The Engineer of Record for Division 22 and 23 of the Specifications, including:

220010	GENERAL PLUMBING REQUIREMENTS
220015	COORDINATION
220500	COMMON WORK RESULTS FOR PLUMBING
220513	COMMON MOTOR REQUIREMENTS FOR PLUMBING EQUIPMENT
220515	BASIC PIPING MATERIALS AND METHODS
220519	METERS AND GAUGES FOR PLUMBING PIPING
220523	GENERAL DUTY VALVES FOR PLUMBING PIPING
220529	HANGERS AND SUPPORTS FOR PLUMBING PIPING
220533	HEAT TRACING FOR PLUMBING PIPING
220550	VIBRATION ISOLATION FOR PLUMBING PIPING AND EQUIPMENT
220553	IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT
220700	PLUMBING INSULATION
220800	COMMISSIONING PLUMBING SYSTEMS
221100	WATER DISTRIBUTION PIPING AND SPCECIALTIES
221111	MECHANICALLY JOINED PLUMBING PIPING SYSTEMS
221123	DOMESTIC WATER PUMPS
221300	SANITARY DRAINAGE AND VENT PIPING AND SPECIALTIES
221328	CONDENSATE PUMPS FOR HVAC EQUIPMENT
221329	SANITARY SEWERAGE PUMPS
221400	STORM DRAINAGE PIPING AND SPECIALTIES
221489	SUMP PUMPS
221500	GENERAL SERVICE COMPRESSED AIR SYSTEMS
223120	WATER FILTER SYSTEMS
223300	ELECTRIC DOMESTIC WATER HEATERS
223400	FUEL FIRED DOMESTIC WATER HEATERS
224000	PLUMBING FIXTURES
226100	GAS AND VACUUM SYSTEMS FOR HEALTH CARE FACILITIES
227000	NATURAL GAS SYSTEMS
227010	MECHANICALLY JOINED NATURAL GAS PIPING SYSTEMS
230010	GENERAL MECHANICAL REQUIREMENTS
230015	COORDINATION
230500	COMMON WORK RESULTS FOR HVAC
230510	BASIC PIPING MATERIALS AND METHODS
230513	COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT
230514	VARIABLE FREQUENCY DRIVES
230516	EXPANSION FITTINGS AND LOOPS FOR HVAC PIPING
230523	GENERAL DUTY VALVES FOR HVAC PIPING
230529	HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT
230550	VIBRATION ISOLATION FOR HVAC
220553	IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT
220593	TESTING, ADJUSTING, AND BALANCING FOR HVAC
230700	HVAC INSULATION
230913	INSTRUMENTATION AND CONTROL DEVICES FOR HVAC
230915	VEHICLE EMISSION MONITORING SYSTEM
230923	DIRECT DIGITAL CONTROL FOR HVAC
232113	HYDRONIC PIPING
232113.13	BURIED HYDRONIC AND STEAM PIPING
232113.23	MECHANICALLY JOINED HYDRONIC PIPING SYSTEMS
232114	HYDRONIC SPECIALTIES
232123	HYDRONIC PUMPS
232500	HVAC WATER TREATMENT
233113	METAL DUCTS

233300	AIR DUCT ACCESSORIES
233413	AXIAL HVAC FANS
233423	HVAC POWER VENTILATORS
233600	AIR TERMINAL UNITS
233723	HVAC GRAVITY VENTILATORS
234000	PARTICULATE AIR FILTRATION
235100	BREECHINGS, CHIMNEYS, AND STACKS
235216	CONDENSING BOILERS
236416	CENTRIFUGAL WATER CHILLERS
236416	SCROLL WATER CHILLERS
237313	CENTRAL STATION AIR HANDLING UNITS
238200	TERMINAL HEATING AND COOLING UNITS
238500	ELECTRIC HEATING UNITS

for the AWSOM, Bentonville, AR Project No. 993A is:

02/22/2023

Date

PART 1 - GENERAL REQUIREMENTS

1.01 DESCRIPTION OF WORK

A. This Division requires the furnishing and installing of complete functioning systems, and each element thereof, as specified or indicated on the Drawings and Specifications or reasonably inferred; including every article, device or accessory (whether or not specifically called for by item) reasonably necessary to facilitate each system's functioning as indicated by the design and the equipment specified. Elements of the work include materials, labor, supervision, supplies, equipment, transportation, and utilities.

B. Division 22 of the Specifications and Drawings numbered with prefixes P, MP and EP, or MEP generally describe these systems, but the scope of the Plumbing work includes all such work indicated in the Contract Documents: Instructions to Bidders; Proposal Form; General Conditions; Supplementary General Conditions; Architectural, Structural, Mechanical, Plumbing and Electrical Drawings and Specifications; and Addenda.

C. The Drawings have been prepared diagrammatically intended to convey the scope of work, indicating the intended general arrangement of the equipment, fixtures, piping, etc. without showing all the exact details as to elevations, offsets, control lines, and other installation requirements. The Contractor shall use the Drawings as a guide when laying out the work and shall verify that materials and equipment will fit into the designated spaces, and which, when installed per manufacturers requirements, will ensure a complete, coordinated, satisfactory and properly operating system.

1.02 QUALITY ASSURANCE

A. All work under this division shall be executed in a thorough professional manner by competent and experienced workmen licensed to perform the Work specified.

B. All work shall be installed in strict conformance with manufacturer’s requirements, recommendations, and installation instructions. Equipment and materials shall be installed in a neat and professional manner and shall be aligned, leveled, and adjusted for satisfactory operation.

C. Material and equipment shall be new, shall be of the best quality and design, shall be current model of the manufacturer, shall be free from defects and imperfections and shall have markings or a nameplate identifying the manufacturer and providing sufficient reference to establish quality, size and capacity. Material and equipment of the same type shall be made by the same manufacturer whenever practicable.

D. Unless specified otherwise, manufactured items shall have been installed and used, without modification, renovation, or repair for not less than one year prior to date of bidding for this project.

1.03 CODES, REFERENCES AND STANDARDS

A. Execute Work in accordance with the National Fire Protection Association and all Local, State, and National codes, ordinances and regulations in force governing the particular class of Work involved. Obtain timely inspections by the constituted authorities, and upon final completion of the Work obtain and deliver to the Owner executed final certificates of acceptance from the Authority Having Jurisdiction.

B. Any conflict between these Specifications and accompanying Drawings and the applicable Local, State and Federal codes, ordinances and regulations shall be reported to the Architect in sufficient time, prior to the opening of Bids, to prepare the Supplementary Drawings and Specification Addenda required to resolve the conflict.

C. The governing codes are minimum requirements. Where these Drawings and Specifications exceed the code requirements, these Drawings and Specification shall prevail.

D. All material, manufacturing methods, handling, dimensions, method or installation and test procedure shall conform to but not be limited to the following industry standards and codes:

	Arkansas Plumbing Code 2018
	Arkansas Fuel Gas Code 2018
	Arkansas Energy Code 2014
ADA	American Disabilities Act
AMCA	Air Movement and Control Association, Inc.
ANSI	American National Standards Institute
AHRI	Airc Conditioning, Heating and Refrigeration Institute
ASHRAE	American Society of Heating Refrigerating and Air Conditioning Engineers
ASME	American Society of Mechanical Engineers
ASSE	American Society of Sanitary Engineering
ASTM	American Society of Testing Materials
AWS	American Welding Society
AWWA	American Water Works Association
CISPI	Cast Iron Soil Pipe Institute
ETL	Electrical Testing Laboratories
FGI	Facilities Guideline Institute
HI	Hydraulic Institute
MSS	Manufacturer’s Standardization Society of the Valve and Fitting Industry
NBFU	National Board of Fire Underwriters
NEC	National Electrical Code
NFPA	National Fire Protection Association
NEMA	National Electrical Manufactures' Association
OSHA	Occupational Safety and Health Act
PDI	Plumbing and Drainage Institute

UL Underwriter's Laboratories

E. Contractor shall comply with rules and regulations of public utilities and municipal departments affected by connections of services.

F. All Plumbing work shall be performed in compliance with applicable safety regulations, including OSHA regulations. Safety lights, guards, shoring and warning signs required for the performance of the Plumbing work shall be provided by the Contractor.

1.04 DEFINITIONS

A. General:

1. Furnish: When 'furnish', 'install', 'perform', or 'provide' is not used in connection with services, materials, or equipment in a context clearly requiring an obligation of Contractor, "provide" is implied.
2. Install: The term "install" is used to describe operations at the project site including the actual "unloading, unpacking, assembly, erection, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning, and similar operations."
3. Provide: The term "provide" means "to furnish and install, complete and ready for the intended use." When 'furnish', 'install', 'perform', or 'provide' is not used in connection with services, materials, or equipment in a context clearly requiring an obligation of Contractor, "provide" is implied.
4. Furnished by Owner or Furnished by Others: The item will be furnished by the Owner or Others. It is to be installed and connected under the requirements of this Division, complete and ready for operation, including items incidental to the Work, including services necessary for proper installation and operation. The installation shall be included under the guarantee required by this Division.
5. Engineer: Where referenced in this Division, "Engineer" is the Engineer of Record and the Design Professional for the Work under this Division, and is a Consultant to, and an authorized representative of, the Architect, as defined in the General and/or Supplementary Conditions. When used in this Division, it means increased involvement by, and obligations to, the Engineer, in addition to involvement by, and obligations to, the "Architect".
6. AHJ: The local code and/or inspection agency (Authority) Having Jurisdiction over the Work.
7. NRTL: Nationally Recognized Testing Laboratory, as defined and listed by OSHA in 29 CFR 1910.7 (e.g., UL, ETL, CSA, etc.), and acceptable to the Authority having Jurisdiction (AHJ) over this project. Nationally Recognized Testing Laboratories and standards listed are used only to represent the characteristics required and are not intended to restrict the use of other listed Manufacturers and models that meet the specified criteria.

8. Substitution: Changes in products, materials, equipment, and methods of construction from those required by the Contract Documents and proposed by Contractor. Substitutions include Value Engineering proposals.

    a) Substitutions for Cause: Changes proposed by Contractor that are required due to changed Project conditions, such as unavailability of product, regulatory changes, or unavailability of required warranty terms.
    b) Substitutions for Convenience: Changes proposed by Contractor or Owner that are not required in order to meet other Project requirements but may offer advantage to Contractor or Owner.

9. Value Engineering: A systematic method to improve the "value" of goods and services by using an examination of function. Value, as defined, is the ratio of function to cost. Value can therefore be increased by either improving the function or reducing the cost. The goal of VE is to achieve the desired function at the lowest overall cost consistent with required performance.

B. The terms "approved equal", "equivalent", or "equal" are used synonymously and shall mean "accepted by or acceptable to the Engineer as equivalent to the item or manufacturer specified". The term "approved" shall mean labeled, listed, or both, by an NRTL, and acceptable to the AHJ over this project.

C. The following definitions apply to excavation operations:

1. Additional Excavation: Where excavation has reached required subgrade elevations, if unsuitable bearing materials are encountered, continue excavation until suitable bearing materials are reached. The Contract Sum may be adjusted by an appropriate Contract Modification.
2. Bedding: as used in this Section refers to the compacted sand or pea gravel installed in the bottom of a pipe trench to immediately support a pipe and cover a pipe.
3. Subbase: as used in this Section refers to the compacted soil layer used in pavement systems between the subgrade and the pavement base course material.
4. Subgrade: as used in this Section refers to the compacted soil immediately below the slab or pavement system.
5. Unauthorized excavation consists of removal of materials beyond indicated subgrade elevations or dimensions without specific direction from the Architect.

1.05 COORDINATION

A. The Contractor shall visit the site and ascertain the conditions to be encountered while installing the Work under this Division, verify all dimensions and locations before purchasing equipment or commencing work, and make due provision for same in the bid. Failure to comply with this requirement shall not be considered

justification for omission, alteration, incorrect or faulty installation of Work under this Division or for additional compensation for Work covered by this Division.

B. The Contractor shall refer to Drawings of the other disciplines and to relevant equipment drawings and shop drawings to determine the extent of clear spaces. The Contractor shall make offsets required to clear equipment, beams and other structural members; and to facilitate concealing piping and ductwork in the manner anticipated in the design.

C. The Contractor shall confirm and coordinate the final location and routing of all mechanical, electrical, plumbing, fire protection, control and audio-visual systems with all architectural features, structural components, and other trades. The contractor shall locate equipment, components, ductwork, piping, conduit, and related accessories to maintain the desired ceiling heights as indicated on the architectural drawings. The contractor shall inform the architect of any areas where conflicts may prevent the indicated ceiling height from being maintained. The contractor shall not proceed with any installation in such areas until the architect has given written approval to proceed or has provided modified contract drawings or written instructions to resolve the apparent conflict.

D. The contractor shall provide materials with trim which will fit properly the types of ceiling, wall, or floor finishes actually installed.

E. The Contractor shall maintain a foreman on the jobsite at all times to coordinate his work with other contractors and subcontractors so that various components of the Plumbing systems will be installed at the proper time, will fit the available space, and will allow proper service access to the equipment. Carry on the Work in such a manner that the Work of the other contractors and trades will not be handicapped, hindered, or delayed at any time.

F. Work of this Division shall progress according to the "Construction Schedule" as established by the Prime Contractor and his subcontractors and as approved by the Architect. Cooperate in establishing these schedules and perform the Work under this Division, in a timely manner in conformance with the construction schedule so as to ensure successful achievement of schedule dates.

1.06 MEASUREMENTS AND LAYOUTS

A. The drawings are schematic in nature, but show the various components of the systems approximately to scale and attempt to indicate how they are to be integrated with other parts of the building. Figured dimensions shall be taken in preference to scale dimensions. Determine exact locations by job measurements, by checking the requirements of other trades, and by reviewing the Contract Documents. The Contractor will be held responsible for errors which could have been avoided by proper checking and inspection.

1.07 COORDINATION DRAWINGS

A. Coordination Drawings, General: Prepare coordination drawings according to the requirements of individual Sections. Additionally, prepare coordination drawings as required scope of installation is not completely shown on Shop Drawings, where limited space availability necessitates coordination, or if coordination is required to facilitate integration of products and materials fabricated or installed by more than one trade.

1. Information shall be project specific and drawn accurately to a scale large enough to resolve conflicts. Do not base coordination drawings on standard dimensional data.
2. Prepare floorplans, sections, elevations, and details as needed to adequately describe relationship of various systems and components.
3. Clearly indicate functional and spatial relationships of components of all systems specified in the Contract Documents, including but not limited to: architectural, structural, civil, mechanical, electrical, fire protection, and specialty systems.
4. Indicate space requirements for routine maintenance and for anticipated replacement of components during the life of the installation.
5. Show location and size of access doors required for access to concealed equipment, fittings, controls, terminations, and cabling.
6. Indicate required installation sequence to minimize conflicts between entities.
7. Indicate dimensions shown on the Drawings. Specifically note dimensions that appear to be in conflict with submitted equipment and minimum clearance requirements. Provide alternate sketches to Contract Administrator indicating proposed resolution of such conflicts. Minor dimension changes and difficult installations will not be considered changes to the Contract.
8. The details of the coordination are the responsibility of the Contractor and, where indicated on the Drawings, minor adjustments in raceway routing, device placement, device type, or equipment arrangement are not to be considered changes to the Contract.

B. Equipment Room Coordination Drawings: In accordance with the submittal procedures outlined within these Specifications, provide dimensioned layouts of electrical equipment locations within electrical rooms/closets, mechanical rooms, generator rooms, and fire pump rooms with equipment drawn to scale and identified therein.

1. Clearly identify all required working clearances and access provisions required for installation and maintenance.
2. Equipment layouts should be arranged accounting for considerations for required door openings and the clearances required by the equipment manufacturer.
3. Indicate path to allow for the future removal of each large piece of equipment (up to and including generators and unit sub-station

transformers) without removal of non-related equipment or architectural elements.

4. Include work provided by others routed through the equipment rooms.

C. Coordination Digital Data Files: Prepare coordination digital data files according to the following requirements:

1. File Preparation Format: Same digital data software program, version, and operating system as original Drawings.
2. BIM File Incorporation: Develop and incorporate coordination drawing files into Building Information Model established for Project.

a) Perform three-dimensional component conflict analysis as part of preparation of coordination drawings. Resolve component conflicts prior to submittal. Indicate where conflict resolution requires modification of design requirements by Contract Administrator.

3. Where Henderson Engineer's digital data files are provided to the Contractor for use in preparing coordination digital data files, Henderson Engineers makes no representations as to the accuracy or completeness of digital data files as they relate to the Drawings or Specifications.
4. Submit coordination drawings in accordance with the submittal procedures outlined within these Specifications.

1.08 SUBMITTALS

A. Refer to Division 01 and General Conditions for submittal requirements in addition to requirements specified herein.

B. Refer to Division 01 for acceptance of electronic submittals. If not specified by Division 01, provide electronic submittals. If Division 01 requires paper submittals, provide the quantity of submittals required, but no fewer than seven (7) sets.

C. For electronic submittals, Contractor shall submit the documents in accordance with this Section and the procedures specified in Division 01. Contractor shall notify the Contract Administrator and Engineer that the submittals have been posted. If electronic submittal procedures are not defined in Division 01, Contractor shall include the website, user name and password information needed to access the submittals. For submittals sent by e-mail, Contractor shall copy the Contract Administrator's and Engineer's designated representatives. Contractor shall allow for the Engineer Review Time as specified. Contractor shall submit only the documents required to purchase the materials and/or equipment in the submittal.

D. Engineer Review Time: Transmit submittals as early as required to support the project schedule. Allow two weeks for Engineer review time or time specified in Henderson's Agreement with the Client, plus to/from mailing time via the Contract Administrator, plus a duplication of this time for resubmittal if required. Transmit

submittals as soon as possible after Notice to Proceed and before Mechanical construction starts.

E. Submittals and shop drawings shall not contain the firm name, logo, seal, or signature of the Engineer. They shall not be copies of the work product of the Engineer. If the Contractor desires to use elements of such product, the license agreement for transfer of information obtained from the Engineer must be used.

F. Assemble and submit for review manufacturer product literature for material and equipment to be furnished and/or installed under this Division. Literature shall include shop drawings, manufacturer product data, performance sheets, samples, and other submittals required by this Division as noted in each individual Section. General product catalog data not specifically noted to be part of the specified product will be rejected and returned without review.

G. Separate submittals according to individual specification sections. Only resubmit those sections requested for resubmittal.

H. Provide submittals in sufficient detail so as to demonstrate compliance with these Contract Documents and the design concept. Highlight, mark, list or indicate the materials, performance criteria and accessories that are being proposed. Illegible submittals will be rejected and returned without review.

I. Refer to individual Sections for additional submittal requirements.

J. Before transmitting submittals and material lists, verify that the equipment submitted is mutually compatible with and suitable for the intended use. Verify that the equipment will fit the available space and maintain manufacturer recommended service clearances. If the size of equipment furnished makes necessary any change in location, or configuration, submit a shop drawing showing the proposed layout.

K. Submittals shall contain the following information:

1. The project name.
2. The applicable specification section and paragraph.
3. Equipment identification acronym as used on the drawings.
4. The submittal date.
5. The Contractor's stamp, which shall certify that the stamped drawings have been checked by the Contractor, comply with the Drawings and Specifications, and have been coordinated with other trades.
6. Submittals not so identified will be returned to the Contractor without action.

L. The checking and subsequent acceptance by the Engineer and/or Contract Administrator of submittals shall not relieve responsibility from the Contractor for (1) deviations from Drawings and Specifications; (2) errors in dimensions, details, sizes of equipment, or quantities; (3) omissions of components or fittings; and (4)

not coordinating items with actual building conditions and adjacent work. Contractor shall request and secure written acceptance from the Engineer and Contract Administrator prior to implementing any deviation.

M. Provide welders' qualification certificates.

1.09 ELECTRONIC DRAWING FILES

A. In preparation of shop drawings or record drawings, Contractor may, at their option, obtain electronic drawing files from the Engineer. Contact the Architect for Architect's written authorization. Contractor shall request and complete the Electronic File Release Agreement form from the Engineer. Architect's written authorization and Engineer's release agreement form must be received before electronic drawing files will be sent.

1.010 SUBSTITUTIONS

A. Refer to Division 01 and General Conditions for substitutions in addition to requirements specified herein.

B. Materials, products, equipment, and systems described in the Bidding Documents establish a standard of required function, dimension, appearance and quality to be met by the proposed substitution.

C. The base bid shall include only the products from manufacturers specifically named in the drawings and specifications.

D. Request for Substitution:

1. Complete and send the Substitution Request Form attached at the end of this section for each material, product, equipment, or system that is proposed to be substituted.
2. The burden of proof of the merit of the proposed substitution is upon the proposer.
3. Unless stated otherwise in writing to the Engineer by the Contractor, Contractor warrants to the Engineer, Architect, and Owner the following:
    a) Proposed substitution has been fully investigated and determined to meet or exceed the specified Work in all respects.
    b) Proposed substitution is consistent with the Contract Documents and will produce indicated results, including functional clearances, maintenance service, and sourcing of replacement parts.
    c) Proposed substitution has received necessary approvals of authorities having jurisdiction.
    d) Same warranty will be furnished for proposed substitution as for specified Work.
    e) If accepted substitution fails to perform as required, Contractor shall replace substitute material or system with that originally specified and bear costs incurred thereby.

f) Coordination, installation and changes in the Work as necessary for accepted substitution will be complete in all respects.

E. Substitution Consideration:

1. No substitutions will be considered unless the Substitution Request Form is completed and attached with the appropriate substitution documentation.
2. No substitution will be considered prior to receipt of Bids unless written request for approval to bid has been received by the Engineer at least ten (10) calendar days prior to the date for receipt of Bids.
3. If the proposed substitution is approved prior to receipt of Bids, such approval will be stated in an Addendum. Bidders shall not rely upon approvals made in any other manner. Verbal approval will not be given.
4. No substitutions will be considered after the Contract is awarded unless specifically provided in the Contract Documents.

1.011 OPERATION AND MAINTENANCE MANUALS

A. Refer to Division 1 and General Conditions for Operation and Maintenance Manuals in addition to requirements specified herein.

B. Submit manuals prior to requesting the final punch list and before all requests for Substantial Completion.

C. Instruct the Owner's permanent personnel in the proper operation of, startup and shutdown procedures and maintenance of the equipment and components of the systems installed under this Division.

D. Prior to Substantial Completion of the project, furnish to the Architect, for Engineer's review, and for the Owner's use, four (4) copies of Operation and Maintenance Manuals in labeled, hard-back three-ring binders, with cover, binding label, tabbed dividers and plastic insert folders for Record Drawings. Include local contacts, complete with address and telephone number, for equipment, apparatus, and system components furnished and installed under this Division of the specifications.

E. Each manual shall contain data listed in Table 5.

F. Refer to Division 1 for acceptance of electronic manuals for this project. For electronic manuals, Contractor shall submit the documents in accordance with this Section and the procedures specified in Division 1. Contractor shall notify the Architect and Engineer that the manuals have been posted. If electronic manual procedures are not defined in Division 1, Contractor shall include the website, user name and password information needed to access the manuals. For manuals sent by e-mail, Contractor shall copy the Architect and Engineer's designated representatives.

1.012 SPARE PARTS

A. Provide to the Owner the spare parts specified in the individual sections in Division 22 of this specification. Refer to Table 2 at the end of this section for a list of specification sections in Division 22 that contain spare parts requirements.

B. Owner or Owner's representative shall initial and date each section line in Table 2 when the specified spare parts for that section are received and shall sign at the bottom when all spare parts have been received.

1.013 RECORD DRAWINGS

A. Refer to Division 01 and General Conditions for Record Drawings in addition to requirements specified herein.

B. A set of work prints of the Contract Documents shall be kept on the jobsite during construction for the purpose of noting changes. During the course of construction, the Contractor shall indicate on these Documents changes made from the original Contract Documents. Particular attention shall be paid to those items which need to be located for servicing. Underground utilities shall be located by dimension, from column lines.

C. At the completion of the project, the Contractor shall obtain, at their expense, reproducible copies of the final drawings and incorporate changes noted on the jobsite work prints onto these drawings. These changes shall be done by a skilled drafter. Each sheet shall be marked "Record Drawing", along with the date. These drawings shall be delivered to the Architect/Engineer.

1.014 TRAINING

A. Provide training as indicated in each specific section. Schedule training with the Owner at least 7 days in advance. Video tape the training sessions in format as agreed to with the Owner. Provide three copies of each session to the Owner and obtain written receipt from the Owner.

1.015 PAINTING

A. Exposed ferrous surfaces, including pipe, pipe hangers, equipment stands and supports and exposed insulated piping shall be painted by the Plumbing Contractor using materials and methods as specified under Division 9 of the Specifications; colors shall be as selected by the Architect.

B. Factory finishes, shop priming and special finishes are specified in the individual equipment specification sections.

C. Where factory finishes are provided and no additional field painting is specified, marred or damaged surfaces shall be touched up or refinished so as to leave a smooth, uniform finish.

1.016 DELIVERY, STORAGE AND HANDLING

A. Refer to Division 1 and General Conditions for Delivery, Storage and Handling in addition to requirements specified herein.

B. Equipment and material shall be delivered to the job site in their original containers with labels intact, fully identified with manufacturer's name, model, model number, type, size, capacity and Underwriter's Laboratories, Inc. labels and other pertinent information necessary to identify the item.

C. Deliver, receive, handle and store equipment and materials at the job site in the designated area and in such a manner as to prevent equipment and materials from damage and loss. Store equipment and materials delivered to the site on pallets and cover with waterproof, tear resistant tarp or plastic or as required to keep equipment and materials dry. Follow manufacturer's recommendations, and at all times, take every precaution to properly protect equipment and material from damage, to include the erection of temporary shelters to adequately protect equipment and material stored at the Site. Equipment and/or material which become rusted or damaged shall be replaced or restored by the Contractor to a condition acceptable to the Architect.

D. The Contractor shall be responsible for the safe storage of his own tools, material and equipment.

1.017 GUARANTEES AND WARRANTIES

A. Refer to Division 1 and General Conditions for Guarantees and Warranties in addition to requirements specified herein.

B. Each system and element thereof shall be warranted against defects due to faulty workmanship, design or material for a period of 12 months from date of Substantial Completion, unless specific items are noted to carry a longer warranty in the Construction Documents or manufacturer's standard warranty. The Contractor shall remedy defects occurring within a period of one year from the date of Substantial Completion or as stated in the General Conditions.

C. The following additional items shall be guaranteed:

1. Piping shall be free from obstructions, holes or breaks of any nature.
2. Insulation shall be effective.
3. Proper circulation of fluid in each piping system.

D. The above guarantees shall include both labor and material; and repairs or replacements shall be made without additional cost to the Owner.

E. The remedial work shall be performed promptly, upon written notice from the Architect or Owner.

F. At the time of Substantial Completion, deliver to the Owner warranties with terms extending beyond the one year guarantee period, each warranty instrument being addressed to the Owner and stating the commencement date and term. Refer to Table 3 at the end of this section for a list of specification sections in Division 22 that contain special warranties.

1.018 TEMPORARY FACILITIES

A. Refer to Division 1 and General Conditions for Temporary Facilities requirements in addition to requirements specified herein.

B. Temporary Utilities: The types of services required include, but are not limited to, water, sewerage, surface drainage and gas. When connecting to existing franchised utilities for required services, comply with service companies' recommendations on materials and methods, or engage service companies to install services. Locate and relocate services (as necessary) to minimize interference with construction operations.

1. Water: Premises are supplied with water services which may be used in this work: Contractor shall make his own arrangements for water services.
2. Provide the necessary backflow prevention devices where connecting to the potable water system. Protect water service from freezing by draining system or by providing adequate heat. Where non-potable water is used, mark each outlet with health hazard warning signs.
3. Sewer Sediment: Maintain sewers and temporary connecting sewers in a clean, nonclogged condition during construction period.

C. Construction Facilities: Provide facilities reasonably required to perform construction operations properly and adequately.

1. Enclosures: When temporary enclosures are required to ensure adequate workmanship, weather protection and ambient conditions required for the work, provide fire-retardant treated lumber and plywood; provide tarpaulins with UL label and flame spread of 15 or less; provide translucent type (nylon reinforced polyethylene) where daylighting of enclosed space would be beneficial for workmanship, and reduce use of temporary lighting.

PART 2 - PRODUCTS AND MATERIALS

2.01 SOIL MATERIALS

A. Provide clean sand, pea gravel or flowable fill material (per the geotechnical engineer's or structural engineer's recommendations).

