPZ in line backflow preventers at all sterilizers. Provide a piped drain from BFP to a funnel floor drain. Install a funnel floor drain behind all sterilizers.

K. Piping under lab benches shall include insulation per Section 2 of these specifications. Label all piping under benches per requirements in Section 3.

3.13 OVERHEAD SERVICE CARRIER

A. Laboratory service benches will be equipped with a ceiling mount overhead prepiped utility service carrier. The service carrier will be furnished under the architectural casework specification section of this contract.

B. Perform The Following:

1. A Unistrut support frame shall be installed under the architectural casework contract. The carrier and carrier support shall be supplied and installed by casework manufacture.
2. Plumbing Contract owns connections to carrier piping system.
3. there are sections per bench
4. The unit is pre-piped (all services/fixtures), this contractor (the plumber) shall connect the sections together to allow for single point of connection above the ceiling.
5. When the sections are put together, the piped joints between the sections are made using swage fittings.
6. This contractor shall receive and install the installation of the hose, Quick Connects and connections to the bench. All systems to be verified leak tight under provisions of the plumbing contract

C. Related Work In Other Sections:

1. Electrical power connections to all equipment and accessories (by electrical sub-contractor).

3.14 HANGER AND SUPPORT INSTALLATION – GENERAL PIPING

A. Comply with requirements in Division 22 for pipe hanger and support devices.

B. Vertical Piping: MSS Type 8 or Type 42 clamps.

C. Individual, Straight, Horizontal Piping Runs:

1. 100 Feet and Less: MSS Type 1, adjustable, steel, clevis hangers.
2. Longer than 100 Feet: MSS Type 43, adjustable, roller hangers.

D. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze. Comply with requirements in Division 22 for trapeze hangers.

E. Base of Vertical Piping: MSS Type 52, spring hangers.

F. Support horizontal piping within 12 inches of each fitting and coupling.

G. Rod diameter may be reduced one size for double-rod hangers, with 3/8-inch- minimum rods.

H. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1/4: 60 inches with 3/8-inch rod.
2. NPS 3/8 and NPS 1/2: 72 inches with 3/8-inch rod.
3. NPS 3/4: 84 inches with 3/8-inch rod.
4. NPS 1: 96 inches with 3/8-inch rod.
5. NPS 1-1/4: 108 inches with 3/8-inch rod.
6. NPS 1-1/2: 10 feet with 3/8-inch rod.
7. NPS 2: 11 feet with 3/8-inch rod.
8. NPS 2-1/2: 13 feet with 1/2-inch rod.
9. NPS 3: 14 feet with 1/2-inch rod.
10. NPS 3-1/2: 15 feet with 1/2-inch rod.
11. NPS 4: 16 feet with 1/2-inch rod.
12. NPS 5: 18 feet with 1/2-inch rod.
13. NPS 6: 20 feet with 5/8-inch rod.
14. NPS 8: 23 feet with 3/4-inch rod.

I. Install supports for vertical copper tubing every 10 feet.

3.15 HANGER AND SUPPORT INSTALLATION - WASTEWATER

A. Pipe sizes in this article refer to aboveground, single-wall piping and carrier piping of containment piping.

B. Comply with requirements in Division 22 for pipe hanger and support devices. Install the following:

1. Vertical Piping: MSS Type 8 or MSS Type 42, riser clamps.
2. Individual, Straight, Horizontal Piping Runs:

a. 100 Feet 30 m and Less: MSS Type 1, adjustable, steel clevis hangers.
b. Longer than 100 Feet 30 m: MSS Type 43, adjustable roller hangers.
c. Longer than 100 Feet 30 m, if indicated: MSS Type 49, spring cushion rolls.

3. Multiple, Straight, Horizontal Piping Runs 100 Feet 30 m or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
4. Base of Vertical Piping: MSS Type 52, spring hangers.

C. Comply with requirements in Division 22 for installation of supports.

D. Support horizontal piping and tubing within 12 inches 300 mm of each fitting and coupling.

E. Support vertical piping and tubing at base and at each floor.

F. Rod diameter may be reduced 1 size for double-rod hangers, to minimum of 3/8 inch 10 mm.

G. Install vinyl-coated hangers for PP piping with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 2 DN 50: 33 inches 840 mm with 3/8-inch 10-mm rod.
2. NPS 2-1/2 and NPS 3 DN 65 and DN 80: 42 inches 1067 mm with 1/2-inch 13-mm rod.
3. NPS 4 and NPS 5 DN 100 and DN 125: 48 inches 1220 mm with 5/8-inch 16-mm rod.
4. NPS 6 DN 150: 48 inches 1220 mm with 3/4-inch 19-mm rod.
5. NPS 8 DN 200: 48 inches 1220 mm with 7/8-inch 22-mm rod.

H. Install supports for vertical PP piping every 72 inches 1830 mm.

I. Install vinyl-coated hangers for PVDF piping with the following maximum horizontal spacing and minimum rod diameters:

1. All Sizes: Install continuous support for piping with liquid waste at temperatures above 140 deg F.

2. NPS 1/2 DN 15 and Smaller: 30 inches 760 mm with 3/8-inch 10-mm rod.
3. NPS 3/4 to NPS 1-1/2 DN 20 to DN 40: 36 inches 910 mm with 3/8-inch 10-mm rod.
4. NPS 2 DN 50: 36 inches 910 mm with 3/8-inch 10-mm rod.
5. NPS 2-1/2 and NPS 3 DN 65 and DN 80: 42 inches 1067 mm with 1/2-inch 13-mm rod.
6. NPS 4 and NPS 5 DN 100 and DN 125: 48 inches 1220 mm with 5/8-inch 16-mm rod.
7. NPS 6 DN 150: 48 inches 1220 mm with 3/4-inch 19-mm rod.

J. Install supports for vertical PVDF piping NPS 1-1/2 DN 40 every 48 inches 1220 mm and NPS 2 DN 50 and larger every 72 inches 1830 mm.

K. Install vinyl-coated hangers for fiberglass piping with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 2 DN 50 and Smaller: 10 feet 3 m with 3/8-inch 10-mm rod.
2. NPS 2-1/2 and NPS 3 DN 65 and DN 80: 10 feet 3 m with 1/2-inch 13-mm rod.
3. NPS 4 and NPS 5 DN 100 and DN 125: 10 feet 3 m with 5/8-inch 16-mm rod.
4. NPS 6 DN 150: 10 feet 3 m with 3/4-inch 19-mm rod.
5. NPS 8 to NPS 12 DN 200 to DN 300: 12 feet 3.6 m with 7/8-inch 22-mm rod.

L. Install supports for vertical fiberglass piping every 12 feet 3.6 m.

M. Install hangers for stainless-steel drainage piping with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 2 DN 50: 10 feet 3 m with 3/8-inch 10-mm rod.
2. NPS 2-1/2 DN 65: 11 feet 3.4 m with 1/2-inch 13-mm rod.
3. NPS 3 DN 80: 12 feet 3.6 m with 1/2-inch 13-mm rod.
4. NPS 4 and NPS 5 DN 100 and DN 125: 12 feet 3.6 m with 5/8-inch 16-mm rod.
5. NPS 6 DN 150: 12 feet 3.6 m with 3/4-inch 19-mm rod.

N. Install supports for vertical stainless-steel drainage piping every 15 feet 4.5 m.

O. Support piping and tubing not listed above according to MSS SP-69.

3.16 IDENTIFICATION

A. Identifying labels and devices for laboratory piping, valves, and specialties. Comply with requirements in Division 22.

B. In addition, install identifying labels and devices for laboratory piping systems according to NFPA 99.

3.17 PROTECTION

A. Protect tubing from damage.

B. Retain sealing plugs in tubing, fittings, and specialties until installation.

C. Clean tubing not properly sealed, and where sealing is damaged, according to "Preparation" Article.

3.18 VALVE SCHEDULE

A. Shutoff Valves: Ball valve with manufacturer-installed ASTM B 819, copper-tube extensions.

B. Zone Valves: Ball valve with manufacturer-installed ASTM B 819, copper-tube extensions with pressure gage on one copper-tube extension.

3.19 BALANCING OF HOT WATER SYSTEMS

A. Building Distribution System, comply with spec section 221110

3.20 FIELD QUALITY CONTROL CLEANING OF PIPING SYSTEMS

A. Vanderweil Engineers to revisit this section at next submission

3.21 FIELD QUALITY CONTROL: TESTING OF LABORATORY PIPING

A. General

1. Submit proposed test procedures, recording forms, and test equipment for review before testing.
2. Notify Architect and authorities involved at least 48 hours before testing and inspection.
3. Test and adjust laboratory gas plumbing systems as specified and as required by NFPA Test and adjust standard plumbing piping systems per state plumbing code requirements to the satisfaction of the authorities having jurisdiction.
4. The Piping systems shall be subjected to testing fluid and shall hold tight at the pressure head stated for the time interval required without adding air or water. While any system is being tested, required head or pressure shall be maintained until joints are inspected. Tests shall be witnessed by inspector having jurisdiction and the Architect with 48-hour notice given these authorities. Equipment, material and labor required for testing of various systems or part thereof shall be provided by Plumbing Contractor.
5. Before date of acceptance, furnish Architect with certificates of testing and inspection indicating approval of authorities having jurisdiction and conformance with requirements of Contract Documents.
6. Supply all materials, labor and power required for testing. Make preliminary tests and prove work satisfactory. Repair defects disclosed by tests or, if required by the Architect, replace defective work with new work without additional cost to the Owner. Pipe insulation shall be installed only after satisfactory completion of the pressure test.
7. Note: All gases necessary for testing, cleaning and commissioning compressed gas piping systems shall be furnished to complete the tests
8. All tests shall be observed by a representative of the Owner. This Contractor shall be responsible for supplying the bottled gas, gauges, adapters, analyzer and all other necessary equipment to conduct these tests. Final testing, outlet flow analysis, outlet concentrations, pressure verification and overall system operation shall be performed and certified by an independent approved gas testing laboratory.
9. This Contractor to submit test report and results to Architect/Engineer or his representative for verification. Also, this Contractor is to submit to the Architect for approval, the testing laboratory to be used for the gas certification. The submission is to include a complete listing and sequence of the proposed testing procedure to be used including which standards are to be followed, which order the outlets are to be tested, the parameters of the flow tests, and the equipment to be used to perform the tests.
10. Do not paint, cover or conceal work before testing, inspecting and obtaining approval; this includes backfilling and application of insulation.
11. Costs of repairs and restoration of work of other trades and of existing building surfaces or material damaged during cleaning or testing shall be borne by trade performing cleaning or testing.
12. No tests shall be started until systems have been cleaned as described under cleaning paragraph. Provide temporary piping and connections for testing, flushing, or draining systems to be tested.
13. Repair or replace leaks, damage and defects that result from tests to like new condition. Remove and replace defective materials with acceptable materials.
14. Piping and joints shall be made tight without caulking. Continue tests until systems operate without adjustments and repair to equipment or piping.
15. Provide testing instruments, force pumps, gauges, equipment and labor necessary to conduct tests. Instruments used for testing and balancing shall have been calibrated within six months before balancing. Instrument calibration shall be certified.

16. Each automatic on/off valve and control valve shall be enabled to the fully open position, unless a by-pass line around the valve is included in the piping system to allow application of pressure to both sides of the valve.
17. One or more calibrated pressure gauges shall be installed in the piping system for indication of the test pressure.
18. Minimum pipe metal temperature shall NOT be below 39 deg F (4 deg C) during the testing period for freeze protection.
19. Submit six (6) copies of complete testing and balancing report to Architect for review.

B. Pressurized Piping Systems

1. Leak tests shall be conducted in accordance with ANSI and NFPA applicable codes .
2. Before piping of various systems has been covered or furred in, piping systems shall be tested tight for 1 hour under hydrostatic pressure 1-1/2 times system working pressures but no greater than test pressure of 150 psig.
3. Equipment shall be valved off or removed during test if equipment pressure rating is less than test pressure.
4. Retest systems after leaks are repaired within Contract Price.

C. Gravity Piping Systems: Test under water pressure at heads specified in Plumbing Codes. Fill pipe lines with water to top of 10 ft. vertical section of pipe, or to level of top of vent pipe; maintain head pressure for 60 minutes.

D. Associated medical gas systems such as Vivarium Oxygen, CO2, Nitrogen, and medical vacuum, shall be tested as specified in this Section under the requirements of NFPA 99C.

E. Equipment – all systems

1. Prove capacity and performance of each piece of equipment by field tests as specified herein in various paragraphs. Equipment and instruments required for tests, as well as additional thermowells or gauge connections shall be installed at no additional cost to Owner.
2. Qualified representative of equipment manufacturer shall be present. Architect may witness tests, if he so desires.
3. Pressure vessels factory-tested by manufacturer in accordance with all applicable industrial regulatory codes, regulations and standards shall be excluded from the pressure testing at the job site.
4. Pumps, compressors, safety valves, rupture discs, self-contained regulators and packaged equipment units factory-tested by manufacturer shall be excluded from pressure testing at the job site.
5. Equipment and items excluded for cleaning and pressure testing shall be by-passed, disconnected, and blind-flanged or removed from the piping system.
6. Inspection for leakage shall be performed when the piping system is under the testing pressure specified for the system.
7. Pumps shall be tested to check impeller trim and operating characteristics. Following data shall be recorded and submitted to Architect for review.

    a. Flow at operating conditions where flow Venturi or orifices are installed in system.
    b. Shutoff pressure required to check impeller trim.
    c. Discharge pressure at operating conditions.
    d. Suction pressure at operating conditions.
    e. Motor amperage on each phase at operating conditions.

F. Hydrostatic Tests for Drainage Piping:

1. Allowable leakage is a maximum of 50 gal./inch of nominal pipe size per mile of pipe, during 24-hour period.
2. Close openings in system and fill with water.
3. Purge air and refill with water.
4. Disconnect water supply.
5. Test and inspect joints for leaks.
6. Air Tests for Drainage Piping: Comply with UNI-B-6.
7. Leaks and loss in test pressure constitute defects that must be repaired.
8. Submit separate reports for each test.
9. Replace leaking sewerage piping using new materials, and repeat testing until leakage is within allowances specified.

G. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect assembled neutralization systems and leak-detection systems and their installation, including piping and electrical connections, and to assist in testing.

H. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.

I. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

J. Chemical-waste piping will be considered defective if it does not pass tests and inspections.

K. Prepare test and inspection reports.

L. Testing Of Piping Systems :

3.22 FIELD QUALITY CONTROL: THIRD PARTY TESTING FOR LABORATORY PIPING

A. Contractor shall provide a third party lab gas certification

B. Testing Agency: Engage a qualified testing agency to perform tests and inspections of Laboratory Compressed-Air, Oxygen, CO_2, N_2 and other installed inert compressed gas piping in facilities and to prepare test and inspection reports.

C. Tests and Inspections:

1. Preparation: Perform the following Installer tests according to requirements in NFPA 99 and ASSE Standard #6010:

   a. Initial blow down.
   b. Initial pressure test.
   c. Cross-connection test.
   d. Piping purge test.
   e. Standing pressure test for positive-pressure laboratory compressed-air piping.
   f. Repair leaks and retest until no leaks exist.

2. System Verification: Perform the following tests and inspections according to NFPA 99, ASSE Standard #6020, and ASSE Standard #6030:

a. Standing pressure test.
b. Individual-pressurization or pressure-differential cross-connection test.
c. Valve test.
d. Master and area alarm tests.
e. Piping purge test.
f. Piping particulate test.
g. Piping purity test.
h. Final tie-in test.
i. Operational pressure test.
j. Laboratory air purity test.
k. Verify correct labeling of equipment and components.

3. Testing Certification: Certify that specified tests, inspections, and procedures have been performed and certify report results. Include the following:

a. Inspections performed.
b. Procedures, materials, and gases used.
c. Test methods used.
d. Results of tests.

D. Remove and replace components that do not pass tests and inspections and retest as specified above.

END OF SECTION

SECTION 226115 – LABORATORY GAS MANIFOLDS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes

1. General assembly descriptions
2. Cylinder vent piping
3. Cross-over cylinder manifold assemblies
4. Gas Manifold CO2
5. Cylinder Brass Differential Changeover Regulator Assemblies with Transducer for Special Gase
6. Laboratory incubator gas panel
7. Laboratory gas master annunciator
8. O2/CO2 Gas Monitor
9. Laboratory compressed gas cylinder storage racks
10. Manifold room monitors

1.3 DEFINITIONS

A. VFC: Variable-frequency controller(s).

B. UL: Underwriter Laboratories

C. FM: shall refer to Factory Mutual Engineering testing and acceptance requirements

D. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control, signaling power-limited circuits.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each manifold system.
2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. LEED Submittals:

1. Product Data for Credit WE 2 Credit WE 3.1 Credit WE 3.1 and Credit WE 3.2 : Documentation indicating flow and water consumption requirements.
    a. Include statement indicating location of manufacturer and distance to Project for each regionally manufactured material.
2. Product Data for Prerequisite EQ 1: Documentation indicating that units comply with ASHRAE 62.1, Section 5 - "Systems and Equipment."
3. Product Data for Credit EQ 4.1: For adhesives and sealants, documentation including printed statement of VOC content.
4. Product Data for Credit EQ 4.1: For solvent cements and adhesive primers, documentation including printed statement of VOC content.
5. Product Data for Credit EQ 4.2: For paints and coatings, documentation including printed statement of VOC content and chemical components.
6. Product Data for Credit EQ 4.4: For hardwood plywood particleboard MDF composite wood products used in documentation indicating that product contains no urea formaldehyde.
7. Laboratory Test Reports for Credit EQ 4: For adhesives sealants composite wood products used inside the weatherproofing system, documentation indicating that products comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

C. Shop Drawings:

1. Include plans, elevations, sections, and mounting attachment details.
2. Include details of equipment assemblies. Indicate dimensions, weights, loads, and required clearances, method of field assembly, components, and location and size of each field connection.
3. Detail fabrication and assembly of racks, anchoring systems, and rackanchors
4. Include diagrams for power, signal, and control wiring.

D. Product Schedule: For. Use same designations indicated on Drawings.

E. Delegated-Design Submittal: For package system.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer Applicator manufacturer fabricator testing agency factory-authorized service representative or specialist.

B. Product Test Reports: For each, for tests performed by a qualified testing agency.

C. Preconstruction Test Reports: factory tests results. (FAT)

D. Source quality-control reports.

E. Field quality-control reports. (SAT)

F. Sample Warranty: For manufacturer's warranty.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For to include in emergency, operation, operation and maintenance manuals.

1.7 QUALITY ASSURANCE

A. Manufacturer Qualifications:

B. Fabricator Qualifications:

C. Installer Qualifications: Fabricator of products.

D. Testing Agency Qualifications: Qualified according to ASTM C 1021 ASTM C 1093 for testing indicated and accredited by IAS or ILAC Mutual Recognition Arrangement as complying with ISO/IEC Standard 17025.

E. Testing Agency Qualifications: Member Company of NETA or an NRTL.

F. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code – Steel

G. Submit Welders Certification:

1. Welder and welding procedure certificate of compliance with ASME Section IX, including welding procedure specifications
2. Procedure qualification records

H. Submit Weld Procedure Specifications (WPS) and Data Sheets for each size of tube, each position, and each type of tube-to-fitting weld involved for production and tack welds.

1. Welding shall not begin until welding procedures have been reviewed and approved by the OWNER representative.

I. Welding technique such as weld deposition sequence, welding program-settings, electrode positioning, etc., shall be indicated in the Weld Procedure Data Sheet.

J. Submit welding schedules for each tube size, which includes the required setting for each and every control of the automatic welding equipment

K. Submit NDT inspection procedures, boroscopic procedures and certification program. Reference applicable ASNT recommended practices.

L. Submit welding samples

1. Provide acceptable, marginal and rejectable butt weld samples of tube-to-fitting end welds (two samples).

2. These samples will be used for comparison to accept or reject production welds.

M. Close-out Submittals:

1. Submit welding log for each weld.

2. Welding log shall give details of weld, including weld number, IS0 or orthographic drawing number, welder's stamp or ID, machine number, date, time and the inspector's signature.

3. Specific welding qualifications.

N. Pipe and Pressure-Vessel Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

1.8 CERTIFICATIONS

A. All welders using WPS procedures shall be qualified in accordance with ASME Section IX. The Contractor shall maintain the Record of Welder Performance Qualification Tests (WPQ).

B. All personnel engaged in the non-destructive inspection and testing of welds shall be certified in accordance with ANSI/ASNT CP-189.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, and handle products under provisions of Section 01600 - Material and Equipment.

B. Tubing and pipe shall be lifted using nylon straps. Care shall be taken to keep the material free from grease and oil.

C. Do not allow stainless steel materials or tools to contact carbon steel materials.

D. All HPSS materials shall be shipped and stored in a flat horizontal position in their original factory sealed bags. Store tubing, fittings, and valves by type in a sheltered, humidity controlled location away from exposure to direct sunlight and protected from freezing.

1. For level 5 through level 6 gases, all cutting and cleaning operations shall be conducted in a Class 100 clean room environment. The contractor shall submit to the OWNER representative their written clean room protocol and records verifying training of all personnel working in the clean room.