B. Subbase Material: Where applicable, provide natural soils with 10% by volume of rocks less than 2" diameter or artificially crushed aggregate. Corrosive fill materials shall not be utilized. When CL clay, rock, or gravel is used, it shall not be

larger than 2 inches in any dimension and be free of debris, waste, frozen materials, vegetable and other deleterious matter.

C. Filter Fabric: Flat needle punched PP or polyester fibers or combination of both, with flow rate range from 110 to 330 gpm/sq. ft. (4,480 to 13,440 L/min. per sq. m) when tested according to ASTM D 4491.

PART 3 - EXECUTION

3.01 PERMITS

A. Secure and pay for permits required in connection with the installation of the Plumbing Work. Arrange with the various utility companies for the installation and connection of required utilities for this facility and pay charges associated therewith including connection charges and inspection fees, except where these services or fees are designated to be provided by others.

3.02 EXCAVATION AND BACKFILLING

A. Refer to Division 01, Division 02, and Division 31, Geotechnical Soils Report and General Conditions for Excavation and Backfilling in addition to the requirements specified herein.

B. Perform excavation of every description, of whatever substance encountered and to the depth required in connection with the installation of the work under this Division. Excavation shall be in conformance with applicable Division and section of the General Specifications.

C. Roads, alleys, streets and sidewalks damaged during this work shall be restored to the satisfaction of Authorities Having Jurisdiction.

D. Trenches close to walks or columns shall not be excavated without prior consultation with the Architect.

E. Erect barricades around excavations. Provide an adequate number of amber lights on or near the work and keep them burning from dusk to dawn. The Contractor shall be held responsible for any damage that any parties may sustain due to neglecting the necessary precautions when performing the work.

F. Slope sides of excavations to comply with local, state and federal codes and ordinances. Shore and brace as required for stability of excavation.

G. Shoring and Bracing: Establish requirements for trench shoring and bracing to comply with local, state and federal codes and authorities. Maintain shoring and bracing in excavations regardless of time period excavations will be open.

1. Remove shoring and bracing when no longer required. Where sheeting is allowed to remain, cut top of sheeting at an elevation of 30 inches below finished grade elevation.

H. Install sediment and erosion control measures in accordance with local codes and ordinances.

I. Dewatering: Prevent surface water and subsurface or ground water from flowing into excavations and trenches.

1. Do not allow water to accumulate in excavations and trenches. Remove water to prevent softening of bearing materials. Provide and maintain dewatering system components necessary to convey water away from excavations.
2. Establish and maintain temporary drainage ditches and other diversions outside excavation and trench limits to convey surface water to collecting or run-off areas. Do not use trench excavations as temporary drainage ditches. In no case shall sewers be used as drains for such water.

J. Material Storage: Stockpile satisfactory excavated materials where directed, until required for backfill or fill. Place, grade, and shape stockpiles for proper drainage.

1. Locate and retain soil materials away from edge of excavations. Do not store within drip-line of trees indicated to remain.
2. Remove and legally dispose of excess excavated materials and materials not acceptable for use as backfill or fill.

K. Excavation for Underground Tanks, Basins, and Plumbing Structures: Conform to elevations and dimensions shown within a tolerance of plus or minus 0.10 foot; plus a sufficient distance to permit placing and removal of concrete formwork, installation of services, other construction, and for inspection.

1. Excavate, by hand, areas within drip-line of large trees. Protect the root system from damage and dry-out. Maintain moist conditions for root system and cover exposed roots with burlap. Paint root cuts of 1 inch in diameter and larger with emulsified asphalt tree paint.
2. Take care not to disturb bottom of excavation. Excavate by hand to final grade just before concrete reinforcement is placed.

L. Trenching: Excavate trenches for Plumbing installations as follows:

1. Excavate trenches to the uniform width, sufficiently wide to provide ample working room and a minimum of 6 to 9 inches clearance on both sides of pipe and equipment.
2. Excavate trenches to depth indicated or required for piping to establish indicated slope and invert elevations. Beyond building perimeter, excavate trenches to an elevation below frost line.
3. Limit the length of open trench to that in which pipe can be installed, tested, and the trench backfilled within the same day.

4. Where rock is encountered, carry excavation below required elevation and backfill with a layer of crushed stone or gravel prior to installation of pipe. Provide a minimum of 6 inches of stone or gravel cushion between rock bearing surface and pipe.
5. Excavate trenches for piping and equipment with bottoms of trench to accurate elevations for support of pipe and equipment on undisturbed soil.

M. Cold Weather Protection: Protect excavation bottoms against freezing when atmospheric temperature is less than 35°F.

N. Bedding:

1. Fill bottom of pipe trench and fill unevenness with compacted bedding material to ensure continuous bearing of the pipe barrel on the bearing surface. Additional bedding installation requirements are in the following piping specifications. Compact bedding as described below:
2. Fill bottom of equipment trench and fill unevenness with compacted sand backfill to ensure continuous bearing of the equipment on the bearing surface. Compact bedding as described below.

O. Backfilling and Filling: Place soil materials in layers to required subgrade elevations for each area classification listed below, using materials specified in Part 2 of this Section.

1. Under walks and pavements, use a combination of subbase materials and excavated or borrowed materials.
2. Under building slabs, use drainage fill materials.
3. Under piping and equipment, use subbase materials where required over rock bearing surface and for correction of unauthorized excavation.
4. For piping less than 30 inches below surface of roadways, provide 4-inch-thick concrete base slab support after installation and testing of piping and prior to backfilling and placement of roadway subbase. Coordinate with AHJ for colored concrete requirements.
5. Other areas, use excavated or borrowed materials.

P. Backfill excavations as promptly as work permits, but not until completion of the following:

1. Inspection, testing, approval, and locations of underground utilities have been recorded.
2. Removal of concrete formwork.
3. Removal of shoring and bracing, and backfilling of voids.
4. Removal of trash and debris.

Q. Placement and Compaction: Place subgrade backfill and fill materials in layers of not more than 8 inches in loose depth for material compacted by heavy equipment, and not more than 4 inches in loose depth for material compacted by hand-operated tampers.

R. Before compaction, moisten or aerate each layer as necessary to provide optimum moisture content. Compact each layer to required percentage of maximum dry density or relative dry density for each area classification specified below. Do not place backfill or fill material on surfaces that are muddy, frozen, or contain frost or ice.

S. Place backfill and fill materials evenly adjacent to structures, piping, and equipment to required elevations. Prevent displacement of piping and equipment by carrying material uniformly around them to approximately same elevation in each lift.

T. Compaction: Place bedding backfill materials in maximum layers of not more than 6 inches loose depth for material compacted by hand-operated tampers. Place subbase backfill materials in maximum layers of not more than 8 inches in loose depth for material compacted by heavy equipment, and not more than 4 inches in loose depth for material compacted by hand-operated tampers. Control soil compaction during construction, providing minimum percentage of density specified for each area classification indicated below.

1. Use of pneumatic backhoe as compaction method is not allowed as an acceptable process for compaction of excavations or trenches.
2. For vertical and/or diagonal pipe installations greater than ½" rise/lf, thoroughly support pipes from permanent concrete structures or undisturbed earth at no less than 10-foot intervals, while placing backfill materials, so that pipes are not deflected, crushed, broken, or otherwise damaged by the backfill placement or settlement.
3. Where subgrade or layer of soil material must be moisture conditioned before compaction, uniformly apply water. Apply water in minimum quantity necessary to achieve required moisture content and to prevent water appearing on surface during, or subsequent to, compaction operations. Compact each layer to required percentage of maximum dry density or relative dry density for each area classification specified below. Do not place backfill or fill material on surfaces that are muddy, frozen, or contain frost or ice.
4. Place backfill and/or drainage fill materials evenly adjacent to structures, piping, and equipment to required elevations. Coordinate with Architect and/or Civil Engineer backfill requirements prior to installation. Prevent displacement of pipes and equipment by carrying material uniformly around them to approximately same elevation in each layer or lift.
5. Percentage of Maximum Density Requirements: Compact soil to not less than the following percentages of maximum density for soils which exhibit a well-defined moisture-density relationship (cohesive soils), determined in accordance with ASTM D 1557 or ASTM D 698 and not less than the following percentages of relative density, determined in accordance with ASTM D 4253, for soils which will not exhibit a well-defined moisture-density relationship (cohesionless soils).

    a) Areas Under Structures, Building Slabs and Steps, Pavements: Compact top 12 inches of subgrade and each layer of backfill or fill

material to 90 percent maximum density for cohesive material, or 95 percent relative density for cohesionless material.

b) Areas Under Walkways: Compact top 6 inches of subgrade and each layer of backfill or fill material to 90 percent maximum density for cohesive material, or 95 percent relative density for cohesionless material.

c) Other Areas: Compact top 6 inches of subgrade and each layer of backfill or fill material to 85 percent maximum density for cohesive soils, and 90 percent relative density for cohesionless soils.

U. Subsidence: Where subsidence occurs at Plumbing installation excavations during the period 12 months after Substantial Completion, remove surface treatment (i.e., pavement, lawn, or other finish), add backfill material, compact to specified conditions, and replace surface treatment. Restore appearance, quality, and condition of surface or finish to match adjacent areas.

V. Additional Excavation: Where additional excavation may be required due to unsuitable bearing materials encountered, notify the architect immediately for resolution.

3.03 CLEANING

A. Dirt and refuse resulting from the performance of the work shall be removed from the premises as required to prevent accumulation. The Plumbing Contractor shall cooperate in maintaining reasonably clean premises at all times.

B. Immediately prior to the final inspection, the Plumbing Contractor shall clean material and equipment installed under the Plumbing Contract. Dirt, dust, plaster, stains, and foreign matter shall be removed from surfaces including components internal to equipment. Damaged finishes shall be touched-up and restored to their original condition.

3.04 SUBSTANTIAL COMPLETION REVIEW

A. Prior to requesting inspection for "CERTIFICATE OF SUBSTANTIAL COMPLETION", the Contractor shall complete the following items:

1. Submit complete Operation and Maintenance Manuals.
2. Submit complete Record Drawings.
3. Perform special inspections. Refer to Table 4 at the end of this section for a list of specification sections in Division 22 that contain special inspection requirements.
4. Start-up testing of systems.
5. Removal of temporary facilities from the site.
6. Comply with requirements for Substantial Completion in the "General Conditions".

B. The Contractor shall request in writing a review for Substantial Completion. The Contractor shall give the Architect/Engineer at least seven (7) days notice prior to the review.

C. The Contractor's written request shall state that the Contractor has complied with the requirements for Substantial Completion.

D. Upon receipt of a request for review, the Architect/Engineer will either proceed with the review or advise the Contractor of unfulfilled requirements.

E. If the Contractor requests a site visit for Substantial Completion review prior to completing the above mentioned items, He shall reimburse the Architect/Engineer for time and expenses incurred for the visit.

F. Upon completion of the review, the Architect/Engineer will prepare a "final list" of outstanding items to be completed or corrected for final acceptance.

G. Omissions on the "final list" shall not relieve the Contractor from the requirements of the Contract Documents.

H. Prior to requesting a final review, the Contractor shall submit a copy of the final list of items to be completed or corrected. He shall state in writing that each item has been completed, resolved for acceptance or the reason it has not been completed.

END OF SECTION

TABLE 1: PLUMBING SPECIFICATION SHOP DRAWING SUBMITTAL REQUIREMENTS

SPECIFICATION NUMBER/TITLE		CODE DESIGNATION
220010	General Plumbing Requirements	NONE
220015	Coordination	NONE
220500	Common Work Results For Plumbing	A, B, G, M
220513	Common Motor Requirements For Plumbing Equipment	B
220515	Basic Piping Materials And Methods	B, G
220516	Expansion Fittings And Loops For Plumbing Piping	A, B, F
220519	Meters And Gauges For Plumbing Piping	B, H
220523	General-Duty Valves For Plumbing Piping	B
220529	Hangers And Supports For Plumbing Piping	B, F, G, H
220533	Heat Tracing For Plumbing Piping	A, B, E, F
220534	Hot Water Temperature Maintenance System	A, B, E, F
220548	Seismic Controls For Plumbing Piping & Equipment	A, B, C, D, I, M
220550	Vibration Isolation For Plumbing Piping & Equipment	A, B, C, F, I, J
220553	Identification For Plumbing Piping & Equipment	B, L, M
220700	Plumbing Insulation	B, M
221100	Water Distribution Piping & Specialties	B, G, H
221111	Mechanically Joined Plumbing Piping Systems	B, G, H
221112	GENERAL PLUMBING REQUIREMENTS & Specialties	B, G, H
221113	Polypropylene Water Distribution Piping and Specialties	B, G, H
221114	Stainless Steel Water Distribution Piping and Specialties	B, G, H
221115	CPVC Water Distribution Systems & Specialties	B, G, H
221123	Domestic Water Pumps	A, B, C, E
221300	Sanitary Drainage & Vent Piping & Specialties	B
221328	Condensate Pumps for HVAC Equipment	???
221329	Sanitary Sewerage Pumps	A, B, C, E
221400	Storm Drainage Piping & Specialties	B
221402	Stainless Steel Storm Drainage Piping & Specialties	???
221410	Siphonic Storm Drainage Piping & Specialties	A, B, I
221489	Sump Pumps	A, B, C, E
221500	General Service Compressed Air Systems	B, C, D, E, F, H
221510	Beverage System Bulk CO2 Systems	B, N
223100	Water Softeners	B, C, E, K
223120	Water Filtration Systems	B, C, E, K
223130	Copper Silver Ionization System	B, C, E, K
223140	Chlorine Dioxide System	B, C, E, K
223200	Domestic Water Filtration Equipment	B, C, E, K
223300	Electric Domestic Water Heaters	B, C, E, F, H, K
223701	Hybrid Heat Pump Domestic Water Heaters	B, C, E, F, H, K
223400	Fuel Fired Domestic Water Heaters	B, C, E, F, H, K
223500	Domestic Water Heat Exchangers	B, C, E, F, H, K
224000	Plumbing Fixtures	B, E, N
226100	Gas & Vacuum Systems For Medical Facilities	B, C, E, F, G
226200	Gas & Vacuum Systems For Laboratories	B, C, E, F, G
226600	Chemical Waste Systems For Laboratory And Medical Facilities	B, C, E, F, G
226700	Process Water Piping And Equipment For Laboratory And Healthcare Facilities	B, C, E, F, G
227000	Natural Gas Systems	A, B, C, D, F, G
227010	Mechanically Joined Natural Gas Piping Systems	B, F, H, N
228000	Beverage Conduit Systems	A, B, D, F
229000	Laboratory Safety Device System	???

CODED LEGEND

A	Shop Drawings
B	Product Data and equipment weights
C	Performance Data, Curves, Certificates and Test Data
D	Coordination Drawings
E	Wiring Diagrams and short circuit current ratings
F	Installation Instructions
G	Welder's Certificates
H	Certificates
I	Calculations
J	Special Inspections
K	Special Warranties
L	Material Samples
M	Schedules
N	Recommended Spare Parts List

TABLE 2: SPARE PARTS REQUIREMENTS FOR PLUMBING EQUIPMENT

SECTION NUMBER		RECEIVED/DATE/INITIAL
220553	Identification For Plumbing Piping & Equipment	_____
221100	Water Distribution Piping & Specialties	_____
221111	Mechanically Joined Plumbing Piping Systems	_____
221112	GENERAL PLUMBING REQUIREMENTS & Specialties	_____
221123	Domestic Water Pumps	_____
221510	Beverage System Bulk CO2 Systems	_____
221329	Sanitary Sewerage Pumps	_____
221489	Sump Pumps	_____
223100	Water Softeners	_____
223120	Water Filtration Systems	_____
223130	Copper Silver Ionization System	_____
223140	Chlorine Dioxide System	_____
224000	Plumbing Fixtures	_____
226100	Gas & Vacuum Systems For Medical Facilities	_____
226200	Gas & Vacuum Systems For Laboratories	_____
227000	Natural Gas Systems	_____

_____
Owner's Signature

TABLE 3: SPECIAL WARRANTY REQUIREMENTS FOR PLUMBING EQUIPMENT

SECTION NUMBER		RECEIVED/DATE/INITIAL
223100	Water Softeners	_____
223120	Domestic Water Filtration Equipment	_____
223300	Electric Domestic Water Heaters	_____
223701	Hybrid Heat Pump Domestic Water Heaters	_____
223400	Fuel Fired Domestic Water Heaters	_____

TABLE 4: SPECIAL INSPECTION REQUIREMENTS FOR PLUMBING EQUIPMENT

SECTION NUMBER		COMPLETED/DATE/INITIAL
220548	Seismic Controls For Plumbing Piping & Equipment	_____
220550	Vibration Isolation For Plumbing Piping & Equipment	_____
226100	Gas & Vacuum Systems For Medical Facilities	_____

TABLE 5: PLUMBING SPECIFICATION OPERATION AND MAINTENANCE SUBMITTAL REQUIREMENTS

SPECIFICATION NUMBER/TITLE		CODE DESIGNATION
220500	Common Work Results For Plumbing	B
220513	Common Motor Requirements For Plumbing Equipment	B
220515	Basic Piping Materials And Methods	B
220516	Expansion Fittings And Loops For Plumbing Piping	A, B
220519	Meters And Gauges For Plumbing Piping	B, G, I
220523	General-Duty Valves For Plumbing Piping	B, H, I
220529	Hangers And Supports For Plumbing Piping	B
220533	Heat Tracing For Plumbing Piping	B, C, E, G, I
220548	Seismic Controls For Plumbing Systems	A, B, C
220550	Vibration Isolation For Plumbing Piping & Equipment	A, B, C
220553	Identification For Plumbing Piping & Equipment	B
220700	Plumbing Insulation	B
221100	Water Distribution Piping & Specialties	A, B, F, H, I
221111	Mechanically Joined Plumbing Piping Systems	A, B, F, H, I
221112	GENERAL PLUMBING REQUIREMENTS & Specialties	A, B, F, H, I
221113	Polypropylene Water Distribution Piping and Specialties	A, B, F, H, I
221114	Stainless Steel Water Distribution Piping and Specialties	A, B, F, H, I
221115	CPVC Water Distribution Systems & Specialties	A, B, F, H, I
221123	Domestic Water Pumps	B, C, D, E, G, H, I
221300	Sanitary Drainage & Vent Piping & Specialties	A, B, F
221329	Sanitary Sewerage Pumps	B, C, D, E, G, H, I
221400	Storm Drainage Piping & Specialties	A, B, F
221410	Siphonic Storm Drainage Piping & Specialties	A, B, F
221489	Sump Pumps	B, C, D, E, G, H, I
221500	General Service Compressed Air Systems	A, B, C, D, E, G, H, I
221510	Beverage System Bulk CO2 Systems	A, B, F, H
223100	Water Softeners	B, C, D, E, G, H, I
223120	Water Filtration Systems	B, C, D, E, G, H, I
223130	Copper Silver Ionization System	B, C, D, E, G, H, I
223140	Chlorine Dioxide System	B, C, D, E, G, H, I
223200	Domestic Water Filtration Equipment	B, C, E, G, H, I
223300	Electric Domestic Water Heaters	B, C, D, E, G, H, I
223701	Hybrid Heat Pump Domestic Water Heaters	B, C, D, E, G, H, I
223400	Fuel Fired Domestic Water Heaters	B, C, D, E, G, H, I
223500	Domestic Water Heat Exchangers	B, C, E, G, I
224000	Plumbing Fixtures	B, E, H, I
226100	Gas & Vacuum Systems For Medical Facilities	A, B, C, D, E, G, H, I
226200	Gas & Vacuum Systems For Laboratories	A, B, C, D, E, G, H, I
226600	Chemical Waste Systems For Lav And Medical Facilities	B, C, E, F, H
226700	Process Water Piping And Equipment For Laboratory And Healthcare Facilities	A, B, C, D, E, G, H, I
227000	Natural Gas Systems	A, B, C, H
227010	Mechanically Joined Natural Gas Piping Systems	B, F, H
228000	Beverage Conduit Systems	A, B

CODED LEGEND

A	As-Built Drawings
B	Product Data
C	Performance Data, Capacities, Curves and Certificates
D	Wiring Diagrams

E Operating Instructions
F Test Reports
G Warranties
H Recommended Spare Parts List
I Service and Maintenance Instructions

TABLE 6: PLUMBING SUBMITTAL REQUIREMENTS FOR LEED PROJECTS

SPECIFICATION NUMBER/TITLE		CODE DESIGNATION
220500	Common Work Results For Plumbing	A, B
220515	Basic Piping Materials and Methods	A, B
220516	Expansion Fittings and Loops for Plumbing Piping	A
220519	Meters and Gauges for Plumbing Piping	A
220523	General-Duty Valves for Plumbing Piping	A
220700	Plumbing Insulation	A, B
221100	Water Distribution Piping & Specialties	A
221111	Mechanically Joined Plumbing Piping Systems	A
221112	GENERAL PLUMBING REQUIREMENTS & Specialties	A
221115	CPVC Water Distribution Systems & Specialties	A
221123	Domestic Water Pumps	A
221300	Sanitary Drainage & Vent Piping & Specialties	A
221400	Storm Drainage Piping & Specialties	A
221410	Siphonic Storm Drainage Piping & Specialties	A
221500	General Service Compressed Air Systems	A
221510	Beverage System Bulk CO2 Systems	A
223200	Domestic Water Filtration Equipment	A
223300	Electric Domestic Water Heaters	A
223701	Hybrid Heat Pump Domestic Water Heaters	A
223400	Fuel Fired Domestic Water Heaters	A
223500	Domestic Water Heat Exchangers	A
224000	Plumbing Fixtures	A, C
229000	Laboratory Safety Device System	A

CODED LEGEND

A LEEDv4 Materials & Resources Submittal Cover Sheet – Form A
B LEEDv4 Low-Emitting Materials Data Submittal Cover Sheet - Form B
C WaterSense labeled products are required for all eligible fixture types and products.

SUBSTITUTION REQUEST FORM

To Project Engineer: _____ Request # (GC Determined): _____

Project Name: _____

Project No/Phase: _____ Date: _____

Specification Title: _____

Section Number: _____ Page: _____ Article/Paragraph: _____

Proposed Substitution: _____

_____

Manufacturer: _____ Model No.: _____

Address: _____ Phone: _____

History: ☐ New product ☐ 1-4 years old ☐ 5-10 years old ☐ More than 10 years old

Differences between proposed substitution and specified Work: _____

_____

☐ Point-by-point comparative data attached – REQUIRED BY ENGINEER
Comparative data may include but not be limited to performance, certifications, weight, size, durability, visual effect, sustainable design characteristics, warranties, and specific features and requirements. Include all information necessary for an evaluation.

Supporting Data Attached: ☐ Drawings ☐ Product Data ☐ Samples ☐ Tests ☐ Reports ☐ Other: _____

Reason for not providing specified item: _____

_____

Similar Installation:
Project: _____ Architect: _____

Address: _____ Owner: _____

_____ Date Installed: _____

Proposed substitution affects other parts of Work: ☐ No ☐ Yes; explain: _____

_____

_____

Substitution Certification Statement:

Unless stated otherwise in writing to the Engineer by the Contractor, Contractor warrants to the Engineer, Architect, and Owner that the:

A. Proposed substitution has been fully investigated and determined to meet or exceed the specified Work in all respects.
B. Proposed substitution is consistent with the Contract Documents and will produce indicated results.
C. Proposed substitution does not affect dimensions and functional clearances.
D. Proposed substitution has received necessary approvals of authorities having jurisdiction.
E. Same warranty will be furnished for proposed substitution as for specified Work.
F. Same maintenance service and source of replacement parts, as applicable, is available.
G. Proposed substitution will not adversely affect other trades or delay construction schedule.
H. Coordination, installation, and changes in the Work as necessary for accepted substitution will be complete in all respects.

_____	_____	_____
Submitting Contractor	Date	Company

Manufacturer's Certification of Equal Quality:

I _____ represent the manufacturer of the Proposed Substitution item and hereby certify and warrant to Architect, Engineer, and Owner that the function and quality of the Proposed Substitution meets or exceeds the Specified Item.

_____	_____	_____
Manufacturer's Representative	Date	Company

Engineer Review and Recommendation Section

Recommend Acceptance	☐ Yes	☐ No
Additional Comments:	☐ Attached	☐ None

Acceptance Section:

_____	_____	_____
Contractor Acceptance Signature	Date	Company
_____	_____	_____
Owner Acceptance Signature	Date	Company
_____	_____	_____
Architect Acceptance Signature	Date	Company
_____	_____	_____
Engineer Acceptance Signature	Date	Company

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PART 1 - GENERAL REQUIREMENTS

1.01 SUMMARY

A. This Section specifies the basic requirements for electrical components which are an integral part of packaged plumbing equipment. These components include, but are not limited to factory furnished motors, starters, and disconnect switches furnished as an integral part of packaged plumbing equipment.

B. Specific electrical requirements (i.e. horsepower and electrical characteristics) for plumbing equipment are scheduled on the Drawings.

C. System shall be complete and operational with power and control wiring provided to meet the design intent shown on the drawings and specified within the specification sections.

1.02 SUBMITTALS

A. No separate submittal is required. Submit product data for motors, starters, and other electrical components with submittal data required for the equipment for which it serves, as required by the individual equipment specification Sections.

1.03 QUALITY ASSURANCE

A. Electrical components and materials shall be UL labeled.

B. All electrical equipment provided and the wiring and installation of electrical equipment shall be in accordance with the requirements of this Section and Division 26.

PART 2 - PRODUCTS AND MATERIALS

2.01 GENERAL

A. The Contractors shall provide all motors, starters, disconnects, wire, conduit, etc. as specified in the Construction Documents. If, however, the Plumbing Contractor furnishes a piece of equipment requiring a different motor, starter, disconnect, wire size, etc. than what is shown and/or intended on the Construction Documents, the Plumbing Contractor shall coordinate the requirements with any other Contractor and shall be responsible for any additional cost incurred by any other Contractor that is associated with installing the different equipment and related accessories for proper working condition.

B. Refer to Division 26, "Common Work Results for Electrical" for specification of motor connections

C. Refer to Division 26, "Enclosed Switches and Circuit Breakers" for specification of disconnect switches.

PART 3 - EXECUTION

3.01 CONTRACTOR COORDINATION

A. Unless otherwise indicated, all motors, equipment, controls, etc. shall be furnished, set in place and wired in accordance with Table 1. Any items not listed but shown on the drawings shall be considered part of the Contract Documents and brought to the attention of the Architect.

B. The General Contractor is the central authority governing the total responsibility of all trade contractors. Therefore, deviations and clarifications of this schedule are permitted provided the General Contractor assumes responsibility to coordinate the trade contractors different than as indicated herein. If deviations or clarifications to this schedule are implemented, submit a record copy to the Engineer.

TABLE 1: ELECTRICAL REQUIREMENTS FOR PLUMBING EQUIPMENT

ITEM	FURN BY	SET BY	POWER WIRING	CONTROL WIRING
Equipment motors	DIV 22	DIV 22	DIV 26	---
Factory furnished motor starters, contactors and disconnects	DIV 22	DIV 26	DIV 26	DIV 23
Loose motor starters, disconnect switches, thermal overloads and heaters.	DIV 26	DIV 26	DIV 26	DIV 23
Factory assembled control panels	DIV 22	DIV 26	DIV 26	DIV 23
Control relays and transformers	DIV 22	DIV 22	DIV 26	DIV 23
Thermostats (line voltage)	DIV 22	DIV 22	DIV 26	---
Time switches	DIV 22	DIV 22	DIV 26	DIV 23
Temperature control panels	DIV 22	DIV 22	DIV 26	DIV 23
Variable speed drives	DIV 22	DIV 22	DIV 26	DIV 23
Motor and solenoid operated valves	DIV 22	DIV 22	DIV 23	DIV 23
Laboratory Safety Devices	DIV22	DIV 26	DIV 26	DIV 23

DIV 22 = Plumbing Contractor
DIV 26 = Electrical Contractor
DIV 23 = Building Automation System Contractor, refer to Division 23 Section ”Direct-Digital Control for HVAC”.

END OF SECTION

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PART 1 - GENERAL REQUIREMENTS

1.01 SUMMARY

A. This Section includes limited scope general construction materials and methods for application with Plumbing installations as follows:

1. Access panels and doors in walls, ceilings, and floors for access to Plumbing materials and equipment.
2. Plumbing equipment nameplate data.
3. Concrete for bases and housekeeping pads.
4. Non-shrink grout for equipment installations.
5. Sleeves for Plumbing penetrations.
6. Miscellaneous metals for support of Plumbing materials and equipment.
7. Wood grounds, nailers, blocking, fasteners, and anchorage for support of Plumbing materials and equipment.
8. Joint sealers for sealing around Plumbing materials and equipment.