E. Fabrication of piping sections shall be carried out as much as possible in the clean room space to minimize the number of welds to be performed in the field.

F. Open ends of all tubes, fittings, valves, etc., shall be kept bagged and sealed until final connections are made. Wood or cloth plugs or any type of tape on or in open ends are not acceptable, shall not be used, and will be cause for the Owner to call for potentially

contaminated sections of piping removed and replaced in accordance with the Field Quality Control sections of Part 3.

G. All material shall be handled and stored throughout the progress of the job so as to prevent contamination.

H. All material that becomes contaminated in handling shall not be re-used, but shall be segregated from the new material under supervision of the OWNER representative.

I. If the high purity gas system becomes contaminated due to fabrication techniques, the Contractor shall clean it to meet the requirements of delivering high purity gas according to the most recent standard, or replace the system at the Contractor's expense.

J. Inspect per approved HPSS material and component inspection procedures all HPSS material and components. Inspection records shall be submitted to the OWNER representative on a weekly basis.

K. Notify the OWNER representative upon component delivery to the job site for inspection. Installation of any component prior to the OWNER representative inspection is prohibited.

L. If the inner bag of any component is found punctured or has otherwise lost its purge, or the end caps have become displaced, the component shall be rejected and replaced at the Contractors expense.

M. All rejected components shall be marked accordingly as contaminated and immediately removed from the job site.

N. Retain shipping flange protective covers and protective coatings during storage.

O. Protect bearings and couplings against damage.

P. Comply with pump manufacturer's written rigging instructions for handling.

1.10 FIELD CONDITIONS

A. Coordinate sizes and locations of concrete bases with actual equipment provided.

1.11 WARRANTY

A. Manufacturer's Warranty: Manufacturer and Installer agree to repair or replace components of that fail(s) in materials or workmanship within manufacturer's standard specified warranty period.

PART 2 - PRODUCTS

2.1 GENERAL ASSEMBLY DESCRIPTION

A. Furnish and install Manifold Systems as shown on the plumbing drawings.

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following

1. Concoa

C. Work Included

1. All manifold piping, headers, switching controls to be furnished and installed as a complete package
2. Manifold racks shall be furnished and installed with support chains and/or brackets. Include support system racks and chains.
3. Control wiring from control panels, regulator valves, pigtails to duplex outlets, whips etc. are to be furnished with the manifold systems under this section such that all manifold systems function fully.
4. All regulators, header piping, relief piping, valves Alarms and appurnatures necessary for full function of the system
5. Alarms and Warning Systems: install alarms and component control wiring to alarms such that alarm systems function locally.
    a. The controller shall have the ability to communicate common field-bus protocols Supply all instrument communication transition hardware to the Building Management System (BMS) installer such that all alarms are reported to the Building Management System

D. Related Work in Other Sections:

1. Cylinders and Gases
    a. Cylinders – the building owner shall provide gas cylinders for connection to the manifold systems
    b. Gases – the owner shall provide gas for contractor testing and fill of the systems
2. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
3. Electrical power connections to fixed control cabinet or duplex receptacles

E. Capacities and Specific Manifold Components :

1. See Plumbing Drawing Schedule Sheet.

2.2 CROSSOVER CYLINDER MANIFOLD ASSEMBLIES

A. Gas Manifold CO2

1. Basis of Design:
    a. Concoa Series 538 Intelliswitch II
2. Number of cylinders per side =see drawings for each manifold provided
3. Application: liquid Dewars

B. System Description

1. Designed to furnish continuous uninterrupted supply of high purity gas from either cryogenic liquid cylinders and/or high pressure gas cylinders. The unit shall be microprocessor controlled electronic fully automatic switchover system for four low pressure CO2 dewars arranged as 2x2 as shown on the drawings, similar to Concoa Intelliswitch II, Model 538 or approved equal, with brass internals for high purity applications, The control box shall have digi-pneumatic control to ensure optimal gas usage from a variety of gas sources; maximum delivery pressure of 150 PSIG (10 BAR); ethernet connectivity with on-board web server; right side inlet: 1/2-inch FPT port; left side inlet: 1/2-inch FPT port; process gas-driven solenoids; 100-240 VAC power supply (CE-marked).
2. The fully-automatic switchover manifold shall be mounted inside a NEMA 4 enclosure. It shall provide inlet supply and delivery pressure notification via digital displays mounted on the front panel. It shall provide inlet supply content status notification as determined by pressure transducer output to a microprocessor by illuminating a LED on the front panel. It shall be made of ASTM B16 brass material cleaned for oxygen use in conformance with CGA G4.1. Delivery pressure shall be kept stable by a single stage regulator utilizing a diffusion resistant 316L diaphragm that exceed the 10,000 cycle requirement of CGA E-4 and a balance stem seat with a Cv of 1.0. The manifold shall use a 3,000 psi rated dual pneumatic valve in a single body to maintain a continuous supply of gas by automatically switching from the primary gas supply bank to the reserve. The system shall have the capability to accommodate 230 psi, 350 psi, 500 psi liquid or 3,000 psi high-pressure cylinders by push button selection on the front panel. The manifold's microprocessor shall manage liquid cylinder venting and residual. The manifold shall provide an Web Server for remote monitoring. Components shall have a pressure safety factor of 4x working pressure.
3. The assembly shall include brass barstock, modular, manifold headers to accommodate the number of cylinders per drawing location, similar to Concoa Model 628 or approved equal. The headers shall include a diaphragm valve at each station; duplex configuration (two sets of headers and extensions with one pigtail per station); two headers and 6 inch extensions (see drawings for number of stations); 36-inch stainless steel-lined flexible hoses with integral check valve and CGA 580 cylinder connection (one per station); 1/4-inch FPT outlet connection; support for x cylinders total; and 3000 PSIG (210 BAR) maximum inlet pressure.

C. Fully- Automatic Cylinder Manifold System

1. Service: High Purity Gases – Refer to drawings for location, service, & number of cylinders.
2. Regulator & Valve Bodies: Brass bar-stock body and diffusion resistant 316L diaphragms that exceed the 10,000 cycle requirement of CGA E-4, seats PCTFE, seals PTFE, PCTFE and Viton, Filter 40 micron 316 mesh, high purity diffusion resistant type; rated at 3,000 psig maximum inlet pressure, 0-150 psig outlet pressure, Flow Capacity Cv 1.0
3. Check valves: Integral to the CGA connection, body brass, Viton "O" rings
4. Inlet pressures indication: two independent 4 digit LCD displays, outlet pressure on one independent 3 digit LCD display
5. LED status lights.
6. Economizer: Electronic design to eliminate liquid cylinder vent loss
7. Internal Burst Discs: Elgiloy

8. Cylinder Leads*: Armor cased, dual braid stainless steel, convoluted, flexible type and 316L CGA connection gland with integral check valve, 3,850 psig maximum working pressure. 36 inches in length. *
9. *Monel Inner Core specific for Oxygen service.
10. Inlet Pressure Transducers: Compact, enclosure IP-67, wetted parts stainless steel, output 1- 5 VDC, 0- 5,000 psi pressure range, external pressure port ¼- NPT male, accuracy 0.5% FS for < 1,000 psi, temperature range -40 to 257 Degrees F, oxygen cleaned. Qty. 2
11. Outlet Pressure Transducer: Compact, enclosure IP-67, wetted parts stainless steel, output 1- 5 VDC, 0- 500 psi pressure range, external pressure port ¼- NPT male, accuracy 0.5% FS for < 1,000 psi, temperature range -40 to 257 Degrees F, oxygen cleaned. Qty. 1
12. Solenoid Valves: 100 psig normally open – with no power on the Intelliswitch, both valves open allowing gas to flow from both banks – until power is restored.

D. Heaters

1. One for Dewar header left bank and one for Dewar header right bank
2. 1000 Watt heater, 2000 PSI max inlet, 120 volt with 1/2 inch M-NPT manifold connector
3. Part number 8514274 Concoa

E. Vent Connectors

1. Brass barstock micro-manifold for vent connection of liquid cylinders featuring duplex configuration (two manifold systems)
2. one 72-inch, flexible PTFE-lined pigtail per station with CGA 295 vent connection; one manifold block and two stations per system (two manifold blocks and four pigtails total); no pressure gauge; no alarm capability; burst disk; wall-mount bracket for use with 483, 485, 603, 605, 623, and 500/600 series switchovers (except 632); and 1000 PSIG (70 BAR) maximum inlet pressure.
3. Part number 52122A2-010295 Concoa

2.3 LONE GSA CYLINDER GAS CABINET

A. Dual stage, four-port, chrome-plated brass barstock, cylinder regulator for ultra high purity applications featuring a 316L stainless steel diaphragm; maximum delivery pressure of 100 PSIG (7 BAR); 1/4-inch FPT port outlet; 0-4000 PSI/0-28,000 kPa dual-scale inlet gauge; 30VAC-0-200 PSI/-100VAC-0-1400 kPa dual-scale outlet gauge; maximum inlet pressure of 3000 PSIG (210 BAR); full functional test and spectrometric helium leak check as an assembly; compliance with CGA E-4 (including 10,000+ cycle life); cleanliness exceeding CGA G-4.1; proof pressure 1.5x maximum working pressure and burst pressure at least 4X maximum working pressure (CRN-listed). Factory-installed option: Protocol Station featuring chrome-plated brass

barstock block assembly; and 36-inch stainless steel-lined hose with check valve and brass CGA 580 cylinder connection.

B. Part number - 3123301-01-580M

2.4 CYLINDER BRASS DIFFERENTIAL CHANGEOVER REGULATOR ASSEMBLIES WITH TRANSDUCER FOR SPECIAL GASES

A. Basis of Design:

1. Concoa Modell 526 Series

B. System Description

1. Designed to furnish a continuous uninterrupted supply of high purity or corrosive gas. Differential semi-automatic manifold system consisting of two high purity, diffusion resistant pressure regulator design (complete with a single reset knob). The primary changeover regulator shall be connected to an active and reserve cylinder. The delivery pressure of one regulator is set higher than the other causing the first regulator to flow gas, while holding the second regulator closed. When the gas in the first bank is exhausted, the second bank regulator will begin to flow gas. Changeover regulator inlet pressure gauges indicate pressure in each bank. Pressure transducers for each bank sense declining pressure in the cylinder and activate an alarm when a pre-determined pressure is reached. The primary bank of cylinder(s) are replaced and the regulator delivery pressures are reversed, causing a reverse changeover when the second bank is exhausted. Cycle is repeated. A line regulator installed on the outlet of the primary changeover regulators compensates for the changeover regulator variances while providing constant setting outlet pressure without pressure fluctuation.

C. Semi- Automatic Cylinder Manifold Systems

1. Service: UHP Specialty Gases – See Drawings for Service & Number of Cylinders
2. Primary Changeover Regulator: Model 400 series, brass bar-stock body and diffusion resistant 316L diaphragms that exceed the 10,000 cycle requirement of CGA E-4 and incorporate encapsulated seats that filter 10-micron or larger particulate, capsule with seats PCTFE for inlet regulators, internal seals PTFE, diaphragm seals, Filter 10 micron 316 mesh, high purity diffusion resistant type; rated at 3,000 psig maximum inlet pressure, 0-150 psig outlet pressure. Cv 0.1
3. Check valves: Integral to the CGA connection with. Body stainless steel, Viton “O” rings (see line 7).
4. Gauges: 400 series, Analog, compound, Brass case, 2 inch, stainless steel bourdon
   a. Inlet: 30”-0-4,000 psig
   b. Outlet: 30”-0-200 Psig
5. Relief Valve (Inter stage): 534 series, Seat type with adjustable setting, seals Viton, Body is brass, spring 302 stainless steel, poppet 304 stainless steel, outlet connection ¼” OD compression fitting, relief factory setting @ 500 psig
6. Isolation Valves inlet and outlet: 533 Series, brass bar stock body, diffusion resistant pack-less, spring-less, type with multi turn handle, Cv 0.1, diaphragm Elgilloy, seats PCTFE, seals metal to metal

7. Cylinder Leads*: Armor cased, dual braid stainless steel, convoluted, flexible type and 316L CGA connection gland with integral check valve, 3,850 psig maximum working pressure. 36 inches in length.
   *Monel Inner Core specific for Oxygen service.

8. Pressure Transducers: Compact, enclosure IP-67, wetted parts stainless steel, output 4-20 mA,0- 6,000 psi pressure range, external pressure port ¼- NPT male, Electrical Connection 3 pin Packard, accuracy 0.5% FS for < 1,000 psi, temperature range -40 to 257 Degrees F, oxygen cleaned. Qty. 2
   (Flammable Gases Require Intrinsic Safety)

9. Line Pressure Regulator: Brass bars-stock body and stainless steel diaphragm, PTFE seats, Internal seals PTFE. High purity diffusion resistant type , rated for 400 psig maximum inlet pressure, adjustable outlet pressure of 0-100 psig.

10. Mounting Bracket: stainless steel x gauge, 7.24" w x 11" H, Four 7/16" mounting slots.

11. Operating Temperature Range -40 degrees F to 140 degrees F.

12. Entire assembly shall be Helium leak tested inboard $1x10^{-8}$ He cc/sec. with a mass spectrometer

13. Manifold Header(s), Compact, for number of cylinders as indicated on drawings, brass, modular design, expandable, metal to metal field assembled joints, station valves: brass barstock, seat PCTFE, stems 303/304 stainless steel, diaphragms Elgiloy, Pigtails: flexible armor cased, dual braid stainless steel, convoluted, flexible type and 316L CGA connection gland with integral check valve, 3,850 psig maximum working pressure. 36 inches in length.

14. *Monel Inner Core specific for Oxygen service

15. Accessories**:** for each of the above 526's the Altos 2 remote alarm

    a. Local Audio/Visual Annunciator system similar to Concoa Model 570025-01-000 Altos 2 Remote Alarm, or approved equal featuring monitoring support for one switchover assembly;

    b. two independent inputs for 4-20 mA transducers or pressure switches (normally open or closed selectable); high visibility status LEDs; large LCD pressure displays; dry contact outputs; 93db audible alarm; and 90-264V universal voltage input with international blade kit

    c. Cable Connection: 10-foot cable (4-wire by 4-wire) to connect a 526 series Altos 2 alarm

2.5 LABORATORY INCUBATOR GAS PANEL:

A. CO2 Point of use panel for double stacked Incubator (two outlet)

1. Applications similar to Concoa Model 55S1200-01-311

2. Panel shall include 300 series, single stage, four-port, stainless steel barstock regulators with 316L stainless steel diaphragms; stainless steel barstock outlet diaphragm valves with Elgiloy diaphragms; maximum inlet pressure of 3000 PSIG (210 BAR) at each station; full functional test and spectrometric helium leak check as an assembly;

3. compliance with CGA E-4 (including 10,000+ cycle life); cleanliness exceeding CGA G-4.1; proof pressure 1.5x maximum working pressure and burst pressure at least 4X maximum working pressure (CRN-listed).

4. Gas station (Carbon dioxide; rear inlet; left outlet): maximum delivery pressure of 15 PSIG (1 BAR); 30VAC-0-30 PSI/-100VAC-0-200 kPa dual-scale delivery pressure gauge; and two shut-off valves with 1/4-inch stainless steel hose barb outlets.

B. CO2 Point of use panel for Two double stacked incubators side by side (four outlet)

1. Applications, similar to Concoa Model 55S1400-01-311 or approved equal,

2. Panel shall include 300 series, single stage, four-port, stainless steel barstock regulators with 316L stainless steel diaphragms; stainless steel barstock outlet diaphragm valves with Elgiloy diaphragms; maximum inlet pressure of 3000 PSIG (210 BAR) at each station;

3. full functional test and spectrometric helium leak check as an assembly; compliance with CGA E-4 (including 10,000+ cycle life); cleanliness exceeding CGA G-4.1; proof pressure 1.5x maximum working pressure and burst pressure at least 4X maximum working pressure (CRN-listed).

4. Gas station (Carbon dioxide; rear inlet; left outlet): maximum delivery pressure of 15 PSIG (1 BAR); 30VAC-0-30 PSI/-100VAC-0-200 kPa dual-scale delivery pressure gauge; and four shut-off valves with 1/4-inch stainless steel hose barb outlets

2.6 LABORATORY GAS MASTER ANNUNCIATOR

A. Provide central gas annunciator panels at the following locations:

1. Floor Cylinder Gas Closets:

B. The annunciator shall monitor cylinder contents in the manifolds. The manifolds will be changeover type and/or single cylinder set up. Each manifold shall have 1 or 2 pressure switches which provide a dry contact signal to the annunciator(s).

C. The annunciator channel shall depend upon the number of manifolds to alarm per given area. Each channel will be designated a gas. The channel shall provide a visual light signal and associated audible horn. When the cylinder is getting low, the light will go on and the horn will sound. A silence button on the box to silence the horn shall be provided.

D. Provide a gas annunciator panel in each area where cylinder gas manifolds are furnished

1. Each manifold shall be capable of report to the Building Management System

E. Power Requirements: 120 VAC, 50-60 Hz, plug-in.

F. Basis of Design:

1. Linde/Spectra Gas Model F9900B8A

2. Beacon Model RAA Series (RAA-8 or RAA-4)

2.7 O2/CO2 GAS MONITOR FOR CO2 DEWAR SPACE

A. Carbon Dioxide/Oxygen monitor, similarto Concoa Model 5803007 or approved equal featuring 0-10,000 ppm Carbon Dioxide and 0-25% Oxygen ranges; 4-20 mA output; two user settable relays; digital display; audible alarm; 110VAC / 24 VDC power supply; and polycarbonate enclosure.

B. Remote display for 5803004 Oxygen deficiency monitor Similar or equal to Concoa Model 5803005, featuring 4-20mA signal input; maximum 250-foot distance; and NEMA 4X enclosure

C. Horn and strobe signal for 5803004 Oxygen deficiency monitor, similar to Concoa Model 5803004, featuring 18-30 VDC input; 80-100 dB at 10 feet; red LED; and NEMA 4X enclosure

2.8 MISCELLANEOUS MANIFOLD ROOM MONITORS (NOT CO2 ROOMS)

A. Where indicated on the drawings, furnish each manifold room with an oxygen depletion monitor mounted in the manifold room at 1.3 meters (4 feet) AFF in a position where cylinders will not contact the sensor or meter. Monitors indicate oxygen low level at 19.5 percent and a second indication at 18 percent. Provide audible and visual indication inside the room.

B. Provide audible and visual indicator outside door at 1.5 meters (5 feet) AFF to alert operator prior to entry. Label “Oxygen Low – Do Not Enter”

C. Provide dry contacts from each alarm monitors for connection to the Building Management System (BMS).

2.9 LABORATORY COMPRESSED-GAS-CYLINDER STORAGE RACKS

A. Wall Storage Racks: Fabricate racks with chain restraints for upright cylinders as indicated or provide equivalent manufactured wall racks. Basis of Design: Beacon Madeas CWB wall brackets

B. Freestanding Storage Racks: Fabricate racks as indicated or provide equivalent manufactured storage racks similar to USA Safety Cylinder Storage Stands.

C. See drawings for details and schedule

PART 3 - EXECUTION

3.1 FABRICATION

A. Each manifold package shall be pre-wired, pre-piped and factory tested prior to shipment.

B. Manifold system gas vent piping: furnish and install relieving vents from gas manifold and cylinder banks per the schedule of piping below:

SERVICE	TAG	PSIG	TEMP	PIPE SPEC	NOTES
Laboratory Inert Gas Manifold Vent,	IGV	200	250	A10	Type L Copper, Soldered joints
Laboratory Flammable Gas Manifold Vent	FGV	250	250	S3	Mill Finish Stainless Steel standard TIG weld joint
Pure N2 and CA vent piping	N2/CA	250	300	S3	Type L Copper, Soldered or Press-Fit joints
Critical Supply laboratory cylinder gas vent piping	SPG	250	300	S3	Mill Finish Stainless Steel standard TIG weld joint
Oxygen vent	O_2	250	300	A10	Type L Copper, soldered or brazed joints
Hydrogen vent	H2	250	300	S3	Mill Finish Stainless Steel standard TIG weld joint
Non Critical Special Gas (Cylinder) 1 and 2 vents	SG1 SG2	250	300	S3	Mill Finish Stainless Steel standard TIG weld joint
Laboratory Gas vents (Exposed To View)		250	300	S3	Stainless Steel, TIG weld with argon on back side

1. See the pipe tables referenced above in specification Division 22 for laboratory piping systems.
2. Label all vent piping in accordance with type and color code requirements for the gas in Division 22.

3.2 EXAMINATION

A. Examine roughing-in for piping to verify actual locations of piping connections before equipment installation.

B. Examine walls, floors, roofs, and for suitable conditions where system will be installed.

C. Prepare written report, endorsed by Installer, listing conditions detrimental to performance.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.3 PREPARATION

A. Install equipment on flat slab, attach support systems to wall

3.4 CYLINDER GAS SYSTEMS

A. Cylinder gases shall be installed with minimum number of fittings. Changes in direction requiring turns of offsets with radii less than five times pipe or tubing outside diameter shall be made by bending tubing. Bends shall be free from appreciable flattening, buckling or thinning of tube wall.