B. Related Sections: The following sections contain requirements that relate to this Section:

1. Division 7 Section “Penetration Firestopping” for material and methods for firestopping systems.
2. Division 22 Section "Basic piping Materials and Methods" for materials and methods for mechanical sleeve seals.
3. Division 22 Section “Sanitary Drainage and Vent Piping and Specialties” for indirect drain piping and installation requirements.
4. Division 23 Section “Direct Digital Controls for HVAC” for integration with building automation system of leak detection system “Water Present” alarm.
5. Division 26 Section “Common Work Results for Electrical” required electrical devices.
6. Division 26 Sections "Enclosed Switches and Circuit Breakers" for field-installed disconnects.

1.02 SUBMITTALS

A. General: Submit the following in accordance with Division 1 and Division 22 Section “General Plumbing Requirements”.

1. Product data for the following products:

a) Access panels and doors.
b) Through and membrane-penetration firestopping systems.
c) Joint sealers.

2. Shop drawings detailing fabrication and installation for metal fabrications, and wood supports and anchorage for Plumbing materials and equipment.

3. Welder certificates, signed by Contractor, certifying that welders comply with requirements specified under "Quality Assurance" article of this Section.

4. Schedules indicating proposed methods and sequence of operations for selective demolition prior to commencement of Work. Include coordination for shut-off of utility services and details for dust and noise control.

    a) Coordinate sequencing with construction phasing and Owner occupancy specified in Division 1 Section "Summary of Work."

5. Through and Membrane Penetration Firestopping Systems Product Schedule: Submit a schedule for each piping system penetration that includes UL listing, location, wall or floor rating and installation drawing for each penetration fire stop system.

    a) Where Project conditions require modification to a qualified testing and inspecting agency's illustration for a particular penetration firestopping condition, submit illustration, with modifications marked, approved by penetration firestopping manufacturer's fire-protection engineer as an engineering judgment or equivalent fire-resistance-rated assembly.

1.03 QUALITY ASSURANCE

A. Qualify welding processes and welding operators in accordance with AWS D1.1 "Structural Welding Code - Steel."

1. Certify that each welder has satisfactorily passed AWS qualification tests for welding processes involved and, if pertinent, has undergone recertification.

B. Fire-Resistance Ratings: Where a fire-resistance classification is indicated, provide access door assembly with panel door, frame, hinge, and latch from manufacturer listed in the UL "Building Materials Directory" for rating shown.

1. Provide UL Label on each fire-rated access door.

C. Through and Membrane Penetration Systems Installer Qualifications: A firm experienced in installing penetration firestopping systems similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful performance. Qualifications include having the necessary experience, staff, and training to install manufacturer's products per specified requirements. Manufacturer's willingness to sell its penetration firestopping system products to Contractor or to Installer engaged by Contractor does not in itself confer qualification on buyer.

1.04 NOISE CRITICAL SPACES

A. Many areas of the building, referred to as "noise-critical spaces", require special attention (special acoustical provisions and restrictions). The table below designates the noise-critical spaces; noise levels due to equipment, ductwork, grilles, registers, terminal devices, diffusers, etc., shall permit attaining sound pressure levels in all 8 octave bands in occupied spaces conforming to RC levels per ASHRAE handbook as indicated.

Space	RC Levels
A/V Spaces	25
Teleconference Rooms	25
Meeting/Banquet Rooms	30
Conference Rooms	30
Courtrooms	30

PART 2 - PRODUCTS AND MATERIALS

2.01 ACCESS TO EQUIPMENT

A. Manufacturer:

1. Bar-Co., Inc.
2. Elmdor Stoneman.
3. JL Industries
4. Jay R. Smith Mfg. Co.
5. Karp Associates, Inc.
6. Milcor
7. Nystrom Building Products
8. Wade
9. Zurn

B. Access Doors:

1. Provide access doors for all concealed equipment, except where above lay-in ceilings. Refer to Section “Identification for Plumbing Piping” for labeling of access doors.
2. Access doors shall be adequately sized for the devices served with a minimum size of 18 inches x 18 inches, furnished by the respective Contractor or Subcontractor and installed by the General Contractor.
3. Access doors must be of the proper construction for type of construction where installed.
4. The exact location of all access doors shall be verified with the Architect prior to installation.
5. Steel Access Doors and Frames: Factory-fabricated and assembled units, complete with attachment devices and fasteners ready for installation. Joints and seams shall be continuously welded steel, with welds ground smooth and flush with adjacent surfaces.

6. Frames: 16-gauge steel, with a 1-inch-wide exposed perimeter flange for units installed in unit masonry, pre-cast, or cast-in-place concrete, ceramic tile, or wood paneling.

    a) For installation in masonry, concrete, ceramic tile, or wood paneling: 1-inch-wide exposed perimeter flange and adjustable metal masonry anchors.
    b) For installation in gypsum wallboard or plaster: perforated flanges with wallboard bead.
    c) For installation in full-bed plaster applications: galvanized, expanded metal lath and exposed casing bead, welded to perimeter of frame.

7. Flush Panel Doors: 14-gauge sheet steel, with concealed spring hinges or concealed continuous piano hinge set to open 175 degrees; factory-applied prime paint.

    a) Fire-Rated Units: Insulated flush panel doors, with continuous piano hinge and self-closing mechanism.

8. Locking Devices: Flush, screwdriver-operated cam locks.
9. Locking Devices: Where indicated on the drawings or where access panels are installed in locations accessible to the public, provide 5-pin or 5-disc type cylinder locks, individually keyed; provide 2 keys.

2.02 PLUMBING EQUIPMENT NAMEPLATE DATA

A. For each piece of power operated Plumbing equipment, provide a permanent operational data nameplate indicating manufacturer, product name, model number, serial number, capacity, operating and power characteristics, labels of tested compliance's, and similar essential data. Locate nameplates in an accessible location.

2.03 CONCRETE EQUIPMENT BASES/HOUSEKEEPING PADS

A. Provide concrete equipment bases and housekeeping pads for various pieces of floor mounted Plumbing equipment. Concrete equipment bases/housekeeping pads shall generally conform to the shape of the piece of equipment it serves with a minimum 4" margin around the equipment and supports.

B. Form concrete equipment bases and housekeeping pads using framing lumber or steel channel with form release agent. Chamfer top edges and corners. Trowel tops and sides of each base/pad to a smooth finish, equal to that of the floors.

C. Concrete equipment bases and housekeeping pads shall be made of a minimum 28 day, 4000 psi concrete conforming to American Concrete Institute Standard Building Code for Reinforced Concrete (ACI 318-99) and the latest applicable recommendations of the ACI standard practice manual. Concrete shall be composed of cement conforming to ASTM C 150 Type I, aggregate conforming to

ASTM C33, and potable water. All exposed exterior concrete shall contain 5 to 7 percent air entrainment.

D. Unless otherwise specified or shown on the structural drawings, reinforce equipment bases and housekeeping pads with No. 4 reinforcing bars conforming to ASTM A 615 or 6x6 – W2.9 x W2.9 welded wire mesh conforming to ASTM A185. Reinforcing bars shall be placed 24" on center with a minimum of two bars each direction.

E. Provide galvanized anchor bolts for all equipment placed on concrete equipment bases and housekeeping pads or on concrete slabs. Anchor bolts size, number and placement shall be as recommended by the Manufacturer of the equipment.

F. Concrete equipment bases and housekeeping pads shall have minimum heights in accordance with the following table:

Equipment	Minimum Height
Water Heaters, Water Softeners and Equipment Less than or equal to 20 tons and Other Equipment Not Listed – Note 1	3-1/2"

NOTES:

1. Height of equipment bases applies to equipment installed on slab-on-grade. For equipment installed on floors above grade and/or roof, reference the drawings.

2.04 GROUT

A. Provide nonshrink, nonmetallic grout conforming to ASTM C 1107, Grade B, in premixed and factory-packaged containers.

B. Grout shall have post-hardening, volume-adjusting, dry, non-staining, non-corrosive, non-gaseous, hydraulic-cement characteristics and shall be as recommended by manufacturer for interior and exterior applications.

C. Grout shall have 5,000 psi, 28-day compressive strength design mix.

2.05 PENETRATIONS

A. Sleeves:

1. Steel Sleeves: Schedule 40 galvanized, welded steel pipe, ASTM A-53 grade A or 12 gauge (0.1084 inches) welded galvanized steel formed to a true circle concentric to the pipe.
2. Sheet-Metal Sleeves: 10 gauge (0.1382 inches), galvanized steel, round tube closed with welded longitudinal joint.

B. Frames for rectangular openings attached to forms and of a maximum dimension established by the Architect. For sleeve cross-section rectangle perimeter less than

50 inches and no side greater than 16 inches, provide 18 gauge (0.052 inches) welded galvanized steel. For sleeve cross-section rectangle perimeter equal to, or greater than, 50 inches and 1 or more sides equal to, or greater than, 16 inches, provide 10 gauge (0.1382 inches) welded galvanized steel. Notify the General Contractor or Architect before installing any box openings not shown on the Architectural or Structural Drawings.

C. Box Frames: Frames for rectangular openings shall be of welded 12 gauge steel attached to forms and of a maximum dimension established by the Architect. Contractor shall notify the General Contractor or Architect before installing any box openings not shown on the Architectural or Structural Drawings.

2.06 DRIP PANS

A. Drip pans for pipes in protected areas shall be 20 gauge galvanized steel with 2" lapped and soldered joints. Drip pan shall have a depth of 2" and a width of 6" in addition to the diameter of the associated pipe. Provide 3/4" galvanized pipe with male NPT outlet at low point of drip pan.

B. Drip pan supports shall be ¼" X 2" galvanized bar stock welded to the drip pan without holes.

2.07 MISCELLANEOUS METALS

A. Steel plates, shapes, bars, and bar grating: ASTM A 36.

B. Cold-Formed Steel Tubing: ASTM A 500.

C. Hot-Rolled Steel Tubing: ASTM A 501.

D. Steel Pipe: ASTM A 53, Schedule 40, welded.

E. Fasteners: Zinc-coated, type, grade, and class as required.

2.08 MISCELLANEOUS LUMBER

A. Framing Materials: Standard Grade, light-framing-size lumber of any species. Number 3 Common or Standard Grade boards complying with WCLIB or AWPA rules, or Number 3 boards complying with SPIB rules. Lumber shall be preservative treated in accordance with AWPB LP-2, and kiln dried to a moisture content of not more than 19 percent.

B. Construction Panels: Plywood panels; APA C-D PLUGGED INT, with exterior glue; thickness as indicated, or if not indicated, not less that 15/32 inches.

2.09 JOINT SEALERS

A. General: Joint sealers, joint fillers, and other related materials compatible with each other and with joint substrates under conditions of service and application.

B. Colors: As selected by the Architect from manufacturer's standard colors.

C. Elastomeric Joint Sealers: Provide the following types:

1. One-part, nonacid-curing, silicone sealant complying with ASTM C 920, Type S, Grade NS, Class 25, for uses in non-traffic areas for masonry, glass, aluminum, and other substrates recommended by the sealant manufacturer. Provide one of the following:

a) "Dow Corning 790," Dow Corning Corp.
b) "Silglaze II SCS 2801," General Electric Co.
c) "Silpruf SCS 2000," General Electric Co.
d) "864," Pecora Corp.
e) "Rhodia 5C," Rhone-Poulenc, Inc.
f) "Spectrem 1," Tremco, Inc.
g) "Spectrem 2," Tremco, Inc.
h) "Dow Corning 795," Dow Corning Corp.
i) "Rhodia 7B," Rhone-Poulenc, Inc.
j) "Rhodia 7S," Rhone-Poulenc, Inc.
k) "Omniseal," Sonneborn Building Products Div.

2. One-part, mildew-resistant, silicone sealant complying with ASTM C 920, Type S, Grade NS, Class 25, for uses in non-traffic areas for glass, aluminum, metal or porcelain plumbing fixtures and nonporous joint substrates; formulated with fungicide; intended for sealing interior joints with nonporous substrates; and subject to in-service exposure to conditions of high humidity and temperature extremes. Provide one of the following:

a) "Dow Corning 786," Dow Corning Corp.
b) "Sanitary 1700," General Electric Co.
c) "898 Silicone Sanitary Sealant," Pecora Corp.

D. Acrylic-Emulsion Sealants: One-part, nonsag, mildew-resistant, paintable complying with ASTM C 834 recommended for exposed applications on interior and protected exterior locations involving joint movement of not more than plus or minus 5 percent. Provide one of the following:

1. Products: Subject to compliance with requirements, provide one of the following:

a) "Chem-Calk 600," Bostik Construction Products Div.
b) "AC-20," Pecora Corp.
c) "Sonolac," Sonneborn Building Products Div.
d) "Tremflex 834," Tremco, Inc.

2.010 ACOUSTICAL SEALANTS

A. General: Penetrations by pipes through surfaces that are around and between noise critical spaces shall be sleeved, packed and sealed airtight with foam rod, non-hardening sealant and/or packing material as described herein.

B. Foam Rod: Foam backer rod shall be closed cell polyethylene suitable for use as a backing for non-hardening sealant.

C. Non-Hardening Sealant: Sealant for penetrations shall be non-hardening polysulphide type. Permanently flexible, approved firestop putty may be used in lieu of the sealant on foam rod in noise critical walls that are also fire rated.

D. Packing Material: Mineral fiber; non-combustible; resistant to water, mildew and vermin. Expanding resilient foams manufactured for this purpose are an acceptable alternative only if the material density is at least 15 pcf (40 kg/m3).

2.011 FIRESTOPPING

A. Sealants and accessories shall have fire-resistance ratings indicated, as established by testing identical assemblies in accordance with UL 2079 or ASTM E 814, or other NRTL acceptable to AHJ. Manufactured by:

1. 3M Corp., Fire Barrier Sealant
2. Hilti
3. Owens Corning, Firestopping Insulation.
4. Pecora, AC-20 FTR
5. RectorSeal
6. Specified Technologies Inc.,
7. United States Gypsum Company SHEETROCK Firecode Compound
8. Tremco, Tremstop Fyre-Sil.

PART 3 - EXECUTION

3.01 INSTALLATION, GENERAL

A. Install leak detection systems, plenum insulation, access doors and sealants in accordance with manufacturer's installation instructions.

3.02 INSTALLATION OF ACCESS DOORS

A. Set frames accurately in position and securely attached to supports, with face panels plumb and level in relation to adjacent finish surfaces.

B. Adjust hardware and panels after installation for proper operation.

3.03 ERECTION OF METAL SUPPORTS AND ANCHORAGE

A. Cut, fit, and place miscellaneous metal fabrications accurately in location, alignment, and elevation to support and anchor Plumbing materials and equipment.

B. Field Welding: Comply with AWS "Structural Welding Code."

3.04 ERECTION OF WOOD SUPPORTS AND ANCHORAGE

A. Cut, fit, and place wood grounds, nailers, blocking, and anchorage accurately in location, alignment, and elevation to support and anchor Plumbing materials and equipment.

B. Select fastener sizes that will not penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections between members. Install fasteners without splitting wood members.

C. Attach to substrates as required to support applied loads.

3.05 PREPARATION FOR JOINT SEALERS

A. Surface Cleaning for Joint Sealers: Clean surfaces of joints immediately before applying joint sealers to comply with recommendations of joint sealer manufacturer.

B. Apply joint sealer primer to substrates as recommended by joint sealer manufacturer. Protect adjacent areas from spillage and migration of primers, using masking tape. Remove tape immediately after tooling without disturbing joint seal.

3.06 APPLICATION OF JOINT SEALERS

A. General: Comply with joint sealer manufacturers' printed application instructions applicable to products and applications indicated, except where more stringent requirements apply.

1. Comply with recommendations of ASTM C 962 for use of elastomeric joint sealants.
2. Comply with recommendations of ASTM C 790 for use of acrylic-emulsion joint sealants.

B. Tooling: Immediately after sealant application and prior to time shinning or curing begins, tool sealants to form smooth, uniform beads; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint. Remove excess sealants from surfaces adjacent to joint. Do not use tooling agents that discolor sealants or adjacent surfaces or are not approved by sealant manufacturer.

3.07 PENETRATIONS:

A. New Construction:

1. Coordinate with Divisions 03 and 04 for installation of sleeves and sleeve seals integrally in cast-in-place, precast, and masonry walls and horizontal slabs where indicated on the Drawings or as required to support piping or ductwork penetrations.

B. Construction in Existing Facilities:

1. Saw cut or core drill existing walls and slabs to install sleeves and sleeve seals in existing facilities. Do not cut or drill any walls or slabs without first coordinating with, and receiving approval from, the Architect, Owner, or both. Seal sleeves and sleeve seals into concrete walls or slabs with a waterproof non-shrink grout acceptable to the Architect.

C. Provide sleeves and/or box frames for openings in all concrete and masonry construction and fire or smoke partitions, for all mechanical work that passes through such construction; Coordinate with other trades and Divisions to dimension and lay out all such openings.

D. The General Contractor will provide only those openings specifically indicated on the Architectural or Structural Drawings as being provided under the General Contractor's work.

E. The cutting of new or existing construction shall not be permitted except by written approval of the Architect.

F. Floor sleeves shall be fitted with means for attachment to forms and shall be of length to extend at least two inches above the floor level.

G. Cut sleeves to length for mounting flush with both surfaces of walls.

H. Extend sleeves installed in floors 2 inches above finished floor level.

I. Seal space outside of sleeves with grout for penetrations of concrete and masonry.

J. Seal space outside of sleeves with approved joint compound for penetrations of gypsum board assemblies.

K. All openings sleeved through underground exterior walls shall be sealed with mechanical sleeve seals as specified in Division 22 Section “Basic Piping Materials and Methods”.

3.08 DRIP PANS

A. Provide drip pans in locations indicated on drawings.

B. Provide drip pans for piping directly above a two hour rated ceiling of an elevator machine room.

C. Provide drip pans, only with written approval obtained prior to installation, installed beneath piping above electrical rooms, telecom rooms, data rooms, servers or any other protected area not clearly indicated by drawings.

D. Provide drip pan supports every 4'-0". Provide ¼" galvanized threaded rods through bar stock on each side of the drip pan and attached with 2 nuts per rod. Attach rods to structure with MSS SP-58 compliant components.

E. Connect ¾" type "L" copper indirect drain line to drip pan outlet. Route and discharge to receptor with air gap outside of the protected area.

F. Install leak detection rope in a zig-zag pattern covering entire length and width of the drip pan. Secure rope to pan per manufacturers recommendations.

G. Mount leak detection controller on wall adjacent to exit of the room above which the drip pan is located unless otherwise indicated on drawings indicated on drawings.

H. Coordinate disconnect and power supply for leak detection system and 120V dedicated receptacle adjacent to controller with Division 26. Power wiring and receptacles are specified in Division 26 Section "Common Work Results for Electrical" Disconnects are specified in Division 26 Section "Enclosed Switches and Circuit Breakers"

I. Coordinate interlock of "Water Present" alarm and "Cable Fault alarm with Building Automation System. Refer to Division 23 Section "Direct Digital Controls for HVAC" for integration with building automation system and low voltage power wiring.

3.09 ACOUSTICAL PENETRATIONS

A. General: There shall be no direct contact of piping with shaft walls, floor slabs and/or partition. All openings around pipes in the structure surrounding the plumbing equipment and surrounding noise-critical spaces shall be sealed, packed with caulking for the full depth of the penetration, as described herein. This includes all slab penetrations and penetrations of noise critical walls.

B. Domestic Water, Sewer, Drain and Vent Piping

1. Where a pipe passes through a wall, ceiling or floor slab of a noise critical space, a steel sleeve shall be cast or grouted into the structure. The internal diameter of the sleeve shall be 2 inches larger than the external diameter of the pipe passing through it. After all of the piping is installed in that area, the Contractor shall check the clearance and correct it, if necessary, to within 1/2 inch. Pack the void full depth with packing material sealed at both ends, 1 inch deep, with non-hardening sealant backed by foam rod.

C. Compressed Air Piping

1. Compressed air pipes may be sleeved and sealed as described above, or may be grouted and caulked into the structure as follows: before grout has set, rake a groove around the pipe on each side of the wall or slab; groove shall be 1/2 inch wide and 1/2 inch deep. After grout has set, fill groove full depth with sealant.

END OF SECTION

PART 1 - GENERAL REQUIREMENTS

1.01 SUMMARY

A. This Section includes the following:

1. Single phase electric motors.
2. Three phase electric motors.

1.02 SUBMITTALS

A. General: Submit the following in accordance with conditions of contract and Division 1 specification Sections.

1. Product Data: Show nameplate data and ratings; characteristics; mounting arrangements; size and location of winding termination lugs, conduit entry, and grounding lug; and coatings.

1.03 QUALITY ASSURANCE

A. All motors shall be UL listed.

PART 2 - PRODUCTS AND MATERIALS

2.01 MANUFACTURERS

A. Century

B. General Electric

C. Westinghouse

D. Baldor

E. Gould

2.02 GENERAL CONSTRUCTION AND REQUIREMENTS

A. Motors Less Than 250 Watts, for Intermittent Service: Provide equipment manufacturer's standard. Motor's need not conform to these specifications.

B. Electrical Service: All motors shall be supplied in accordance with the following voltage and phase unless noted otherwise on the Drawings.

1. Motors 3/4 HP and Larger: 480 volts, three phase, 60 Hz.
2. Motors 1/2 HP and Smaller: 120 volts, single phase, 60 Hz.

C. Type:

1. Open drip-proof except where noted otherwise.
2. Motors: Design for continuous operation in 40 degrees C environment.
3. Design for temperature rise in accordance with NEMA MG 1 limits for insulation class, service factor, and motor enclosure type.
4. Motors with frame sizes 254T and larger: Energy Efficient Type.

D. Visible Nameplate: Indicating motor horsepower, voltage, phase, cycles, RPM, full load amps, locked rotor amps, frame size, manufacturer's name and model number, service factor, power factor, efficiency.

E. Wiring Terminations:

1. Provide terminal lugs to match branch circuit conductor quantities, sizes, and materials indicated. Enclose terminal lugs in terminal box sized to NFPA 70, threaded for conduit.
2. For fractional horsepower motors, provide flexible conduit connection in end frame. Maximum length of flexible conduit shall be five feet.

2.03 SINGLE PHASE POWER - SPLIT PHASE MOTORS

A. Starting Torque: Less than 150 percent of full load torque.

B. Starting Current: Up to seven times full load current.

C. Breakdown Torque: Approximately 200 percent of full load torque.

2.04 SINGLE PHASE POWER - PERMANENT-SPLIT CAPACITOR MOTORS

A. Starting Torque: Exceeding one fourth of full load torque.

B. Starting Current: Up to six times full load current.

C. Multiple Speed: Through tapped windings.

D. Open Drip-proof or Enclosed Air Over Enclosure: Class A (50 degrees C temperature rise) insulation, minimum 1.0 Service Factor, prelubricated sleeve or ball bearings, automatic reset overload protector.

2.05 THREE PHASE POWER - SQUIRREL CAGE MOTORS

A. Starting Torque: Between 1 and 1-1/2 times full load torque.

B. Starting Current: Six times full load current.

C. Power Output, Locked Rotor Torque, Breakdown or Pull Out Torque: NEMA Design B characteristics.

D. Design, Construction, Testing, and Performance: Conform to NEMA MG 1 for Design B motors.

E. Insulation System: NEMA Class B or better.

F. All motors controlled by variable frequency controllers shall have a 1.15 Service Factor.

G. Testing Procedure: In accordance with IEEE 112. Load test motors to determine free from electrical or mechanical defects in compliance with performance data.

H. Motor Frames: NEMA Standard T-Frames of steel, aluminum, or cast iron with end brackets of cast iron or aluminum with steel inserts.

I. Thermistor System (Motor Frame Sizes 254T and Larger): Three PTC thermistors imbedded in motor windings and epoxy encapsulated solid state control relay for wiring into motor starter; refer to Division 16 - Motor Controlling Equipment.

J. Bearings: Grease lubricated anti-friction ball bearings with housings equipped with plugged provision for relubrication, rated for minimum AFBMA 9, L-10 life of 20,000 hours. Calculate bearing load with NEMA minimum V-belt pulley with belt center line at end of NEMA standard shaft extension. Stamp bearing sizes on nameplate.

K. Sound Power Levels: To NEMA MG 1.

L. All totally enclosed motors shall be fan cooled type. Non-ventilated type motors are not acceptable.

M. Variable Frequency Drive Motors: Motors controlled by variable frequency drives shall be rated for voltage peaks and minimum rise times in accordance with NEMA MG1, Part 31.

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. Inverter-Duty Motors: Class B temperature rise; Class F insulation.
3. Grounding: Provide shaft grounding system equal to AEGIS SGR Bearing Protection Ring, Inpro/Seal Current Diverter Ring (CDR) or approved equal. Install system in accordance with manufacturer's recommendations.

N. Nominal Efficiency: Motors shall have minimum efficiency meeting the requirements of the Energy Policy Act of 1992 and as scheduled at full load and rated voltage when tested in accordance with IEEE 112.

O. Nominal Power Factor: As scheduled at full load and rated voltage when tested in accordance with IEEE 112.

PART 3 - EXECUTION

3.01 APPLICATION

A. Single phase motors for pumps and air compressors: Capacitor start type.

3.02 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install securely on firm foundation.

C. Check line voltage and phase and ensure agreement with nameplate.

3.03 NEMA OPEN MOTOR SERVICE FACTOR SCHEDULE

HP	3600 RPM	1800 RPM	1200 RPM	900 RPM
1/6-1/3	1.35	1.35	1.35	1.35
1/2	1.25	1.25	1.25	1.15
3/4	1.25	1.25	1.15	1.15
1	1.25	1.15	1.15	1.15
1.5-150	1.15	1.15	1.15	1.15

3.04 PERFORMANCE SCHEDULE: THREE PHASE-ENERGY EFFICIENT, TOTALLY ENCLOSED, FAN COOLED

HP	RPM(Sync)	NEMA Frame	Minimum Percent Efficiency	Minimum Power Factor
1-1/2	3600	143T	82.5	85
2	3600	145T	84	87
3	3600	182T	85.5	87
5	3600	184T	87.5	88
7-1/2	3600	213T	88.5	86
10	3600	215T	89.5	86
15	3600	254T	90.2	91
20	3600	256T	90.2	89
25	3600	284T	91	92
30	3600	286T	91	92
40	3600	324T	91.7	91
50	3600	326T	92.4	92
60	3600	364T	93	93
75	3600	365T	93	91
100	3600	405T	93.6	92

END OF SECTION

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PART 1 - GENERAL REQUIREMENTS

1.01 SUMMARY

A. This Section specifies piping materials and installation methods common to more than one Section of Division 22 and includes joining materials, piping specialties and basic piping installation instructions.

B. Related Sections: The following sections contain requirements that relate to this Section:

1. Division 22 Section "Common Work Results for Plumbing," for materials and methods for sleeve materials.

1.02 DEFINITIONS

A. Lead Free: Refers to the wetted surface of pipe, fittings and fixtures in potable water systems that have a weighted average lead content ≤0.25% per Safe Drinking Water Act as amended January 4th 2011 Section 1417.

1.03 SUBMITTALS

A. Refer to Division 1 and Division 22 Section “General Plumbing Requirements” for administrative and procedural requirements for submittals.

B. Product Data: Submit product data on the following items:

1. Escutcheons
2. Dielectric Unions
3. Dielectric Flanges and Flange Kits
4. Mechanical Sleeve Seals
5. Wall Pipes
6. Strainers
7. Flexible Connectors

C. Quality Control Submittals:

1. Submit welders' certificates specified in Quality Assurance below.

D. Submit certification that specialties and fittings for domestic water distribution comply with NSF 61 Annex G and / or NSF 372.

E. Submit a schedule of dissimilar metal joints and dielectric waterway fittings, unions, flanges or flange kits. Include joint type materials, connection method and proposed dielectric waterway fittings, unions and flanges to isolate dissimilar metals. Include minimum and maximum torque requirements for flange connections to valves. Refer to the individual piping system specification sections

in Division 22 for specifications for piping materials and fittings relative to that particular system and additional requirements.

F. Submit certification that fittings and specialties are manufactured in plants located in the United States or certified that they comply with applicable ANSI and ASTM standards.

1.04 QUALITY ASSURANCE

A. Welder's Qualifications: All welders shall be qualified in accordance with ASME Boiler and Pressure Vessel Code, Section IX, Welding and Brazing Qualifications.

B. Welding procedures and testing shall comply with ANSI Standard B31.9 - Standard Code for Building Services Piping and The American Welding Society, Welding Handbook.

C. Soldering and Brazing procedures shall conform to ANSI B9.1 Standard Safety Code for Plumbing Refrigeration.

D. Pipe specialties and fittings shall be manufactured in plants located in the United States or certified to meet the specified ASTM and ANSI standards.