B. Tubing shall be cut accurately to system measurements obtained at site and installed without springing or forcing. Tubing shall be protected against mechanical injury in manner satisfactory to authorities that have jurisdiction.

C. All tube, fittings and valves are to be factory cleaned and capped/bagged for shipment. Protect all parts on the jobsite during construction. Cap unfinished ends of the piping system at the end of each work day.

3.5 INSTALLATION

A. Comply with requirements for pipe hangers and supports specified in Division 22.

B. Comply with requirements for general-duty valves specified in Division 22

C. Install continuous-thread hanger rods and spring hangers spring hangers with vertical-limit stop of size required to support associated piping weight. Pipe shall not bear on the equipment.

1. Comply with requirements for vibration isolation devices specified in Division 22. Fabricate brackets or supports as required.

2. Comply with requirements for hangers and supports specified in Division 22.

D. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Install lacing bars and distribution spools.

3.6 SERVICE COMPONENT INSTALLATION

A. Install compressed-air, nitrogen and CO_2 pressure control panel in walls. Attach to substrate.

B. Install laboratory manifolds anchored to wall anchored to substrate.

C. Install all lab gas cylinders and connect to manifold piping.

3.7 IDENTIFICATION

A. Identify equipment and associated piping per Division 22 requirements

3.8 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

B. Perform the following tests and inspections with the assistance of a factory-authorized service representative:

1. Perform visual and mechanical inspection.

2. Leak Test: After installation, charge booster pump and test for leaks. Repair leaks and retest until no leaks exist.
3. Operational Test: After electrical circuitry has been energized, start system to confirm proper operation.
4. Performance qualification – take adequate readings to assure the equipment meets the criteria outlined in the plumbing schedule sheet
5. Commission and start equipment
6. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

C. The system will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

3.9 FIELD QUALITY CONTROL: CLEANING, TESTING AND START-UP

A. Factory Qualifications: All manifold systems shall be factory cleaned and factory tested

B. Installation Qualifications: Clean installation practices shall be followed when connecting piping to manifold outlets

C. Performance Qualifications:

1. Contractor shall provide start-up service of the system by an authorized factory-trained manufacturer's representative for each manifold. Start-up service shall include inspection of overall installation, initial start-up and running of the system, confirmation of all automated and alarm functions and operational and maintenance instructions to facility personnel.

D. Complete installation and startup checks according to manufacturer's written instructions.

3.10 ADJUSTING

A. Adjust hardware moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.

B. Occupancy Adjustments: When requested within 12 months from date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

3.11 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain units.

END OF SECTION

SECTION 226119 - COMPRESSED-AIR EQUIPMENT FOR LABORATORY AND HEALTHCARE FACILITIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Performance requirements
2. General requirements for air compressors
3. Compressed air equipment index
4. Template package - science building lab air
5. Inlet air filters
6. Motors

1.3 DEFINITIONS

A. Actual Air: Air delivered at air-compressor outlet. Flow rate is compressed air delivered and measured in acfm.

B. Laboratory Air Equipment: Compressed-air equipment and accessories for nonmedical laboratory facilities.

C. Standard Air: Free air at 68 deg F and 1 atmosphere before compression or expansion and measured in scfm.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For air compressors, compressed-air dryers, and compressed-air purification systems.

1. Include plans, elevations, sections, and mounting details.

2. Include details of equipment assemblies. Indicate dimensions, weights, loads, and required clearances, method of field assembly, components, and location and size of each field connection.

3. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.

4. Include diagrams for power, signal, and control wiring.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For compressed-air equipment to include in operation and maintenance manuals.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Air-Compressor, Inlet-Air Filter Elements: Equal to 10 percent of quantity installed, but no fewer than two (2) units.

2. Belts: Two for each belt-driven compressor.

1.7 QUALITY ASSURANCE

A. Installer Qualifications:

1. Laboratory Air Equipment for Nonmedical Laboratory Facilities: An employer of workers trained and approved by manufacturer.

B. Testing Agency Qualifications: An independent testing agency, with the experience and capability to conduct the compressed-air equipment testing indicated, that is a member of the Medical Gas Professional Healthcare Organization or is an NRTL and that is acceptable to authorities having jurisdiction.

1. Qualify testing personnel according to ASSE 6020 for inspectors and ASSE 6030 for verifiers.

PART 2 - PRODUCTS

2.1 MANUFACTURERS REQUIREMENTS

A. Compressor Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified

1. Hydrovane

2. Atlas Copco
3. Ingersol Rand

B. Dryer Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified

1. Sahara Products
2. Hankinson
3. Pneumatic Products Inc

C. Filter Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified

1. Ingersoll-Rand.
2. Parker Hannifin Corp.
3. Pioneer Air Systems, Inc.
4. Sahara Products
5. Wilkerson Corporation

2.2 PNEUMATIC PRODUCTS CORPORATION DHA (SERIES), GENERAL REQUIREMENTS FOR AIR COMPRESSORS

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Comply with NFPA 99, "Health Care Facilities," for compressed-air equipment and accessories for medical compressed-air systems.

C. Comply with UL 544, "Medical and Dental Equipment," for medical compressed-air equipment.

D. Description: Factory-assembled, -wired, -piped, and -tested; electric-motor-driven; air-cooled; continuous-duty air compressors and receivers that deliver air of quality equal to intake air.

E. Control Panels: Automatic control station with load control and protection functions. Comply with NEMA ICS 2 and UL 508.

1. Enclosure: NEMA ICS 6, Type 12 control panel unless otherwise indicated.
2. Motor Controllers: Full-voltage, combination-magnetic type with under voltage release features and motor-circuit-protector-type disconnecting means and short-circuit protective device.
3. Control Voltage: 120-V ac or less, using integral control power transformer.
4. Motor Overload Protection: Overload relay in each phase.
5. Starting Devices: Hand-off-automatic selector switch in cover of control panel, plus pilot device for automatic control.
6. Automatic control switches to alternate lead-lag air compressors for duplex and sequence lead-lag air compressors for multiplex air compressors.

7. Instrumentation: Include discharge-air and receiver pressure gages, air-filter maintenance indicator, hour meter, air-compressor discharge-air and coolant temperature gages, and control transformer.

8. Alarm Signal Device: For connection to alarm system to indicate when backup air compressor is operating.

F. Receivers: Steel tank constructed according to ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.

1. Pressure Rating: At least as high as highest discharge pressure of connected air compressors and bearing appropriate code symbols.

2. Interior Finish: Corrosion-resistant coating.

3. Accessories: Include safety valve, pressure gage, automatic drain, and pressure regulator.

2.3 PACKAGE - SCIENCE BUILDING LAB AIR – EACH COMPRESSOR 86 SCFM LOAD AT 116 PSIG

A. DESCRIPTION

1. Duplex Hydrovane model HV30 RS with VFD Oil Free rotary vane compressor machine s
   a. Compressor contaol panel shall be capable of report to the BMS indicating machine status and trouble
   b. Each machine capable of specific duty outlined on the drawing schedule sheet
   c. Two required at 100 percent load each
   d. Furnish flexible stainless steel braided connector, oxygen cleaned at compressorconnection to piping system
   e. Furnish Hydrovane Pro-Master sequencer suitable for equal hour rotation of the compressors
   f. Provide enclosures for the compressed air machines
   g. Electrical: 460V/3ph/60hz
   h. Air outlet - 1½ inch
   i. 73 dB(A)
   j. Air Quality less than 3ppm
   k. Starter: DOL
   l. Floor Mount on vibration pad
   m. Speed: VFD drive with 1760 rpm
2. 200gallon ASME receiver, epoxy coated and stamped
   a. Furnish auto drain valve
   b. Furnish relief valve and relief piping to safe location
3. Duplex Coalescing Prefilters – 1 micron
   a. Match building load plus 20 % for each filter

b. Two required at 100 percent load each

4. Duplex Desiccant Dryers
   a. Dryer output after purge cycle – see drawing schedule sheet
   b. Two required at 100 percent load each
   c. Furnish Hankinson SensaTherm series control to match purge cycle to demand air use to ensure maximum energy performance
   d. Include moisture indicator
   e. Pressure Dewpoint: - -40°F dewpoint
5. Duplex final filters – .5 micron
   a. Match building load plus 20 % for each filter
   b. Two required at 100 percent load each

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean compressed-air equipment, accessories, and components that have not been cleaned for oxygen service and sealed or that are furnished unsuitable for laboratory air and medical air applications, according to CGA G-4.1, "Cleaning Equipment for Oxygen Service."

3.2 COMPRESSED-AIR EQUIPMENT INSTALLATION

A. General Requirements for Compressed-Air Equipment Installation:

B. Install compressed-air equipment to allow maximum headroom unless specific mounting heights are indicated.

C. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces unless otherwise indicated.

D. Install mechanical equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.

E. Install equipment to allow right of way for piping installed at required slope.

F. Install the following devices on compressed-air equipment:

   a. Thermometer, Pressure Gage, and Safety Valve: Install on each compressed-air receiver.
   b. Pressure Regulators: Install downstream from air compressors, dryers, purification units, and filter assemblies.

c. Drain Valves: Install on after coolers, receivers, and dryers. Discharge condensate over nearest floor drain.

G. Non-medical Laboratory Compressed-Air Equipment Installation:

H. Install all compressed-air equipment, except wall-mounted equipment, on cast-in-place concrete equipment bases. Comply with requirements for equipment bases and foundations specified in Division 03.

I. Comply with requirements for vibration isolation devices specified in Division 22.

a. Anchor air compressors to surface according to manufacturer's written instructions .

3.3 CONNECTIONS

A. Comply with requirements for water-supply piping specified in Division 22.

B. Comply with requirements for drain piping specified in Division 22.

C. Comply with requirements for compressed-air piping specified in Division 22. Drawings indicate general arrangement of piping, fittings, and specialties.

D. Where installing piping adjacent to equipment, allow space for service and maintenance.

E. Connect compressed-air piping to compressed-air equipment, accessories, and specialties with shutoff valve and union or flanged connection.

3.4 IDENTIFICATION

A. Identify nonmedical laboratory compressed-air equipment system components. Comply with requirements for identification specified in Division 22.

B. Identify medical compressed-air equipment system components. Comply with requirements for identification specified in Division 22.

3.5 FIELD QUALITY CONTROL FOR HEALTHCARE-FACILITY MEDICAL COMPRESSED-AIR EQUIPMENT

A. Testing Agency: Engagea qualified testing agency to perform tests and inspections.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

C. Perform the following tests and inspections with the assistance of a factory-authorized service representative.

D. Medical Compressed-Air Equipment Testing Coordination: Perform tests, inspections, verifications, and certification of medical compressed-air equipment concurrently with tests, inspections, and certification of medical vacuum equipment medical vacuum piping medical compressed-air piping and medical gas piping systems.

E. Preparation: Perform medical compressed-air equipment tests according to requirements in NFPA 99 for the following:

a. Air-quality purity test.
b. System operation test.

F. Equipment Verification: Comply with requirements in ASSE 6020, ASSE 6030, and NFPA 99 for verification of medical compressed-air equipment.

G. Replace damaged and malfunctioning controls and equipment.

H. Testing Certification: Certify that specified tests, inspections, and procedures have been performed and certify report results. Include the following:

a. Inspections performed.
b. Procedures, materials, and gases used.
c. Test methods used.
d. Results of tests.

I. Components will be considered defective if they do not pass tests and inspections.

J. Prepare test and inspection reports.

3.6 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

B. Complete installation and startup checks according to manufacturer's written instructions.

C. Check for lubricating oil in lubricated-type equipment.

D. Check belt drives for proper tension.

E. Verify that air-compressor inlet filters and piping are clear.

F. Check for equipment vibration-control supports and flexible pipe connectors and verify that equipment is properly attached to substrate.

G. Check safety valves for correct settings. Ensure that settings are higher than air-compressor discharge pressure, but not higher than rating of system components.

H. Drain receiver tank(s).

I. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.

J. Test and adjust controls and safeties.

K. Prepare written report documenting testing procedures and results.

3.7 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain air compressors, compressed-air dryers compressed-air purification units and compressed-air filter assemblies.

END OF SECTION

SECTION 226219 - VACUUM EQUIPMENT FOR LABORATORY AND HEALTHCARE FACILITIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Performance requirements
2. Laboratory packaged rotary, dry claw vacuum pumps
3. Laboratory packaged rotary vane vacuum pumps
4. Motors

1.3 DEFINITIONS

A. Actual Air: Air delivered at vacuum producer inlet. Flow rate is air measured in acfm.

B. HVE: High-volume oral evacuation for dental applications in healthcare facilities.

C. Standard Air: Free air at 68 deg F and 1 atmosphere before compression or expansion and measured in scfm.

D. National Fire Protection Association (NFPA), NFPA 99 Health Care Facilities.

E. National Fire Protection Association (NFPA), NEC National Electrical Code.

F. American Society of Sanitary Engineers (ASSE) 6010 Professional Qualification Standards for Medical Gas System Installers.

G. American Society of Sanitary Engineers (ASSE) 6030 Professional Qualification Standards for Medical Gas System Verifiers.

H. ISO 1217 2009 Displacement Compressors - Acceptance Tests

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For vacuum producers.

1. Include plans, elevations, sections, and mounting details.
2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.
4. Include diagrams for power, signal, and control wiring.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer and testing agency.

B. For Medical Vacuum and Laboratory Vacuum plants include:

1. Package drawing indicating package style, dimensions when complete, method of disassembly and sizes of subsections for rigging and installation.
2. Compressor and package capacity expressed in inlet SCFM.
3. Lubrication method (if any).
4. Drive detail including adjustment method.
5. Motor including manufacturer, frame type, service factor, horsepower, current draw, and RPM.
6. Exhaust Air filters including type and replacement element.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For vacuum equipment to include in operation and maintenance manuals.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Belts: Two for each belt-driven vacuum producer.

1.8 QUALITY ASSURANCE

A. Installer Qualifications:

1. Laboratory Vacuum Equipment for Nonmedical Laboratory Facilities: An employer of workers trained and approved by manufacturer.
2. Vivarium Vacuum Equipment for Healthcare Facilities: Qualify installers according to ASSE 6010.
3. Medical Vacuum Equipment for Healthcare Facilities: Qualify installers according to ASSE 6010.

B. Testing Agency Qualifications: An independent testing agency, with the experience and capability to conduct the vacuum equipment testing indicated, that is a member of the Medical Gas Professional Healthcare Organization or is an NRTL, and that is acceptable to authorities having jurisdiction.

1. Qualify testing personnel according to ASSE 6020 for inspectors and ASSE 6030 for verifiers.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. All materials used shall be new and of the best grade and quality obtainable and workmanship shall be first class in every respect. Contractor shall be responsible for compliance with all Local, State or Federal codes.

B. Provide all elements and accessories required for complete systems per NFPA 99 most recent edition.

C. Contractor shall make all necessary connections to owner furnished equipment.

D. Install all piping as shown on Drawings, as described herein and as described in Division 22, using methods of fabrication, grading, testing, repairing, cleaning and other procedures as described.

E. Electrical power wiring for vacuum pump(s), associated with the system(s) shall be part of the electrical contract. Any equipment supplied by this contractor that requires additional electrical services shall be the responsibility of this contractor to supply these services.

F. Perform Installer pressure testing, cross connection testing and final testing per NFPA 99 most recent edition and using procedures as specified.

G. Vacuum Requirements: Note, pressures are expressed negative vacuum pressure in inches of Mercury (in HG) gauge and may be followed by metric conversion to mm HG/torr

Application	Delivered Vacuum Pressure to outlets	Application Remarks
General Laboratory	20 - 22 in HG (200 torr)	Laboratory vacuum, Air Cooled

2.2 GENERAL REQUIREMENTS FOR VACUUM PUMPS

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Comply with NFPA 99, "Health Care Facilities," for vacuum equipment and accessories for medical vacuum systems and Vivarium Vacuum Systems

C. Comply with UL 544, "Medical and Dental Equipment," for medical vacuum equipment.

D. Description: Factory-assembled, -wired, -piped, and -tested; electric-motor-driven; air-cooled; continuous-duty vacuum pumps and receivers.

E. Control Panels: Automatic control station with load control and protection functions. Comply with NEMA ICS 2 and UL 508.

1. Control Voltage: 120-V ac or less, using integral control power transformer.

F. Receivers: Steel tank constructed according to ASME Boiler and Pressure Vessel Code, Section VIII, Division 1; bearing appropriate code symbols.

1. Accessories: Include, vacuum gage, and drain, and for medical systems vacuum relief.

2.3 LABORATORY PACKAGED ROTARY, DRY-VANE VACUUM PUMPS

A. Lab Vacuum Pumps Package System LVAC P102 with drives

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. BeaconMedaes.
   b. Busch USA.
   c. Kinney Vacuum, Inc.

2. System components - the system includes but is not limited to the following:

   a. Laboratory Vacuum system shall be furnished and installed per the drawings for Vacuum System. The Laboratory system shall be comprised of the following equipment:

      1) Laboratory Central Vacuum System with VFD control
      2) Vertical Stack Mounted quadraplex
      3) Galvanized Receiver (1)
      4) Receiver monitors and controls
      5) Controls: Control System.
      6) Integral Exhaust silencers
      7) Equipment skid

   b. The package shall include multiple vacuum pumps and associated equipment, one ASME tank and one medical control panel. Each pump is factory piped to a common intake manifold. The system shall be completely tested prior to shipment. Vibration isolation pads are included with the system

3. Vacuum Pumps

   a. Each pump shall be a dry rotary vane type vacuum pump, and shall be direct-driven through a shaft coupling by a C-face, TEFC electric motor..
   b. Each vacuum pump shall be dry-running, featuring selflubricating carbon/graphite vanes and shall not require any sealing fluid in the pumping chamber. The patented vane material shall be constructed of a carbon compound with a plastic polymer binder (as opposed to a salt binder). The vane material shall not retain

moisture from internal pump condensation like other designs, thus extending the vane life. This polymer construction also makes the vanes softer and less susceptible to cracking. Each vacuum pump shall include an internal relief valve, a check valve, inlet and discharge flex connectors, a 5 micron inlet filter and a pump isolation valve.

c. Duty: see drawing schedule sheet

4. Vacuum Receiver and Piping

a. All pumps shall be skid mounted in a vertical stacked arrangement that allows for a quadruplex system. The pumps shall be connected to a common manifold and piped to a 200 gallon vertical receiver with a NPT inlet on the side and a manual drain valve on the bottom. The receiver should be ASME code stamped and rated at 200 psig and full vacuum. A vacuum gauge and a vacuum transmitter shall be mounted on the receiver. . Each vacuum pump shall include an automatic ball-type isolation valve, an auto-purge assembly, a vacuum gauge, and a flexible connector between the pumps and manifold. Each pump shall be equipped with a 10 micron inlet filter for removal of particulates.

b. Each pump shall be equipped with an automatic purge system to flush any gases from the pump to prevent condensation as the pump cools. The purge system shall include an air-actuated isolation valve, auto-purge assembly with purge air filters and solenoid bleed valve, and controls to operate a timed shutdown purge.

1) Furnish 80 psig compressed air for the valve actuators.

5. Control Panel

a. The system shall include a UL listed control panel in a NEMA 12 enclosure with the following accessories for each pump: externally operable disconnect, magnetic starter with 3-leg overload protection, Hand/Off/Auto lighted selector switch, minimum run timer to prevent short cycling of the pump, and hour meter. Standard features shall also include a main power on light, timed lead/lag pump alternation, a reserve pump-inuse alarm with visual and audible indications, and duplex control circuit transformers with fused primary and secondary protection. All alarms shall have dry contacts on a labeled terminal strip for remote alarm monitoring, and an acknowledge pushbutton for horn silencing. The lag vacuum pump shall be able to start automatically if the lead vacuum pump fails to operate.

2.4 MOTORS

A. Comply with NEMA designation, temperature rating, service factor, and efficiency requirements for motors specified in Division 22.

1. Efficiency: Premium efficient.
2. NEMA Design: 12
3. Service Factor: 1.15

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean vacuum equipment, accessories, and components that have not been cleaned for oxygen service and sealed or that are furnished unsuitable for medical vacuum applications, according to CGA G4.1, "Cleaning Equipment for Oxygen Service."

3.2 VACUUM EQUIPMENT INSTALLATION

A. Install vacuum equipment for healthcare facilities according to ASSE 6010 and NFPA 99.

B. Equipment Mounting:

1. Install vacuum producers, except diaphragm vacuum pumps, Insert vacuum producer types on cast-in-place concrete equipment base(s). Comply with requirements for equipment bases and foundations specified in Division 03.
2. Comply with requirements for vibration isolation devices specified in Division 22.

C. Install vacuum equipment anchored to substrate.

D. Orient equipment so controls and devices are accessible for servicing.

E. Maintain manufacturer's recommended clearances for service and maintenance.

F. Install the following devices on vacuum equipment:

1. Thermometer, Vacuum Gage, and Pressure Relief Valve: Install on each vacuum pump receiver.
2. Drain Valves: Install on receivers and separators. Discharge receiver condensate over nearest floor drain. Discharge separator oral evacuation fluids by direct connection into sanitary waste piping system.

3.3 CONNECTIONS

A. Comply with requirements for water-supply piping specified in Division 22. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Comply with requirements for drain piping specified in Division 22. Drawings indicate general arrangement of piping, fittings, and specialties.