E. Comply with NSF 61 Annex G and / or NSF 372 for wetted surfaces of specialties and fittings containing no more than 0.25% lead by weight for domestic water distribution.

PART 2 - PRODUCTS AND MATERIALS

2.01 MANUFACTURERS

A. Manufacturer: Subject to compliance with requirements, provide piping materials and specialties from one of the following:

1. Pipe Escutcheons:
    a) AWI Manufacturing.
    b) Keeney Manufacturing Company
    c) Wal-Rich Corp.
    d) Jones Stephens Corp.
2. Dielectric Unions:
    a) JOMAR International
    b) Smith Cooper International
    c) Watts Regulator Co.
    d) Zurn Industries
3. Dielectric Flanges and Flange Kits:
    a) Calpico, Inc.
    b) FMC Technologies

c) Pipeline Seal & Insulator, Inc.
d) Tampa Rubber and Gasket Co., inc.
e) Watts Industries Inc.; Water Products Div.
f) Zurn Industries, Inc.; Wilkins Div.

4. Strainers – 2" and smaller:

a) Apollo
b) Hammond
c) Milwaukee
d) NIBCO

5. Strainers – 2-1/2" and larger:

a) Metraflex Co.
b) Watts Regulator Co.
c) Zurn Industries, Inc.; Wikins Div.

6. Mechanical Sleeve Seals:

a) Advance Products & Systems
b) Calpico, Inc.
c) GPT Industries/Link Seal
d) Metraflex Co.
e) Proco Products, Inc.

7. Metal Flexible Connectors:

a) United Flexible, Inc.
b) Hyspan
c) Mason Industries, Inc.
d) Mercer Rubber Co.
e) Metraflex Co.
f) Proco Products, Inc.
g) Resistoflex
h) Tyler Pipe; Gustin-Bacon Div.

8. Wall Pipes

a) Josam Mfg. Co.
b) Smith (Jay R) Mfg. Co.
c) Tyler Pipe/Wade Div.; Subs. of Tyler Corp.
d) Watts Industries, Inc.
e) Zurn Industries, Inc.; Hydromechanics Div.

2.02 PIPE AND FITTINGS

A. Refer to the individual piping system specification sections in Division 22 for specifications on piping and fittings relative to that particular system.

B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

2.03 JOINING MATERIALS

A. Refer to individual Division 22 Piping Sections for special joining materials not listed below.

B. Welding Materials: AWS D10.12; Comply with Section II, Part C, ASME Boiler and Pressure Vessel Code for welding materials appropriate for the wall thickness and chemical analysis of the pipe being welded.

C. Brazing Materials: AWS A5.8; Comply with SFA-5.8, Section II, ASME Boiler and Pressure Vessel Code for brazing filler metal materials appropriate for the materials being joined.

D. Soldering Materials: ASTM B32; Refer to individual piping system specifications for solder appropriate for each respective system.

E. Gaskets for Flanged Joints: ASME B16.21; Gasket material shall be full-faced for cast-iron flanges and raised-face for steel flanges. Select materials to suit the service of the piping system in which installed and which conform to their respective ANSI Standard (A21.11, B16.20, or B16.21). Provide materials that will not be detrimentally affected by the chemical and thermal conditions of the fluid being carried.

2.04 PIPING SPECIALTIES

A. Escutcheons: Chrome-plated, stamped steel, hinged, split-ring escutcheon, with set screw. Inside diameter shall closely fit pipe outside diameter, or outside of pipe insulation where pipe is insulated. Outside diameter shall completely cover the opening in floors, walls, or ceilings.

B. Unions:

1. Malleable-iron, Class 150 for low pressure service and class 300 for high pressure service; hexagonal stock, with ball-and-socket joints, metal-to-metal bronze seating surfaces; female threaded ends.
2. Bronze, Class 125, with lead free cast bronze body meeting ASTM B584, for low pressure service and class 250 for high pressure service; hexagonal stock, with ball-and-socket joints, metal-to-metal bronze seating surfaces; solder or female threaded ends.

C. Dielectric Unions: Factory-fabricated with lead free cast bronze body meeting ASTM B584 and galvanized steel body with plastic dielectric gasket, class 125 for low pressure service and class 250 for high pressure service, and appropriate end connections for the pipe materials in which installed (screwed or soldered) to effectively isolate dissimilar metals, prevent galvanic action, and stop corrosion.

D. Dielectric Flanges and Flange Kits:

1. Full faced gasket with same outside diameter and bolt hole arrangement as the flange. Pressure rating of 200psi for low pressure service and 400 psi for high pressure service at a continuous operating temperature of 180F.
2. Steel washers, thermoplastic washers and bolt isolation sleeves or thermoplastic combination washers and bolt sleeves.
3. Lead free cast bronze meeting ASTM B584, class 125 solder type or cast iron class 125 threaded type for low pressure service and bronze class 250 solder type or cast iron class 250 threaded type for high pressure service.

E. Y-Type Strainers: Provide strainers full line size of connecting piping, with ends matching piping system materials. Screens for 4" and smaller shall be Type 304 stainless steel mesh with 0.062" perforations and screens for 5" and larger shall be Type 304 stainless steel, with 0.125" perforations.

1. For low pressure applications, cast iron strainers shall have 125 psi working pressure rating and cast bronze strainers shall have 150 psi working pressure rating. For high pressure applications, cast iron strainers shall have 250 psi working pressure rating and cast bronze strainers shall have 300 psi working pressure rating.
2. Solder Ends, 2" and Smaller: Lead free cast bronze body meeting ASTM B584, screwed screen retainer with centered blowdown fitted with pipe plug.
3. Flanged Ends, 2-1/2" and Larger: Cast-iron body, with FDA fused epoxy coating, bolted screen retainer with off-center blowdown fitted with pipe plug.

F. Sleeves:

1. Sleeve: Refer to Division 22 Section "Common Work Results for Plumbing" for sleeve materials.

G. Mechanical Sleeve Seals: Modular Plumbing type, consisting of interlocking synthetic rubber links shaped to continuously fill annular space between pipe and sleeve, connected with bolts and pressure plates which cause rubber sealing elements to expand when tightened, providing watertight seal and electrical insulation.

H. Flexible Connectors: Fabricated from materials suitable for system fluid and that will provide flexible pipe connections.

1. Stainless-Steel-Hose, Flexible Connectors: For 2" and smaller, corrugated, stainless-steel, inner tubing covered with stainless-steel wire braid. Include ANSI 150# 304 stainless-steel nipples with screwed connections, welded to hose.
2. Bronze Hose, Flexible Connectors: For 2" and smaller, corrugated bronze inner tubing covered with bronze wire braid. Include ANSI 150# brass nipples with screwed connections, braised to hose.
3. Stainless-Steel-Hose, Flexible Connectors: For 2-1/2" and larger, corrugated, stainless-steel, inner tubing covered with stainless-steel wire

braid. Include ANSI 150# 304 stainless-steel nipples or flanges, welded to hose.

2.05 WALL PIPES

A. Cast-iron sleeve with integral clamping flange with clamping ring, bolts, and nuts for membrane flashing.

1. Underdeck Clamp: Clamping ring with setscrews.

2.06 WALL SLEEVES

1. Steel sleeve of schedule 40 pipe meeting ASTM A53B with 2" wide metal plate meeting ASTM A36 welded all around. Hot dip galvanized inside and out.

PART 3 - EXECUTION

3.01 INSTALLATION, GENERAL

A. Install in accordance with manufacturer's installation instructions.

3.02 PREPARATION

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

B. Remove scale, slag, dirt, and debris for both inside and outside of piping and fittings before assembly.

3.03 INSTALLATIONS

A. General Locations and Arrangements: Drawings (plans, schematics, and diagrams) indicate the general location and arrangement of the piping systems. Location and arrangement of piping layout take into consideration pipe sizing and friction loss, expansion, pump sizing, and other design considerations. So far as practical, install piping as indicated. Refer to individual system specifications for requirements for coordination drawing submittals.

B. Conceal all pipe installations in walls, pipe chases, utility spaces, above ceilings, below grade or floors, unless indicated otherwise.

C. Install piping free of sags and bends and with ample space between piping to permit proper insulation applications.

D. Install exposed piping at right angles or parallel to building walls. Diagonal runs are not permitted, unless expressly indicated on the Drawings.

E. Install horizontal piping as high as possible allowing for specified slope and coordination with other components. Install vertical piping tight to columns or

walls. Provide space to permit insulation applications, with 1" clearance outside the insulation. Allow sufficient space above removable ceiling panels to allow for panel removal.

F. Locate groups of pipes parallel to each other, spaced to permit applying full insulation and servicing of valves.

G. Support piping from structure. Do not support piping from ceilings, equipment, ductwork, conduit and other non-structural elements.

H. Install drains at low points in mains, risers, and branch lines consisting of a tee fitting, 3/4" ball valve, and short 3/4" threaded nipple and cap.

I. Verify final equipment locations for roughing in.

3.04 PIPING PROTECTION

A. Protect piping during construction period, to avoid clogging with dirt and debris, and to prevent damage from traffic and construction work.

B. Place plugs in ends of uncompleted piping at end of day or whenever work stops.

3.05 PENETRATIONS

A. Plumbing penetrations occur when piping penetrate concrete slabs, concrete or masonry walls, or fire / smoke rated floor and wall assemblies.

B. Above Grade Concrete or Masonry Penetrations

1. Provide sleeves for pipes passing through above grade concrete or masonry walls, concrete floor or roof slabs. Sleeves are not required for core drilled holes in existing masonry walls, concrete floors or roofs. Provide sleeves as follows:

   a) Provide schedule 40 galvanized steel pipe for sleeves smaller than 6 inches in diameter.
   b) Provide galvanized sheet metal for sleeves 6 inches in diameter and larger, thickness shall be 10 gauge (0.1382 inches).
   c) Provide welded galvanized sheet metal for rectangular sleeves with the following minimum metal thickness:

      1) For sleeve cross-section rectangle perimeter less than 50 inches and no side greater than 16 inches, thickness shall be 18 gauge (0.052 inches).
      2) For sleeve cross-section rectangle perimeter equal to, or greater than, 50 inches and 1 or more sides equal to, or greater than, 16 inches, thickness shall be 10 gauge (0.1382 inches).

d) Schedule 40 PVC pipe sleeves are acceptable for use in areas without return air plenums.

2. Extend pipe insulation for insulated pipe through floor, wall and roof penetrations, including fire rated walls and floors. The vapor barrier shall be maintained. Size sleeve for a minimum of 1" annular clear space between inside of sleeve and outside of insulation.
3. Seal elevated floor, exterior wall and roof penetrations watertight and weathertight with non-shrink, non-hardening commercial sealant. Pack with mineral wool and seal both ends with minimum of ½" of sealant.

C. Underground, Exterior-Wall Penetrations: Provide galvanized steel wall sleeve. Wall sleeve is not required for existing concrete walls with core drilled penetrations. Size wall sleeves to allow for 1-inch or larger, if required by the mechanical sleeve seal manufacturer) annular clear space between pipe and sleeve. Provide mechanical sleeve seal.

1. Use type and number of sealing elements recommended by manufacturer 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.
2. Verify sleeve and mechanical sleeve seal installations for damage and faulty work. Verify watertight integrity of sleeves and mechanical sleeve seals installed below grade to seal against hydrostatic water pressure. If sleeve and or sleeve seal are not watertight, provide new wall sleeve and mechanical sleeve seal.

D. Elevated Floor Penetrations of Waterproof Membrane:

1. Provide cast-iron wall pipes for sleeves, extend top of wall pipe minimum 1" above finish floor. Size wall pipe for minimum ½" annular space between pipe and wall pipe.
2. Extend pipe insulation for insulated pipe through wall pipe. The vapor barrier shall be maintained. Size wall pipe for a minimum of 1" annular clear space between inside of sleeve and outside of insulation.
3. Pack with mineral wool and seal both ends with minimum of ½" of waterproof sealant. Refer to Division 07 Section "Joint Sealants" for materials and installation.
4. Secure waterproof membrane flashing between clamping flange and clamping ring. Comply with requirements for flashing specified in Division 7 Section "Sheet Metal Flashing and Trim."
5. Extend bottom of wall pipe below floor slab as required and secure underdeck clamp to hold wall pipe rigidly in place.

E. Interior Foundation Penetrations: Provide sleeves for horizontal pipe passing through or under foundation. Sleeves shall be cast iron soil pipe two nominal pipe sizes larger than the pipe served.

F. Concrete Slab on Grade Penetrations:

1. Provide schedule 40 PVC pipe sleeves for vertical pressure pipe passing through concrete slab on grade. Sleeves shall be one nominal pipe size larger than the pipe served and two pipe sizes larger than pipe served for ductile iron pipes with restraining rods. Seal water-tight with silicone caulk.
2. Provide ½" thick cellular foam insulation around perimeter of non-pressure pipe passing thru concrete slab on grade. Insulation shall extend to 2" above and below the concrete slab.

G. Interior Penetrations of Non-Fire-Rated Walls: Seal annular space between sleeve and pipe or duct, using joint sealant appropriate for size, depth, and location of joint. Pack with mineral wool and seal both ends with minimum of ½" of sealant. Refer to Division 07 Section "Joint Sealants" for materials and installation.

1. Extend pipe insulation for insulated pipe through sleeve. The vapor barrier shall be maintained. Size sleeve for a minimum of 1" annular clear space between inside of sleeve and outside of insulation.

H. Exterior Wall Penetrations: Seal annular space between sleeve and pipe or duct, using joint sealant appropriate for size, depth, and location of joint. Pack with mineral wool and seal both ends with minimum of ½" of waterproof sealant. Refer to Division 07 Section "Joint Sealants" for materials and installation.

1. Extend pipe insulation for insulated pipe through sleeve. The vapor barrier shall be maintained. Size sleeve for a minimum of 1" annular clear space between inside of sleeve and outside of insulation.

I. Fire / Smoke Rated Floor and Wall Assemblies: Seal around penetrations of fire rated assemblies to maintain fire resistance rating of fire-rated assemblies. Coordinate fire ratings and locations with the architectural drawings. Install sealants in compliance with the manufacturer's UL listing. Refer to Division 22 Section "Common Work Results for Plumbing" for firestoppings and materials.

J. Acoustical Barrier Penetrations: Where a pipe passes through a wall, ceiling or floor slab of a noise critical space, a steel sleeve shall be cast or grouted into the structure. Refer to Section "Basic Mechanical Materials and Methods" for noise critical spaces. The internal diameter of the sleeve shall be a minimum of 2 inches larger than the external diameter of the pipe. After the piping is installed, the Contractor shall check the clearance and correct it to within 1/2-inch. Contractor shall pack the void full depth with glass/mineral fiber insulation and seal at both ends, 1-inch deep, with sealant backed by foam rod.

1. Penetration of sound isolating ceilings by sprinkler pipes and heads shall be sleeved and sealed and shall have no rigid connections between them.

3.06 FITTINGS AND SPECIALTIES

A. Use fittings for all changes in direction and all branch connections.

B. Remake leaking joints using new materials.

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

D. Install strainers on the supply side of each control valve, pressure reducing or regulating valve, solenoid valve, mixing valve, backflow preventer and elsewhere as indicated.

E. Install unions at the final connection to each piece of equipment adjacent to each isolation valve or valve assembly for connections 2" and smaller. Install unions where indicated elsewhere on the drawings.

F. Install flanges at the final connection to each piece of equipment, adjacent to each isolation valve or valve assembly in piping 2-1/2" and larger. Install flanges at each valve 2-1/2" and larger.

G. Install dielectric unions for piping 2" and smaller to connect piping materials of dissimilar metals in dry piping systems (gas, compressed air, vacuum) for copper or brass connected to carbon steel, cast or ductile iron.

H. Install dielectric flanges for piping 2-1/2" and larger to connect piping materials of dissimilar metals in dry piping systems (gas, compressed air, vacuum) for copper or brass connected to carbon steel, cast or ductile iron.

I. Install dielectric unions for piping 2" and smaller to connect piping materials of dissimilar metals in wet piping systems (water) (except do not install dielectric unions in concealed spaces, instead, install dielectric waterway fittings) for copper or brass connected to carbon steel, cast or ductile iron.

J. Install dielectric flanges for piping 2-1/2" and larger to connect piping materials of dissimilar metals in wet piping systems (water) (except do not install dielectric unions in concealed spaces, instead, install dielectric waterway fittings) for copper or brass connected to carbon steel, cast or ductile iron.

K. Install dielectric flanges for piping 2-1/2" and larger for copper or brass pipe connections to carbon steel equipment connections, steel, ductile iron or cast iron valves and fittings.

L. Dielectric Flange Installation:

1. Provide brass nipples between the equipment connection and dielectric flange for screwed connections. Provide an iron flange for the equipment side and a bronze flange for the copper or brass piping side of the joint.
2. Provide a bronze flange for the copper or brass piping connection to a cast iron, ductile iron or steel flange.
3. Provide full face gasket with pressure rating equal to system served.

4. At each bolt provide, steel washers, thermoplastic washers and bolt isolation sleeves or thermoplastic combination washers and bolt sleeves.

3.07 JOINTS

A. Steel Pipe Joints:

1. Pipe 2" and Smaller: Thread pipe with tapered pipe threads in accordance with ANSI B2.1. Cut threads full and clean using sharp dies. Ream threaded ends to remove burrs and restore full inside diameter. Apply pipe joint lubricant or sealant suitable for the service for which the pipe is intended on the male threads at each joint and tighten joint to leave not more than 3 threads exposed.
2. Pipe Larger Than 2":
    a) Weld pipe joints (except for exterior water service pipe) in accordance with ASME Code for Pressure Piping, B31.
    b) Weld pipe joints of exterior water service pipe in accordance with AWWA C206.
    c) Install flanges on all valves, apparatus, and equipment. Weld pipe flanges to pipe ends in accordance with ASME B31.9 Code for Building Services Piping. Clean flange faces and install gaskets. Tighten bolts to torque specified by manufacturer of flange and flange bolts, to provide uniform compression of gaskets.

B. Non-ferrous Pipe Joints:

1. Brazed And Soldered Joints: For copper tube and fitting joints, braze joints in accordance with ANSI B31.9 - Standard Code for Building Services Piping and ANSI B9.1 - Standard Safety Code for Plumbing Refrigeration.
2. Thoroughly clean tube surface and inside surface of the cup of the fittings, using very fine emory cloth, prior to making soldered or brazed joints. Wipe tube and fittings clean and apply flux. Flux shall not be used as the sole means for cleaning tube and fitting surfaces.

C. Joints for other piping materials are specified within the respective piping system Sections.

3.08 FLEXIBLE CONNECTORS

A. Install flexible connectors for piping system connections on equipment side of shutoff valves for all Plumbing equipment, pumps, and where indicated on Drawings.

1. Install stainless steel connectors for domestic water copper equipment connections 2” and smaller.
2. Install flanged stainless steel connectors for flanged equipment connections 2-1/2” and larger.

B. Install connectors according to manufacturer’s recommendations.

3.09 PIPE FIELD QUALITY CONTROL

A. Testing: Refer to individual piping system specification sections.

B. Inspection Report Form: Refer to the inspection report form at the end of this section for inspection data to be completed for each piping system. Submit completed forms to the Owner and Engineer.

END OF SECTION

PLUMBING & PLUMBING PIPING SYSTEMS
INSPECTION REPORT FORM

Project Name:
Project No: _____ Contractor Project No. _____
General Contractor: _____
Inspection Date: _____Temperature: _____

System Inspected

Building: _____
Location/Description: _____
Service: _____

Inspection Results

Time of Inspection: _____
Approval to Insulate: Y N Approval to Cover in Wall: Y N
Approval to backfill Y N

Signatures

Witness: _____ Representing: _____
Witness: _____ Representing: _____
Witness: _____ Representing: _____

Remarks
_____
_____
_____
Contractor Supervisor's signature: _____

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PART 1 - GENERAL REQUIREMENTS

1.01 SUMMARY

A. This Section includes the following types of meters and gauges:

1. Temperature gauges and fittings.
2. Pressure gauges and fittings.

1.02 SUBMITTALS

A. General: Submit the following in accordance with conditions of Contract and Division 1 Specification Sections.

1. Product data for each type of meter and gauge. Include scale range, ratings, and calibrated performance curves, certified where indicated. Submit meter and gauge schedule showing manufacturer's figure number, scale range, location, and accessories for each meter and gauge.
2. Product certificates signed by manufacturers of meters and gauges certifying accuracy under specified operating conditions and products' compliance with specified requirements.
3. Maintenance data for each type of meter and gauge for inclusion in Operating and Maintenance Manuals specified in Division 1 and Division 22 Section "General Plumbing Requirements."

PART 2 - PRODUCTS AND MATERIALS

2.01 MANUFACTURERS

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

1. Glass Tube Industrial Thermometers:

a) H. O. Trerice Co.
b) Marshalltown Instruments, Inc.
c) Miljoco Corporation
d) Weiss Instruments, Inc.
e) Weksler Instruments Corp.
f) Winters Instruments

2. Thermometer Wells: Same as for thermometers.
3. Pressure Gauges:

a) Ametek, U.S. Gauge Div.
b) Ashcroft Dresser Industries Instrument Div.
c) Ernst Gage Co.
d) H. O. Trerice Co.
e) Marsh Instrument Co., Unit of General Signal.

f) Marshalltown Instruments, Inc.
g) Miljoco Corporation
h) Weiss Instruments, Inc.
i) Weksler Instruments Corp.
j) WIKA Instruments Corp.
k) Winters Instruments

4. Pressure Gauge Accessories: Same manufacturers as for pressure gauges.

2.02 THERMOMETERS, GENERAL

A. Accuracy: Plus or minus 1 percent of range span or plus or minus one scale division to maximum of 1.5 percent of range span.

B. Scale range: Temperature ranges for services listed as follows:

1. Domestic Hot Water: 30 to 240 deg with 2-degree scale divisions (0 to 115 deg C with 1-degree scale divisions).
2. Domestic Cold Water: 0 to 100 deg F with 2-degree scale divisions (minus 18 to 38 deg C with 1-degree scale divisions).

2.03 GLASS TUBE INDUSTRIAL THERMOMETERS

A. Case: Die cast, aluminum finished, in baked epoxy enamel, glass front, spring secured, 9 inches long.

B. Adjustable Joint: Finished to match case, 180-degree adjustment in vertical plane, 360-degree adjustment in horizontal plane, with locking device.

C. Tube: Non-red color reading, non-toxic organic spirit-filled glass tube, magnifying lens.

D. Scale: Satin-faced, nonreflective aluminum, with permanently etched markings.

E. Stem: Copper-plated steel, aluminum or brass, for separable socket, length to suit installation.

2.04 THERMOMETER WELLS

A. Thermometer Wells: Brass or stainless steel, pressure rated to match piping system design pressure; with 2-inch extension for insulated piping and threaded cap nut with chain permanently fastened to well and cap.

2.05 PRESSURE GAUGES

A. Type: General use, ASME B40.1, Grade A, phosphor bronze bourdon-tube type, bottom connection.

B. Case: Cast aluminum or stainless steel case, glass lens, 4-1/2-inches diameter.

C. Connector: Brass, 1/4-inch NPS.

D. Scale: White coated aluminum, with permanently etched markings.

E. Accuracy: Plus or minus 1 percent of range span.

F. Range: Conform to the following:

1. Vacuum: 30 inches Hg to 15 psi.
2. All fluids: 2 times operating pressure.

G. Liquid-Filled: Provide liquid filled gauges where specified in Part 3 of this section.

2.06 PRESSURE GAUGE ACCESSORIES

A. Snubber: 1/4-inch NPS brass bushing with corrosion-resistant porous metal disc. Disc material shall be suitable for fluid served and rated pressure.

PART 3 - EXECUTION

3.01 THERMOMETERS INSTALLATION

A. Install in the following locations and elsewhere as indicated:

1. At outlet of each domestic water heater.

B. Remote-Reading Dial Thermometers: Install in control panels, with tubing connecting panel and thermometer bulb supported to prevent kinks. Use minimum tubing length.

C. Thermometer Wells: Install in piping tee where thermometers are indicated, in vertical position. Fill well with oil or graphite and secure cap.

3.02 INSTALLATION OF PRESSURE GAUGES

A. Install in the following locations, and elsewhere as indicated:

1. Provide liquid-filled gauge at suction and discharge of each pump.
2. At discharge of each pressure-reducing valve.
3. At building water service entrance.

B. Pressure Gauge Needle Valves: Install in piping tee with snubber.

END OF SECTION

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PART 1 - GENERAL REQUIREMENTS

1.01 SUMMARY

A. This Section includes general duty valves common to most plumbing water distribution piping systems.

1. Special purpose valves are specified in individual piping system specifications.

B. Contractors Option:

1. The Division 22 contractor may provide mechanically joined plumbing piping systems to connect mechanical joints, couplings, fittings, valves and related components as an option in lieu of, in whole or in part, copper sweat, brazing, threaded or flanged piping methods. Mechanically joined plumbing piping systems to connect plumbing piping where used shall be provided in compliance with specification Section 221111 "Mechanically Joined Plumbing Piping Systems".

1.02 DEFINITIONS

A. Lead Free: Refers to the wetted surface of pipe, fittings and fixtures in potable water systems that have a weighted average lead content ≤0.25% per Safe Drinking Water Act as amended January 4th, 2011 Section 1417.

1.03 SUBMITTALS

A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections.

1. Product data, including body material, valve design, pressure and temperature classification, end connection details, seating materials, trim material and arrangement, dimensions and required clearances, and installation instructions.

B. Submit certification that valves for domestic water distribution comply with NSF 61 Annex G and / or NSF 372.

1.04 QUALITY ASSURANCE

A. Single Source Responsibility: Provide products specified in this section from the same manufacturer where products are available and conform to the specification requirements.

B. American Society of Mechanical Engineers (ASME) Compliance: Comply with ASME B31.9 for building services piping and ASME B31.1 for power piping.

C. Manufacturers Standardization Society of the Valve and Fittings Industry (MSS) Compliance: Comply with the MSS Standard Practices below:

1. MSS SP 67 “Butterfly Valves”
2. MSS SP 70 “Gray Iron Gate Valves, Flanged and Threaded Ends”
3. MSS SP 71 “Gray Iron Swing Check Valves, Flanged and Threaded Ends”
4. MSS SP 72 “Ball Valves with Flanged or Butt Welding Ends”
5. MSS SP 80 “Bronze Gate, Globe, Angle and Check Valves”
6. MSS SP 85 “Gray Iron Globe and Angle Valves, Flanged and Threaded Ends”
7. MSS SP 110 “Ball Valves, Threaded, Socket Welding, Solder Joint, Grooved and Flared Ends”
8. MSS SP 125 “Check Valves: Gray Iron and Ductile Iron, In-Line, Spring Loaded, Center-Guided”
9. MSS SP 139 “Copper Alloy Gate, Globe, Angle and Check Valves for Low Pressure/Low Temperature Plumbing Applications”

D. Valves shall be manufactured in plants located in the United States or certified that they comply with applicable ANSI, ASTM and MSS standards.

E. Comply with NSF 61 Annex G and / or NSF 372 for wetted surfaces of valves containing no more than 0.25% lead by weight compliance for valves for domestic water distribution.

PART 2 - PRODUCTS AND MATERIALS

2.01 MANUFACTURERS

A. Manufacturer: Subject to compliance with requirements, provide products from one of the manufacturers listed in valve schedule.

2.02 VALVE FEATURES, GENERAL

A. Valve Design: Rising stem or rising outside screw and yoke stems.

1. Non-rising stem valves may be used where headroom prevents full extension of rising stems.

B. Pressure and Temperature Ratings: As scheduled and required to suit system pressures and temperatures.

C. Sizes: Same size as upstream pipe, unless otherwise indicated.

D. Operators: Provide the following special operator features:

1. Handwheels, fastened to valve stem, for valves other than quarter turn.
2. Lever handles, on quarter-turn valves 6-inch and smaller.

3. Chain-wheel operators, for valves 2-1/2-inch and larger, installed 72 inches or higher above finished floor elevation. Extend chains to an elevation of 5'-0" above finished floor elevation.
4. Gear drive operators, on quarter-turn valves 8-inch and larger.

E. Extended Stems: Where insulation is indicated or specified, provide extended stems arranged to receive insulation.

F. End Connections: As indicated in the valve specifications.

1. Threads: Comply with ANSI B1.20.1.
2. Flanges: Comply with ANSI B16.1 for cast iron, ANSI B16.5 for steel, and ANSI B16.24 for bronze valves.
3. Solder-Joint: Comply with ANSI B16.18.
    a) Caution: Where soldered end connections are used, use solder having a melting point below 840 deg F for gate, globe, and check valves; below 421 deg F for ball valves.

2.03 BALL VALVES

A. Ball Valves, 2 Inch and Smaller: Meeting MSS SP 110, Class150, 600-psi CWP; two-piece construction; with ASTM B 584 cast lead free bronze, full port, blowout-proof stem and chrome-plated lead free brass ball, with replaceable "Teflon" or "TFE" seats and seals, solder ends and vinyl-covered steel handle.

B. Cast Iron Body Ball Valves, 2-1/2” and larger: Meeting MSS SP 72, 200 CWP, lead free with FDA epoxy coating, maximum operating temperature of 140F; two piece cast iron body meeting ASTM A126 Class B with flanged ends, 304 stainless steel full port ball and shaft, ductile iron handle, FDA epoxy coating, PTFE gasket, stem seal and seat.

2.04 BUTTERFLY VALVES

A. Butterfly Valves, 2-1/2-Inch and Larger: Meeting MSS SP-67 and lead free; 200-psi CWP; lug-type body constructed of ductile iron conforming to ASTM A 536. Provide valves with field replaceable EPDM sleeve/seat, aluminum-bronze disc, 416 stainless steel stem, and EPDM O-ring stem seals. Provide lever operators, (10 position minimum), with lock and stops with locks for sizes 2-1/2 through 6 inches and gear operators with position indicator for sizes 8 inch and larger. Drill and tap valves on dead-end service or requiring additional body strength. Valves must be rated for dead end service at 150 psi with no downstream flange required.

2.05 CHECK VALVES

A. Swing Check Valves, 2-Inch and Smaller: Meeting MSS SP-80; Class 125, 200-psi CWP, body and cap of ASTM B 584 cast lead free bronze; with horizontal swing, Y-pattern, disc and disc holder of ASTM B 283 alloy C46400 naval brass;

solder ends. Provide valves capable of being reground while the valve remains in the line.

B. Swing Check Valves, 2-1/2-Inch and Larger: Meeting MSS SP-71 and lead free; Class 125 200-psi CWP, cast iron body and bolted cap conforming to ASTM A 126, Class B; with FDA epoxy coating, horizontal swing, lead free bronze disc with lead free bronze disc face ring, and bronze seat ring; and flanged ends. Provide valves capable of being refitted while the valve remains in the line.

C. Swing Check Valves, 2-1/2-Inch and Larger: Meeting MSS SP-71 and lead free; Class 250 500-psi CWP, cast iron body and bolted cap conforming to ASTM A 126, Class B; with FDA epoxy coating, horizontal swing, lead free bronze disc with lead free bronze disc face ring, and bronze seat ring; and flanged ends. Provide valves capable of being refitted while the valve remains in the line.

D. Lift Check Valves, 2-Inch and Smaller: Meeting MSS SP-139; 250-psi CWP, body, disc holder and cap of ASTM B 584 cast lead free bronze; horizontal or angle pattern, lift-type valve, with stainless steel spring, renewable "Teflon" disc and solder ends. Provide valves capable of being refitted and ground while the valve remains in the line.

PART 3 - EXECUTION

3.01 INSTALLATIONS

A. Install valves in accordance with manufacturer’s installation instructions.

B. Locate valves for easy access and provide separate support where necessary. Provide access doors and fire rated access doors as required.

C. Install valves and unions for each fixture and item of equipment arranged to allow equipment removal without system shutdown. Unions are not required on flanged devices.

D. Install three-valve bypass around each pressure reducing valve using throttling-type valves.

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

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

G. Installation of Check Valves: Install for proper direction of flow as follows:

H. Swing Check Valves: Horizontal position with hinge pin level.

I. Lift Check Valve: With stem upright and plumb.

3.02 VALVE ENDS SELECTION

A. Select valves with the following ends or types of pipe/tube connections:

1. Copper Tube Size, 2-Inch and Smaller: Solder ends.
2. Copper Tube Sizes 2-1/2 Inch and Larger: flanged end.

3.03 VALVE PRESSURE/TEMPERATURE CLASSIFICATION SCHEDULES

A. Domestic Hot and Cold Water Service

VALVE TYPE	2" AND SMALLER	2-1/2" AND LARGER
Ball	150	200
Butterfly	N/A	200
Check	125	125

3.04 VALVE SCHEDULE

A. Ball Valves (full port) – 2 inch and smaller:

MANUFACTURER	SOLDER ENDS	THREADED ENDS
Apollo (Conbraco)	77C-LF-200	77C-LF-100
Hammond	UP8311A	UP8301A
Milwaukee	UPBA-450	UPBA-400
NIBCO	S-585-80-LF	T-585-80-LF

B. Iron Body Ball Valves (full port) – 2-1/2" and larger:

MANUFACTURER	FLANGED ENDS
Apollo (Conbraco)	6PLF
Watts	G4000-FDA

C. Butterfly Valves (aluminum-bronze disc) - 2-1/2 inch and larger:

MANUFACTURER	LEVER	GEAR
Apollo (Conbraco)LD141	xx BE1*	LD141 xx BE2*
Hammond	6411-01	6411-03
NIBCO	LD-2000-3	LD-2000-5
Watts	XXBF-03-121-15	XBF-03-121-1G

* xx = Valve Size

D. Swing Check Valves – 2 inch and smaller:

MANUFACTURER	SOLDER ENDS	THREADED ENDS
Apollo	161S-LF	161T-LF
Milwaukee	UP1509	UP509
NIBCO	S-413-Y-LF	T-413-Y-LF

E. Swing Check Valves - 2-1/2 inch and larger – Class 125:

MANUFACTURER	Flanged Ends
Apollo	910F-LFA

F. Lift Check Valves – 2 inch and smaller:

MANUFACTURER	SOLDER ENDS	THREADED ENDS
Hammond	UP947	UP943
Milwaukee	UP1548T	UP548T
NIBCO	S-480-Y-LF	T-480-Y-LF

3.05 APPLICATION SCHEDULE

A. General Application: Use gate, ball, and butterfly valves for shutoff duty; globe, ball, and butterfly for throttling duty. Refer to piping system Specification Sections for specific valve applications and arrangements.

B. Domestic Water Systems: Use the following valve types:

1. Ball Valves, 2” and Smaller: Class 150, 600-psi CWP, with stem extension if installed in insulated pipe.,.
2. Butterfly Valves, 2-1/2” and larger200-psi working pressure with cast or ductile iron body
3. Swing Check, 2-1/2” and smaller: Class 125, cast bronze, with rubber seat.
4. Check Valves, 2-1/2” and larger: Class 125, swing or wafer type as indicated.

C. Domestic Water Systems – High Pressure: Use the following valve types:

1. Ball Valves, 2” and Smaller: Class 150, 600-psi CWP, with stem extension if installed in insulated pipe.

3.06 FIELD QUALITY CONTROL

A. Tests: After piping systems have been tested and put into service, but before final adjusting and balancing, inspect valves for leaks. Adjust or replace packing to stop leaks; replace valves if leak persists.

3.07 ADJUSTING AND CLEANING

A. Cleaning: Clean mill scale, grease, and protective coatings from exterior of valves and prepare valves to receive finish painting or insulation.

B. Inspect valves for leaks after piping systems have been tested and put into service, but before final adjusting and balancing. Adjust or replace packing, as required, on valves with leaks. Replace valve if leak persists.

END OF SECTION

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PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Support and attachment components.

B. Horizontal-piping hangers and supports.

C. Shields

D. Vertical piping clamps

E. Pre-engineered roof supports

F. Anchors and fasteners.

G. Miscellaneous materials.

H. Related Sections: The following sections contain requirements that relate to this Section:

1. Division 22 Section "Plumbing Insulation", for high density insulation for protecting insulation vapor barrier and materials and methods for piping hanger installations.
2. Division 22 “Water Distribution Piping and Specialties”, for pipe hanger types and spacing for horizontal and vertical domestic water distribution and heat traced piping of sizes and materials indicated.
3. Division 22 “Sanitary Drainage & Vent Piping and Specialties”, for pipe hanger types and spacing for heat traced and cold sanitary piping of sizes and materials indicated.
4. Division 22 “Storm Drainage & Piping and Specialties”, for pipe hanger types and spacing for horizontal and vertical storm drainage piping of sizes and materials indicated.

1.02 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Coordinate sizes and arrangement of supports and bases with the actual equipment and components to be installed.
2. Coordinate the work with other trades to provide additional framing and materials required for installation.
3. Coordinate compatibility of support and attachment components with mounting surfaces at the installed locations.
4. Coordinate the arrangement of supports with ductwork, piping, equipment and other potential conflicts installed under other sections or by others.

5. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

B. Sequencing:

1. Do not install products on or provide attachment to concrete surfaces until concrete has fully cured.

1.03 SUBMITTALS

A. Product Data : Provide manufacturer's standard catalog pages and data sheets for each type of hanger and support. Include a hanger and support schedule showing manufacturer's figure number, size, location, and features for each hanger and support. Submit style and type to Structural Engineer for approval prior to installation.

B. Product Certificates: Signed by the manufacturer of hangers and supports certifying the products meet the specified requirements.

C. Welder Certificates: Signed by Contractor certifying that welders comply with requirements specified under "Quality Assurance" Article.

D. Maintenance Data: For inclusion in Operating and Maintenance manual specified in Division 01 and Division 22 Section "General Plumbing Requirements."

E. Shop Drawings: Include details for fabricated hangers and supports where materials or methods other than those indicated are proposed for substitution. Include dimensions, weights, required clearances, and method of assembly.

1. Application of protective inserts, and shields at pipe hangers for each type of insulation and hanger.

F. Installer's Qualifications: Include evidence of compliance with specified requirements.

G. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

1.04 QUALITY ASSURANCE

A. Comply with applicable building code.

B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.

C. Installer Qualifications for Field-Welding:

1. Qualify welding processes and welding operators in accordance with AWS D1.1 "Structural Welding Code - Steel."

2. Certify that each welder has satisfactorily passed AWS qualification tests for welding processes involved and, if pertinent, has undergone recertification.
3. Qualify welding processes and welding operators in accordance with ASME BPVC Section IX, "Welding and Brazing Qualifications."

D. Flame/Smoke Ratings: Provide hangers and supports with flame-spread index of 25 or less, and smoke-developed index of 50 or less, as tested by UL 723 or ASTM E84 (NFPA 255) method.

E. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

1.06 DEFINITIONS

A. Terminology used in this Section is defined in MSS SP-90.

PART 2 - PRODUCTS AND MATERIALS

2.01 SUPPORT AND ATTACHMENT COMPONENTS

A. General Requirements:

1. Comply with MSS SP-58.
2. Provide all required hangers, supports, anchors, fasteners, fittings, accessories, and hardware as necessary for the complete installation of work.
3. Provide products listed, classified, and labeled as suitable for the purpose intended, where applicable.
4. Where support and attachment component types and sizes are not indicated, select in accordance with manufacturer's application criteria as required for the load to be supported. Include consideration for vibration, equipment operation, and shock loads where applicable.
5. Do not use wire, chain, perforated pipe strap, or wood for permanent supports unless specifically indicated or permitted.
6. Materials: Products and materials listed in this specification are based on indoor, dry locations. Use corrosion resistant materials suitable for the environment where installed.

a) Indoor Dry Locations: Painted carbon steel, galvanized steel or zinc-plated steel. Where supports will be field painted in exposed locations, provide carbon steel.

b) Indoor Damp or Wet Locations: Galvanized steel or type 304 stainless steel.
c) Natatorium or other treated pool environments: Type 316 stainless steel.
d) Outdoor Locations: Galvanized steel or type 304 stainless steel.
e) Dielectrics Barriers: Provide dielectric barriers between metallic supports and metallic piping and associated items of dissimilar type. Acceptable barriers include rubber, or copper-plated coatings where attachments are in direct contact with copper.
f) Zinc-Plated Steel: Electroplated in accordance with ASTM B633.
g) Galvanized Steel: Hot-dip galvanized after fabrication in accordance with ASTM A123/A123M or ASTM A153/A153M.
h) Stainless Steel: Type 304 or 316 in accordance with ASTM A240.

B. Metal Channel (Strut) Framing Systems:

1. Manufacturers:

a. Cooper B-Line.
b. Ferguson Enterprises/FNW.
c. PHD Manufacturing.
d. Thomas & Betts Corporation.
e. Unistrut, a brand of Atkore International Inc.
f. Source Limitations: Furnish channels (struts) and associated fittings, accessories, and hardware produced by a single manufacturer.

2. Factory-fabricated continuous-slot metal channel (strut) and associated fittings, accessories, and hardware required for field-assembly of supports.
3. Comply with MSS SP-69, Type 59, MSS SP-89, and MFMA-4. Welds shall comply with AWS D1.1.

4. Channel Material:

a. Indoor Dry Locations: Galvanized steel or zinc-plated steel.
b. Indoor Damp or Wet Locations: Galvanized steel or type 304 stainless steel.
c. Outdoor Locations: Galvanized steel or type 304 stainless steel.
d. Natatorium or other treated pool environments: Type 316 stainless steel.
e. All nuts, brackets, and clamps shall have the same finish as the channel.

5. Minimum Channel Thickness: Steel sheet, 14 gage, 0.0747 inch.
6. Minimum Channel Dimensions: 1-5/8 inch width by 13/16 inch height with factory-punched attachment holes.
7. Provide plastic galvanic isolators for connecting bare copper pipe for use with pre-engineered support strut system where indicated.

C. Hanger Rods:

1. Material:

a. Indoor Dry Locations: Zinc-plated steel.

b. Indoor Damp or Wet Locations or Outdoor Locations: Zinc-plated steel or type 304 stainless steel.
c. Natatorium or other treated pool environments: Type 316 stainless steel.

2. Threaded both ends or continuously threaded.
3. Minimum Size: Reference piping specification sections for rod thicknesses.
4. Threaded Rods: Threaded rods are not allowed for floor supports except when the maximum length of the rod is less than 12". Threaded rod sizes shall be the same size diameter as specified for pipe hanger rods based upon pipe size being supported. Refer to system piping specification sections for rod size requirements.

2.02 HORIZONTAL PIPING HANGERS AND SUPPORTS

A. MANUFACTURERS

1. ASC Engineered Solutions.
2. Cooper B-Line, Inc.
3. Elite Components
4. ERICO/Michigan Hanger Co./Caddy
5. Ferguson/FNW.
6. Halfen-DEHA.
7. Hilti.
8. National Pipe Hanger Corporation.
9. PHD Manufacturing.
10. Power-Strut.
11. Unistrut.

B. Single Hangers:

1. Split Ring: Carbon steel, adjustable swivel, split ring type.
2. Split Ring 2 inch and smaller: Copper alloy, split ring type.
3. Clevis Hanger: Carbon steel, adjustable, clevis type.
4. Roll Support Hanger: Adjustable steel yoke, cast iron roll.

C. Trapeze and Strut-mounted Supports:

1. Two-piece clamp: Designed for use with channel strut, held in place at channel shoulder when clamp attachment nut is tightened.
2. Roll Support: Adjustable cast iron roll attached to metal channel strut framing system with brackets and nuts.

D. Hangers and strut-mounted supports with pre-manufactured polymer inserts:

1. Manufacturers:

a) ASC Engineered Solutions.
b) Holdrite.
c) Klo-Shure.

2. Strut-mounted pipe clamps and clevis hangers with pre-manufactured polymer inserts designed to receive butted insulation internally. Inserts

shall support piping independent of insulation to avoid crushing. Installed system shall provide equal thermal and vapor barrier performance as systems with continuous unbroken insulation. Metal shields are not required with clevis hangers of this type.

E. Spring Hangers:

1. Reference Section "Vibration Isolation for Plumbing Piping and Equipment" for spring isolation hangers.

F. Wall Supports:

1. Two-hole strap, galvanized steel or copper to suit pipe material. Provide rigid insulation between strap and pipe to maintain continuous insulation and vapor barrier where required.
2. Welded steel bracket reinforced with angle or strut. Support pipe from bracket using horizontal pipe hanger or support appropriate for the pipe type.

G. Floor Supports:

1. Pipe Saddle: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
2. Roller Support: Adjustable cast iron roll and stand, steel screws, and concrete pier or steel support.

H. Pre-Insulated Supports:

1. Manufacturers:

a) Aeroflex USA, Inc.
b) Armacell.
c) Buckaroos, Inc.
d) Cooper B-Line, Inc.
e) Pipe Shields, Inc.

2. General Construction and Requirements:

a) Flexible elastomeric insulation with integral high-density pipe support insert shall conform to ASTM C534, Type I.
b) Surface Burning Characteristics: Assembly shall have a flame spread index/smoke developed index of 25/50, maximum, when tested in accordance with ASTM E84 or UL 723.
c) Waterproof calcium silicate insulation shall conform to ASTM C795.
d) Rigid phenolic foam insulation shall conform to ASTM C1126, Type III.
e) Insulation inserts shall be surrounded by a 360 degree jacket or shield.

3. Pipe insulation protection shields to be provided at the hanger points and guide locations on pipes requiring insulation as indicated on drawings.

2.03 SHIELDS

A. Insulation Protection Shield:

1. Sheet metal construction, meeting SP-58 Type 40, of 18 gauge for 5-1/2" inside dimension and smaller, 16 gauge for 6-1/2" to 10-3/4" inside dimension 14 gauge for 11-3/4" to 17" inside dimension, and 12 gauge for 18" to 28" inside dimension.
2. Shield shall cover half of the circumference of the pipe and shall be of length indicated by manufacturer for pipe size and thickness of insulation.
3. Lengths for pipes greater than 2 inches: Minimum 8 inch long section at each support. .
4. For pipes 2 inch and smaller using fiberglass or flexible elastomeric insulation without pre-insulated supports, provide insulation protection shields installed between hanger and pipe which meets the following minimum length requirements:

Pipe Size (NPS)	Insulation Thickness (inches)	Minimum Shield Length, (in) Hanger Spacing, (ft) 5	6	7	8	9	10
	0.5	5	6	8	-	-	-
	1	3	5	5	-	-	-
≤ 1	1.5	3	5	5	-	-	-
	2	3	3	3	-	-	-
	3	3	3	3	-	-	-
	0.5	8	8	11	11	12	14
	1	5	6	8	9	11	11
≤ 2	1.5	5	6	8	8	9	9
	2	5	5	6	6	8	8
	3	5	5	6	6	6	8

B. 360° Insulation Protection Shield: Shield shall cover all of the circumference of the pipe with two half circumference sections held together with bolts and nuts and shall be of length indicated by manufacturer for pipe size and thickness of insulation.

C. Plastic Shields:

1. Manufacturers:
   a) Armacell.
   b) Eaton.
   c) Hydra-Zorb.
   d) PHD Manufacturing.
   e) Zsi Foster.
2. Polymer-based, snap-on or clip-on design, with non-adhesive surface and lip to allow lateral movement of piping without damaging insulation, field-paintable.

2.04 VERTICAL-PIPING SUPPORTS

A. Manufacturers:

1. ASC Engineered Solutions.
2. Cooper B-Line, Inc.
3. Halfen-DEHA.
4. Hilti.
5. ERICO/Michigan Hanger Co.
6. National Pipe Hanger Corporation.
7. PHD Manufacturing.
8. Power-Strut.
9. Unistrut.

B. Components shall be factory fabricated of materials, design, and manufacturer complying with MSS SP-58.

1. Components shall have galvanized coatings where installed for piping and equipment that will not have factory applied or field-applied finish.
2. Pipe attachments shall be copper-plated or have nonmetallic coating for electrolytic protection where attachments are in direct contact with copper tubing.
3. Components as listed below shall be made of 304 stainless steel where installed in corrosive environments and/or where indicated on the drawings.

C. Riser Clamps with pre-manufactured polymer insert:

1. Manufacturers:

a) Hydra-Zorb; Titan Riser Clamp.
b) National Pipe Hanger.
c) Pipe Hangers, Inc.

D. Riser clamp with pre-manufactured polymer inserts designed to withstand vertical loading and receive butted insulation internally. Inserts shall support piping independent of insulation to avoid crushing. Installed system shall provide equal thermal and vapor barrier performance as systems with continuous unbroken insulation.

2.05 PRE-ENGINEERED ROOF PIPE SUPPORTS

A. Manufacturers:

1. Airtec.
2. ASC Engineered Solutions.
3. Cooper B-Line, Inc.
4. Elite Components.
5. ERICO/Michigan Hanger Co./Caddy.
6. Ferguson/FNW.
7. Miro.

8. PHP Systems/Design.
9. PHD Manufacturing.
10. Roof Top Blox.
11. Unistrut, a brand of Atkore International Inc.
12. Zsi Foster.

B. General: Pre-engineered devices with embedded pipe support fixtures as specified.

C. Pedestals: Steel pedestals with thermoplastic or rubber base with the following dimensions:

1. Up to 12 inch strut length support: 18 inch x 18 inch.
2. Up to 16 inch strut length support: 24 inch x 18 inch.
3. Up to 24 inch strut length support: 30 inch x 18 inch.
4. Thickness: Minimum 3/16 inch thick.

D. Block Bases: Closed-cell polyethylene blocks with the following dimensions.

1. Length: Nominal 10 inch, 12 inch, 16 inch, or 24 inch
2. Width: Nominal 4 inches.

E. Attachment/Support Fixtures: As recommended by manufacturer, same type as indicated for equivalent indoor hangers and supports.

F. Mounting Height: Provide minimum clearance of 6 inches under supported component to top of roofing.

2.06 ANCHORS AND FASTENERS

A. Manufacturers:

1. Hilti, Inc.
2. Illinois Tool Works, Inc.
3. Phillips.
4. Powers Fasteners, Inc.
5. Rawl.
6. Simpson Strong-Tie Company Inc.

B. Unless otherwise indicated and where not otherwise restricted, use the anchor and fastener types indicated for the specified applications.

1. Concrete: Use preset concrete inserts or expansion anchors.
2. Solid or Grout-Filled Masonry: Use expansion anchors.
3. Hollow Masonry: Use toggle bolts.
4. Hollow Stud Walls: Use toggle bolts.
5. Steel: Use beam clamps.
6. Sheet Metal: Use sheet metal screws.
7. Wood: Use wood screws.
8. Plastic and lead anchors are not permitted.
9. Hammer-driven anchors and fasteners are permitted only as follows:

a. Nails are permitted for attachment of nonmetallic boxes to wood frame construction.
b. Staples are permitted for attachment of nonmetallic-sheathed cable to wood frame construction.

D. Preset Concrete Inserts: Continuous metal channel (strut) and spot inserts specifically designed to be cast in concrete ceilings, walls, and floors.

1. Comply with MFMA-4.
2. Channel Material: Use galvanized steel.
3. Minimum Channel Thickness: Steel sheet, 12 gauge, 0.1046 inch minimum base metal thickness.
4. Spot Inserts: Carbon steel with zinc plating or galvanized steel body and base plate, with protective sleeve for anchor rod insert, sized to accommodate anchor rode dimensions.
5. Manufacturers:

a. Same as manufacturer of metal channel (strut) framing system.
b. DeWalt "Bang-It" concrete inserts.

E. Post-Installed Concrete and Masonry Expansion Anchors:

1. Evaluated and recognized by ICC Evaluation Service, LLC (ICC-ES) for compliance with applicable building code.
2. Self-drilling, drilled flush or shell type. Size inserts to suit threaded rods.

F. Beam Clamps: MSS SP-58 C-Type or adjustable, Types 19 through 23, 25 or 27 through 30 based on required load.

1. Material: ASTM A36/A36M carbon steel or ASTM A181/A181M forged steel.
2. Provide clamps with hardened steel cup-point set screws and lock-nuts for anchoring in place.

G. Vibration Isolation Anchors: Reference Division 22 Section "Vibration Isolation for Plumbing Piping and Equipment" for vibration isolation anchors.

2.07 MISCELLANEOUS MATERIALS

A. Steel Plates, Shapes, and Bars: ASTM A 36.

B. Malleable Iron: ASTM A47

H. Cement Grout: Portland cement (ASTM C 150, Type I or Type III) and clean uniformly graded, natural sand (ASTM C 404, Size No. 2). Mix ratio shall be 1.0 part cement to 3.0 parts sand, by volume, with minimum amount of water required for placement and hydration.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that mounting surfaces are ready to receive support and attachment components.

C. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION, GENERAL

A. Install hangers and supports in accordance with manufacturer's installation instructions.

B. Install anchors and fasteners in accordance with ICC Evaluation Services, LLC (ICC-ES) evaluation report conditions of use where applicable.

C. Provide independent support from building structure. Do not provide support from piping, ductwork, conduit, or other systems.

D. Unless specifically indicated or approved by Architect, do not provide support from suspended ceiling support system or ceiling grid.

E. Unless specifically indicated or approved by Architect, do not provide support from roof deck.

F. Do not penetrate or otherwise notch or cut structural members without approval of Structural Engineer.

G. Provide thermal insulated pipe supports complete with hangers and accessories. Install thermal insulated pipe supports during the installation of the piping system.

3.03 INSTALLATION OF HANGERS AND SUPPORTS

A. Install in accordance with ASME B31.9, ASTM F708, or MSS SP-58 unless indicated otherwise.

B. If type of hanger or support for a particular situation is not indicated, select appropriate type using MSS SP-58 recommendations.

C. Space attachments within maximum piping span length specified in Division 22 piping sections.

D. Install hangers to provide minimum 1/2 inch space between finished covering and adjacent work.

E. Install hangers, supports, clamps and attachments to support piping properly from building structure.

F. Do not attach to ceilings, equipment, ductwork, conduit and other non-structural elements such as floor and roof decking.

G. Hanger and clamps sizing:

1. Cold Piping: Provide pipe hangers sized for the pipe outside diameter plus insulation thickness.
2. Hot Piping: Provide pipe hangers sized for the pipe outside diameter.
3. Vertical Piping: Provide clamps sized for the pipe outside diameter and extend clamp through insulation.
4. Refer to Division 22 Section "Plumbing Insulation" for definition of hot and cold piping and required insulation thickness.

H. Where several pipes can be installed in parallel and at the same elevation, Contractor has option to provide metal channel strut framing. Install supports with maximum spacing specified within Division 22 piping sections.

1. Space strut framing at the required distance for the smallest pipe size or install intermediate supports for smaller diameter pipe as specified above for individual pipe hangers.
2. Where strut systems are attached to walls, install anchor bolts per manufacturer's recommendations.

a) Uninsulated Copper Pipe: Install with plastic galvanic isolators
b) Insulated Tube or Pipe: Install with 360° insulation protection shields or pre-engineered thermal hanger-shield inserts as specified in Division 22 Section "Plumbing Insulation".

I. Install building attachments within concrete or to structural steel.

1. Install additional attachments at concentrated loads, including valves, flanges, guides, strainers, expansion joints, and at changes in direction of piping as specified in Division 22 piping sections.
2. Install concrete inserts before concrete is placed; fasten insert to forms. Where concrete with compressive strength less than 2,500 psi is indicated, install reinforcing bars through openings at top of inserts.

J. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories. Provide two nuts on threaded supports to securely fasten the support.

K. Install appropriate types of hangers and supports to allow controlled 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.

L. Load Distribution: Install hangers and supports so that piping live and dead loading and stresses from movement will not be transmitted to connected equipment.

M. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes, and so that maximum pipe deflections allowed by ASME B31.9 Building Services Piping Code is not exceeded.

N. Insulated Piping: Comply with the following installation requirements.

1. Riser Clamps: Attach riser clamps to piping with riser clamps projecting through insulation. Do not use riser clamps to support horizontal, insulated piping. Seal insulation for hot piping and protect vapor barrier for cold piping as specified in Division 22 Section "Plumbing Insulation".

    a) Contractor's Option: Provide riser clamps with pre-manufactured polymer insert for cold piping 2-1/2 inches and larger.

2. Insulation Protection Shield: Install insulation protection shield with high density insulation insert where vapor barrier is indicated, sized for the insulation thickness used as specified in Division 22 Section "Plumbing Insulation". Do not use polymer-based shields for hot piping.

    a) Exception for horizontal cold–piping with fiberglass or flexible elastomeric insulation 2 inch and smaller: Rest fiberglass insulated pipe on hanger shield with length specified for pipe size and insulation thickness to prevent puncture or other damage.

3. Contractor's Option: Provide pre-engineered thermal hanger inserts for piping insulated with flexible elastomeric insulation at pipe supports for piping 2-1/2 inches and larger.
4. Contractor's Option: Provide strut-mounted pipe clamps and clevis hangers with pre-manufactured polymer inserts.

O. Strut Framing Systems: Channel strut systems can be used at the Contractors option in lieu of individual hangers for horizontal pipes. Arrange for grouping of parallel runs of horizontal piping. Space channel strut systems at the required distance for the smallest pipe supported. Provide channel gauge and hanger rods per the manufacturer's recommendations for the piping supported. Where strut systems are attached to walls, install anchor bolts per manufacturer's recommendations.