C. Comply with requirements for vacuum piping specified in Division 22. Drawings indicate general arrangement of piping, fittings, and specialties.

D. Where installing piping adjacent to equipment, allow space for service and maintenance.

E. Connect vacuum piping to vacuum equipment, accessories, and specialties with shutoff valve and union or flanged connection.

F. Connect water supply to vacuum equipment that requires water. Include backflow preventer. Backflow preventers are specified in Division 22.

3.4 IDENTIFICATION

A. Identify nonmedical laboratory vacuum equipment system components. Comply with requirements for identification specified in Division 22.

3.5 FIELD QUALITY CONTROL FOR HEALTHCARE-FACILITY MEDICAL VACUUM EQUIPMENT

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

C. Perform the following tests and inspections with the assistance of a factory-authorized service representative:

1. Equipment Verification: Comply with requirements in ASSE 6020, ASSE 6030, and NFPA 99 for verification of medical vacuum equipment.
2. Replace damaged and malfunctioning controls and equipment.
3. Testing Certification: Certify that specified tests, inspections, and procedures have been performed and certify report results. Include the following:

    a. Inspections performed.
    b. Procedures and materials used.
    c. Test methods used.
    d. Results of tests.

D. Components will be considered defective if they do not pass tests and inspections.

E. Prepare test and inspection reports.

3.6 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.
2. Check for lubricating oil in lubricated-type equipment.
3. Check belt drives for proper tension.
4. Verify that vacuum producer outlet piping is clear.
5. Check for equipment vibration-control supports and flexible pipe connectors and verify that equipment is properly attached to substrate.
6. Check safety valves for correct settings.
7. Drain receiver and separator tank(s).
8. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.

9. Test and adjust controls and safeties.

B. Verify that vacuum equipment is installed and connected according to the Contract Documents.

C. Verify that electrical wiring installation complies with manufacturer's submittal and written installation requirements in electrical Sections.

D. Prepare written report documenting testing procedures and results.

3.7 DEMONSTRATION

A. Engage a factory-authorized service representative to train. Owner's maintenance personnel to adjust, operate, and maintain vacuum producers.

END OF SECTION

SECTION 226701 - PURIFIED WATER PIPING-THERMOPLASTICS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and General Provision of Contract, including General and Supplementary Conditions and Division 1 specifications, apply to this section.

B. Where Paragraphs of this Section conflict with similar paragraphs of the General and Supplementary Conditions and Division 1, requirements of this Section shall prevail.

1.2 SUMMARY

A. This Specification section describes the technical specifications and general instructions for the furnishing, handling, delivery and installation of pipe, tube, fittings and valves to be used for purified water applications.

B. Pipe materials and components specified in this Section include:

1. Pipe.
2. Fittings and couplings.
3. Valves.

1.3 REFERENCES

A. Unless noted otherwise, the most current issue, revision, or affirmation of the references listed herein shall be used, including all addenda, errata, and referenced documents:

B. American Iron and Steel Institute (AISI)

C. Code of Federal Regulations (CFR)

1. 21 CFR, Chapter 1, Part 177.1520 “Olefin Polymers”

D. American National Standards Institute (ANSI)

1. B16.5 “Pipe Flanges and Flanged Fittings”
2. B46.1 “Surface Texture (Surface Roughness, Waviness, and Lay)”

E. American Society for Testing and Materials (ASTM)

1. D3222 “Standard Specification for Unmodified Poly (Vinylidene Fluoride) (PVDF) Molding Extrusion and Coating Materials”
2. D638 “Standard Test Method for Tensile Properties of Plastics”

3. D790 “Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials”
4. D1784 “Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds”
5. D2122 “Test Method for Determining Dimensions of Thermoplastic Pipe and Fittings”
6. D2464 “Standard Specification for Threaded Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80”
7. D2467 “Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80”
8. D2564 “Standard Specification for Solvent Cements for Poly (Vinyl Chloride) (PVC) Plastic Piping Systems”
9. D2657 “Standard Practice for Heat Fusion Joining of Polyolefin Pipe and Fittings”
10. D2837 “Standard Test Method for Obtaining Hydrostatic Design Basis for Thermoplastic Pipe Materials”
11. D2855 “Standard Practice for Making Solvent-Cemented Joints with Poly (Vinyl Chloride) (PVC) Pipe and Fittings”
12. D3915 “Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds for Plastic Pipe and Fittings Used in Pressure Applications”
13. D4101 “Standard Specification for Propylene Plastic Injection and Extrusion Materials”
14. E84 “Standard Test Method for Surface Burning Characteristics of Building Materials”
15. F402 “Standard Practice for Safe Handling of Solvent Cements, Primers, and Cleaners Used for Joining Thermoplastic Pipe and Fittings”
16. F439 “Standard Specification for Socket-Type Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80”
17. F656 “Standard Specification for Primers for Use in Solvent Cement Joints of Poly (Vinyl Chloride) (PVC) Plastic Pipe and Fittings”

1.4 SUBMITTALS

A. Documentation Requirements

1. Submitted documentation shall be complete and consistent to provide a written record to prove that the pipe, tube and components conform to the specifications and intent of the design.

B. Shop Drawings

1. Refer to Division 20 for procedural requirements and also to the other related documents referenced in paragraph 1.1 of this section.
2. Submittal package shall include for all equipment (where applicable):

    a. Cover letter,
    b. Pipe dimensions, wall thickness, pressure ratings at temperature.
    c. Heat fusion procedures for thermoplastic pipe,
    d. Thermoplastic heat fusion installer certifications by manufacturer,
    e. Internal finish specifications,
    f. Shop Drawings detailing pipe anchors, special pipe support assemblies, alignment guides, and expansion joints and loops.
    g. Detailed isometric diagrams of all loop distribution systems.

C. Installation check procedures,

D. Pre-Start-up Check Procedures,

1.5 CERTIFICATIONS

A. Refer to Division 20 for procedural requirements and also to the other related documents referenced in paragraph 1.1 of this section.

1.6 DELIVERY STORAGE AND HANDLING

A. Packing/Shipping/Handling/Unloading

1. Ship tube and pipe with capped ends.

B. Storage and Protection

1. Store pipe, tube, fittings and valves on site in accordance with manufacturer recommendations.
2. Place materials indoors and on elevated platforms in a dry location away from construction activity that may cause damage or contamination.
3. Maintain packaging, caps and seals on all materials until ready for immediate installation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with requirements stated herein and with the Drawings, provide materials from one of the following manufacturers:

1. Polyvinyl Chloride (PVC) and Chlorinated Polyvinyl Chloride (CPVC) Pipe and Fittings

a. ASAHI AMERICA
b. GF Piping Systems
c. IPEX

2. Polypropylene and PVDF Pipe and Fittings

a. ASAHI AMERICA
b. GF Piping Systems
c. Sani-Tech

3. PVC and CPVC Valves, Actuators and Strainers

a. GF Piping Systems
b. ASAHI AMERICA
c. Hayward Safe Block
d. Plast-O-Matic
e. IPEX

4. Polypropylene and PVDF Valves and Actuators

    a. GF Piping Systems
    b. ASAHI AMERICA
    c. Sani-Tech
    d. Plast-O-Matic

B. All pipe, fittings and components of a given pipe class shall originate from one source and be the product of a single manufacturer (e.g., All components of a Pipe Class - pipe, fittings, ball valves, diaphragm valves, check valves shall be as produced by one manufacturer).

C. The following table summarizes the pipe classes specified in this Section. Refer to the respective Pipe Class data sheets for detailed requirements.

2.2 HIGH PURITY WATER PIPE FITTINGS AND VALVE MATERIALS

A. PRE-TREATMENT WATER PIPING

1. PIPE

    a. Material: Polyvinylchloride (PVC), Type 1 complying with ASTM D3915.
    b. Manufacture: ASTM D1784.
    c. Wall Thickness: Schedule 80.

2. FITTINGS

    a. Material: PVC complying with ASTM 2467.
    b. End Connections: Socket for solvent weld. Flanged as noted on P&ID's.

3. JOINTS

    a. Method: Solvent cementing methods per ASTM D2855 standard procedures.
    b. Solvent: Use ASTM D2564 solvent.
    c. Primer: Use ASTM F656 primers.

4. FLANGE

    a. ANSI B16.5 Class 150 pattern of same pipe material.

5. BALL VALVE

    a. Materials

        1) Body: PVC, Type 1, ASTM D1784
        2) Ball: PVC
        3) Seat: Polytetrafluoroethylene (PTFE)
        4) O-Ring: Viton
        5) Stem: Manufacturer Standard

6. CHECK VALVE

a. Materials

1) Body: PVC, Type 1, ASTM D1784.
2) Ball: PVC
3) Seat: Polytetrafluoroethylene (PTFE)
4) End Connections: Union or solvent cement socket.

B. THERMOPLASTIC PURE WATER PIPING - PIGMENTED POLYPROPYLENE

1. PIPE Furnish a complete high purity pigmented PP piping system to include pipe, fittings, anchors, gaskets, specialty fittings and valves.

a. System shall be Polypropylene – equal to GF Piping systems LLC Progef Standard. The system shall be made of uniform pipe, fitting and valve resin. System pressure ratings shall be based on continuous use of 50 years. PP Pipe Fittings and valves shall be based on a Standard Dimensional Ratio (SDR) of 11, 3/8 inch through 20 inches (16-500mm). Pressure rating for pipe and fittings, unless otherwise noted, shall be 150 psi for all SDR11 material and 150 psi for all applied valves at 68 deg F.
b. Pipe, valves and fittings shall be made from a Group 1 Class 2 Beta Polypropylene resin produced by one supplier. The resin shall meet or exceed the requirements outlined for a random copolymer resin according to DIN 16774 and ASTM D 4101-96a. Melt Flow Range of resin shall be 1.25 g/10 min per 230/5. Resin is approved for contact with foodstuff as per the FDA CFR, Title 21 (2001) 177.1520.
c. All pipes shall have ends sealed with PE bags and then capped. Pipe shall be sleeved in a PE bag and heat-sealed on both sides.

2. FITTINGS Production

a. All standard fittings through 12 inches (315mm) shall be injected molded. All fittings are to be molded with equipment in a clean environment.
b. Packaging: All fittings are to be packaged in a class 100. Fittings are to be bagged in clean diffusion resistant PE (composite) bags. Bags are to be silicone free and anti-static.
c. Fabricated Fittings/Specialty Fittings: Fabricated Fittings/Specialty fittings shall be machined or molded of the same PP resin as the pipe and fittings. Machined components made from semi-finished PP block and rod used in fabrication or parts or sub-assemblies shall be inspected, cleaned, tested and packaged similar to fittings and valves. Final inspection is to be made prior to packaging by 100 percent visual inspection of every weld. Pressure test for welded assemblies as required.

3. JOINTS: Contact Butt Fusioon:

a. Contact Butt Fusion

1) Fusion weld joint shall be accomplished of a bench machine type butt fusion machine capable of joining pipe, fittings and valves. For sizes 3/4 inch (25 mm) through 4 inches (110 mm) installer shall use MC 110 Machine which shall come complete with a thermostatically controlled heater, two base clamping plates (wide), base clamping plate (left narrow), electrically operated planer and table clamp for a majority of the required joints of the system. A paddle type hand held heater plate may be used only for system

joints for which the bench unit use would be impractical. Contractor shall be responsible for renting of or purchase of complete machine as described above from the manufacturer.

2) Contact Butt Fusion Joining Equipment: An onsite installation seminar shall be conducted by manufacturer's personnel who are certified to conduct said seminar. Seminar topics shall include all aspects of product installation (storage, set-up, support spacing, fusion process, machine care, testing procedures, etc.). At the conclusion of the seminar, all installers will be given a written certification test and will be required to prepare and complete one fusion joint of the type being implemented on the project. Upon successful completion of said test, the installer will be issued a certification card verifying that they have met the requirements of the manufacturer with regards to knowledge of proper product installation and testing.

4. Valves all valves shall be rated for ASTM type 2 water distribution and shall be suppled by a single manufacturer

   a. Check Valve : All sizes class 150, ball type PP body with EPDM/FPM seats and seals. 150 PSI @ 68 deg C for sizes 3/8 inch (15 mm) through 4 inches (110 mm). Valves shall be equal to GF Piping systems LLC Type 561 (no spring) or Type 562 (with spring).

   b. True Union Diaphragm Valves All valves shall have a PP body with PTFE/EPDM diaphragm and threaded PP bonnet. 150 PSI @ 68 deg C for sizes 1/2 inch (20 mm) through 2 inches (63 mm). Valves shall be equal to GF Piping Systems LLC Type 514 w/locking handle and fitting ends for socket fusion.

   c. Flanged Diaphragm Valves All valves shall have a PP body with PTFE/EPDM diaphragm and threaded PP bonnet. 150 PSI @ 68 deg C for sizes 1/2 inch (20 mm) through 2 inches (63 mm). Valves shall be equal to GF Piping Systems LLC Type 517 w/locking handle and fitting ends for socket fusion.

   d. Sample Valve (SV) Shall be PP with threaded NPT connections, Angle or Globe body type. Valves shall be equal to GF Piping Systems LLC Type 522.

   e. Flow Sensors All Flow Sensors shall be Paddlewheel type made of PP body, rotor and pin. Shall be manufactured for installation within pipe sizes 1/2 inch (20 mm) to 8 inches (200 mm). Shall be equal to GF Piping Systems LLC Type 2537. Unit shall send a 4-20mA signal to GF Piping Systems Type 8900 Controller either panel or wall mounted. Test Certification shall be provided for all units.

   f. Pressure Reducing Valve All valves shall have a PP body with PTFE/EPDM diaphragm and threaded PP bonnet. 150 PSI @ 68 deg C for sizes 1/2 inch (20 mm) to 2 inches (63 mm). Valves shall be equal to GF Piping Systems LLC Type 582 provided with fitting ends for socket fusion. Provide Gauge Guard and Pressure Gauge.

   g. Pressure Retaining Valve All valves shall have a PP body with PTFE/EPDM diaphragm and threaded PP bonnet. 150 PSI @ 60 deg C for sizes 1/2 inch (20 mm to 2 inches (63 mm). Valves shall be equal to GF Piping Systems LLC Type 586 provided with fitting ends for socket fusion. Provide Gauge Guard and Pressure Gauge.

5. DELIVERY, STORAGE AND HANDLING Any PP pipe that becomes damaged in transit handling and does not arrive at the site as shipped by the factory shall not be used. It must be rejected by the quality control representative.

a. All material and equipment shall be handled and stored in an indoor location throughout the progress of the job in such a manner as to prevent damage and/or contamination. Room shall be maintained dry and dust free. Pipe, fittings, and valves shall be stored as originally packaged by the manufacturer.
b. Lift, support and transport PP piping per manufacturer's recommendations.

6. SUBMITTALS Submit the following:

a. Product data for the system specified; relative to materials, dimensions of individual components, profiles, and finishes.
b. Product certificates signed by manufacturer of PP piping product, showing compliance to stated requirements.
c. Copy of Manufacturer's Training and Certification material showing the field training documentation and certification testing that all on-site installers will be required to complete prior to commencement of product installation.
d. Qualification of firms supplying materials: Firms must have a minimum of five years experience in HP design, installation and operation of thermoplastic high-purity piping systems.

7. QUALITY ASSURANCE

a. Obtain components from a single source having responsibility and accountability to answer and resolve problems regarding proper installation, compatibility, performance, and acceptance.

8. WARRANTY Warranty period is one year after date of substantial completion

9. Installation Notes:

a. Installation, including support spacing, compensation for expansion and contraction, and joining shall be in compliance with manufacturer's recommendations.
b. For metric systems, supply proper metric fusion spigots.
c. Jointing method to be outlined and submitted with pipe, fittings and valves shop drawings.
d. All pipe, valves, fittings, sensors and instrumentation shall be the product of one manufacturer.
e. All piping shall be stored with caps in a clean dry area. The pure integrity of pipe fittings and valves shall not be jeopardized.
f. All piping shall be supported with continuous support channel under all horizontal pipe runs. Pipe and channel will be supported from the piping suspension system.
g. Turn over to owner at end of construction necessary welding equipment as suggested by manufacturer for repair, additions and maintenance of the pp standard polypropylene piping system
h. Under this specification, the contractor shall be responsible for the purchase or rental of the proper machine required to meet the intent of the specification and be used for installation of the product on site.
i. Installer shall ensure that all pipe and fittings used for pp piping are components of the same system. No mixing of various manufacturers pipe and or fittings shall be allowed
j. Installation, including support spacing, compensation for expansion and contraction, and joining shall be in compliance with manufacturer's recommendations
k. Installers must be trained and certified in fusion system by the manufacturer.

2.3 HIGH PURITY WATER PIPE AT GLASSWASHERS, AUTOCLAVES, STERILIZERS AND VIVARIUM WASH EQUIPMENT

A. At each piece of equipment where pure water is connected to same, furnish and install stainless steel pipe fittings and valves for the last 10 feet of supply and return piping to the equipment.

B. Pipe

1. ANSI 304L stainless steel tubing
2. Finish number 3 - 150 grit mechanical polish interior and mill finish exterior
3. 065 wall 1 inch - 3 inch. Conforming to ASTM 270
4. Pipe to be capped

C. Fittings Type 304L stainless steel, sizes 1 inch and larger with butt weld ends conforming to ANSI B31.1 and B31.2, sizes 3/4 inch and smaller may be SwageLok or Parker tube fittings. Fittings and pipe to be by one manufacturer to assure proper fit and system conformance.

D. Clamp Tri-clamp.

E. Fabrication

1. Field or shop fabricated TIG weld method with purge on back side weld, flanged connections to valves, equipment, and where indicated on the contract drawings.
2. Note that U-bends down to this equipment may be prefabricated and shipped clean with transition fittings to circuit polypropylene pipe to the field.

F. Connection Valve: Tri-clamp or weld

G. Valves

1. Ball Valve Valve sized for proper tube connection, min 120 grit finish.
   a. 316l SS body and ball, tube butt weld extended connections, 300 series handle, follower, sprig Teflon seat, seal and stem packing.
2. Check Valve Flanged or Butt Weld end connections
   a. ANSI 304L Stainless per ASTM A182

H. Notes:

1. All fittings, tube, valves, etc., are to be supplied by one manufacturer to assure continuity and proper fit of system
2. All pipe fittings and valves shipped to jobsite capped or bagged ready for clean installation

I. Testing and Cleaning:

1. Isolate or remove all metal parts of the system that are not 300 series stainless steel.
2. Fill and purge system with sufficient the feedwater from the RODI system water to maintain circulation. Start circulating the water and inspect all pipe, tri-clamp fittings, and joint seals for leaks. Eliminate leaks before continuing.

3. The documentation for the system, including all data sheets shall be placed in the "Cleaning Documentation Section" of the documentation file.

PART 3 - EXECUTION

3.1 PIPE MATERIALS SCHEDULE

Service	Drawing Tag	Maximum Service Operating Limits		Class	Pipe Material
		Pressure (psig)	Temperature (°F)		
PRE-TREATMENT WATER	PTW	100	70	Application - BFP through pretreatment up to Carbon Filters	PVC Or CPVC
ASTM/CAP REAGENT WATER TYPE II	RODI	100	68	application – RO only water feed water to to CS Generator Glasswasher circuit Vivarium Wash Areas	Pigmented Polypropylene Contact Butt Fusion
Last 10 FEET OF PIPE TO HOT EQUIPMENT	RODI	150	180		Stainless steel type 304L

3.2 INSTALLATION

A. General:

1. Refer to Division 22 for general requirements for pipe installation pipe supports and pipe identification markers.
2. Installation, including support spacing, compensation for expansion and contraction, and joining shall be in compliance with manufacturer's recommendations.
3. Support all thermoplastic piping with continuous support channel under all horizontal pipe runs. Support pipe and channel from the piping suspension system.

B. Piping

1. Distribution system shall be installed to achieve complete drain-ability.
2. Distribution system should be sloped towards pure water outlets to facilitate drain-ability.
3. Distribution system shall prevent the entrapment of pure water.
4. Drain valves shall be provided at low points of the distribution system when system valves are not available.
5. Pipe installers shall be certified by the pipe manufacturer on the use of the fusion equipment and performing fusion connections.
6. Refer to architectural, lab casework and plumbing drawings for location of pure water outlets, scientific equipment and polisher connections.
7. Refer to section 220529 for spacing and installation of pipe supports.

    a. Note: all pure water thermoplastic pipe to be supported with continuous V shaped angle

C. Solvent-Cemented, Thermoplastic Pipe and Fitting Joints:

1. Handle cleaners, primers, and solvent cements according to ASTM F 402.
2. Follow ASTM D2855 standard procedures for the joining of solvent-cemented joints.

D. Heat Fused Olefin and Fluoropolymer Thermoplastic Pipe and Fitting Joints:

1. Follow ASTM D2757standard procedures for the joining of heat fusion joints.
2. Use heat fusion equipment supplied by the pipe and fitting manufacturer. Follow manufacturer's instructions.

E. Pipe Insulation and Identification Markers:

1. Refer to Division 22 for general requirements of pipe insulation and pipe and valve identification markers.

3.3 CLEANING OF THERMOPLASTICS

A. If a system is to be sterilized in place, leak check and pressure test the system with air or water, prior to sterilization.