1. Uninsulated Copper Pipe: Install with plastic galvanic isolators
2. Insulated Tube or Pipe: Install with 360 degree insulation protection shields or pre-engineered thermal hanger-shield inserts as specified in Division 22 Section "Plumbing Insulation".

P. Vertical Piping Risers:

1. Reference Section "Vibration Isolation for Plumbing Piping and Equipment" for piping riser supports.

Q. Expansion Anchors: Use in existing concrete, masonry or in pre-cast concrete construction.

R. Pre-Engineered Roof Pipe Supports: Set supports on an 18" X 18" x 3/16" thick roof walkway material compatible with the roof material.

3.04 EQUIPMENT SUPPORTS

A. Use metal fabricated supports or supports assembled from metal channel (strut) to support equipment as required.

B. Use metal channel (strut) secured to studs to support equipment surface-mounted on hollow stud walls.

C. Use metal channel (strut) to support surface-mounted equipment in wet or damp locations to provide space between equipment and mounting surface.

D. Securely fasten floor-mounted equipment. Do not install equipment such that it relies on its own weight for support.

E. Preset Concrete Inserts and Expansion Anchors: Use manufacturer provided closure strips to inhibit concrete seepage during concrete pour.

1. Where concrete slabs form finished ceiling, locate anchors flush with slab surface.

F. Secure fasteners according to manufacturer's recommended torque settings.

G. Remove temporary supports.

H. Fabricate structural steel stands to suspend equipment from structure above or support equipment above floor.

I. Grouting: Place grout under supports for piping and equipment.

3.05 METAL FABRICATION

A. Cut, drill, and fit miscellaneous metal fabrications for pipe anchors and equipment supports. Install and align fabricated anchors in indicated locations.

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 for procedures of manual shielded metal-arc welding, appearance and quality of welds made, methods used in correcting welding work, and the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.

2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. Finish welds at exposed connections so that no roughness shows after finishing, and so that contours welded surfaces to match adjacent contours.

3.06 FIELD QUALITY CONTROL

A. Examine support and attachment components for damage and defects.

B. Hanger Adjustment: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

C. Repair cuts and abrasions in galvanized finishes using zinc-rich paint recommended by manufacturer. Replace components that exhibit signs of corrosion.

D. Touch-Up Painting: Immediately after erection of anchors and supports, clean field welds and abraded areas of shop paint and paint exposed areas with same material as used for shop painting to comply with SSPC-PA-1 requirements for touch-up of field-painted surfaces. Comply with Division 09 Section "Painting."

1. Apply by brush or spray to provide a minimum dry film thickness of 2.0 mils.

E. For galvanized surfaces clean welds, bolted connections and abraded areas and apply galvanizing repair paint to comply with ASTM A 780.

F. Correct deficiencies and replace damaged or defective support and attachment components.

3.07 HANGER AND SUPPORT SCHEDULE

A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.

B. Provide the following acceptable hangers and supports for each type of piping system. Hangers and supports may be single type or strut-mounted:

C. Single Hangers:

1. All pipe sizes 1-1/2 inch and less:
    a. Band hanger.
    b. Swivel split ring.
    c. Clevis hanger.
2. Cold and Hot pipe sizes 2 to 4 inches: Clevis hanger.
3. Cold and Hot pipe sizes 6 inches and greater: Roll support hanger.
4. All drainage pipe sizes: Clevis hanger.

D. Trapezes and Strut-mounted Supports:

1. All pipe sizes less than 6 inches: Two-piece clamp.
2. Pipe sizes 6 inches and greater: Roll support.

E. Wall Supports:

1. Pipe sizes 3 inches and less:

a. Two-hole strap mounted to wall.
b. Welded steel bracket with reinforced angle or strut.

2. Pipe sizes 4 inch and greater:

c. U-bolt
d. Welded steel bracket with reinforced angle or strut.

F. Floor Supports:

1. Pipe sizes 4 inch and less: Pipe saddle.
2. Pipe sizes 6 inch and greater: Roll support.

END OF SECTION

PART 1 - GENERAL REQUIREMENTS

1.01 SUMMARY

A. This Section includes pipe freeze protection system, grease waste temperature maintenance system, and installation instructions.

B. Related Sections: The following sections contain requirements that relate to this Section:

1. Division 22 Section “Plumbing Insulation” for piping insulation and installation requirements.
2. Division 23 Section “Direct-Digital Control for HVAC” for interlock of alarms with building automation system and alarm wiring.
3. Division 26 Section “Common Work Results for Electrical” required electrical devices.
4. Division 26 Sections "Enclosed Switches and Circuit Breakers" for field-installed disconnects.

1.02 SUBMITTALS

A. Refer to Division 1 and Division 22 Section “General Plumbing Requirements” for administrative and procedural requirements for submittals.

B. Product Data: Submit product data on the following items:

1. Pipe Freeze Protection System

C. Submit complete heat trace calculations and drawings including:

1. Floor plans designating pipes to be heat traced
2. Control panel quantities and locations
3. Pipe heat loss and required heat trace cable watts per foot and number of runs
4. Total cable length, maximum cable length and required number of circuits
5. Electrical requirements

1.03 QUALITY ASSURANCE

A. Pipe freeze protection system shall be listed and classified by Underwriter’s Laboratories, Inc. as suitable for purpose intended.

PART 2 - PRODUCTS AND MATERIALS

2.01 MANUFACTURERS

A. Manufacturer: System components shall be factory tested with manufacturers’ standard tests to ensure that all devices, components, and systems are in proper

working order before shipment. Coordinate with Division 23 contractor to provide single manufacturer for all Division 22 and Division 23 heat trace components. Subject to compliance with requirements, provide piping materials and specialties from one of the following:

1. Pipe Freeze Protection System

    a) Chromalox
    b) Nextron
    c) Nelson
    d) Tyco Thermal Controls/Raychem

2.02 PIPE FREEZE PROTECTION SYSTEM

A. In general the system shall include the following items:

1. Heating cable control panel.
2. Transformer(s).
3. Outdoor ambient thermostat(s). Pipe mounted temperature sensor.
4. Junction boxes.
5. Parallel circuit heating cable.
6. Branch circuit wiring and conduit.
7. Other items necessary for a complete system.

B. Heating Cable and Accessories:

1. Parallel circuit, jacketed cable, self-limiting, designed to operate on voltage as specified on the drawings. Cable shall consist of two nickel-copper bus wires embedded in parallel in a self regulating polymer core. Cable shall be capable of varying its output along its length. Provide wattage as required for piping and insulation involved per manufacturer's recommendations.
2. Heating cable shall be covered by a polyolefin dielectric jacket.
3. Heating cable shall be grounded with a braid of tinned copper.
4. Where indicated on the drawings, heating cable shall have polyolefin outer jacket for protection against aqueous inorganic chemicals. Where indicated on the drawings, heating cable shall have fluoropolymer outer jacket for protection against organic chemicals or corrosives.
5. Termination fittings for direct connection to junction boxes.
6. Junction Boxes: Junction boxes shall be NEMA 4X Watertight, even where located indoors.

C. Control Panel:

1. NEMA 4X Fiberglass Reinforced Plastic enclosure for outdoor installation with hinged access door with window and furnished with the following:
2. Microprocessor based controller with LED display with keypad interface and non-volatile memory.

3. Ground fault circuit protection capable of checking heating cable circuit faults
4. LED Indicator Lights: Current mode, heater on, alarm conditions and receive / transmit data.
5. Alarm Conditions: RTD failure, high/low temperature, high/low current, hi/low resistance and high/low voltage, ground fault alarm, trip, loss of programmed values and electromechanical relay failure.
6. Alarm Contacts: One single pole single throw rated at 0.75 amp 120 to 277 volt relay and one dry pilot duty only relay rated at 48 VAC / DC 50 milliamps, 10VA maximum resistive switching
7. Power strip for connecting 277 volt single phase at 30 amps maximum.
8. Temperature Control Sensors: Total of two three wire 100 Ohm RTD's with 10 foot long stainless steel sheath, ambient temperature range of –76°F to 1058°F with an accuracy of ±3°F and a repeatability of ±3°F.

D. Temperature Control Sensor

1. Provide outdoor ambient thermostat with adjustable contacts set to close on decreasing temperature.
2. Provide pipe mounted sensor with adjustable setpoint set to close on decreasing temperature.

PART 3 - EXECUTION

3.01 PIPE FREEZE PROTECTION SYSTEM INSTALLATION

A. Furnish and install a pipe freeze protection system to prevent the following piping from freezing where located in unheated areas:

1. Domestic water piping.
2. Sanitary P-traps.
3. Horizontal sanitary piping
4. Horizontal and vertical grease waste piping and P-traps
5. Condensate drain piping.

B. Installation:

1. Cut cable to length as required to suit pipe lengths and watt per foot requirements.
2. Install and test heating cable after pipe is pressure tested and before pipe is insulated.
3. Secure cable to pipe with cable ties or belts and install according to manufacturer's instructions.
4. Install cable on piping in accordance with manufacturer's recommendations for a minimum ambient temperature of minus 20 degrees F.
5. Install junction boxes where necessary.
6. Install control panels at the locations indicated.

7. For plastic piping, apply heating cable using aluminum tape.

C. Connections:

1. Electrical wiring and connections are specified in Division 26 Section "Common Work Results for Electrical".
2. Coordinate interlock of heat trace system control panel alarm conditions with the building automation system. Alarm wiring and alarm interlock with the building automation system are specified in Division 23 Section "Direct-Digital Control for HVAC".

D. Insulation:

1. Install and test electric heat trace prior to installation of insulation. Insulation is specified in Division 22 section "Plumbing Insulation".

E. Factory Tests:

1. Conduct manufacturers' standard tests on all system components to assure that all devices, components, and systems are in proper working order before shipment.

F. Field Tests:

1. Before and after installation of the thermal insulation, test heating cable with megohmeter between the heating cable bus wires and metallic braid. Minimum insulation resistance shall be 20 megohms regardless of length.
2. Submit test report of megohmeter readings to the Owner.

END OF SECTION

PART 1 - GENERAL REQUIREMENTS

1.01 SUMMARY

A. It is the intent of this specification to provide vibration isolation supports for Plumbing equipment as scheduled at the end of this Section.

B. This work shall include all materials and labor required for the installation of the vibration isolation devices.

C. Vibration isolators shall be selected by the weight distribution to produce reasonably uniform deflection. Deflections shall be as noted on the equipment schedule included at the end of this Section.

D. All vibration isolation equipment shall be furnished by one manufacturer unless specifically approved otherwise in writing by the Engineer.

E. All vibration isolation devices shall be treated for corrosion resistance using galvanization for exterior applications and painting for interior applications.

F. Related Sections:

1. Division 22 Section “Common Work Results for Plumbing” for materials and methods for concrete equipment pads.
2. Division 22 Section "Basic Piping Material and Methods," for materials and methods for flexible connectors.
3. Division 22 Section "Hangers and Supports for Plumbing Piping," for materials and methods for hangers and supports.
4. Division 22 Section “Domestic Booster Pumps,” for materials and methods for domestic booster pumps.
5. Division 22 Section “Gas and Vacuum Systems for Health Care Facilities” for materials and methods for medical air compressors and vacuum pumps.
6. Division 22 Section “General Service Compressed Air Systems” for materials and methods for air compressors.

1.02 WORK INCLUDED

A. Provide complete vibration isolation systems as shown or specified and in accordance with the requirements of the Contract Documents. System shall be complete with:

1. Foundations, vibration isolation, and supports for rigidly supported equipment.
2. Vibration Isolation

1.03 RELATED WORK SPECIFIED ELSEWHERE

1.04 CONTRACTOR'S RESPONSIBILITY

A. Consult all other Section to determine the extent of work specified elsewhere but related to this Section. This work shall be properly coordinated to produce an installation satisfactory to the Owner. The Contractor shall be responsible for verifying the completeness of the isolation installation and the overall suitability of the equipment to meet the intent of this specification. Any additional equipment needed to meet the intent of this specification, even if not specifically mentioned herein or in the Contract Documents, shall be provided by the Contractor without claim for additional payment.

B. Performance or waiving of inspection, testing or surveillance for any portion of the Work shall not relieve the Contractor of the responsibility to conform strictly to the Contract Documents. The Contractor shall not construe performance or waiving of inspection, testing or surveillance by the Owner or Architects to relieve the Contractor from total responsibility to perform in strict accordance with the Contract Documents.

1.05 MANUFACTURER'S RESPONSIBILITIES

A. Manufacturer of vibration isolation equipment shall have the following responsibilities:

1. Determine vibration isolation for all equipment and systems in accordance with the local governing code.
2. Provide piping and equipment isolation systems as scheduled or specified.
3. Guarantee specified isolation system deflection.
4. Provide installation instructions, drawings and field supervision to assure proper installation and performance.
5. The vibration isolation systems shall be guaranteed to have deflection indicated on the schedule on the drawings. Mounting sizes shall be determined by the mounting manufacturer, and the sizes shall be installed in accordance with the manufacturer's instructions.
6. The vibration isolator vendor shall ensure that all equipment to be isolated has sufficient support structure to distribute equipment loads onto isolators. Where additional support structure is required, this shall be provided by vibration isolator vendor.

1.06 SUBMITTALS

A. Submittal data shall show type, size, and deflection of each isolator proposed. Include clearly outlined procedures for installing and adjusting the isolators.

B. Submit a vibration isolation system schedule indicating the following:

1. Manufacturer, type, model number, size

2. Height when uncompressed and static deflection of each isolation element
3. Spring constant of each isolation element
4. Estimated imposed load on each isolation element
5. Spring o.d., free operating, and solid heights
6. Design of supplementary bases.
7. Layout of isolator hangers, mounts, and other elements shown on an outline of the isolated equipment, including complete details of attachment to load-bearing structure or supplementary framing.
8. Piping isolators shown and identified on piping layout drawings.
9. All concrete foundations and supports (and required reinforcing and forms) will be furnished and installed by another trade. However, this trade shall furnish shop drawings showing adequate concrete reinforcing steel details and templates for all concrete foundations and supports, and all required hanger bolts and other appurtenances necessary for the proper installation of the Contractor's equipment. Although another trade will complete all concrete work, all such work shall be shown in detail on the shop drawings, prepared by this trade which drawings shall be submitted showing the complete details of all foundations including necessary concrete and steel work, vibration isolation devices, etc.

1.07 QUALITY ASSURANCE

A. It is the objective of this Specification to provide for the control of vibration due to the operation of machinery or equipment, and/or due to interconnected piping or conduit.

B. The installation of all vibration isolation systems shall be under the supervision of the manufacturer's representative.

PART 2 - PRODUCTS AND MATERIALS

2.01 MANUFACTURERS

A. All vibration isolation equipment and materials shall be provided by a single manufacturer. The following manufacturers are approved provided systems are in compliance with the specified design and performance requirements:

1. Amber Booth.
2. Kinetics Noise Control.
3. Mason Industries, Inc.
4. Vibration Eliminator Co., Inc.
5. Vibration Mounting and Controls.

2.02 GENERAL

A. All equipment provided for vibration isolation shall be new and manufactured specifically for the purpose intended.

2.03 VIBRATION ISOLATORS

A. GENERAL

1. The static deflection of isolators shall be as given in the equipment schedule and specified below. The isolator schedule shall take precedence.
2. Vibration isolator sizes and layout shall be determined by the vibration isolator supplier.
3. All vibration isolators shall have either known undeflected heights or calibration markings so that, after adjustment, the amount of deflection can be verified, thus determining that the load is within the proper range of the device and that the correct degree of vibration isolation is being provided according to the design.
4. All isolators shall operate in the linear portion of their load versus deflection curve. Load versus deflection curves shall be furnished by the manufacturer, and must be linear over a deflection range of not less than 50% above the design deflection.
5. The theoretical vertical natural frequency for each support point, based upon load per isolator and isolator stiffness, shall not differ from the design objectives for the equipment as a whole by more than ±10%.
6. All neoprene mountings shall have a Shore hardness of 30 to 60 ±5, or as specified herein, after minimum aging of 20 days or corresponding over-aging.
7. Housed or caged spring isolators are not acceptable.
8. Where steel spring isolation systems are described in the specifications, the mounting assemblies shall utilize bare springs with the spring diameter not less than 0.8 of the loaded operating height of the spring. Each spring isolator shall be designed and installed so that the ends of the spring remain parallel during and after the spring installation. All isolators shall operate in the linear portion of their load versus deflection curve and have 50% excess capacity without becoming coil bound.
9. All mounting systems exposed to weather and other corrosive environments shall be protected with factory corrosion resistance. All metal parts of mountings (except springs and hardware) shall be hot dip galvanized. Springs shall be cadmium plated and neoprene coated. Nuts and bolts shall be cadmium plated.

B. ISOLATOR TYPE WP

1. Type WP (Waffle Pads) shall be 5/16 inch thick neoprene pads ribbed or waffled on both sides. The pads shall be manufactured with bridge bearing quality neoprene, and selected for a maximum durometer of 50 and designed for 15% strain. Where required, steel load-spreading plates shall be incorporated between the equipment and the neoprene pad.
2. If the isolator is bolted to the structure, a neoprene vibration isolation washer and sleeve (Uniroyal Type 620/660 or as approved) shall be installed under the bolt head between the steel washer and the base plate.
3. (Type WP: Mason Industries Type W or as approved.)

C. ISOLATOR TYPE MWP

1. Type MWP (Metal and Waffle Sandwich Pads) shall consist of two 5/16 inch thick ribbed or waffle neoprene pads sandwiching a 16 gauge stainless steel shim plate. The pad shall be manufactured with bridge bearing quality neoprene, and selected for a maximum durometer of 50 and designed for 15% strain.
2. If the isolator is bolted to the structure, a neoprene vibration isolation washer and sleeve (Uniroyal Type 620/660, or as approved) shall be installed under the bolt head between the steel washer and the base plate.
3. (Type MWP: Mason Industries Type WSW or as approved.)

D. ISOLATOR TYPE DDNM

1. Type DDNM (Double Deflection Neoprene Mounts) shall be laterally stable, double deflecting, molded neoprene isolators. All metal surfaces shall be covered with neoprene. The top and bottom surfaces shall be ribbed and bolt holes shall be provided in the base. The mounts shall have leveling bolts rigidly secured to the equipment.
2. The isolator shall be manufactured with bridge bearing quality neoprene, and selected for a maximum durometer of 50 and designed for 15% strain. DDNM mounts shall be selected for a static deflection of 3/8 inch unless otherwise specified.
3. (Type DDNM: Mason Industries Type ND or as approved.)

E. ISOLATOR TYPE DDNH

1. Type DDNH (Double Deflection Neoprene Hangers) shall consist of a molded neoprene isolating element in a steel hanger box. A neoprene sleeve shall be provided where the lower hanger rod passes through the steel hanger box, such that the hanger rod cannot contact the steel hanger. The diameter of the clear hole in the hanger box shall be at least 3/4 inch larger than the diameter of the hanger rod and permit the hanger rod to swing through a 30 degree arc. When installed, the hanger box shall be allowed to rotate through a full 360 degrees without encountering any obstructions.
2. The isolator shall be manufactured with bridge bearing quality neoprene, and selected for a maximum durometer of 50 and designed for 15% strain. Unless otherwise specified, the static deflection of DDNH hangers shall be 0.3 inches.
3. (Type DDNH: Mason Industries Type HD or as approved.)

F. ISOLATOR TYPE SPNM

1. Type SPNM (Spring and Neoprene Mounts) shall have a free-standing and laterally stable steel spring without any housing. Springs shall be designed so that the ratio of the horizontal to vertical spring constant is between one and two. The spring diameter shall be not less than 80% of the compressed height of the spring at rated load. Loaded springs shall have a minimum additional travel to solid equal to 50% of the specified static deflection.

2. Unless otherwise specified, the minimum static deflection of SPNM isolators for equipment mounted on grade slabs shall be 1 inch, and the minimum static deflection for equipment mounted above grade level shall be 2 inches.
3. Two Type WP isolation pads sandwiching a 16 gauge stainless or galvanized steel separator plate shall be bonded to the isolator baseplate.
4. Unless otherwise specified, isolators need not be bolted to the floor for indoor installations. If the base plates are bolted to the structure, a neoprene vibration isolation washer and sleeve (Uniroyal Type 620/660 or as approved) shall be installed under the bolt head between the steel washer and the base plate.
5. (Type SPNM: Mason Industries Type SLFH or as approved.)

G. ISOLATOR TYPE SPNH

1. Type SPNH (Spring and Neoprene Hangers) shall consist of a steel spring in series with a neoprene isolating element. The spring shall have a minimum additional travel to solid equal to 50% of the specified deflection. The neoprene element shall have a static deflection of not less than 0.3 inches with a strain not exceeding 15%.
2. Unless otherwise specified, the static deflection of SPNH hangers shall be 2 inches.
3. Spring diameter and hanger box hole size shall be large enough to permit the hanger rod to swing through a 30 degree arc. A neoprene sleeve shall be provided where the lower hanger rod passes through the steel hanger box, such that the hanger rod cannot contact the steel hanger. The diameter of the clear hole in the hanger box shall be at least 3/4 inch larger than the diameter of the hanger rod. When installed, the spring element shall not be cocked, and the hanger box shall be allowed to rotate through a full 360 degree arc without encountering any obstructions.
4. (Type SPNH: Mason Industries Type 30N or as approved.)

H. BASE TYPE CIB

1. Inertia base Type CIB (Concrete Inertia Base) shall have an integral rectangular structural steel form into which concrete is poured.
2. Perimeter members shall be beams of depth equal to 10% of the longest span of the base, but not more than 12 inches nor less than 6 inches deep. Forms shall include motor slide base and all reinforcing steel. Where anchor bolt locations fall in concrete, the reinforcing steel shall include drilled members with sleeves welded below the steel to accept the anchor bolts. Height saving steel brackets shall be used in all mounting locations.
3. When the concrete base is "T" shaped, isolators shall be located under the projections as well as under the main body in order to prevent cantilever distortion.
4. The structural perimeter frame, mounting templates, height saving brackets, and spring system shall be provided as an assembly by the vibration control vendor.

5. (Base Type CIB: Mason Industries Type KSL or as approved)

I. NEOPRENE MOUNTING SLEEVES

1. Neoprene mounting sleeves for hold-down applications of equipment with vibration isolators shall be Uniroyal Type 620/660 or as approved.

J. PIPE FLEXIBLE CONNECTORS

1. Refer to Section "Basic Piping Materials and Methods" for requirements for flexible pipe connectors.

PART 3 - EXECUTION

3.01 GENERAL

A. All equipment, piping, etc. shall be mounted on or suspended from approved foundations and supports, all as specified herein, or as shown on the drawings.

B. All floor-mounted equipment shall be erected on concrete equipment pads over the complete floor area of the equipment, unless otherwise specified herein. Refer to Section "Basic Piping Materials and Methods" for concrete equipment pad requirements. These pads shall be integrally keyed to structural slab. Wherever vibration eliminating devices and/or concrete inertia blocks are specified, these items shall, in all cases, be mounted on concrete equipment pads unless otherwise specified herein.

C. Furnish and install neoprene mounting sleeves for hold-down bolts to prevent any metal to metal contact.

D. All equipment shall be provided with lateral restraining isolators as required to limit horizontal motion to 1/4" maximum, under all operating conditions. Lateral restraining isolators shall have the same static deflection as the vertical isolators for the equipment being isolated.

E. Unless otherwise indicated, all equipment mounted on vibration isolators shall have a minimum operating clearance of 2 inches between the bottom of the equipment or inertia base (and height-saving bracket) and the concrete equipment pad (or bolt heads) beneath the equipment. The clearance shall be checked by the Contractor to ensure that no material has been left to short- circuit the vibration isolators. There shall be a minimum 4 inch clearance between isolated equipment and the walls, ceiling, floors, columns and any other equipment not installed on vibration isolators.

F. Piping or plumbing equipment shall be supported from building structure, not hung from or supported on other equipment, pipes, or ductwork.

G. Equipment connected to water or other fluid piping shall be erected on isolators or isolated foundations at correct operating heights prior to connection of piping, and blocked-up with temporary shims to final operating height. When the system is assembled and fluid is added, the isolators shall be adjusted to allow removal of the shims.

H. All plumbing equipment not specifically identified in this specification that contains rotating or vibrating elements, and any associated electrical apparatus installed by this division that contains transformers or inductors shall be installed on Type DDNM neoprene isolators as appropriate.

I. All wiring connections to plumbing equipment on isolators shall be made with a minimum 18 inch long flexible conduit in a "U" shaped loop.

J. Elastomeric isolators that will be exposed to temperatures below 32 degrees F shall be fabricated from natural rubber instead of neoprene.

K. Springs shall be designed and installed so that ends of springs remain parallel and all springs installed with adjustment bolts.

L. Springs shall be sized to be non-resonant with equipment forcing frequencies or support structure natural frequencies.

M. Refer to Vibration Isolation Schedule at the end of this Section.

3.02 INLINE PUMPS

A. Inline pumps shall be supported on Type SPNH spring isolators. Provide flexible pipe couplings on each side of pump. The vertical load shall be carried by the supports, not by the flexible couplings.

3.03 DOMESTIC BOOSTER PUMPS

A. Packaged domestic booster pumps installed on slab on grade shall be bolted and grouted thru their factory provided equipment frames to equipment pads and be provided with vibration isolators as scheduled in the table at the end of this section.

B. Packaged domestic booster pumps installed on suspended slabs shall be bolted and grouted thru their factory provided equipment frames to a spring supported concrete inertia base and be provided with vibration isolators as scheduled in the table at the end of this section. Provide concrete inertia base with thickness as scheduled in the table at the end of this section and provide with a 2" minimum operating clearance between the base and equipment pads.

3.04 AIR COMPRESSORS AND VACUUM PUMPS

A. Base-mounted air compressors and vacuum pumps shall be bolted and grouted to Base Type CIB with the inertia base supported on Type SPNM isolators as scheduled in the table at the end of this section.

B. Packaged air compressors and vacuum pumps installed on slab on grade shall be bolted and grouted thru their factory provided equipment frames to equipment pads and be provided with vibration isolators as scheduled in the table at the end of this section.

C. Packaged air compressors and vacuum pumps installed on suspended slabs shall be bolted and grouted thru their factory provided equipment frames to Base Type CIB with the inertia base and be provided with vibration isolators as scheduled in the table at the end of this section.

D. Tank mounted air compressors and vacuum pumps installed on slab on grade shall be bolted and grouted to equipment pads and be provided with vibration isolators as scheduled in the table at the end of this section.

E. Tank mounted compressors and vacuum pumps installed on suspended slabs shall be bolted and grouted thru their factory provided equipment frames to Base Type CIB with the inertia base and be provided with vibration isolators as scheduled in the table at the end of this section.

3.05 SUPPORT OF PIPING

A. The following water and condensate piping shall be resiliently supported:

1. Piping within 50 feet of connected rotating equipment.
2. Piping installed below or adjacent to noise sensitive areas.

B. Pipes connected to equipment installed on spring vibration isolators shall be suspended or supported by Type SPNM or Type SPNH isolators. Provide vibration isolation anchors and guides as specified elsewhere in this section. The first isolator both upstream and downstream of equipment on springs shall have a static deflection equal to 1.5 times that of the equipment isolators, up to a maximum of 2 inches. The static deflection of the remaining pipe isolators shall be 1 inch.

C. Piping that is connected only to machinery installed on neoprene isolators shall be either supported from the floor on Type DDNM mounts or suspended from the structure on Type DDNH hangers.

D. Where a pipe run connects multiple items of equipment in the mechanical room the pipe isolators for the entire run shall be chosen to suit the connected equipment of greatest static deflection.

E. Resilient diagonal mountings or other approved devices shall be provided as required to limit piping motion due to equipment startup or shut down, to a maximum of 1/8".

F. Water piping hanger rod isolators shall contain a steel spring in series with a 1/4" acoustical neoprene pad within a steel box retainer. The hanger rod isolator assembly shall be rigidly supported from the spring sub-assembly and shall not contact the steel box retainer. Clearances in the isolator design shall be capable of accepting a 15 degree misalignment in any direction from the vertical.

G. The steel spring element of the assembly shall be designed to have a minimum surge frequency of 340 HZ and a minimum deflection of 3/4".

H. Hanger rod isolators for steam and condensate piping including steam pressure reducing valve stations shall be supported by means of neoprene-in-shear mountings providing a minimum static deflection of 1/2".

I. Where supplementary steel is required to support piping, the supplementary steel shall be sized so that maximum deflection between supports does not exceed 0.08" and shall be resiliently supported from the building structure with mountings as described above. Supported piping from the supplementary steel shall be rigidly suspended or supported.