B. Disconnect any UV lights and remove any sub-micron filter cartridges from their housings and install 5 micron filter cartridges.

C. Close valves on inlet and outlet and open bypass on any DI bottles to prevent the sterilizing solution from entering DI bottles and contacting the resin, while still allowing the solution to circulate.

D. Fill storage tank to a depth of approximately 3 ft. with DI water. Calculate the total volume of water in the storage tank AND the piping loop. Add sufficient hydrogen peroxide (H_2O_2) to the water in the storage tank to result in a solution strength of 10% H_2O_2).

E. When circulating the H_2O_2 solution, sample the water at each sink valve, as follows, to verify the presence of the H_2O_2 solution:

1. Utilize a Nach Co., Inc. pre-manufacturing test kit Model no. HYP-1 (Cat. No. 2291-00) or approved equal. This kit shall be used to test H202 presence by a drop count titration) thiosulfide method.
2. Adjust the pH of a quart of potassium permanganate ($KMNO_4$) and pH 6.5 with sulfuric acid (H_2SO_4). A quart should be adequate for testing most systems.
3. Draw approximately one-half cup of water from each sink valve, individually, and add a small amount of the test solution ($KMNO_4$) to the sample.
4. If H_2O_2 is present in the sample, it will turn clear or brown; if no H_2O_2 is present, it will remain purple.

F. When testing verifies the H_2O_2 solution is present at all test locations, turn off the distribution pump and open inlet and outlet valve as required to retain the solution in the loop for a minimum of 12 hours, while isolating the tank from the loop.

G. During the 12 hour retention period, the storage tank can be drained and cleaned. This is accomplished by first draining the tank to below the manhole. Enter the tank and using suitable spraying device and pressure, wash the tank walls and dome with the residual H_2O_2 in the tank.

After spraying, drain the tank to a suitable drain and then thoroughly rinse the interior with DI water allowing it to go to drain also. Vacuum any residual DI water and then dry the tank, replace the manhole and close the tank drain. Fill the storage tank with DI water and revalve or install a bypass to allow the building loop return line to discharge to drain for the flushing and draining of the loop.

1. While performing the following tank cleaning procedure, full body protective gear including breathing apparatus is required. Also, a life line must be attached to the person entering the tank and an additional person should be stationed outside within sight and sound, in case of an emergency.

H. After the 12 hour retention period, flush the H_2O_2 solution in the loop to drain, utilizing the distribution pump and the DI water in the storage tank. Flush until testing with $KMNO_4$ indicates no residual H_2O_2 in the loop.

I. Open inlet and outlet valves on DI bottles and reconnect loop return to the storage tank, and remove and discard the 5 micron cartridges from the sub-micron filter housing and install proper sub-micron filter cartridges and reconnect UV lights. This procedure should be repeated at least annually or more often if contamination occurs.

3.4 CLEANING OF THERMOPLASTICS FOR PURIFIED WATER USE

A. Cleaning of High Purity Water Piping. Minimum Standard

1. General

   a. All cleaning and flushing work shall be coordinated with and supervised by the Water Treatment Sub-subcontractor for chemicals and procedures to be followed. See the Water Treatment Section of these Specifications.
   b. Following the successful testing of the piping systems, they shall be cleaned under the supervision of the Pure Water Treatment Sub-subcontractor.
   c. Before submitting piping systems for acceptance, all strainers shall be inspected and thoroughly cleaned.
   d. Cleaning shall be started only after all piping has been hydrostatically tested and all systems have been completely connected up.
   e. Operate pumps and circulate water throughout system for period of one 8 hour day. At the end of each day of circulation, remove and clean all strainer baskets and blow off all low points.

2. Fluid Used: Water - ambient, RODI water, Peroxide sanitization
3. Cleaning

   a. Cleaning accomplished by a flushing process. The flushing rate shall be equal to a velocity of 4 fps in all portions of the piping system.
   b. If a system is to be sterilized in place, leak check and pressure test the system with air or water, prior to sterilization.
   c. Disconnect any UV lights and remove any sub-micron filter cartridges from their housings and install 5 micron filter cartridges.
   d. Verify that all sink valves are closed.
   e. Close valves on inlet and outlet and open bypass on DI bottles to prevent the sterilizing solution from entering the DI bottles and contacting the resin, while still

allowing the solution to circulate from the storage tank, through the high purity water system loop using one distribution pump and back to the tank.

f. Fill storage tank to a depth of approximately 3 ft. with DI water. Calculate the total volume of water in the storage tank and the piping loop. Add sufficient hydrogen peroxide (H2O2) to the water in the storage tank to result in a solution strength of 10% H2O2).

g. When circulating the H2O2 solution, sample the water at each sink valve, as follows, to verify the presence of the H2O2 solution:

    1) Utilize a Nach Co., Inc. pre-manufacturing test kit Model no. HYP-1 (Cat. No. 2291-00) or approved equal. This kit shall be used to test H202 presence by a drop count titration) thiosulfide method.
    2) Adjust the pH of a quart of potassium permanganate (KMNO4) and pH 6.5 with sulfuric acid (H2SO4). A quart should be adequate for testing most systems.
    3) Draw approximately one-half cup of water from each sink valve, individually, and add a small amount of the test solution (KMNO4) to the sample.
    4) If H2O2 is present in the sample, it will turn clear or brown; if no H2O2 is present, it will remain purple.
    5) When testing verifies the H2O2 solution is present at all test locations, turn off the distribution pump and open inlet and outlet valve as required to retain the solution in the loop for a minimum of 12 hours, while isolating the tank from the loop.

h. During the 12 hour retention period, the storage tank can be drained and cleaned. This is accomplished by first draining the tank to below the manhole. Enter the tank and using suitable spraying device and pressure, wash the tank walls and dome with the residual H2O2 in the tank. After spraying, drain the tank to a suitable drain and then thoroughly rinse the interior with DI water allowing it to go to drain also. Vacuum any residual DI water and then dry the tank, replace the manhole and close the tank drain. Fill the storage tank with DI water and revalve or install a bypass to allow the building loop return line to discharge to drain for the flushing and draining of the loop.

i. While performing the following tank cleaning procedure, full body protective gear including breathing apparatus is required. Also, a life line must be attached to the person entering the tank and an additional person should be stationed outside within sight and sound, in case of an emergency.

j. After the 12 hour retention period, flush the H2O2 solution in the loop to drain, utilizing the distribution pump and the DI water in the storage tank. Flush until testing with KMNO4 indicates no residual H2O2 in the loop.

k. Open inlet and outlet valves on DI bottles and reconnect loop return to the storage tank, and remove and discard the 5 micron cartridges from the sub-micron filter housing and install proper sub-micron filter cartridges and reconnect UV lights. This procedure should be repeated at least annually or more often if contamination occurs

4. Flushing: After disinfection, flush the system with deionized water of the same resistivity as is generated by the system.

5. Flushing Duration: Strainers and/or baskets shall be inspected frequently during the flushing operation and cleaned. Flushing operation shall continue until extraneous material is no longer accumulating in the strainer or basket at the discharge point. After the completion of flushing, the system shall be drained completely and returned to the pre-cleaning condition.

6. Purge: Blow the system down for 2 hours with 5-PSI nitrogen. Assure that all outlets are open during blowdown. Do not pressurize the system. After N2 purge, fill and circulate system PURE RODI water through the system.
7. Final product: Test the return after 2 hours of circulation. The return conductivity shall equal the supply conductivity. If not, repeat the above

B. IQ/OQ/PQ Qualifications Outlined By The Validation Team Are To Be Strictly Followed.

C. Cleaning and sterilizing piping system for validated use shall be outlined by the validation protocol.

END OF SECTION

SECTION 226722 – PURE WATER EQUIPMENT FOR LABORATORY FACILITIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Specification section describes the technical specifications and general instructions for the furnishing, factory testing, handling, delivery and installation of water purification equipment for general laboratory or academic research facility reagent water.

B. The Contractor is responsible for preparing the detailed engineering specifications, skid fabrication drawings and wiring diagrams necessary for fabrication, quality of materials, and quality of workmanship. This specification is intended to establish minimum acceptable standards consistent with industry practice.

C. Section Includes:

1. Manufacturers
2. General Fabrication
3. General Description
4. Design and Performance
5. Documentation
6. ASTM Type II water system pretreatment
7. Central RO/CDI units
8. Storage Tank
9. Distribution skid #1 - laboratory glasswashers and autoclaves
10. Distribution skid #2 - Vivarium Distribution Skid
11. Vivarium Make Up Water to Bottle Fill Station Equipment
12. Additional Requirements for Pure Water

D. Related Sections:

1. 221117 – Purified Water Piping - Thermoplastics-

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. LEED Submittals:

1. Product Data for Credit IEQ 4.1: For solvent cements and adhesive primers, documentation including printed statement of VOC content.
2. Laboratory Test Reports for Credit IEQ 4: For solvent cements and adhesive primers, documentation indicating that products comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

1.4 INFORMATIONAL SUBMITTALS

A. Welding certificates.

B. Field quality-control reports.

1.5 SUBMITTALS

A. Submit shop drawings and submittals per requirements set forth in Section 1

B. Documentation Requirements

1. Submitted documentation shall be complete and consistent to provide a written record to prove that the utilities and equipment conform to the specifications and intent of the design.

C. General

1. Submit technical specification for all equipment including pretreatment equipment, reverse osmosis and deionization equipment, tanks, pumps, starters, heat exchangers, instrumentation and controls.
2. Submit electrical, plant steam and cooling water requirements.
3. Submit electrical data and wiring diagrams. Differentiate between factory wiring and field wiring.
4. Submit control loop diagrams and ladder logic diagrams.
5. Materials of construction and finishes of all product contact (wet) and non-contact parts.

D. Shop Drawings

1. Submit shop drawings two weeks after receipt of purchase order.
2. Submittal package shall include for all equipment (where applicable):

    a. Cover letter.
    b. Owner name and plant location.
    c. Equipment name and identification number on the Drawings.
    d. Purchase order number and date.
    e. Manufacturer name and plant location.
    f. Equipment specification including utility requirements, connection sizes and types.
    g. Equipment drawings including plan and elevation, dimensions, and parts identification.
    h. Equipment model, serial number, shop order number and date of fabrication.
    i. Internal finish specifications.

j. External finish specifications.
k. Drawing title, number, revision number and date of issue.
l. P&ID with parts list.
m. Installation check procedures.
n. Pre-start-up check procedures.
o. Water quality test procedures.
p. Equipment weights.
q. Electrical schematics with parts list.
r. Exceptions list to specification (if applicable).
s. Exceptions list to vendor specification (if applicable).

3. Cartridge Filter: Also include the following:

   a. Overall dimensions and tolerances including access clearances.
   b. Quantity and type of cartridge

4. Softeners: Also include the following:

   a. Overall dimensions and tolerances including access clearances.
   b. Quantity and type of softener resin including grains/gallon capacity.
   c. Material Safety Data Sheets (MSDS) for brine solution.
   d. Vessel interior coating.
   e. Valve specifications including solenoids, tubing and accessories.
   f. Control sequences.
   g. Regeneration flow rate and duration.
   h. Backwash flow rate and duration.
   i. NSF Certification.

5. Service Carbon (AGC) Assembly: Also include the following:

   a. Dimensions and tolerances.
   b. Quantity and type of activated carbon media.
   c. Vessel interior coating.
   d. Valve specifications including solenoids, tubing and accessories.
   e. NSF Certifications.

6. Reverse Osmosis and/or Continuous Electrodeionization Unit: Also include the following:

   a. Membrane specifications and module assembly.
   b. Percent rejection of TDS rating.
   c. Rated permeate yield.
   d. Percent brine rejection to permeate yield.
   e. Percent rejection of TDS rating.
   f. Discharge resistivity.

7. Purified Water Tank submittals: Also include the following:

   a. Overall dimensions and tolerances for the tank and accessories.
   b. Design data including applicable codes and standards.
   c. Complete bills of materials for tank and accessories.
   d. Welding specifications (if applicable).
   e. Cleaning procedures (if applicable).
   f. Details of weld preparation (if applicable).

g. Nozzle connection types, sizes and dimensioned physical locations.
h. Customer nameplate.

8. Centrifugal Pumps: Also include the following:

a. Complete performance curves showing pump rate vs. discharge pressure, impeller diameter, brake horsepower, motor horsepower, hydraulic efficiency and net-positive suction head required (NPSHR).
b. Highlighted duty point of the pump on the performance curves.
c. Detailed pump and seal drawings.
d. Overall pump dimensions, including motor and frame.
e. Size, type and location of suction and discharge connections.
f. Operating weight (lbs.).
g. Sterilization procedures.
h. Design and operating conditions.
i. Materials of construction.
j. Details of seal materials and design.

9. UV and Final Filters: Also include the following:

a. Dimensions and tolerances.
b. Quantity and type

10. Submit Instrument Datasheets.

E. Closeout Submittals

1. General

a. Revise final drawings and documents to incorporate all mark-ups and notes in the shop drawings to reflect the specific installation.
b. Submit Inspection and test reports specified in "Source Quality Control" Articles in Part 2 of this Section.

2. Pre-Treatment, Primary Treatment: Provide equipment documentation as follows:

a. User manual (3 sets): Include information to install, operate, configure, calibrate, troubleshoot and service the equipment. Include final as-built drawings, parts lists and component manufacturer literature as part of the User Manual.
b. Manufacturing documentation (3 sets): Include safety and authorization certificates of vendor policies. Provide certificates of compliance for pressure vessel and piping materials, manufacturing, welding, surface treatment, inspection, testing and pressure vessel test report (Form U-1 for ASME) with a copy of the name plate. A certificate of compliance is defined as a description of design and manufacturing principles, practices, methods and equipment. Include boroscopic documentation.
c. Control system validation documentation (3 sets): Include the PLC input/output listing, control valve table and a source code listing. Include change control documentation, version and media management documentation, and software development guidelines.
d. Qualification documentation (3 sets): Include a general description of the factory acceptance test (FAT) procedures and compliance test report. General description of FAT procedures defines the objectives and describes the contents of each test and verification.

e. Pressure vessel inspection procedure and reports.
f. Document and software review procedures.
g. Functional software and design specification.
h. Hardware design specification.
i. Hardware acceptance test specification.
j. System acceptance test specification.

3. Storage Tank: Provide equipment documentation as follows:

a. Materials of construction.
b. Wall thicknesses.
c. Details of weld preparation (if applicable).
d. Location of all welded joints (if applicable).
e. Hydrostatic test report (if applicable).
f. Cleaning procedures and inspection report
.

4. Distribution skid with Centrifugal Pumps, UV, Final Filters, Backpressure Valve, and Provide equipment documentation as follows:

a. Operating, Installation and maintenance manual.
b. Recommended spare parts for 12 month operation.

5. Instrumentation: Provide equipment documentation as follows:

a. Calibration certificates of all process instrumentation.

1.6 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."

B. Pure water equipment vendor shall have a minimum of five (5) years' experience in manufacturing water purification equipment and provide references for five (5) similar facilities.

1.7 REFERENCES

A. American National Standards Institute (ANSI).

1. ANSI/NSF 42 "Drinking Water Treatment Units – Aesthetic Effects".
2. ANSI/NSF 44 "Catson Exchange Water Softeners".
3. ANSI/NSF 53 "Drinking Water Treatment Units – Health Effects".

B. American Water Works Association (AWWA).

C. American Society of Mechanical Engineers (ASME).

D. American Society of Mechanical Engineers (ASME), Section IX, "Welding and Brazing Qualifications."

E. ASME Boiler and Pressure Vessel Code, Section VIII, Division 1, “Unfired Pressure Vessels.”

F. ASME B31.3 “Process Piping”

G. American Society for the Testing of Materials (ASTM)

1. A380 “Standard Practice for Cleaning, Descaling, and Passivation of Stainless Steel Parts, Equipment and Systems.”
2. A967 “Standard Specification for Chemical Passivation Treatments for Stainless Steel Parts.”
3. D 859 “Test Methods for Silica in Water,”
4. D 1067 “Test Methods for Acidity or Alkalinity of Water,”
5. D 1125 “Test Methods for Electrical Conductivity and Resistivity of Water,”
6. D 1068 “Test Method for Iron in Water,”
7. D 1126 “Test Methods for Hardness in Water,”
8. D 1129 “Terminology Relating to Water,”
9. D 1193 “Standard Specification for Reagent Water,”
10. D 1293 “Test Methods for pH of Water,”
11. D 1998 “Standard Specification for Polyethylene Upright Storage Tanks,”
12. D 3370 “Practices for Sampling Water,”
13. D 4453 “Practice for Handling of Ultra-Pure Water Samples,”
14. D 4517 “Test Method for Low-Level Total Silica in High-Purity Water by Flameless Atomic Absorption Spectroscopy,”
15. D 4779 ”Test Method for Total, Organic, and Inorganic Carbon in High Purity Water by Ultraviolet (UV) or Persulfate Oxidation, or Both, and Infrared Detection,”
16. D 5391 “Test Method for Electrical Conductivity and Resistivity of a Flowing High Purity Water Sample,”
17. D 5542 “Test Method for Trace Anions in High Purity Water by Ion Chromatography,”
18. D 5997 “Test Method for On-Line Monitoring of Total Carbon, Inorganic Carbon in Water by Ultraviolet, Persulfate Oxidation and Membrane Conductivity Detection,”
19. D 6071 “Test Method for Low Level Sodium in High Purity Water by Graphite Furnace Atom Absorption Spectroscopy.”
20. D 6161 “Standard Terminology used for Crossflow Microfiltration, Ultrafiltration, Nanofiltration and Reverse Osmosis Membrane Process”.

H. American Welding Society (AWS)

I. College of American Pathologists (CAP)

1. “College of American Pathologists Commission on Laboratory Inspection and Accreditation: Reagent Water Specifications.”

J. Tubular Exchanger Manufacturers Association (TEMA)

K. National Committee for Clinical Laboratory Standards (NCCLS)

1. Document C3-A3 “Preparation and Testing of Reagent Water in the Clinical Laboratory—Third Edition; Approved Guideline”

L. National Electrical Manufacturers Association (NEMA)

M. Occupational Safety and Health Act (OSHA)

N. Underwriter's Laboratories (UL)

1.8 DEFINITIONS

A. For definitions of terms used in this Section, refer to ASTM D1129, D6161 and NCCLS Document C3-A3.

1.9 DELIVERY, STORAGE AND HANDLING

A. Packing/Handling

1. Prior to shipment, all openings shall be adequately sealed to protect from damage.
2. Disassemble units only to the extent to prevent damage during shipping and to facilitate field handling.
3. Pack each unit individually and include in packaging all necessary appurtenances and parts required for field installation.
4. Equipment shall be match-marked or tagged to identify location.

B. Shipping

1. Ship F.O.B. job site.

1.10 SYSTEM START UP

A. Perform start-up services and training of operators by a factory-trained field service engineer. Provide travel and accommodation costs of factory personnel.

B. Start-up service of the pure water system and storage tank shall include the following:

1. Installation checks including utility connections.
2. System operation for routine start-up and shut-down.
3. Programming of control set points.
4. "Off-spec" permeate dumping set-points and response.
5. Storage tank level control interfacing.
6. Alarm condition and response.
7. After system has been operating for 24 hours, collect RO/CEDI water samples at hourly intervals for 8 hours. Owner analysis of samples shall meet the requirements of this specification in all respects.
8. During sampling period, check RO and CEDI production rate. Production rate shall be in excess of 95% of the specified capacity.
9. After completion of start-up testing, obtain written sign-off of system from Owner. Correct design and fabrication deficiencies responsible for unsatisfactory test results at no cost to the Owner.
10. Conduct training of system operation and maintenance for Owner personnel.

C. Start-up of the purified water distribution loop shall include the following:

1. System operation for routine start-up and shut-down.

2. Programming of control set points.
3. Verification of pump rotation, speed and discharge pressure.
4. Verification of UV light intensity.
5. Verification of polishing deionization skid outlet resistivity.
6. Collect pure water samples at use points at hourly intervals for 8 hours. Owner analysis of samples shall meet the requirements of this specification in all respects.
7. During sampling period, check flow rate and velocity through distribution loop.
8. After completion of start-up testing, obtain written sign-off of system from Owner. Correct design and fabrication deficiencies responsible for unsatisfactory test results at no cost to the Owner.
9. Conduct training of system operation and maintenance for Owner personnel.

1.11 MAINTENANCE

A. Pure water equipment vendor shall have an established field service organization and guarantee less than 12-hour response time, 24 hours per day, 7 days per week.

B. Provide as an option, the cost for a basic spare parts kit for an average 2 years operation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with requirements and Drawings, provide products by one of the following:

1. Complete System

    a. Evoqua Water Technologies LLC
    b. Burt Process
    c. Veolia Water Technologies, Inc.
    d. Hydro Water Systems Inc.
    e. GE Water and Process Technologies

2. Ultra-Violet Sterilizers

    a. Aquafine
    b. Approved vendor standard.

3. Storage Tanks (Thermoplastic)

    a. American Process Technology, Inc.
    b. Teracon
    c. Nalgene
    d. Approved vendor standard

4. Pumps, Sanitary

a. Tri-Clover “Tri-Flo” Series
b. Fristam Pumps
c. Waukesha Pumps
d. Grunfos

5. Filters and Housings

a. Gelman
b. Pall
c. Aquapure

6. Programmable Logic Controllers

a. Allen-Bradley
b. Seimens
c. Approved vendor standard.

B. Subject to compliance with requirements and Drawings, and unless specified otherwise, instruments and controls provided with standard vendor-packaged units will be considered acceptable.

C. Refer to related sections and instrument lists, valve lists, and equipment lists for explicit specifications of attached instrumentation and controls. Some instruments and controls specified may be substitutes to standard vendor components within skid-mounted units.

2.2 GENERAL FABRICATION

A. Unless otherwise noted, all skids shall be fabricated of welded carbon steel with an epoxy or PVC protective finish. All welds shall be ground smooth and polished.

B. Unless otherwise noted, all electrical enclosures shall be NEMA 4X and constructed of epoxy coated carbon steel.

C. All skids shall be assembled by the vendor to allow for single field connections for power, feed, product, drain, and control air. All electrical components shall be pre-wired, neatly arranged and run in conduit. All electrical shall be wired to an electrical enclosure.

D. Provide all interconnecting wiring (power and control) between skids back to main PLC-1. The main PLC for the pure water system shall be provided as part of the pure water system.

E. Power wriring from the building electrical panels to the pure water system PLC-1 shall be provided under Division 26.

2.3 GENERAL DESCRIPTION

A. System Description

1. Building Water Supply for lab use

a. All water for lab function, domestic hot water system and vivarium use shall be softened via central water softening equipment.

b. Water softening equipment for the building lab water system is specified under section 223200 “general purpose water filtration equipment”.

2. Vivarium

a. Reverse Osmosis water for the vivarium equipment will be provided locally from point of use equipment. The system will connect to the soft cold water distribution in the building.
b. Provide purified water for the vivarium bottle filling equipment,

3. Laboratory Use Pure Water:

a. ASTM Type II water for the laboratories will be generated centrally from the pure water equipment as designated on the drawings

b. Higher quality water, if required at each lab floor shall be generated by point of use end polishihg units furnished and installed by the owner.

c. Install a tee and diaphragm valve and cap with maximum 6D deadleg at areas designated on the drawings for end polishing units

4. Laboratory Glasswashers and Sterilizers:

a. Pure water for glasswashers, cage washers, and sterilizers shall be from the combined ASTM type 2, grade C water system.
b. The central system will be provided and piped to deliver ASTM Type II water via two separate loops. One loop dedicated for laboratory service including glasswashers and sterilizers in the facility and a second loop dedicated to the Vivarium wash equipment.

1) Note: the piping is specified in 226701 purified water piping. Furnish and install for the last 10 feet of connection to each glasswashe, cage washer and sterilizer, 316L stainless piping.

5. Humidification RODI Water System: Purified water shall be supplied to HVAC humidifier from the return loop of the ASTM type 2 water system.

B. The system shall consist of packaged, modular unit treatment skids. Operation of the system shall be fully automatic.

C. Water Analysis

1. Obtain a source water analysis and include all parameters as part of the final design to produce water in accordance with this specification
2. Collect a representative sample. Use appropriate methods and quality-assurance measures to ensure that the field sites selected and the samples collected accurately represent the environment intended for study and can fulfill data-quality objectives

D. The specification is provided with references to Evoqua Water technologies Equipment. The contract shall include all components as required to provide a completely operational system as outlined by these documents and verified by the vendors detailed P& I, D drawings.

E. The system shall be controlled via a local control panels with touch screen operator interface. System will require a single three phase power connection as well as a 120 VAC single phase power connection..

a. System components other than storage tanks to be factory mounted and plumbed on common epoxy coated carbon steel skids.
b. Electrical conduit shall be corrosion resistant PVC with PolyTuff flexible conduit as manufactured by Hubbell.
c. System manufacturer shall provide five days of site assistance to cover start-up and training.
d. System Maintenance: Manufacturer shall be capable of providing a maintenance agreement with the system owner should the owner wish to enter into such an agreement.

2.4 DESIGN AND PERFORMANCE

A. Minimum Working Pressure Ratings:

1. Laboratory or Reagent-Water Piping: 50 psig unless otherwise indicated.

B. Project Laboratory Water Delivery Performance Requirements:

1. Laboratory Use: The system shall generate water equal to the following, measured at the effluent of the distribution skid outlet: ASTM Type II Water at the laboratory use outlet of the lab faucet.
2. Glasswasher and Autoclave use: The system will supply ASTM type II water to user outlets through a central treatment and distribution system.

a. Piping will be arranged such that the maximum dead leg to all use points does not exceed 6D to said use point.
b. All pumps, filtration, process and sanitization system shall be from a single fabrication vendor; shall be skid mounted, pre-piped and pre-wired and furnished with factory tested documentation.
c. The ASTM type 2 water supply pumps will run in parallel and shall be furnished with VFD's. The system shall be controlled via a common PLC driven control panel with touch screen operator interface.

2.5 DOCUMENTATION

A. The equipment supplier shall furnish the following with the system, in duplicate. All documents and prints described below will be contained in the system operating manuals.

a. Detailed Piping and instrumentation diagram (P&ID).

1) Valves tag numbers
2) Instruments tag numbers

3) Alarms
4) Pipe sizing and material of construction
5) Skid limitations
6) Plan of component layout
7) Written sequence of operation

b. Electrical ladder diagrams for control panel, in accordance with accepted practices.
c. Complete bill of materials, including system sub components along with major components
d. Cross-reference between each print and the bill of materials, providing references to system components.
e. Operating and maintenance manuals containing descriptive information on the operation of the system, operating and troubleshooting information, spare parts, specification sheets and manufacturer's cut sheets and service manuals.
f. Complete ladder and logic diagram (program) loaded into PLC

B. Mechanical Assemblies Of All Skids

1. Dimensions
2. Major components highlighted
3. Bill of materials

C. Control Panel Layout

1. Lights, switches and instrument plaques
2. Back panel layout.
3. The operations shall be monitored by BMS. See P&ID for details.

D. Manufacture Catalog Data Sheets

1. All Major components

E. Testing

1. Hydrostatic of all equipment
2. Control panel checkout

F. Insurance

1. Manufacturer shall include a Certificate of Insurance with their submittal approving that they are insured as a supplier and manufacturer of such systems.

G. System Maintenance

1. Manufacturer shall be capable of providing a maintenance agreement with the system owner should the owner wish to enter into such an agreement.

H. Equipment Warranty

1. System manufacturer shall warrant all equipment against defects in materials and workmanship, including part and labor, for a period of 12 months from date of startup or 18 months from delivery, whichever occurs first, for all equipment above.

2. Field Services - System manufacturer shall provide a trained factory field service engineer or technician, as required, for installation supervision, media loading, system startup, loop balancing, loop sanitization, and operator training.

I. Electrical Work:

1. CElectrical power only connections to all main control panels (by electrical sub-contractor). Note that electrical power from the control panel to equipment is included under this contract (220000 section) as part of the pure water system installation.

   a. All Control wiring to instruments and components in the RODI System – Plumbing Contract
   b. All Skid to Skid, component to component wiring in the RODI System – Plumbing Contract

2.6 ASTM TYPE 2 WATER SYSTEM PRETREATMENT EQUIPMENT

A. General Equipment (each system)
   1. Duplex 5 micron cartridge filters
   2. Simplex Backwashable Carbon Filter
   3. Duplex Backwashable Water Softeners

B. Cartridge Filter/S

1. Prefilter - Media cartridge filter for removal of suspended solids and turbidity. Packaged and skid or wall mounted. Each cartridge is rated for 100% and is supplied with pressure gauges and isolation valves
2. Source Water: Municipal water supply.
3. Number of filters – two (2)
4. System piping - parallel installation with isolation valves on the inlet and outlet of each filter. Each filter to be drainable with drain and relief port valves
5. Media: Provide 5 micron particulate removal.
6. Flow rate: 25 gpm each filter
7. Basis of Design: Pentak Big Blue 20 inch filter 1 psig ΔP at 20 gpm

C. Carbon Filter: simplex

1. Provide carbon filters capable of backwash cycle based on time
2. The activated carbon filter shall include an FRP vessel, internal distributors, Tanks shall be supplied with quick disconnect fittings, flexible interconnecting hoses, isolation valves, and an outlet sampling valve.
3. Source Water: Municipal water supply downstream of cartridge media filtration. Placement before or after water softeners to be determined by equipment supplier..
4. Provide organics reduction pre RO..
5. Normal flow rate: 18 gpm as rated for chlorine removal
6. Peak flow rate: 36 gpm
7. Pressure rating: 100 psi maximum

8. Media: Activated Carbon:
9. ASME code stamped: No
10. Internal Distributors Basket Diffuser
11. Underdrain Distributor PVC Basket Strainer
12. Size: 18 x 65
13. Control valve: Fleck model 2850S brass valve
14. Controller: touch screen HMI Deluxe NXT controller
15. Flow meter: none
16. Electrical: 110V single phase
17. Back wash flow: 22 gpm
18. Face piping: schedule 80 PVCl
19. Basis of design model: Evoqua PTCCSD04

D. Water Softeners: duplex with single brine tank

1. FRP vessels, internal distributors, brine maker, top mounted multiport valve, pressure gauges, sample valves, media and a control panel. Furnish all Media, Media shall be shipped separately. The unit shall have down flow re-generation and downflow service
2. Number of units : 2 installed in parallel
3. Performance Conditions: A top mounted, motorized control valve shall provide for quiet, efficient and dependable automatic operation of the units. One softener shall be on line while the other is in standby. The units shall alternate automatically.
4. Operating Parameters (each) Normal flow rate 22 gpm
5. Rinse flow rate: 12 gpm
6. Pressure: 100 maximum
7. Media Cation resin in sodium form – 5 cubic feet per vessel.
8. Materials of Construction FRP lined with Polyethylene
9. Diameter: 18"
10. Shell Straightside: 65"
11. Hydrostatic test pressure: 150 psi
12. ASME code stamped: No
13. Influent distributor (top): Basket diffuser
14. Underdrain distributor : PVC basket strainer.
15. Controls and Instrumentation Deluxe NXT Controller with Fleck 2850S valve and pressure gauges
16. Type: 316SS, liquid filled, 2½" face psi.
17. Flow Meter: Fleck for duplex operation
18. Face Piping Pipe material: Schedule 80 PVC Connections PVC Sch 80 - solvent welded (by Contractor):

19. Connections (on control valve):
20. Feed water: 1½" female pipe thread
21. Product: 1½" female pipe thread
22. Waste: 3/4"female pipe thread
23. Regeneration and Brine Regeneration dosage
24. Brine Maker
    a. Construction: Polyethylene
    b. Electrical: 120 V, 1 Ph, 60 Hz, 10 watts
    c. Electrical Description - Water meter shall initiate flow based on volume. The operator shall be able to manually initiate re-generation at any time.
25. Basis of Design: Evoqua PTCSDD07

2.7 CENTRAL RO/CDI UNITS

A. Description Supply a reverse osmosis systems rated to produce 540 gallons per hour of product water when fed with 40°F cold water. Units shall be furnished with controls for manual or automatic operation.

B. Number of units (2) Evoqua IonRight RO/CDI

C. Performance Conditions
1. SDI 3-5
2. Each Maximum Operating Pressure 300 psig
3. System Projected Rejection Rates >90%
4. Feed Water Requirements
    a. Maximum Fouling Index (Silt Density Index) 5
    b. Maximum Langelier Saturation Index: Negative by a factor of at least 1.00
5. Reject Scaling Index
    a. Maximum Free Chlorine . 0.02 ppm
    b. Operating Temperature Range 38°-77°F
6. Operating pH Range 4-11

D. Controls and Instrumentation Controller
1. The reverse osmosis controller shall be controlled by a means of solid state programmable controller housed in a NEMA 4 splash proof housing. The controller shall be capable of operating all solenoid valve motors and safety interlocks associated with the system as listed below:
    a. Inlet Solenoid Valve
    b. Flush Solenoid Valve
    c. High Pressure Pump Relay

d. Pretreatment Interlock

e. Low Feed Pressure

f. High Feed Pressure

g. Tank Level Switch

h. Standard input voltage shall be 120 volts AC single phase. Output voltage shall be 24 volts AC for safety.

2. The controller shall be supplied with a time and duration automatic flush cycle field adjustable timing of automatic flush cycle(s). The RO system reject and autoflush valves shall be compatible with peroxide based sanitants. Automated flush cycles shall occur when the RO system is in full tank shutdown mode and/or system standby modes to prevent stagnant water conditions. Flush flow rate shall be controlled to provide a flow rate during flush mode equivalent to that of normal system operation.

3. The controller shall be equipped with a conductivity monitor. A percent rejection reading shall be calculated by the controller and displayed on a digital light emitting diode display module. The controller shall have the capability of providing and alarm output for the following conditions:

a. High Feed Temperature with Indicator Lamp

b. Low Feed Pressure with Indicator Lamp Percent Rejection Below Setpoint with Indicator Lamp

c. Pretreatment in Regeneration (Standby Status Light)

d. These conditions shall also initiate a visual alarm or indicator on the controller module. Also, the controller shall have a 12 VDC general RO alarm output terminal.

4. The PLC shall report status of the water system to the HVAC Central Building Monitoring System. Wiring to the head end of the BMS shall be installed by the HVAC controls vendor. Coordinate with the controls vendor hardware required.

a. Furnish a bacNET card in the panel to transmit all information.

E. Electrical Potential

1. 460 VAC, 3 Phase

2. Provide separate 120 VAC for control

F. Basis of Design IonRight Units by Evoqua Water Technologies . Model SDIR 2612 X with lead lag flow sequence

2.8 STORAGE TANK

A. Description

1. Vertical cylindrical design Provide vertical, conical bottom, cylindrical tanks with a total capacity of 2000 gallons.

B. Tank complete with vent connection, bulkhead nozzles, manway, isolation valves and drain.

C. The tank shall be furnished with structural support, base and wall, to effect stable installation. Tank shall be supported by steel cage when capacity exceeds the rating of tank material alone

D. Vessel Rating:Non-ASME

E. Location Interior

F. Pressure Atmospheric

G. Temperature Ambient. 100ºF Maximum.

H. Content Water. Pure – 1 to 10 meg-ohm/cm2 resistivity

I. Flange ANSI B16.5 Class 150. or NPT Conical or blade gusset reinforcements.

J. Nozzles: same as vessel

K. Access Top inspection manway. Bolted and gasketed air tight.

L. Tanks and tank accessories will be shipped loose for field installation.

M. Operating Arrangement Provide all nozzles. Provide spray ball on return line, pressure / vacuum relief device for tank protection, level switch, and vent filters on each tank. Each tank shall be fully drainable while the other tank is in use

N. Material of construction Polyethylene or Polypropylene

O. Controls and Instrumentation Auxiliary Equipment

1. Level switches
   a. High-high tank overflow
   b. High Level - shutdown RO
   c. Low level - fill tank, alarm
   d. Low low level – shut down distribution pumps, alarm
2. Level Transmitter – in lieu of switches level transmitter can be used to control pumps and RO's and also transmit level information to the main PLC. Instruments may be capacitance or vibronic detectors with transmittors.

P. Backpressure Valve At the return of each polishing loop, back pressure regulating valve shall be "close mounted" to the storage tank(s).

1. Valve Type: Spring Loaded
2. Relief Setting: 15-50 psi adjustable above working pressure

Q. Instruments: 0-100 psi pressure gauge to be mounted immediately up stream of valve.

R. Overflow – 4 inch full size with trap and seal piped to drain

S. Vent Filters RO storage tank shall be equipped with 0.2 micron Hydrophobic vent filters to assure that airborne particulate matter and/or bacteria are not drawn into the tank during tank

drawdown. Filter housing(s) shall be self-draining to reduce the potential hazard(s) of cartridge wet out which could result in tank implosions.

1. Cartridges and vent filter housings shall be shipped separately with appropriate mounting hardware and supports for "above tank" mounting

T. Valves Provide one (1) three-way valve (or (2) two-way valves) located on each RO tank. The divert valve shall be mounted directly on the side of each tank to avoid dead leg between the RO and the storage tanks. The purpose of this valve shall be to divert RO product to drain on system startup and allow for periodic flushing on a timer to drain during RO standby or full tank mode. The divert valve will divert to fill the RO storage tank when water is needed. The valve shall be of polypropylene or stainless steel construction and be electrically actuated.

U. Temperature Control of Storage:

1. Temperature in the storage tank shall be controlled by a temperature dump valve connected downstream of the distribution pumps on the pipe loop
2. A temperature element and transmitter shall be located in the storage tank to monitor temperature
3. The temperature valve shall open on temperature excursion in the storage tank and discharge water to thus allow for makeup water to the storage tank until a set point is reached
4. Set point dump: 100^{o}F valve discharge and valve returns to off at 95oF. Valve to be field adjustable to within 20 degrees of set point
5. Discharge of the rejected high temperature water - route dumped water to the drain via a 1” CPVC pipeline
6. Note: temperature control may alternatively be through the PLC and three way diversion valve noted in the above section 2.8 T.

2.9 DISTRIBUTION SKID #1: DISTRIBUTION SKID #1 LABORATORY ASTM TYPE II WATER TO GLASSWASHERS AND AUTOCLAVES

A. Package 1: distribution to the Glasswasher and Autoclave Circuit. Design such that sufficient inlet pressure is available at the lowest level Glasswasher

1. Return circuit to the RO water storage tank via backpressure valve

B. Skid and Pump Package

1. Laboratory RODI Water Distribution
2. To circulate the water that has been treated by RO/CDI units and stored, to thus pressurize the circuit RODI piping system, and return constant circulated flow to the storage tank.
3. Provide a duplex pump skid - mount UV filters, final filters, backpressure valve, Control Panel and all instrumentation on the skid
4. Skid Instrumentation
   a. Pressure indicators (type) 316SS, 2.5” face, liquid filled, -160 psig
   b. Pressure indicators (locations) before and after each unit process

c.	Flow meter (1)	Electronic, Signet or equal
d.	Conductivity analyzer (1)	Thornton M800 with (2) Probes
e.	Sample valves	before and after each unit process
f.	Control System	
g.	PLC Control Panel	
h.	From the Distribution skid package system	
i.	All required controls wiring from skids back to the main PLC's are to be included in this contract work.	

5. Pumps

a.	Quantity	Two (2
b.	Pump type	Multistage RODI water centrifugal pumps
c.	Design pressure	see drawing schedule sheet
d.	Manufacturer	Grundfos or Approved vendor standard
e.	Materials of construction	316L stainless steel (wetted surfaces)
f.	Horsepower	see schedule sheet
g.	Phases	3 phase
h.	Voltage	460 VAC
i.	Components	316 stainless steel

6. Ultraviolet Sterilizer

a.	Quantity	One
b.	Unit shall be rated for service and constructed of 316L stainless steel. Include intensity monitor and stainless steel elbows. Units hall be supplied with temperature alarm and intensity monitor.	
c.	Similar to Aquafine Optima HX02CDS 254 nM UV destruct	
d.	Two lamps with two stainless steel light traps	
e.	Basis of Design:	Full Model Number: Aquafine HX-02CDSD1DCXXSPFS – S132ESSX

7. 0.2 Micron Absolute Filters

a.	Quantity	two piped in parallel
b.	Isolation Valves:	inlet and outlet for each filter
c.	Housing type	316L stainless steel
d.	Connections	inlet/outlet Flanged
e.	Pressure gauges:	inlet and outlet with diaphragm isolation
f.	Vent/Drain valves	One each per housing
g.	Part Number :	FZHGAF0630 Evoqua with FCWNO30S2 filter

2.10 DISTRIBUTION SKID #2: VIVARIUM ASTM TYPE II DISTRIBUTION SKID

A. Package 2: distribution to the Vivarium wash facility Circuit. Design such that 45 psig is available at the cagewashers

1. Return circuit to the RO water storage tank via backpressure valve

B. Skid and Pump Package

1. Laboratory RODI Water Distribution
2. To circulate the water that has been treated by RO/CDI units and stored, to thus pressurize the circuit RODI piping system, and return constant circulated flow to the storage tank.
3. Provide a duplex pump skid - mount UV filters, final filters, backpressure valve, Control Panel and all instrumentation on the skid
4. Skid Instrumentation

a.	Pressure indicators (type)	316SS, 2.5” face, liquid filled, -160 psig
b.	Pressure indicators (locations)	before and after each unit process
c.	Flow meter (1)	Electronic, Signet or equal
d.	Conductivity analyzer (1)	Thornton M800 with (2) Probes
e.	Sample valves	before and after each unit process
f.	Control System	
g.	PLC Control Panel	
h.	From the Distribution skid package system	
i.	All required controls wiring from skids back to the main PLC’s are to be included in this contract work.	

5. Pumps

a.	Quantity	Two (2
b.	Pump type	Multistage RODI water centrifugal pumps
c.	Design pressure	see drawing schedule sheet
d.	Manufacturer	Grundfos or Approved vendor standard
e.	Materials of construction	316L stainless steel (wetted surfaces)
f.	Horsepower	see schedule sheet
g.	Phases	3 phase
h.	Voltage	460 VAC
i.	Components	316 stainless steel

6. 0.2 Micron Absolute Filters

a.	Quantity	two piped in parallel
b.	Housing type	316L stainless steel

c.	Connections	inlet/outlet Flanged
d.	Pressure gauges:	inlet and outlet
e.	Vent/Drain valves	One each per housing
f.	Part Number :	FZHGAF0630 Evoqua with FCWNO30S2 filter

2.11 VIVARIUM MAKE-UP WATER TO BOTTLE FILL STATION EQUIPMENT

A. General

1. The PURELAB Prima 30
2. 30 liters per hour of water for bottle fill station
3. Connect outlet to bottle fill station.

B. Package Equipment: boost pump, pretreatment module, sanitization port, analytical water quality sensors, docking storage tank, integral pump, and dispensing tap.

C. Electrical: Permanent electrical service, within 3 ft. of Option unit: 110V, 60 Hz., 1 Ph. i.e. Duplex electrical outlet

D. Feedwater: ½" valved permanent soft cold water supply of potable water with threaded connection within 5 feet of equipment. Minimum CWF of 30 psi dynamic pressure. Furnish backflow preventer on feedwater to the unit.

E. Drain: Drain capable of handling 2 gpm. Drain should be located below the placement of the equipment (no further than 8 feet from equipment).

F. Mounting: Wall capable of holding 150 lbs. This should be either a concrete brick wall or a ¾" (24" X 24") backboard mounted into the studs of the wall to support Evoqua equipment (if system is to be wall mounted on Docking Vessel)

2.12 ADDITIONAL REQUIREMENTS FOR PURE WATER SYSTEMS

A. Warranty

1. System manufacturer shall warrant all equipment against defects in materials and workmanship, including part and labor, for a period of 12 months from date of startup or 18 months from delivery, whichever occurs first, for all equipment above.

B. Field Services

1. System manufacturer shall provide a trained factory field service engineer or technician, as required, for installation supervision, media loading, system startup, loop balancing for each floor, equipment and all distribution loop piping cleaning and sanitization, and 2 days of operator training. Water samples shall be taken to assure water quality is met one week after system sanitization.

C. Supplies and Services for Operation

1. System manufacturer shall provide and include in equipment pricing, sufficient supplies and services, including consumables (including, but not limited to cartridge filters, salt, and service deionization exchanges), for the first four months of operation, or until the system is accepted by owner.

PART 3 - EXECUTION

3.1 RODI WATER SYSTEM

A. RODI water piping system shall be installed as a continuous recirculation type loop from pure water equipment through the distribution network back to the pure water storage tank. Piping drops at each point of use shall be as indicated on drawings. Piping from point of use connection to Owner furnished equipment shall be piped as directed by Owner. After final use points have been installed, clean and sanitize system as specified in specification section 226701 ‘Purified Water Piping - Thermoplastics”.

B. Pipe running horizontal whether above the ceiling or below shall be supported in a continuous V angle iron support channel and hung at intervals not to exceed 5'- 0" with extended V-shape hangers. All piping shall slope at 1/8" per ft. toward use points. Pipe hangers shall not touch piping.

3.2 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Where installing piping adjacent to equipment, allow space for service and maintenance of equipment.

C. Connect ASTM type I or type II purified-water piping to equipment and service outlets with compatible pure piping style unions or flanges.

3.3 IDENTIFICATION

A. Comply with requirements for identification specified in Section 220553 "Identification for Plumbing Piping and Equipment."

3.4 SOURCE QUALITY CONTROL

A. Perform factory acceptance tests to guarantee that the manufacture, functionality, and performance of the system is in accordance with approved submittal documentation package.

B. Perform factory Fabrication QC and provide the following:

1. Unit identification including unit type, drawing number, serial number, etc.

2. Drawing and diagram verification with record of as-built drawing numbers of equipment drawings, Drawings and circuit diagrams.
3. Equipment verification to certify the critical dimensions of the unit and recorded serial numbers of critical components, such as control valve, pumps safety valves, etc.
4. Control system hardware acceptance tests verifying the correct hardware has been installed, system initialized correctly and inputs and outputs (I/O) of the system are functioning correctly.
5. Process instrument calibration reports of temperature, pressure, control system, recorders, gauges and displays.
6. Inspection reports of all internal pressure vessel and piping welds and primary welds.
7. Hydrostatic test reports of pressure vessels.
8. Test equipment calibration to certify the conductivity meter reference instrument and resistor systems.

C. Adjust flow control valves, level sensors and pressure switches.

3.5 FIELD QUALITY CONTROL

A. Test new piping, and parts of existing piping that have been altered, extended, or repaired, for leaks and defects.

1. Schedule tests and their inspections by authorities having jurisdiction Owner, with at least 24 hours' advance notice.
2. Do not cover piping or put into service before inspection and approval.
3. Test completed piping according to authorities having jurisdiction Owner. If authorities having jurisdiction do Owner does not have published procedures, perform tests as follows:

    a. Hydrostatic Tests: Test piping at pressure not less than 1-1/2 times the maximum system operating pressure, but not less than 100 psig.

        1) Exception: Do not subject glass piping to pressure above manufacturer's pressure rating for size.

4. Replace leaking joints with new materials and retest until no leaks exist.
5. Submit separate reports for each test.

B. RO/CDI units

1. Field Services: System manufacturer shall provide a trained factory field service engineer or technician, as required, for installation supervision, media loading, system startup, loop balancing, loop sanitization, and operator training.
2. Perform Operational QC and provide the following:

    a. Verification of proper connection of test utilities and the tuning of valves Alarm testing report of all alarms on the unit.

    b. Test report of safety interlocks.

3. Perform Performance QC and provide the following:

a. Test run reports indicating capacity and utility consumption rates. Utility connections shall be similar to those at the project site.

4. Provide test report of unit purification capability. Report percent rejection of TDS and permeate yield for RO and CEDI units.

3.6 CLEANING

A. Use procedures prescribed by authorities having jurisdiction Owner and Pure Water Equipment Manufacturer or, if not prescribed, use procedures described below:

1. Before using, purge new equipment piping and parts of existing equipment piping that have been altered, extended, or repaired.
2. Clean pure water equipment piping by flushing with clean product water.
3. Clean and fully sanitize all pure water equipment components per manufacturers standard prior to charging the main piping system

END OF SECTION

SECTION 230500 - COMMON WORK RESULTS FOR HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. Certain requirements common to all the mechanical and electrical trades (Fire Suppression, Plumbing, HVAC, Electrical, and Tele/Data) are specified in Division 20. To avoid repetition, they are not repeated in each relevant Section. These requirements are applicable to the work of this Division, and are hereby incorporated by reference.

1.2 SUMMARY

A. This Section includes the following:

1. Piping materials and installation instructions common to most piping systems.
2. Transition fittings.
3. Dielectric fittings.
4. Mechanical sleeve seals.
5. Sleeves.
6. Escutcheons.
7. Grout.
8. Equipment installation requirements common to equipment sections.
9. Painting and finishing.
10. Concrete bases.
11. Supports and anchorages.
12. Containment Room Sealing Requirements.
13. Rated fire penetration sealants.
14. Material and workmanship.
15. Access panels.

1.3 REFERENCES

A. Publications listed below (including amendments, addenda, revisions, supplements, and errata) form part of this specification to the extent referenced. Publications are referenced in the text by the basic designations only.

1. American Iron and Steel Institute (ASI)
2. National Fire Protection Association (NFPA)

    a. NFPA 70 National Electric Code

3. American Society for Testing and Materials (ASTM)

    a. ASTM A36 Standard Specification for Carbon Structural Steel

b.	ASTM A53	Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
c.	ASTM A109	Standard Specification for Steel, Strip, Carbon (0.25 Maximum Percent), Cold-Rolled
d.	ASTM A123	Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
e.	ASTM A240	Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications
f.	ASTM A500	Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes
g.	ASTM A501	Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing
h.	ASTM A633	Standard Specification for Normalized High-Strength Low-Alloy Structural Steel Plates
i.	ASTM A635	Standard Specification for Steel, Sheet and Strip, Heavy-Thickness Coils, Carbon, Commercial Steel, Drawing Steel, Structural, High-Strength Low-Alloy, and High-Strength Low-Alloy with Improved Formability, Hot-Rolled
j.	ASTM A653	Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
k.	ASTM A682	Standard Specification for Steel, Strip, High-Carbon, Cold-Rolled
l.	ASTM A924	Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process
m.	ASTM A1011	Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability
n.	ASTM A1018	Standard Specification for Steel, Sheet and Strip, Heavy Thickness Coils, Hot Rolled, Carbon, Structural, High-Strength Low-Alloy, Columbium or Vanadium, and High-Strength Low-Alloy with Improved Formability
o.	ASTM B117	Standard Practice for Operating Salt Spray (Fog) Apparatus
p.	ASTM B633	Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel
q.	ASTM C920	Standard Specification for Elastomeric Joint Sealants
r.	ASTM C1193	Standard Guide for Use of Joint Sealants
s.	ASTM D522	Standard Test Methods for Mandrel Bend Test of Attached Organic Coatings
t.	ASTM D523	Standard Test Method for Specular Gloss
u.	ASTM D610	Standard Test Method for Evaluating Degree of Rusting on Painted Steel Surfaces.
v.	ASTM D2247	Standard Practice for Testing Water Resistance of Coatings in 100 per Relative Humidity
w.	ASTM D3451	Standard Guide for Testing Coating Powders and Powder Coatings
x.	ASTM E84	Standard Test Method for Surface Burning Characteristics of Building Materials
y.	ASTM F1136	Standard Specification for Chromium/Zinc Corrosion Protective Coatings for Fasteners

4. American Wood-Preservers' Association (AWPA)

a. AWPA C2 Lumber, Timber, Bridge Ties and Mine Ties - Preservative Treatment by Pressure Processes
b. AWPA C9 Plywood - Preservative Treatment by Pressure Process
c. AWPA C20 Structural Lumber - Fire-Retardant Treatment by Pressure Processes
d. AWPA C22 Lumber and Plywood for Permanent Wood Foundations- Preservative Treatment by Pressure Processes
e. AWPA C27 Plywood-Fire-Retardant Treatment by Pressure Processes

5. American Welding Society (AWS)
6. Code of Federal Regulations (CFR)
7. Metal Framing Manufactures Association (MFMA)

a. MFMA Metal Framing Standards Publication

8. Underwriters Laboratories (UL)

a. UL 723 Test for Surface Burning Characteristics of Building Materials

1.4 DEFINITIONS

A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.

B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.

C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.

D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and chases.

E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

F. The following are industry abbreviations for plastic materials:

1. CPVC: Chlorinated polyvinyl chloride plastic.
2. PE: Polyethylene plastic.
3. PVC: Polyvinyl chloride plastic.

G. The following are industry abbreviations for rubber materials:

1. EPDM: Ethylene-propylene-diene terpolymer rubber.
2. NBR: Acrylonitrile-butadiene rubber.

1.5 SUBMITTALS

A. Product Data: For the following:

1. Transition fittings.
2. Dielectric fittings.
3. Mechanical sleeve seals.
4. Escutcheons.
5. Containment room sealants.
6. Rated fire penetration sealants.

B. Welding certificates.

1.6 CLOSE OUT

A. Submit one electronic copy of all approved submittals as a single bookmarked pdf documents. Include a table of contents, bookmark/tab manual based on specification chapters or sections.

B. Submit one electronic copy of the Operations and Maintenance manual as a single bookmarked pdf document. Include a table of contents, bookmark/tab manual based on specification chapters or sections

1.7 QUALITY ASSURANCE

A. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."

B. Steel Pipe Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."

1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

C. Align components. No strain shall be placed on weld during welding. No part of pipe shall be offset more than 20 percent of thickness. Set flanges and branches properly.

D. Weld only by approved acetylene or electric welding processes. All welders shall hold certificate from approved insurance company.

E. Conduct test to demonstrate suitability of procedures to be used in making welds that conform to specified requirements.

F. Welder Qualification:

1. Test welders to demonstrate ability to make acceptable welds. Tests conducted for qualification of welder for work under one Division or Section shall not qualify welder for work under another Division or Section.
2. Tests shall be as prescribed for welder qualification in Section IX of the ASME code.

3. Records of tests shall be as follows: Each welder shall be assigned an identifying number, letter or symbol. Identifying mark shall be stamped adjacent to welds made by this welder. Identification shall be at top of horizontal piping and at front of vertical piping.
4. Maintain record of welders employed, showing dates and results of tests and identifying mark assigned to each welder. Certify records and make them accessible to Owner's project representative and/or project manager. Before completion of project, one copy of records
5. No qualification shall be older than three years when welder commences work on this project. If welder has not welded in required welding process for a period of six months, he shall be re-certified.

G. Welding Tests

1. As designated by Architect, remove welds for destructive testing or for testing by non-destructive means. Tests shall be as determined by Architect.
2. If, in Architect's opinion, welds so tested do not meet requirements of Sections VIII and IX of ASME, then the contractor shall pay for the costs of the tests. Remove welds welded by that welder, at no cost to the Owner. Rewelding shall be performed by qualified welder other than welder whose welds did not pass test. Welders whose welds were defective shall not be employed on site for remainder of project.
3. Welding of stanchions, brackets, anchors and other welding not performed on pipe joints shall be in accordance with requirements of AWS specifications and requirements.

H. Electrical Characteristics for HVAC Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

I. Formation of Condensation: Should condensation occur on outside of insulated ducts, pipes, HVAC equipment, flexible ducts, etc. during the construction period, contractor shall notify the Owner and the Architect of the occurrences and the Project Team (Design Team, Construction Team and Owner) shall collaboratively work to determine the cause and remedy.

1. If such an event were to occur, construction on the affected systems shall cease until the causes are determined and the remedy effected.
2. Substantial completion will not be approved by the Owner and Architect until such an event is brought to satisfactory resolution.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.

B. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

C. Protect and cover equipment (VAV boxes, coils, fans, pumps, control valves, etc) and ductwork components with plastic when stored on site to prevent entrance of dirt, debris and moisture.

1.9 COORDINATION

A. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for HVAC installations.

B. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.

C. Coordinate requirements for access panels and doors for HVAC items requiring access that are concealed behind finished surfaces. Access panels and doors are specified in Division 08.

1.10 SHORT CIRCUIT RATING OF CONTROLLERS AND CONTROL PANELS

A. For all control panels and controllers whether provided by Section 230900, Section 230995 or as part of an OEM controlled piece of equipment comply with UL 508A.

B. At general bid phase of project, the, Short Circuit Current Rating:

1. All three phase 480 volt System Control Panels identified on the drawings shall accommodate minimum available fault current of 35,000 amperes RMS.

2. For all single phase 120 volt control panels identified on the drawings shall accommodate minimum available fault current of 10,000 amperes RMS.

3. For other ratings see Plumbing Drawings schedule sheet where SCCR ratings are specified per panel

C. At final installation phase of project, the Short Circuit Current Rating for each control panel shall be based on the electrical contractor final available current short circuit analysis for the building electrical system. Submittals shall include this information.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:

1. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

2.2 PIPE, TUBE, AND FITTINGS

A. Refer to individual Division 23 for pipe, tube, and fitting materials and joining methods.

B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

2.3 DIELECTRIC FITTINGS

A. Description: Combination fitting of copper alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.

B. Insulating Material: Suitable for system fluid, pressure, and temperature.

C. Dielectric Unions: Factory-fabricated, union assembly, for 250-psig minimum working pressure at 180 deg F.

1. Manufacturers:

a. Capitol Manufacturing Co.
b. Central Plastics Company.
c. Eclipse, Inc.
d. Epco Sales, Inc.
e. Hart Industries, International, Inc.
f. Watts Industries, Inc.; Water Products Div.
g. Zurn Industries, Inc.; Wilkins Div.

D. Dielectric Flanges: Factory-fabricated, companion-flange assembly, for 150- or 300-psig minimum working pressure as required to suit system pressures.

1. Manufacturers:

a. Capitol Manufacturing Co.
b. Central Plastics Company.
c. Epco Sales, Inc.
d. Watts Industries, Inc.; Water Products Div.

E. Dielectric-Flange Kits: Companion-flange assembly for field assembly. Include flanges, full-face- or ring-type neoprene or phenolic gasket, phenolic or polyethylene bolt sleeves, phenolic washers, and steel backing washers.

1. Manufacturers:

a. Advance Products & Systems, Inc.
b. Calpico, Inc.
c. Central Plastics Company.
d. Pipeline Seal and Insulator, Inc.
e. Thunderline

2. Separate companion flanges and steel bolts and nuts shall have 150- or 300-psig minimum working pressure where required to suit system pressures.

F. Dielectric Couplings: Galvanized-steel coupling with inert and noncorrosive, thermoplastic lining; threaded ends; and 300-psig minimum working pressure at 225 deg F.

1. Available Manufacturers:

a. Calpico, Inc.
b. Lochinvar Corp.

G. Dielectric Nipples: Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, threaded, or grooved ends; and 300-psig minimum working pressure at 225 deg F.

1. Manufacturers:

a. Perfection Corp.
b. Precision Plumbing Products, Inc.
c. Sioux Chief Manufacturing Co., Inc.
d. Victaulic Co. of America.

2.4 MECHANICAL SLEEVE SEALS

A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.

1. Available Manufacturers:

a. Advance Products & Systems, Inc.
b. Calpico, Inc.
c. Metraflex Co.
d. Pipeline Seal and Insulator, Inc.
e. Thunderline

2. Sealing Elements: EPDM interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
3. Pressure Plates: Plastic. Include two for each sealing element.
4. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating or Stainless steel of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.5 SLEEVES

A. Galvanized-Steel Sheet: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.

B. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.

C. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.

1. Underdeck Clamp: Clamping ring with set screws.

2.6 ESCUTCHEONS

A. Description: Manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening.

B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with polished chrome-plated finish.

C. One-Piece, Cast-Brass Type: With set screw.

1. Finish: Polished chrome-plated

D. Split-Casting, Cast-Brass Type: With concealed hinge and set screw.

1. Finish: Polished chrome-plated

E. One-Piece, Stamped-Steel Type: With set screw and chrome-plated finish.

F. Split-Plate, Stamped-Steel Type: With concealed hinge, set screw, and chrome-plated finish.

G. One-Piece, Floor-Plate Type: Cast-iron floor plate.

H. Split-Casting, Floor-Plate Type: Cast brass with concealed hinge and set screw.

2.7 GROUT

A. Description: ASTM C 1107, Grade B, non-shrink and nonmetallic, dry hydraulic-cement grout.

1. Characteristics: Post-hardening, volume-adjusting, non-staining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
2. Design Mix: 5000-psi, 28-day compressive strength.
3. Packaging: Premixed and factory packaged.

2.8 RATED FIRE PENETRATION SEALANTS

A. Submit 3M, Hilti or Firespec sealants for approval prior to use.

B. Sealants, caulking and devices shall be rated the same as the wall rating they are used in.

2.9 ACCESS PANELS

A. Description: Interior construction access panels.

1. Manufacturers:

a. Milcor
b. Knapp
c. Nystorm
d. Inland Steel

B. Coordinate selection with other Divisions supplying similar access panels.

C. Access panels shall have same fire rating classification as surface penetrated.

PART 3 - EXECUTION

3.1 PIPING SYSTEMS - COMMON REQUIREMENTS

A. Install piping according to the following requirements and Division 23 Sections specifying piping systems.

B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

C. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.

D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

F. Install piping to permit valve servicing.

G. Install piping at indicated slopes as specified in other Division 23 sections.

H. Install piping free of sags and bends.

I. Install fittings for changes in direction and branch connections.

J. Install piping to allow application of insulation.

K. Select system components with pressure rating equal to or greater than system operating pressure.

3.2 PENETRATIONS AND SLEEVES

A. General

1. Lay out penetration and sleeve openings in advance, to permit provision in work. Coordinate work carefully with architectural and structural work. Set sleeves and conduit in forms before concrete is poured. Provide remedial work where sleeves and conduits are omitted or improperly placed. Remedial work includes core drilling (see requirements below) for penetrations if walls are poured, or otherwise constructed, without required sleeves. Provide core drilling (see requirements below) of existing construction. Do not penetrate structural members without Structural Engineer’s/Architect's written approval.
2. Provide sleeves and packing materials at penetrations of foundations, walls, basement floors, slabs (except on-grade), partitions and floors. Sleeve installation shall meet NFPA-101 requirements, UL rated assemblies requirements, and materials requirements of these specifications. Submit a list of the UL listed details that the Contractor intends on using on this project in all rated assemblies.

3. Sleeves that penetrate outside walls, basement slabs, footings and beams shall be waterproof. Sleeves that penetrate floors shall be fireproof and waterproof.
4. Sleeves for insulated pipe and duct in non-fire rated construction shall accommodate continuous insulation without compression. Sleeves and/or penetrations in fire rated construction that do not require fire dampers shall be packed with fire rated material that shall maintain the fire rating of the wall. Seal ends of penetrations to provide continuous vapor barrier where insulation is interrupted. Where fire dampers are required, install sleeve and damper assembly in accordance with damper listing.
5. Where pipes passing through openings are exposed in finished rooms, finishes of filling materials shall match and be flush with adjoining floor, ceiling, and wall finishes.
6. Identify unused sleeves and slots for future installation. Fill slots, sleeves and other openings in floors or walls if not used. Fill spaces in openings after installation of pipe, duct, conduit or cable. Fill for floor penetrations shall prevent passage of water, smoke, fire, and fumes. Fill shall be fire resistant in fire floors and walls, and shall prevent passage of air, smoke and fumes.
7. Do not support piping risers or conduit on sleeves.
8. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Refer to Division 7 for materials.
9. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements. Verify final equipment locations for roughing-in.
10. Installation Testing, Listings and Approvals

    a. Installation of sleeves, fill and packing shall meet material manufacturer's recommendations exactly, particularly as regards safety, ventilation, removal of foreign materials and other details of installation. Dam openings as recommended. Remove flammable materials used for damming and forming seals in fire-rated construction.
    b. Sleeve penetration methods shall be water- and gas-tight and shall meet requirements of ASTM E-119 Standard Methods of Fire Tests of Building Construction and Materials.
    c. Fire-stop penetration seal methods and materials shall be FM-approved and UL-listed as applicable. They shall have the same rating as the structure penetrated. Submit manufacturer's detail sheet indicating assembly rating.

        1) Inspect foamed sealants to ensure manufacturer's optimum cell structure and color ranges.

B. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs. Sleeves are not required for slab-on-grade floors unless specified otherwise. Sleeves are required for core-drilled holes on any floor.

1. Cut sleeves to length for mounting flush with both surfaces.

    a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.

2. Install sleeves in new walls and slabs as new walls and slabs are constructed.
3. Install sleeves that are large enough to provide 1/4 inch annular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials:

    a. Steel Pipe Sleeves: For pipes smaller than NPS 6.

b. Steel Sheet Sleeves: For pipes NPS 6 and larger, penetrating gypsum-board partitions.
c. Stack Sleeve Fittings: For pipes penetrating floors with membrane waterproofing. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level. Refer to Division 07 for flashing.

1) Seal space outside of sleeve fittings with grout.

4. Except for underground wall penetrations, seal annular space between sleeve and pipe or pipe insulation, using joint sealants appropriate for size, depth, and location of joint. Refer to Division 07 for materials and installation.

C. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1 inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.

1. Install steel pipe for sleeves smaller than 6 inches in diameter.
2. Install cast-iron "wall pipes" for sleeves 6 inches and larger in diameter.
3. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

D. Underground, Exterior-Wall Pipe Penetrations: Install cast-iron "wall pipes" for sleeves. Seal pipe penetrations using mechanical sleeve seals. Select sleeve size to allow for 1 inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.

1. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

E. Duct Sleeves and Prepared Openings

1. Provide galvanized-steel sheet duct sleeves for round ducts 15 inches and smaller. Provide prepared, framed openings for round ducts larger than 15 inches and for square, rectangular and flat oval ducts, except as specified otherwise. Sleeves shall meet SMACNA requirements.
2. Provide galvanized-steel sheet duct sleeves for ducts through 1-, 2- or 3-hour fire-rated construction and smoke partitions, regardless of size and shape of ducts. Sleeves shall maintain fire rating of construction penetrated. Sleeve and seal materials, construction and clearances shall meet requirements of SMACNA Fire Damper and Heat Stop Guide for Air Handling Systems.
3. Prepared openings shall be framed to provide 1 inch clearance between framing and duct or duct insulation.
4. Provide 4 inches wide 20 gauge galvanized sheet metal collars at sleeves and prepared openings, sized to cover entire duct penetration including sleeve and seal, and to accommodate duct and insulation as necessary. Edges shall have milled lips ground smooth. Paint to match finish of duct or as directed by Architect.

5. All duct penetrations through concrete floors in mechanical rooms shall be provided with 2 inches high water stopped curbs surrounding the openings. This applies to mechanical rooms located above the lowest floor level.

F. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Refer to Division 07 for materials.

G. Verify final equipment locations for roughing-in.

H. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

3.3 CORE DRILLING

A. Core drilling shall be avoided in new construction. Set sleeves prior to installation of structure for passage of pipes, conduit and ducts. Where core drilling is unavoidable (e.g. when individual sleeves are not installed or incorrectly located) or required by renovation projects, locate required openings prior to coring and submit locations for review.

B. Coordinate openings with other Divisions.

C. Do not disturb existing systems. Protect areas from damage.

D. Thoroughly investigate existing conditions in vicinity of required opening prior to coring.

3.4 PIPING JOINT CONSTRUCTION

A. Join pipe and fittings according to the following requirements and Division 23 Sections specifying piping systems.

B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.

E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.

F. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

G. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.

H. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

3.5 PIPING CONNECTIONS

A. Make connections according to the following, unless otherwise indicated:

1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.
2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.
3. Dry Piping Systems: Install dielectric unions and flanges to connect piping materials of dissimilar metals.
4. Wet Piping Systems: Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.

3.6 EXPANSION PROVISIONS

A. Installation of piping must allow for expansion using offsets, loops, swing joints, expansion joints, etc. as necessary to prevent undue strain. Takeoffs from mains to runouts shall not have less than three-elbow swing.

B. Mains and risers with loops or offsets shall be securely anchored to structure so as to impart expansion towards loops or offsets. Anchors shall be constructed of heavy forged wrought iron, secured to pipe and to structure. Provide vibration isolation as required.

C. Provide pipe alignment guides as required to guide expanding pipe to move freely from anchor points toward expansion joints, offsets, etc.

3.7 ANCHORS AND INSERTS

A. Inserts shall be iron or steel of type to receive machine bolt head or nut after installation. Inserts shall permit adjustment of bolt in one horizontal direction and shall develop strength of bolt when installed in properly cured concrete.

B. Provide anchors for attachment of equipment supports and hangers.

3.8 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

A. Install equipment to allow maximum possible headroom unless specific mounting heights are not indicated.

B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.

C. Install equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.

D. Install equipment to allow right of way for piping installed at required slope.

E. Avoid interference with structure and with work of other trades, preserving adequate headroom and clearing doors and passageways, to satisfaction of Architect and in accordance with code requirements.

F. Distribute equipment loads on building structural members provided for equipment support. Roof-mounted equipment shall be installed and supported on structural steel.

G. Provide suspended platforms, strap hangers, brackets, shelves, stands or legs for floor, wall or ceiling mounting of equipment.

H. Provide steel supports and hardware for proper installation of hangers, anchors and guides.

I. Provide cuts, weights, and other pertinent data required for proper coordination of equipment support provisions and installation.

J. Structural steel and hardware shall conform to Standard Specifications of ASTM; use of steel and hardware shall conform to requirements of Section Five of Code of Practice of American Institute of Steel Construction.

K. Verify site conditions and dimensions of equipment to ensure access for proper installation of equipment without disassembly that will void warrantee. Report in writing to Architect, prior to purchase or shipment of equipment involved, on conditions that may prevent proper installation.

L. For all equipment installed external to the building; whether on roofs, supports, grade, etc., the installation shall comply with wind loading and impact requirements of the applicable codes for this project site. All equipment provided for this project shall be certified by the manufacturer that the equipment meets the applicable wind, and hurricane impact requirements as set forth by the Authority Having Jurisdiction.

M. .

3.9 CONCRETE BASES

A. Concrete Bases: Anchor equipment to concrete base according to equipment manufacturer's written instructions and according to codes at Project.

1. Construct concrete bases of dimensions indicated, but not less than 4 inches larger in both directions than supported unit.
2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18 inch centers around the full perimeter of the base.
3. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.
4. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
5. Install anchor bolts to elevations required for proper attachment to supported equipment.

6. Install anchor bolts according to anchor-bolt manufacturer's written instructions.
7. Use 3000 psi, 28-day compressive-strength concrete and reinforcement as specified in Division 03.

3.10 ERECTION OF METAL SUPPORTS AND ANCHORAGES

A. Refer to Division 05 for structural steel.

B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor HVAC materials and equipment.

C. Field Welding: Comply with AWS D1.1.

3.11 ERECTION OF WOOD SUPPORTS AND ANCHORAGES

A. Cut, fit, and place wood grounds, nailers, blocking, and anchorages to support, and anchor HVAC materials and equipment.

B. Select fastener sizes that will not penetrate members if opposite side will be exposed to view or will receive finish materials. Tighten connections between members. Install fasteners without splitting wood members.

C. Attach to substrates as required to support applied loads.

3.12 GROUTING

A. Mix and install grout for HVAC equipment base bearing surfaces, pump and other equipment base plates, and anchors.

B. Clean surfaces that will come into contact with grout.

C. Provide forms as required for placement of grout.

D. Avoid air entrapment during placement of grout.

E. Place grout, completely filling equipment bases.

F. Place grout on concrete bases and provide smooth bearing surface for equipment.

G. Place grout around anchors.

H. Cure placed grout.

3.13 ACCESS AND ACCESS PANELS

A. Access panels are generally not shown on the drawings, but shall be provided.

B. Provide proper access to materials and equipment that require inspection, replacement, repair or service, and coordinate their delivery with the installing Trade. If proper access cannot be

provided, confer with Architect as to best method of approach for minimizing effect of reduced access that may result.

C. Coordinate and prepare a location, size, and function schedule of access panels required to fully service equipment and deliver to a representative of the installing Trade. Furnish and install distinctively colored buttons (color as selected by Architect) in finished ceiling to identify access panels

D. Furnish access panels for installation under other Sections where fire dampers, smoke dampers, volume dampers, smoke detectors, controls, shut-off valves, control valves, check valves, or other items installed under this Section require access and are concealed in floor, wall, furred space or above ceiling.

E. Ceilings consisting of lay-in or removable splined tiles do not require access panels and dampers, splitters, or test hole openings above ceiling shall have location marked with thumbtack on finished ceiling panel. Location shall be noted on record drawings.

F. Access panels shall be at least large enough to remove the component requiring access. Where individual components (e.g. control valves) requiring access are within 8 inches of the finished surface, panels shall be a minimum of 12 inch by 12 inch. Where component is more than 8 inches from surface and at equipment requiring service (e.g. VAV boxes, fan boxes, fire dampers), access panels shall be a minimum of 24 inch x 24 inch.

3.14 MATERIALS AND WORKMANSHIP

A. Work shall be neat and rectilinear. Ductwork, piping and conduit shall run concealed except in mechanical rooms and areas where no hung ceiling exists. Install material and equipment in accordance with manufacturers written instructions. Installation shall operate safely and without leakage, undue wear, noise, vibration, corrosion or water hammer. Work shall be properly and effectively protected, and pipe and duct openings shall be temporarily closed to prevent obstruction and damage before completion.

B. Except as specified otherwise, material and equipment shall be new. Provide supplies, appliances and connections necessary for complete and operational installation. Provide components required or recommended by OSHA and applicable NFPA documents.

C. Owner will not be responsible for material and equipment before testing, commissioning, and acceptance.

END OF SECTION

SECTION 230513 - COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. Certain requirements common to all the mechanical and electrical trades (Fire Suppression, Plumbing, HVAC, Electrical, and Tele/Data) are specified in Division 20. To avoid repetition, they are not repeated in each relevant Section. These requirements are applicable to the work of this Division, and are hereby incorporated by reference.

1.2 SUMMARY

A. Section includes general requirements for single-phase and polyphase, general-purpose, horizontal, small and medium, squirrel-cage induction motors for use on ac power systems up to 600 V and installed at equipment manufacturer's factory or shipped separately by equipment manufacturer for field installation.

1.3 COORDINATION

A. Coordinate features of motors, installed units, and accessory devices to be compatible with the following:

1. Motor controllers.
2. Torque, speed, and horsepower requirements of the load.
3. Ratings and characteristics of supply circuit and required control sequence.
4. Ambient and environmental conditions of installation location.
5. Variable-speed drive controllers.

PART 2 - PRODUCTS

2.1 GENERAL MOTOR REQUIREMENTS

A. Comply with requirements in this Section except when stricter requirements are specified in HVAC equipment schedules or Sections.

B. Comply with NEMA MG 1 unless otherwise indicated.

C. Comply with IEEE 841 for severe-duty motors.

D. Motors under 1/2 HP shall be designed for 120V, 60 Hz, single phase, unless otherwise specified.

E. Motors 1/2 HP and over shall be voltages as indicated in schedules on drawings.

F. Individual pumps serving variable flow systems and VAV fans with a motor horsepower of 5 hp or larger shall be provided with variable speed drives that will result in pump or fan motor demand of no more than 30 percent of design wattage at 50 percent of design flow.

2.2 MOTOR CHARACTERISTICS

A. Duty: Continuous duty at ambient temperature of 40 deg C and at altitude of 3300 feet above sea level.

B. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.

2.3 POLYPHASE MOTORS

A. Description: NEMA MG 1, Design B, medium induction motor.

B. Efficiency: All motors shall be premium efficiency type as defined in NEMA MG 1 and shall have their efficiencies determined in accordance with IEEE Standard 112 Method B. The NEMA nominal efficiency shall be listed on the motor nameplate.

C. Minimum nominal efficiencies shall be as follows:

Premium Efficiency Motor Totally Enclosed Fan-Cooled (TEFC)				Premium Efficiency Motor Open Drip-Proof (ODP)			
Size HP	Speed (rpm)			Size HP	Speed (rpm)		
	1200	1800	3600		1200	1800	3600
	NEMA Nominal Efficiency				NEMA Nominal Efficiency		
1	82.5	85.5	78.5	1	82.5	85.5	80.0
1.5	87.5	86.5	85.5	1.5	86.5	86.5	85.5
2	88.5	86.5	86.5	2	87.5	86.5	86.5
3	89.5	89.5	88.5	3	89.5	89.5	86.5
5	89.5	89.5	89.5	5	89.5	89.5	89.5
7.5	91.7	91.7	91.0	7.5	91.7	91.0	89.5
10	91.7	91.7	91.7	10	91.7	91.7	90.2
15	92.4	92.4	91.7	15	92.4	93.0	91.0
20	92.4	93.0	92.4	20	92.4	93.0	92.4
25	93.0	93.6	93.0	25	93.0	93.6	93.0
30	93.6	93.6	93.0	30	93.6	94.1	93.0
40	94.1	94.1	93.6	40	94.1	94.1	93.6
50	94.1	94.5	94.1	50	94.1	94.5	93.6
60	94.5	95.0	94.1	60	95.0	95.0	94.1
75	95.0	95.4	94.5	75	95.0	95.0	94.5
100	95.4	95.4	95.0	100	95.0	95.4	94.5
125	95.4	95.4	95.4	125	95.4	95.4	95.0
150	95.8	95.8	95.4	150	95.8	95.8	95.4
200+	95.8	96.2	95.8	200+	95.4	95.8	95.4

D. Service Factor: 1.15.

E. Rotor: Random-wound, squirrel cage.

F. Bearings: Regreasable, shielded, antifriction ball bearings suitable for radial and thrust loading.

G. Temperature Rise: One class below insulation rating. Example: Class B temperature rise for Class F insulation.

H. Insulation: Class F or Class H as noted below.

I. Code Letter Designation:

1. Motors 15 HP and Larger: NEMA starting Code F or Code G.
2. Motors Smaller than 15 HP: Manufacturer's standard starting characteristic.

J. Enclosure Material: Cast iron for motor frame sizes 324T and larger; rolled steel for motor frame sizes smaller than 324T.

2.4 POLYPHASE MOTORS WITH ADDITIONAL REQUIREMENTS

A. Premium Efficiency Motors, not operating with VFD: Class B temperature rise; Class F insulation.

B. Motors Used with Reduced-Voltage: Match wiring connection requirements for controller with required motor leads. Provide terminals in motor terminal box, suited to control method.

C. Motors Used with Variable Frequency Controllers: Ratings, characteristics, and features coordinated with and approved by controller manufacturer. Motors shall be premium efficiency "inverter-duty" or "drive duty" motors, compatible with the drive to which it is connected. Use of the motor with a VFD shall not adversely affect the operation, useful life or warranty of the motor.

1. Windings: Copper magnet wire with moisture-resistant insulation varnish, designed and tested to resist transient spikes, high frequencies, and short time rise pulses produced by pulse-width modulated inverters.
2. Premium-Efficient Motors: Class F temperature rise; Class H insulation.
3. Motor windings shall be spike resistant to withstand 1,600 peak volts. Motors shall have shaft grounding system to protect bearings from induced voltage. Shaft grounding system shall have very low drag, less than 1/2 percent of motor HP, and shall operate for a minimum of three (3) years without periodic adjustments. All consumables of the shaft grounding system shall be replaceable without a shutdown of the motor or VFD. System shall be as manufactured by SGS (Albany, Oregon) or approved equal.
4. Motors used with VFD shall have a minimum three (3) year manufacturer warranty.

D. Thermal Protection (all polyphase motors): Comply with NEMA MG 1 requirements for thermally protected motors.

E. Severe-Duty Motors: Comply with IEEE 841, with 1.15 minimum service factor.

2.5 SINGLE-PHASE MOTORS

F. Except where specified as part of terminal equipment (i.e. ECM motors in fan coil units), motors larger than 1/20 hp shall be one of the following, to suit starting torque and requirements of specific motor application and shall be premium efficiency type:

1. Permanent-split capacitor.
2. Split phase.
3. Capacitor start, inductor run.
4. Capacitor start, capacitor run.

G. Multispeed Motors: Variable-torque, permanent-split-capacitor type.

H. Bearings: Prelubricated, antifriction ball bearings or sleeve bearings suitable for radial and thrust loading.

I. Motors 1/20 HP and Smaller: Shaded-pole type.

J. Thermal Protection: Internal protection to automatically open power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of motor insulation. Thermal-protection device shall automatically reset when motor temperature returns to normal range.

K. Electronically Commutated Motors (ECM): Motors shall be an electronic commutation (EC) motor specifically designed for HVAC applications. AC induction type motors are not acceptable. Motors shall be permanently lubricated with heavy-duty ball bearings to match the load, and prewired to the specific voltage and phase. Internal motor circuitry shall convert AC power supplied to the equipment to DC power to operate the motor. Motor shall be speed controllable down to 20 percent of full speed (5:1 turndown). Speed shall be controlled by either

a potentiometer dial mounted on the motor or by a 0-10 VDC control signal. Motor shall be a minimum of 85 percent efficient at all speeds.

2.6 STARTERS

L. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include:

1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
3. Rockwell Automation, Inc.; Allen-Bradley brand.
4. Siemens Energy & Automation, Inc.
5. Square D; a brand of Schneider Electric
6. Cutler-Hammer
7. Clark
8. Arrow Hart

M. Furnish starters for HVAC equipment, except those served by variable frequency drives. Provide control and other related wiring including interlocks. Power wiring (to panelboards, disconnect switches, starters and motors) will be provided under Division 26. Starters that are not integral to equipment will be installed and wired under Division 26, Electrical, and furnished under this Section.

N. Starters that require interlocks or remote control shall be magnetic with HAND-OFF-AUTOMATIC switch (fast-slow-off-auto for two speed motors) in cover. Provide magnetic starters with auxiliary contacts, buttons and switches. Refer to other Division 23 sections and control drawings for interlock requirements. Starters shall be by single manufacturer.

1. Each 3-phase, 60 Hz motor shall be provided with magnetic starter with hand-off-automatic switch.
2. Other motors shall be provided with a manual starter with ON-OFF switch.
3. Control relay for each starter shall be for operation on 120V, single phase. Provide transformer of sufficient capacity within starter case.
4. Provide inverse time limit overload and under voltage protection in each leg and with pilot lights.
5. Provide red and green On-Off pilot lights.
6. Provide nameplates with engraved white lettering to designate area and equipment served.
7. Starters for refrigeration machines shall be furnished by unit manufacturer.
8. Furnish for all single speed motors, 25 HP and above, 95 percent power factor correction capacitors. Capacitors shall be in NEMA enclosure of the same rating as the motor's starter.

2.7 DRIVES

O. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to:

1. Allis-Chalmers
2. Browning

3. Woods

P. Drives for belted motors shall be flame retardant V-belt drives with adjustable motor sheave. Drives shall be as short as practical and shall have number of belts necessary to transmit required horsepower without undue slip or strain.

Q. Sheaves shall be balanced statically and dynamically.

R. Hazardous exhaust drives and all drives for smoke control or pressurization fans shall be sized for 150 percent safety factor and shall be dual groove (2 belt) minimum.

3.0 EXECUTION (NOT USED)

END OF SECTION

SECTION 230516 - EXPANSION FITTINGS AND LOOPS FOR HVAC PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Flexible, ball-joint, packed expansion joints.
2. Slip-joint packed expansion joints.
3. Expansion-compensator packless expansion joints.
4. Flexible-hose packless expansion joints.
5. Metal-bellows packless expansion joints.
6. Rubber packless expansion joints.
7. Grooved-joint expansion joints.
8. Pipe loops and swing connections.
9. Alignment guides and anchors.

1.3 PERFORMANCE REQUIREMENTS

A. Compatibility: Products shall be suitable for piping service fluids, materials, working pressures, and temperatures.

B. Capability: Products to absorb 200 percent of maximum axial movement between anchors.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

1.5 INFORMATIONAL SUBMITTALS

A. Welding certificates.

B. Product Certificates: For each type of expansion joint, from manufacturer.