J. Pre-compressed type hanger rod isolators shall be provided for all water piping greater than 12" diameter and all supplementary steel supports. The pre-compression shall be factory set at 75% of rated deflection.

K. Where isolated water piping 8" and larger is supported directly below exposed steel beams, attachment to the beam shall be made by means of welded channel beam attachments located directly under the web of the beam. For piping 6" and smaller, beam clamps may be used in lieu of welding subject to approval of beam clamp selection.

L. Except as noted elsewhere in this section, all 2-inch and smaller domestic water piping that is installed outside equipment rooms shall be isolated from the structure with sponge neoprene, felt or glass/mineral fiber sleeves between the pipe and pipe clamp or with Type WP pads between the clamp and the structure. The sleeve shall be not less than 1/8-inch in thickness when compressed.

3.06 PIPING ANCHORS, GUIDES AND SUPPORTS

A. General: Pipe riser guides, anchors and supports including piping anchors in mechanical equipment rooms or occupied spaces shall be isolated from the building structure such that there shall be no direct metal to metal contact of the piping with the building structure.

B. Piping Anchors and Guides

1. The all directional pipe anchor isolation mountings shall consist of a telescoping arrangement of two sizes of steel tubing separated by a minimum of 1/2" thick heavy duty neoprene and canvas duct isolation pad. Vertical restraints shall be provided by similar material arranged to prevent vertical travel in either direction. The allowable load on the isolation material shall not exceed 500 psi.
2. Steel guides shall be welded to the pipe at a maximum spacing of 90°. The outside diameter of the opposing guide bars shall be smaller than the inside diameter of the pipe riser clamp in accordance with standard field construction practice. Each end of the pipe guide shall be rigidly attached to an all directional pipe anchor isolation mounting which in turn, shall be rigidly fastened to the steel framing within the shaft.
3. Low temperature piping guides shall be constructed with a 360 degree 10 gauge metal sleeve around the piping. The thermal insulation requirements for the piping shall be provided between the piping and the sleeve. Heavy duty neoprene and canvas duct isolation pad of thickness equal to thermal insulation requirements shall space the metal sleeve away from the piping with urethane or other suitable thermal insulation provided in the voids between the pipe-sleeve and isolation pan material. The metal sleeve outside diameter shall be smaller than the pipe riser clamp inside diameter in accordance with standard field construction practice. The pipe riser clamp shall be rigidly attached to the steel framing within the shaft.

C. Piping Supports:

1. Piping supports within shafts shall be provided with suitable bearing plates and two layers 1/4" thick ribbed or waffled neoprene pad loaded for 50 psi maximum. The isolation pads shall be separated with 1/4" steel plate. The isolation pads shall be Type WP or approved equal.
2. Piping isolation supports at the base of risers shall be two layers of 1/2" thick heavy duty neoprene and canvas duct isolation pad separated by 1/4" thick steel plate. Suitable bearing plates sized to provide a pad loading of 500 psi maximum shall be provided. The stanchion between the pipe and isolation support shall be welded to the pipe and welded or bolted to the isolation support. The isolation support shall be bolted to the floor slab with resilient sleeves and washers. All pipe support resilient materials shall be HL Mason Industries, Inc., or as approved.

3.07 FLEXIBLE PIPING CONNECTORS

A. Flexible piping connectors shall be installed to connect piping diameter 2” or greater to reciprocating or rotating equipment.

3.08 PIPE RISER SUPPORTS

A. Where pipes rise in a vertical chase and are supported from a structure with type SPNH or DDNH isolators and require lateral bracing, neoprene riser guides shall

be mounted around the pipe to limit lateral movement and to prevent direct contact with the supporting structure.

B. Support vertical pipe risers subjected to thermal expansion and/or contraction with spring isolators and central anchors designed to ensure loading within design limits at support points. Perform design calculations for sizing the riser supports incorporating the initial load, initial deflection, change in deflection, final load and change in load at support locations. Design calculations must include anchor loads when installed, cold filled and at operating temperature and pipe stress at end connections and branch locations. Design system for an initial spring deflection of at least 4 times the thermal movement. Design must be stamped and signed by a licensed professional engineer.

3.09 WIRING

A. All wiring connections to plumbing equipment on vibration isolators (either spring or neoprene type) shall be made with a minimum 18 inch long flexible conduit in a "U" shaped loop. This Contractor shall coordinate wiring connections with the Electrical Contractor.

3.010 FIELD QUALITY

A. Contractor shall work in accord with best trade practices, shall fabricate and install all items in accordance with manufacturer's recommendations and Architect's directions, and shall consult with trades doing adjoining work in order to provide an installation of first class quality.

3.011 ADJUSTMENT AND TESTING

A. Site Access: During installation of equipment, Contractor shall arrange for access as necessary for inspection of isolation and noise control equipment by Architect and the Contractor's representatives.

B. Contractor's Vibration Isolation Report: The vibration isolation vendor shall inspect and approve the installation of the vibration isolators and shall submit a report to the Architect which verifies that all of the isolation equipment has been properly installed and that the installation is in full conformance with the specification. The report shall record the vibration isolator identification and model or type. For isolators containing steel springs the report shall also record the size and uncompressed height, design static deflection and measured static deflection of the isolators provided.

C. Consultant's Inspection: Upon completing installation and adjustment for suitable operation of all work specified under this section, the Contractor shall notify the Architect in writing. The letter shall certify that all work specified under this section is complete, operational and adjusted in every respect, and that all work is ready for

the completion checkout. The notification letter shall be accompanied by the vibration isolation report.

3.012 GUARANTEE

A. If, in the actual installation, any equipment fails to meet the vibration control requirements specified herein, that equipment shall be corrected or replaced without claim for additional payment, inclusive of all labor and material costs. Such corrective measures shall be done within a time schedule specified by the Owner.

3.013 SCHEDULE OF VIBRATION ISOLATORS

EQUIPMENT	BASE TYPE	ISOLATOR TYPE	STATIC DEFLECTION
Base-mounted pumps (less than 50 HP) (Slab-On-Grade)	Equipment Pad		
Domestic Booster Pumps (Slab on Grade)	Equipment Pad	MWP	0.25
Air Compressors and Vacuum Pumps (Packaged) (Slab on Grade)	Equipment Pad	MWP	0.25”
Piping		Isolation as per specification.	

END OF SECTION

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PART 1 - GENERAL REQUIREMENTS

1.01 SUMMARY

A. Extent of Plumbing work to be identified as required by this Section is indicated on drawings and/or specified in other Division 22 Sections.

B. Types of identification devices specified in this Section include the following:

1. Plastic Pipe Markers
2. Plastic Tape
3. Underground-Type Plastic Line Marker
4. Valve Tags
5. Valve Schedule Frames
6. Engraved Plastic-Laminate Signs
7. Plastic Equipment Markers
8. Plasticized Tags

1.02 CODES AND STANDARDS:

A. ANSI Standards: Comply with ANSI A13.1 for lettering size, length of color field, colors, and viewing angles of identification devices.

1.03 SUBMITTALS

A. Product Data: Submit manufacturer's technical product data and installation instructions for each identification material and device required.

B. Schedules: Submit valve schedule for each piping system, typewritten and reproduced on 8-1/2" x 11" bond paper. Tabulate valve number, piping system, system abbreviation (as shown on tag), location of valve (room or space), and variations for identification (if any). Mark valves which are intended for emergency shut-off and similar special uses, by special "flags", in margin of schedule. In addition to mounted copies, furnish extra copies for Maintenance Manuals as specified in Division 1.

C. Maintenance Data: Include product data and schedules in Maintenance Manuals as specified in Division 1 and Section “General Plumbing Requirements.”

1.04 SPARE PARTS

A. Furnish minimum of 5% extra stock of each plumbing identification material required, including additional numbered valve tags (not less than 3) for each piping system, additional piping system identification markers, and additional plastic laminate engraving blanks of assorted sizes.

1. Where stenciled markers are provided, clean and retain stencils after completion of stenciling and include used stencils in extra stock, along with required stock of stenciling paints and applicators.

PART 2 - PRODUCTS AND MATERIALS

2.01 ACCEPTABLE MANUFACTURERS

A. Manufacturer: Subject to compliance with requirements, provide plumbing identification materials of one of the following:

1. Allen Systems, Inc.
2. Brady (W.H.) Co.; Signmark Div.
3. Industrial Safety Supply Co., Inc.
4. Seton Name Plate Corp.

2.02 PLUMBING IDENTIFICATION MATERIALS

A. General: Provide manufacturer's standard products of categories and types required for each application as referenced in other Division 22 sections. Where more than single type is specified for application, selection is Installer's option, but provide single selection for each product category.

2.03 PLASTIC PIPE MARKERS

A. Snap-On Type: Provide manufacturer's standard pre-printed, semi-rigid snap-on, color-coded pipe markers, complying with ANSI A13.1

B. Pressure-Sensitive Type: Provide manufacturer's standard pre-printed, permanent adhesive, color-coded, pressure-sensitive vinyl pipe markers, complying with ANSI A13.1

C. Insulation: Furnish 1" thick molded fiberglass insulation with jacket for each plastic pipe marker to be installed on uninsulated pipes subjected to fluid temperatures of 125 degrees F (52 degrees C) or greater. Cut length to extend 2" beyond each end of plastic pipe marker.

D. Small Pipes: For external diameters less than 6" (including insulation if any), provide full-band pipe markers, extending 360 degrees around pipe at each location, fastened by one of the following methods:

1. Snap-on application of pre-tensioned semi-rigid plastic pipe marker.
2. Adhesive lap joint in pipe marker overlap.
3. Laminated or bonded application of pipe marker to pipe (or insulation).
4. Taped to pipe (or insulation) with color-coded plastic adhesive tape, not less than 3/4" wide; full circle at both ends of pipe marker, tape lapped 1-1/2".

E. Large Pipes: For external diameters of 6" and larger (including insulation if any), provide either full-band or strip-type pipe markers, but not narrower than 3 times letter height (and of required length), fastened by one of the following methods:

1. Laminated or bonded application of pipe marker to pipe (or insulation).
2. Taped to pipe (or insulation) with color-coded plastic adhesive tape, not less than 1-1/2" wide; full circle at both ends of pipe marker, tape lapped 3".
3. Strapped-to-pipe (or insulation) application of semi-rigid type, with manufacturer's standard stainless steel bands.

F. Arrows: Print each pipe marker with arrows indicating direction of flow, either integrally with piping system service lettering (to accommodate both directions), or as a separate unit of plastic.

G. Lettering: Manufacturer's standard pre-printed nomenclature which best describes piping system in each instance, as selected by Architect/Engineer in cases of variance with names as shown or specified.

H. Lettering: Comply with piping system nomenclature as specified, scheduled, or shown, and abbreviate only as necessary for each application length.

2.04 PLASTIC TAPE

A. General: Provide manufacturer's standard color-coded pressure-sensitive (self-adhesive) vinyl tape, not less than 3 mils thick.

B. Width: Provide 1-1/2" wide tape markers on pipes with outside diameters (including insulation, if any) of less than 6", 2-1/2" wide tape for larger pipes.

C. Color: Comply with ANSI A13.1, except where another color selection is indicated.

2.05 UNDERGROUND-TYPE PLASTIC LINE MARKER

A. General: Manufacturer's standard permanent, bright-colored, continuous-printed plastic tape, intended for direct-burial service; not less than 6" wide x 4 mils thick. Provide tape with printing which most accurately indicates the type of service of buried pipe.

1. Provide multi-ply tape consisting of solid aluminum foil core between 2-layers of plastic tape.

2.06 VALVE TAGS

A. Brass Valve Tags: Provide 19-gauge polished brass valve tags with stamp-engraved piping system abbreviation in 1/4" high letters and sequenced valve numbers 1/2" high, and with 5/32" hole for fastener.

1. Provide 1-1/2" diameter tags, except as otherwise indicated.

2. Fill tag engraving with black enamel.

B. Valve Tag Fasteners: Provide manufacturer's standard solid brass chain (wire link or beaded type), or solid brass S-hooks of the sizes required for proper attachment of tags to valves, and manufactured specifically for that purpose.

2.07 ACCESS PANEL MARKERS

A. Access Panel Markers: Provide manufacturer's standard 1/16" thick engraved plastic laminate access panel markers, with abbreviations and numbers corresponding to concealed valve. Include 1/8" center hole to allow attachment.

2.08 VALVE SCHEDULE FRAMES

A. General: For each page of valve schedule, provide glazed display frame, with screws for removable mounting on masonry walls. Provide frames of finished hardwood or extruded aluminum, with SSB-grade sheet glass.

2.09 ENGRAVED PLASTIC-LAMINATE SIGNS

A. General: Provide engraving stock melamine plastic laminate, complying with ASTM D 709, in the sizes and thickness indicated, engraved with engraver's standard letter style of the sizes and wording indicated, black with white core (letter color) except as otherwise indicated, punched for plumbing fastening except where adhesive mounting is necessary because of substrate.

B. Thickness: 1/16" for units up to 20 sq. in. or 8" length; 1/8" for larger units.

C. Fasteners: Self-tapping stainless steel screws, except contact-type permanent adhesive where screws cannot or should not penetrate the substrate.

2.010 PLASTIC EQUIPMENT MARKERS

A. General: Provide manufacturer's standard laminated plastic, color coded equipment markers. Conform to the following color code:

1. Green: Cooling equipment and components.
2. Yellow: Heating equipment and components.
3. Yellow/Green: Combination cooling and heating equipment and components.
4. Brown: Energy reclamation equipment and components.
5. Blue: Equipment and components that do not meet any of the above criteria.
6. For hazardous equipment, provide colors and designs recommended by ANSI A13.1.

B. Nomenclature: Include the following, matching terminology on schedules as closely as possible:

1. Name and plan number.

2. Equipment service.
3. Design capacity.
4. Other design parameters such as pressure drop, entering and leaving conditions, rpm, etc.

C. Size: Provide 2-1/2" x 4" markers for control devices, dampers, and valves; and 4-1/2" x 6" for equipment.

2.011 PLASTICIZED TAGS

A. General: Manufacturer's standard pre-printed or partially pre-printed accident-prevention tags, of plasticized card stock with matt finish suitable for writing. Tags shall be minimum 3-1/4" x 5-5/8" in size, provided with brass grommets and wire fasteners, and with appropriate pre-printed wording including large-size primary wording (as examples; DANGER, CAUTION, DO NOT OPERATE).

2.012 LETTERING AND GRAPHICS

A. General: Coordinate names, abbreviations and other designations used in plumbing identification work, with corresponding designations shown, specified or scheduled. Provide numbers, lettering and wording as indicated or, if not otherwise indicated, as recommended by manufacturers or as required for proper identification and operation/maintenance of plumbing systems and equipment.

1. Multiple Systems: Where multiple systems of same generic name are shown and specified, provide identification which indicates individual system number as well as service (as examples; Boiler No. 3, Air Supply No. 1H, Standpipe F12).

PART 3 - EXECUTION

3.01 GENERAL INSTALLATION REQUIREMENTS

A. Coordination: Where identification is to be applied to surfaces which require insulation, painting or other covering or finish, including valve tags in finished plumbing spaces, install identification after completion of covering and painting. Install identification prior to installation of acoustical ceilings and similar removable concealment.

3.02 PIPING SYSTEM IDENTIFICATION

A. General: Install pipe markers of one of the following types on each system indicated to receive identification, and include arrows to show normal direction of flow:

1. Plastic pipe markers, with application system as indicated under "Materials" in this section. Install on pipe insulation segment where required for hot non-insulated pipes.

B. Application: Provide piping system identification for the following systems:

1. Domestic cold water piping.
2. Domestic hot water piping.
3. Domestic hot water recirculating piping.
4. Non potable water piping
5. Lawn irrigation piping.
6. Sanitary and waste piping.
7. Storm water piping.
8. Vent piping.
9. Insulated and non-insulated storm water piping.
10. Compressed air piping.
11. Medical gas piping (indicate each type of system, accordingly).
12. Natural gas piping.

C. Location: Install pipe markers and color bands in the following locations where piping is exposed to view, concealed only by a removable ceiling system, installed in machine rooms, installed in accessible maintenance spaces (shafts, tunnels, plenums) and exterior non-concealed locations.

1. Within 5 feet of each valve and control device.
2. Within 5 feet of each branch, excluding take-offs less than 25 feet in length for fixtures; mark flow direction of each pipe at branch connection.
3. Within 5 feet where pipes pass through walls, floors or ceilings or enter non-accessible enclosures. Provide identification on each side of wall, floor or ceiling.
4. At access doors, manholes and similar access points which permit view of concealed piping.
5. Within 5 feet of major equipment items and other points of origination and termination.
6. Spaced intermediately at maximum spacing of 50' along each piping run, except reduce spacing to 25' in congested areas of piping and equipment where there are more than two piping systems or pieces of equipment.

3.03 UNDERGROUND PIPING IDENTIFICATION

A. General: During back-filling/top-soiling of each exterior underground piping systems, install continuous underground-type plastic line marker, located directly over buried line at 6" to 8" below finished grade. Where multiple small lines are buried in common trench and do not exceed overall width of 16", install single line marker. For tile fields and similar installations, mark only edge pipe lines of field.

3.04 VALVE IDENTIFICATION

A. General: Provide valve tag on every valve, cock and control device in each piping system; exclude check valves, valves within factory-fabricated equipment units, plumbing fixture faucets, convenience and lawn-watering hose bibbs, and shut-off

valves at plumbing fixtures and similar rough-in connections of end-use fixtures and units.

B. List each tagged valve in valve schedule for each piping system. Mount valve schedule frames and schedules in machine rooms where indicated or, if not otherwise indicated, where directed by Architect/Engineer.

1. Where more than one major machine room is shown for project, install mounted valve schedule in each major machine room, and repeat only main valves which are to be operated in conjunction with operations of more than single machine room.

3.05 PLUMBING EQUIPMENT IDENTIFICATION

A. General: Install engraved plastic laminate sign or plastic equipment marker on or near each major item of plumbing equipment and each operational device, as specified herein if not otherwise specified for each item or device. Provide signs for the following general categories of equipment and operational devices:

1. Main control and operating valves, including safety devices and hazardous units such as gas outlets.
2. Meters, gauges, thermometers and similar units.
3. Pumps
4. Heat exchangers
5. Water heaters, tanks and pressure vessels.
6. Strainers, water treatment systems and similar equipment.

B. Optional Sign Types: Where lettering larger than 1" height is needed for proper identification, because of distance from normal location of required identification, stenciled signs may be provided in lieu of engraved plastic, at Installer's option.

C. Lettering Size: Minimum 1/4" high lettering for name of unit where viewing distance is less than 2'-0", 1/2" high for distances up to 6'-0", and proportionately larger lettering for greater distances. Provide secondary lettering of 2/3 to 3/4 of size of the principal lettering.

D. Text of Signs: In addition to name of identified unit, provide lettering to distinguish between multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations.

1. Optional Use of Plasticized Tags: At Installer's option, where equipment to be identified is concealed above acoustical ceilings or similar concealment, plasticized tags may be installed within concealed space to reduce amount of text in exposed sign (outside concealment).
2. Operational valves and similar minor equipment items located in non-occupied spaces (including machine rooms) may, at Installer's option, be identified by installation of plasticized tags in lieu of engraved plastic signs.

END OF SECTION

PART 1 - GENERAL REQUIREMENTS

1.01 SUMMARY

A. Extent of Plumbing insulation required by this Section is indicated on drawings and schedules, and by requirements of this Section.

B. Types of Plumbing insulation specified in this Section include the following:

1. Piping Systems Insulation:

a) Fiberglass
b) Flexible Elastomeric

2. Equipment Insulation:

a) Fiberglass

1.02 QUALITY ASSURANCE

A. Flame/Smoke Ratings: Provide composite Plumbing insulation (insulation, jackets, coverings, sealers, mastics and adhesives) with flame-spread index of 25 or less, and smoke-developed index of 50 or less, as tested by UL 723 or ASTM E 84 (NFPA 255) method.

1. Exception: Outdoor Plumbing insulation may have flame spread index of 75 and smoke developed index of 150.
2. Exception: Industrial Plumbing insulation that will not affect life safety egress of building may have flame spread index of 75 and smoke developed index of 150.

B. Related Sections: The following sections contain requirements that relate to this Section:

1. Division 22 Section "Hangers and Supports for Plumbing Piping," for insulation shields for protecting insulation vapor barrier and materials and methods for piping installations.

1.03 SUBMITTALS

A. Product Data: Submit manufacturer's technical product data and installation instructions for each type of Plumbing insulation. Submit schedule showing manufacturer's product number, k-value, thickness, and furnished accessories for each Plumbing system requiring insulation.

B. Maintenance Data: Submit maintenance data and replacement material lists for each type of Plumbing insulation. Include this data and product data in maintenance manual.

PART 2 - PRODUCTS AND MATERIALS

2.01 ACCEPTABLE MANUFACTURERS

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

1. Aeroflex USA, Inc.
2. Armacell LLC.
3. CertainTeed Corp.
4. Knauf Insulation
5. Johns Manville
6. K-Flex USA
7. Owens Corning

2.02 PIPING INSULATION MATERIALS

A. Fiberglass Piping Insulation: ASTM C 547, Class 1 unless otherwise indicated.

B. Flexible Elastomeric Piping Insulation: ASTM C534, Type I.

C. Jackets for Piping Insulation: ASTM C1136, Type I for piping with temperatures below ambient, Type II for piping with temperatures above ambient. Type I may be used for all piping at Installers option.

1. PVC: One-piece, pre-molded PVC cover conforming to ASTM D1784, Johns Manville Zeston 2000 PVC or approved equivalent. Factory supplied, pre-cut insulation blanket inserts for use with PVC fitting covers are acceptable.

D. Staples, Bands, Wires, and Cement: As recommended by insulation manufacturer for applications indicated.

E. Adhesives, Sealers, and Protective Finishes: As recommended by insulation manufacturer for applications indicated.

F. Insulation Diameters: Comply with ASTM C585 for inner and outer diameters of rigid thermal insulation.

G. Pipe, Valve and Fitting Covers: Comply with ASTM C450 for fabrication of fitting covers for pipe, valves and fittings.

H. High Density Insulation Billets:

1. Cellular Glass: ASTM C552.

2.03 EQUIPMENT INSULATION MATERIALS

A. Rigid Fiberglass Equipment Insulation: ASTM C612, Class 2.

B. Flexible Fiberglass Equipment Insulation: ASTM C553, Type I, Class B-4.

C. Flexible Elastomeric Equipment Insulation: ASTM C534, TYPE II.

D. Jacketing Material for Equipment Insulation: Provide pre-sized glass cloth jacketing material, not less than 7.8 ounces per square yard, or metal jacket at Installer's option, except as otherwise indicated.

E. Equipment Insulation Compounds: Provide adhesives, cements, sealers, mastics and protective finishes as recommended by insulation manufacturer for applications indicated.

F. Equipment Insulation Accessories: Provide staples, bands, wire, wire netting, tape, corner angles, anchors and stud pins as recommended by insulation manufacturer for applications indicated.

PART 3 - EXECUTION

3.01 INSTALLATION, GENERAL

A. Install in accordance with manufacturer's installation instructions.

3.02 PLUMBING PIPING SYSTEM INSULATION

A. Insulation Omitted: Omit insulation on the following:

1. Chrome-plated exposed piping
2. Water Hammer Arrestors
3. Balancing and flow valves
4. Check Valves
5. Drain lines from water coolers
6. Exterior condensate drain piping
7. Exposed storm drainage piping in parking structures

B. Cold Piping:

1. Application Requirements: Insulate the following cold plumbing piping systems:

a) Potable cold water piping.
b) Non-potable cold water piping
c) Potable chilled water piping.
d) Plumbing vents within 6 lineal feet of roof outlet.
e) Horizontal interior above-ground storm drainage piping and vertical run from roof drain to horizontal run.
f) Horizontal and vertical interior above-ground storm drainage piping and vertical run from roof drain to horizontal run.
g) Horizontal and vertical interior above-ground overflow storm drainage piping and vertical run from roof drain to horizontal run.

Where vertical overflow storm drainage piping from the outlet exceeds 15 feet, only insulate within 15 feet of the outlet.

h) Lawn irrigation piping.
i) Condensate piping inside the building.
j) Auxiliary Condensate Piping.
k) Trap arms, waste branches and dedicated stacks serving chilled water waste or condensate drains.

2. Insulate each piping system specified above with one of the following types and thicknesses of insulation:

a) Fiberglass: 1" thickness.

C. Hot Piping:

1. Application Requirements: Insulate the following hot plumbing piping systems:

a) Potable hot water piping.
b) Potable hot water recirculation piping.
c) Hot drain piping (where indicated).

2. Insulate hot water piping systems up to 140F specified above with one of the following types and thicknesses of insulation:

a) Fiberglass: 1" thick for pipe sizes up to and including 1-1/4", 1-1/2" thick for pipe sizes 1-1/2" and larger.

D. P-traps:

1. Insulate P-traps receiving chilled water waste and P-traps of water coolers as described below:

a) Flexible Elastomeric: 1/2" thick for pipe sizes up to and including 2", 1” thick for pipe sizes 2” to 6” (largest size permitted).

2. Insulate P-traps receiving hot water waste above 140F as described below:

a) Fiberglass: 1" thickness.
b) Flexible Elastomeric (high temp formula up to 300F: 1” thickness.

E. Piping Inside Masonry Wall Units:

1. Insulate cold, hot and hot water recirculation piping installed inside of masonry walls where the piping needs to be insulated as the wall is constructed as described below:

a) Flexible Elastomeric: 1/2" thick for pipe sizes up to and including 2", 1” thick for pipe sizes 2” to 6” (largest size permitted).

F. Exterior piping:

1. Encase exterior piping insulation with aluminum weather-proof jackets.

2. Insulate exterior cold water, hot water, hot water recirculation and non-potable water piping as previously described.
3. Insulate and heat trace exterior sanitary p-traps, sanitary, and grease waste piping as described below. Refer to Division 22 Section "Heat Tracing for Plumbing Piping" for heat trace system material and installation requirements.

    a) Fiberglass: 1" thickness.

3.03 EQUIPMENT INSULATION

A. Cold Equipment (Below Ambient Temperature):

1. Application Requirements: Insulate the following cold equipment:

    a) Roof drain bodies.

2. Insulate each item of equipment specified above with one of the following types and thicknesses of insulation:

    a) Fiberglass: 2" thick for cold surfaces above 35 degrees F (2 degrees C) and 3" thick for surfaces 35 degrees F (2 degrees C) and lower.

3.04 INSTALLATION OF PIPING INSULATION

A. General: Install insulation products in accordance with manufacturer's written instructions, and in accordance with recognized industry practices to ensure that insulation serves its intended purpose.

B. Maintain continuous thermal and vapor-retarder integrity throughout entire installation unless otherwise indicated.

C. Install insulation on pipe systems subsequent to installation of heat tracing, painting, testing, and acceptance of tests.

D. Install insulation materials with smooth and even surfaces. Insulate each continuous run of piping with full-length units of insulation, with a single cut piece to complete run. Do not use cut pieces or scraps abutting each other.

E. Clean and dry pipe surfaces prior to insulating.

F. Cold Pipe Insulation:

1. Insulate all cold piping to prevent moisture condensation on exterior surfaces.
2. Provide high density insulation material under supports or pre-insulated supports. Refer to Division 22 Section "Hangers and Supports for Plumbing Piping" for pre-insulated supports.
3. Protect insulation with shields to prevent puncture or other damage. Refer to division 22 Section "Hangers & Supports for Plumbing Piping" for insulation shields.

4. High density insulation material shall extend a minimum 2 inches past the pipe shield on each side.
5. Butt pipe insulation tightly at insulation joints. Apply wet coat of vapor barrier lap cement on joint and seal with 3 inch wide vapor barrier tape or band and coat all taped seams and staple penetrations with vapor barrier coating to prevent moisture ingress.

G. Hot Pipe Insulation:

1. Provide pipe hangers for hot piping sized for the outside diameter of piping.
2. Butt insulation to hanger or riser clamp for vertical pipe. Butt pipe insulation tightly at insulation joints. Seal exposed insulation at hanger with joint sealant.

H. Pipe insulation:

1. Insulate all cold piping to prevent moisture condensation on exterior surfaces.
2. Provide high density insulation material under supports or pre-insulated supports. Refer to Division 22 Section "Hangers and Supports for Plumbing Piping" for pre-insulated supports.
3. Protect insulation with shields to prevent puncture or other damage. Refer to division 22 Section "Hangers & Supports for Plumbing Piping" for insulation shields.
4. High density insulation material shall extend a minimum 2 inches past the pipe shield on each side.
5. Butt insulation to hanger or riser clamp for vertical pipe. Butt pipe insulation tightly at insulation joints.
6. For hot pipes, apply 3" wide vapor barrier tape or band over the butt joints.
7. For cold pipes, apply wet coat of vapor barrier lap cement on joint and seal with 3 inch wide vapor barrier tape or band and coat all taped seams and staple penetrations with vapor barrier coating to prevent moisture ingress.

I. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:

1. Install insulation over fittings, valves (except balancing and flow control 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. Butt tightly against adjoining pieces and bond 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, install fitted PVC cover over elbows, tees, strainers, valves (except balancing and flow control 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.

J. 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.

K. 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 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.

L. Extend piping insulation without interruption through walls, floors and similar piping penetrations, except where otherwise indicated.

3.05 INSTALLATION OF EQUIPMENT INSULATION

A. General: Install equipment thermal insulation products in accordance with manufacturer's written instructions, and in compliance with recognized industry practices to ensure that insulation serves intended purpose.

B. Install insulation materials with smooth and even surfaces and on clean and dry surfaces. Redo poorly fitted joints. Do not use mastic or joint sealer as filler for gapping joints and excessive voids resulting from poor workmanship.

C. Maintain integrity of vapor-barrier on equipment insulation and protect it to prevent puncture and other damage.

D. Apply insulation using the staggered joint method for both single and double layer construction, where feasible. Apply each layer of insulation separately.

E. Coat insulated surfaces with layer of insulating cement, troweled in workmanlike manner, leaving a smooth continuous surface. Fill in scored block, seams, chipped edges and depressions, and cover over wire netting and joints with cement of sufficient thickness to remove surface irregularities.

F. Cover insulated surfaces with all-service jacketing neatly fitted and firmly secured. Lap seams at least 2". Apply over vapor barrier where applicable.

G. Equipment Exposed to Weather: Protect outdoor insulation from weather by installation of weather-barrier mastic protective finish, or jacketing, as recommended by the manufacturer.

3.06 PROTECTION AND REPLACEMENT

A. Replace damaged insulation which cannot be repaired satisfactorily, including units with vapor barrier damage and moisture saturated units.

B. Protection: Insulation Installer shall advise Contractor of required protection for insulation work during remainder of construction period, to avoid damage and deterioration.

END OF SECTION

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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. These requirements shall be in addition to applicable Division 01, 23 and 26 Sections.

1. Division 01 Section "General Commissioning Requirements" for general commissioning activities and requirements.
2. Division 23 Section "Commissioning HVAC Systems" for commissioning process activities for HVAC equipment, sub-systems, and systems.
3. Division 26 Section "Commissioning Electrical Systems" for commissioning process activities for electrical equipment, sub-systems, and systems.

1.2 SUMMARY

A. This section defines commissioning process requirements for plumbing equipment systems and sub-systems. Other testing as required under other Division 22 sections still apply.

B. Commissioning is the process of ensuring that building systems operate as intended through their life cycle as defined in the Contract Documents.

C. Commissioning during the construction phase is intended to achieve the following objectives according to the Contract Documents:

1. Verify that applicable systems and equipment are installed according to the manufacturer's recommendations and to industry accepted minimum standards.
2. Verify that applicable systems and equipment received adequate operational checkout by installing contractors.
3. Verify and document proper performance of equipment and systems.
4. Verify that O&M documentation provided to the Owner is complete.
5. Verify that the Owner's operating personnel are adequately trained.

D. General commissioning requirements and coordination are detailed in Division 01. Division 22 shall execute all commissioning responsibilities assigned to them in the Contract Documents and include the cost of commissioning in the Contract Sum.

1.3 ABBREVIATIONS & DEFINITIONS

A. Refer to Division 01 Section 019113 “General Commissioning Requirements” for abbreviations and definitions.

1.4 COMMISSIONING TEAM

A. Refer to Division 01 Section 019113 “General Commissioning Requirements” for commissioning team responsibilities for this project.

1.5 COMMISSIONING DOCUMENTATION

A. The responsible Sub-Contractor(s) shall provide the following information to the CA for inclusion in the commissioning final report:

1. Copies of completed Plan and Documentation Requirements for Start-up and Initial Checkout (as applicable).
2. Copies of completed Commissioning Corrective Action Reports.
3. Building operations and maintenance information documents shall be provided and consist of manufacturers’ information specifications, recommendations; programming procedures and data points; narratives and other means of illustrating to the owner how the building, equipment and systems are intended to be installed, maintained, and operated. Required regular maintenance actions for equipment and systems shall be clearly stated on a ready visible label.

1.6 SUBMITTALS

A. Refer to Division 01 Section 019113 “General Commissioning Requirements” for submittal requirements.

1.7 PLUMBING EQUIPMENT AND SYSTEMS TO BE COMMISSIONED

A. The following equipment and systems shall be commissioned within the scope of this project. All general references to equipment and systems in this document refer only to the listed equipment and systems.

1. Domestic Water Heaters
2. Plumbing Fixtures & Controls
3. Domestic Water Booster Pumps
4. Sump Pumps
5. Sewage Ejector Pumps

6. Drinking Water System

B. The CxA will coordinate and execute FPTs for 100% of the primary commissioned systems (domestic water heating, etc). For plumbing fixture controls, the CxA will coordinate and execute testing of 100% (or minimum of one) of each type.

PART 2 - PRODUCTS

2.1 TEST EQUIPMENT

A. All testing equipment shall be of sufficient quality and accuracy to test and/or measure system performance within the tolerances specified elsewhere in the Contract Documents.

1. If not otherwise specified, 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°F and a resolution of ±0.1°F. Pressure sensors shall have an accuracy of ±2.0% of the value range being measured (not full range of meter) and have been calibrated within the last year.

B. Include special tools and instruments (only available from equipment manufacturer, specific to a piece of equipment) required for testing equipment in the base bid price to the CA.

C. Contractors shall comply with test equipment manufacturers calibration procedures and intervals. Recalibrate test equipment immediately after equipment has been repaired resulting from being dropped or damaged. Affix calibration tags to test equipment. Furnish calibration records to the CxA upon request.

PART 3 - EXECUTION

3.1 COMMISSIONING PROCESS OVERVIEW

A. The following narrative provides a brief overview of the typical commissioning tasks during the construction, acceptance, and post-occupancy phases and the general order in which they occur.

1. Construction-related submittals for all commissioned equipment are provided to the CxA during the normal submittal process.
2. Early during construction, the CxA conducts a kick-off meeting and presents the commissioning process for the project. Additional meetings with the commissioning team will occur throughout the project as required.

3. The CA and responsible Sub-Contractors shall document equipment start-up and initial checkout with assistance from manufacturer's technicians. The CxA may request copies of the manufacturer's or contractor's field start-up reports.
4. The CxA develops specific FPT plans for review by the A/E, CA, and responsible Sub-Contractors.
5. The CA and responsible Sub-Contractors complete installation and checkout of all building control systems.
6. The CxA coordinates and executes FPTs with the assistance of responsible Sub-contractors. The CxA reports on the testing process including all observed deficiencies.
7. Testing of other commissioned systems not requiring formal functional testing is completed.
8. The CxA verifies training as required by the Contract Documents is completed.
9. The CxA may review close-out documentation and schedule deferred testing.
10. The CxA submits a final commissioning report.

3.2 COORDINATION

A. Sub-Contractors shall provide sufficient notice to the CA regarding their completion schedule for start-up of all equipment and systems. Sub-Contractors shall transmit completed start-up documentation to the CxA without delay.

B. The CxA will finalize scheduling of functional tests through the CA and responsible Sub-Contractors only upon completion of all checklists and start-up activities related to the equipment or systems and receipt of a completed FPT Readiness Checklist from the CA.

C. Individual Sub-Contractor's shall be responsible for notifying the CA if commissioning activities involving a CxA site visit require rescheduling due to insufficient system completion. A Sub-Contractor's failure to notify the CA or the CA's failure to notify the CxA five (5) business days in advance of a scheduled CxA site visit shall result in back-charges to the CA for all reasonable travel expenses and lost time.

1. At the direction of the CxA, the CA and responsible Sub-Contractors shall participate in a meeting prior to functional testing. The meeting shall be used to verify that all commissioned systems are properly installed, functional and are ready for functional testing. Any known problems that may impact or prevent functional testing shall be discussed during the meeting. Based on the outcome of the meeting a date to commence functional testing will be determined.

3.3 TESTING PREPARATION

A. Certify in writing to the CxA that plumbing equipment and systems have passed start-up and controls checkout.

1. The equipment has passed start-up in accordance with the manufacturer's recommendations and the start-up has been documented. All start-up reports shall be submitted to the CxA.
2. The plumbing control systems have been completed and calibrated, and are operating according to the Contract Documents, and the pretest setpoints have been recorded.
3. The CA has submitted a completed FPT Readiness Checklist to the CxA.

B. Place 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).

C. Verify the position of each device and interlocks identified on checklists.

D. Check safety kill switches, alarms, and interlocks (as applicable) during each mode of operation.

E. Install measuring instruments and logging devices to record test data as directed by the CxA.

3.4 FUNCTIONAL PERFORMANCE TESTING

A. Scope

1. The following procedures apply to all commissioning FPTs for this division.

B. Purpose

1. The objective of the FPT is to demonstrate that each commissioned system is operating according to the documented design intent and Contract Documents.

C. Execution

1. Each commissioned system shall be tested through its approved sequence of operation including all specified modes of operation.
2. Before test procedures are written, the CxA will be provided all requested documentation including the most currently approved controls submittals and any device parameters that could impact testing. The CxA will develop specific test procedures and forms to verify and document proper system operation. The CA shall

authorize the required Sub-Contractors and equipment manufacturers to assist in developing the test procedures if requested by the CxA.

3. The CxA will submit the test procedures to the Sub-Contractors and equipment manufacturers for review for feasibility, safety, equipment, and warranty protection. The CxA will also submit the test procedures to the A/E for confirmation that the functionality matches the design intent. All review comments shall be submitted to the CxA and if necessary, the CxA will revise the test procedures per the submitted review comments prior to scheduling functional testing.

    a. The time required for the CxA to coordinate and execute any retesting due to a Sub-Contractor's failure to disclose during this review that test procedures are not feasible within the context of the control system installed, shall be back-charged on an hourly basis to the CA. Any required retesting shall not be considered justification for a claim of delay or request for time extension by the CA.

4. All training documentation, test reports, O&Ms, and submittals shall be at the jobsite before functional testing commences.
5. The Sub-Contractors shall have trained technicians available to assist in the execution of the functional testing and/or coordinate with equipment manufacturers to make authorized technicians available. The CxA will coordinate and execute the testing and document the testing results.

D. Documentation, Deficiencies and Approval of Tests

1. The CxA will document the results of the functional performance tests using the specific procedural forms developed for that purpose.
2. All deficiencies shall be noted and reported to the CA by the CxA within five (5) business days of test completion. The CxA may recommend corrective actions to deficiencies found, however the burden of responsibility to clear any deficiency is with the CA and A/E.
3. Corrections of minor deficiencies identified may be made during testing at the discretion of the CxA. In such cases the deficiency and resolution shall be documented in the functional test plan.
4. As testing progresses and deficiencies are identified, the CxA will discuss the deficiencies with the responsible Sub-Contractor(s).

    a. When there is no dispute regarding the deficiency and the Sub-Contractor(s) accepts responsibility to perform the approved corrective action:

        1) The CxA documents the deficiency and the Sub-Contractor(s) response and the testing proceeds. At the discretion of the CxA retesting of the corrected deficiency is rescheduled and the test is repeated.

b. If there is a dispute about a deficiency, regarding whether a deficiency exists or who is responsible for corrections:

   1) The CxA documents the deficiency and the Sub-Contractor(s) response and reports to the CA within five (5) business days.
   2) Resolutions are made at the lowest management level possible. Other parties are brought into the discussions as needed. Final interpretive authority is with the A/E. Final acceptance authority is with the Owner. The CxA documents the resolution process.
   3) The appropriate party performs the approved corrective actions. The CxA reschedules the test and testing is repeated until the deficiency is cleared.
   4) Any deficiencies accepted by the Owner as found, or not corrected prior to submission of the final commissioning report, shall be marked as a non-conforming item for the purpose of the final report.

c. The time required for the CxA to coordinate and execute any retesting due to a specific start-up test item, reported to have been successfully completed, but determined during functional testing to be faulty, shall be back-charged on an hourly basis to the CA. Any required retesting shall not be considered justification for a claim of delay or request for time extension by the CA.

d. The CxA notes each accepted functional test on the test plan. Formal approval of the completed FPTs is contingent on the final review by the CxA and the A/E. The CxA recommends acceptance of each completed test to the Commissioning Team.

3.5 PLUMBING SYSTEMS, SUBSYSTEMS, AND EQUIPMENT TESTING PROCEDURES

A. Manufacturer's or independent testing requirements are specified in individual Division 22 sections. Provide test reports and certifications to the CxA.

B. Test requirements for plumbing systems cleaning, flushing, hydrostatic tests, and sterilization are specified in Division 22 piping sections. Plumbing Sub-Contractor shall prepare a pipe system cleaning, flushing, and hydrostatic testing plan. Provide cleaning, flushing, and testing 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 sterilization 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 sterilized.

3.6 DEFERRED TESTING

A. If any FPT cannot be completed due to an unforeseen condition not within control of the CA, execution of the FPT shall be deferred based on the recommendation of the CxA and approval of the Owner. The affected testing shall be completed as soon as practical.

3.7 TRAINING OF OWNER PERSONNEL

A. The CA shall be responsible for training coordination, scheduling and for ensuring training is completed in accordance with the Contract Documents.

END OF SECTION

PART 1 - GENERAL REQUIREMENTS

1.01 SUMMARY

A. This Section includes domestic cold water, hot water, and hot water recirculation piping, fittings, and specialties within the building to a point 5 feet outside the building.

B. Contractors Option:

1. The Division 22 contractor may provide mechanically joined plumbing piping systems to connect mechanical joints, couplings, fittings, valves, and related components as an option in lieu of, in whole or in part, copper sweat, brazing, threaded or flanged piping methods. Mechanically joined water distribution piping systems where used shall be provided in compliance with specification Section 221111 “Mechanically Joined Plumbing Piping Systems”.

C. Related Sections: The following sections contain requirements that relate to this Section:

1. Division 22 Section "General Plumbing Requirements," for trenching and backfilling materials and methods for underground piping installations.
2. Division 2 Section "Water Service Systems," for water service piping beginning from 5'-0" outside the building.
3. Division 7 Section "Joint Sealers," for materials and methods for sealing pipe penetrations through basement and foundation walls, and fire and smoke barriers.
4. Division 11 Section “Kitchen and Food Service Equipment,” for faucets and valves furnished with the food service and kitchen equipment.
5. Division 12 Section “Laboratory Casework and Fixtures,” for laboratory trim installed in the casework.
6. Division 22 Section "Identification, for Plumbing Piping and Equipment" for labeling and identification of water distribution piping.
7. Division 22 Section "Common Work Results for Plumbing," for materials and methods for fire barrier penetrations, wall penetrations and equipment pads.
8. Division 22 Section "Basic Piping Material and Methods," for materials and methods for strainers, flexible connectors, unions, dielectric unions, dielectric flanges, and mechanical sleeve seals.
9. Division 22 Section "General Duty Valves for Plumbing Piping," for materials and methods for installing water distribution piping valves.
10. Division 22 Section "Hangers and Supports for Plumbing Piping," for insulation shields, materials, and methods for hanging and supporting water distribution piping.
11. Division 22 Section "Plumbing Insulation," for materials and methods for insulating water distribution piping.

12. Division 22 Section “Sanitary Drainage and Vent Piping and Specialties,” for material and methods for trap primer outlet piping.

D. Products installed but not furnished under this Section include water meters that will be provided by the utility company to the site and ready for installation. Following is the name and address of the utility company:

_____

_____

_____

1.02 DEFINITIONS

A. Water Distribution Pipe: A pipe within the building or on the premises that conveys water from the water service pipe or meter to the points of usage.

B. Water Service Pipe: The pipe from the water main or other source of potable water supply to the water distribution pipe of the building served.

C. Pipe sizes used in this Specification are nominal pipe size (NPS).

D. Lead Free: Refers to the wetted surface of pipe, fittings and fixtures in potable water systems that have a weighted average lead content ≤0.25% per Safe Drinking Water Act as amended January 4th, 2011 Section 1417.

1.03 SUBMITTALS

A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specifications Sections.

1. Product data for each piping specialty and valve specified.
2. Welder Certificates signed by Contractor certifying that welders comply with requirements specified in Article "Quality Assurance" below.
3. Certification of Compliance with ASME and UL fabrication requirements specified in Article "Quality Assurance" below.
4. Maintenance data for each piping specialty and valve specified for inclusion in Maintenance Manual specified in Division 1 and Division 22 Section "General Plumbing Requirements."
5. Test reports specified in Part 3 of this Section.
6. Submit certification that specialties and fittings for domestic water distribution for drinking or cooking comply with NSF 61 Annex G and / or NSF 372. The following specialties need not comply:

    a) Hose bibbs
    b) Wall, yard, and roof hydrants

c) Backflow preventers isolating irrigation or mechanical make-up systems
d) Emergency mixing valves
e) Trap primers

1.04 QUALITY ASSURANCE

A. Qualify welding processes and welding operators in accordance with ASME Boiler and Pressure Vessel Code, Section IX, "Welding and Brazing Qualifications."

B. Regulatory Requirements: Comply with the provisions of the following codes:

1. ASME B31.9 "Building Services Piping" for materials, products, and installation. Safety valves and pressure vessels shall bear the appropriate ASME label.
2. ASME Boiler and Pressure Vessel Code, Section IX, "Welding and Brazing Qualifications" for Qualifications for Welding Processes and Operators.

C. Comply with NSF 61 Annex G and / or NSF 372 for wetted surfaces of specialties and fittings containing no more than 0.25% lead by weight for domestic water distribution for drinking or cooking.

D. Pipe, fittings, and specialties shall be manufactured in the United States or be certified to meet ASTM and ANSI standards.

1.05 SPARE PARTS

A. Maintenance Stock: Furnish one valve key for each key-operated wall hydrant, hose bibb, fixture supply, or faucet installed.

PART 2 - PRODUCTS AND MATERIALS

2.01 MANUFACTURERS

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

1. Automatic Flow Control Valves:

a) Calefi
b) Flow Design, Inc., Autoflow Div.
c) Victaulic Company

2. Hose Bibbs with Vacuum Breaker:

a) Chicago Faucet Co.
b) Eljer, A Household International Company
c) T & S Brass & Bronze Works, Inc.

3. Wall/Yard Hydrants:

a) Josam Co.
b) Mifab Manufacturing, Inc.
c) Smith (Jay R.) Mfg. Co.
d) Prier, Inc.
e) Tyler Pipe/Wade Div.; Subs. of Tyler Corp.
f) Watts Drainage
g) Woodford Mfg. Co.
h) Zurn Industries Inc., Hydromechanics Div.

4. Backflow Preventers:

a) Cla-Val Co.
b) Conbraco Industries, Inc.
c) Febco
d) Hersey Products, Inc.
e) Mifab Manufacturing, Inc./Beeco
f) Watts Regulator Co.
g) Zurn Industries Inc. Wilkins Regulator Div.

5. Self Contained Pressure-Reducing Valves:

a) Cash (A. W.) Valve Mfg. Corp.
b) Cla-Val Co.
c) Conbraco Industries, Inc.
d) Mifab Manufacturing, Inc./Beeco
e) Watts Regulator Co.
f) Zurn Industries Inc., Wilkins Regulator Div.

6. Water Meters:

a) Badger Meter, Inc.
b) Hays Div., Romac Industries
c) Hersey Products, Inc.
d) Neptune Water Meter Co.; Subs. Neptune Intl. Corp.
e) Rockwell Intl.; Measurement & Flow Control Div.

7. Piston Type Water Hammer Arresters:

a) Amtrol, Inc.
b) Josam Co.
c) Precision Plumbing Products, Inc.
d) PROFLO
e) Sioux Chief Manufacturing Co.
f) Tyler Pipe/Wade Div.; Subs. of Tyler Corp.
g) Watts Regulator Co.
h) Zurn Industries, Inc. Wilkins Regulator Div.

8. Point of Use Thermostatic Mixing Valves

a) Acorn Engineering Co.
b) Cash Acme
c) Leonard Valve Co.

d) Powers Process Controls

9. Emergency Mixing Valves

a) Acorn Engineering Co.
b) Bradley
c) Haws Corp.
d) Lawler Manufacturing Co., Inc.
e) Leonard Valve Co.
f) Stingray Systems

10. Trap Primers and Distribution Units

a) Mifab Manufacturing, Inc.
b) Precision Plumbing Products, Inc.
c) PROFLO
d) Sioux Chief

11. Plumbing Pipe Support Brackets

a) Holdrite
b) PROFLO
c) Sioux Chief

12. Tube Suspension Clamps

a) PROFLO
b) Sioux Chief or approved Equivalent

2.02 PIPE AND TUBE MATERIALS, GENERAL

A. Pipe and Tube: Refer to Part 3, Articles "Above Ground Water Distribution Pipe and Fittings" or “Below Ground Water Distribution Pipe and Fittings”, for identification of systems where the materials listed below are used.

B. Copper Tube: ASTM B88, Type L Water Tube, drawn temper.

C. Copper Tube: ASTM B88, Type K Water Tube, annealed temper.

D. Ductile-Iron Pipe: AWWA C151 or AWWA C115 ductile-iron pipe, with AWWA C104 cement-mortar lining.

E. Brass Pipe: Chrome Plated Schedule 40 ASTM B43 iron pipe size (IPS.)

2.03 FITTINGS

A. Wrought Copper Solder-Joint Fittings: ANSI B16.22, streamlined pattern.

B. Ductile or Gray-Iron Flanged Fittings: AWWA C110 Class 125 with AWWA C116 epoxy coating inside and outside.

C. Ductile-Iron Gasketed Fittings: AWWA C153, 150 psi rating, with AWWA C104 cement mortar lining and AWWA C111 rubber gaskets.

D. Brass Fittings: Chrome plated ANSI B16, Class 125 with threaded connections.

E. Cast-Iron Threaded Flanges: ANSI B16.1, Class 125, raised ground face, bolt holes spot faced.

F. Bronze Flanges: ANSI B16.24, Class 150, raised ground face, bolt holes spot faced.

2.04 JOINING MATERIALS

A. Solder Filler Metal: ASTM B32 Alloy Sb-5, 95-5 Tin-Antimony.

B. Brazing Filler Metals: AWS A5.8, BAg Silver.

C. Gasket Material: Thickness, material, and type suitable for fluid to be handled and design temperatures and pressures.

2.05 GENERAL-DUTY VALVES

A. General-duty valves (i.e., check, ball, and butterfly valves) are specified in Division 22 Section "General Duty Valves for Plumbing Piping." Special duty valves are specified below by their generic name; refer to Part 3, Article "Valve Applications" for specific uses and applications for each valve specified.

2.06 SPECIAL DUTY VALVES

A. Automatic Flow Control Valves: 400 PSI WOG, flow regulator, with series 300 stainless steel body, series 300 stainless steel automatic pre-set flow balancing cartridge, union connection body, and threaded-end connections.

2.07 PIPING SPECIALTIES

A. Hose Connections: Hose connections shall have garden hose thread outlets conforming to ASME B1.20.7.

B. Hose Bibbs: Bronze body, renewable composition disc, tee handle, 1/2- or 3/4-inch solder inlet, hose outlet.

C. Hose Bibbs: Bronze body with chrome- or nickel-plated finish, with renewable composition disc, wheel handle, 1/2- or 3/4-inch solder inlet, hose outlet.

D. Recessed Nonfreeze Wall Hydrants: Cast-bronze box, with chrome-plated face, tee handle key, vacuum breaker, hinged locking cover, 3/4-inch inlet, and hose outlet. Bronze casing shall be length to suit wall thickness.

E. Roof Hydrants: As specified on the drawings.

F. Backflow Preventers: Comply with requirements of ASSE Standard 1013 and as specified on the drawings.

G. Pressure Reducing Valves: Comply with requirements of ASSE Standard 1003 and as specified on the drawings.

H. Flood Control Valves: As specified on the drawings.

I. Water Meters: Provide water meters with registration in gallons.

1. Water Meter - 2 Inches And Smaller: Disc type conforming to AWWA C700.
2. Remote Registration System: Utility company standards.

J. Piston Type Water Hammer Arresters: Piston type, with casing of type "L" copper tube and spun copper ends, nylon piston with two EPDM "O"rings pressure lubricated with FDA approved silicone, pressure rated for 250 psi, tested and certified in accordance with PDI Standard WH-201.

K. Point of Use Thermostatic Mixing Valves:

1. Lead free bronze or brass body meeting ASTM B584 with non-corrosive parts, tamper resistant temperature adjustment, checks, stops, other components as scheduled and meeting ASSE 1070. Valve shall be designed to fail to the cold side of the system. Maximum pressure drop shall not be exceeded for the scheduled flow rate.

L. Emergency Mixing Valves:

1. Bronze body construction meeting ASTM B584, non-corrosive parts, tamper resistant temperature adjustment, union inlets. Valve shall be designed to fail to the cold side of the system with full cold water flow. Maximum pressure drop shall not be exceeded for the scheduled flow rate.

M. Pipe Support Brackets:

1. Sheet Stud Bracket: 20 gauge copper with nominal copper tube holes of 1/2" on 2" centers and holes of 3/4" or 1" on 4" centers.
2. Pipe Mounted Bracket: 20 gauge copper or plastic bracket with clamps for securing copper water tube and stainless steel hose clamp for securing bracket to vertical waste and vent pipe in wall.
3. Carrier Bracket: 20 gauge copper bracket with 1" hole for supporting rough-in for flush valve copper tube and bolt slot for attaching to chair carrier.

N. Tube Suspension Clamps

1. Combination plastic supports and insulators for installing copper tube in stud walls with integral bracket for securing to stud with screws.

PART 3 - EXECUTION

1.1 INSTALLATION, GENERAL

A. Install piping, valves and specialties in accordance with manufacturer's installation instructions.

3.02 PREPARATION FOUNDATION FOR BELOW GROUND WATER DISTRIBUTION PIPE AND FITTINGS

A. Copper Tube: Provide 6" thick sand pipe bed underneath and around sides of pipe, up to middle half of the pipe. Support pipe in trench with sand bags level and true at fittings to prevent sand, gravel or debris from interfering with the brazing process. After pressure testing is complete, install bedding at fittings and install subbase. Refer to Section "General Plumbing Requirements" for bedding and subbase materials, excavation, trenching, backfill and compaction requirements.

B. Ductile Iron Pipe: Shape bottom of trench to fit bottom of pipe for 90-degrees (bottom 1/4 of the circumference). Fill unevenness with tamped sand bedding. At each pipe joint dig bell holes to relieve the bell of the pipe of all loads, and to ensure continuous bearing of the pipe barrel on the foundation. For piping with rock trench bottoms, provide sand pipe bed 6" underneath and around sides of pipe up to middle half of the pipe, including fittings. After pressure testing is complete, provide first layer of pea gravel backfill 6" above pipe, tamp backfill with mechanical tamper and install bedding at fittings and install subbase. Refer to Section "General Plumbing Requirements" for bedding and subbase materials, excavation, trenching, backfill and compaction requirements.

3.03 ABOVE GROUND WATER DISTRIBUTION PIPE AND FITTINGS

A. Install Type L, drawn copper tube with wrought copper fittings and solder joints for pipe sizes 8 inches and smaller, within the building.

B. Install chrome plated brass pipe and fittings for exposed water piping within the building where indicated on the drawings.

C. Install ductile or gray-iron epoxy coated fittings for 3" and larger at water service entrance riser and only upstream of the backflow preventer.

3.04 BELOW GROUND WATER DISTRIBUTION PIPE AND FITTINGS

A. Install Type K, soft annealed copper tube and brazed joints for pipe sizes 2 inches and smaller, with minimum number of joints, inside and outside building.

B. Install cement-lined ductile-iron pipe with rubber gasketed joints, inside and outside under the building, for pipe 3 inches and larger.

3.05 PIPING INSTALLATION

A. General Locations and Arrangements: Drawings (plans, schematics, and diagrams) indicate the general location and arrangement of the piping systems. Location and arrangement of piping layout take into consideration pipe sizing and friction loss, expansion, pump sizing, and other design considerations. So far as practical, install piping as indicated.

B. Use fittings for all changes in direction and branch connections.

C. Install piping at right angles or parallel to building walls. Diagonal runs are not permitted, unless expressly indicated.

D. Install piping free of sags or bends and with ample space between piping to permit proper insulation applications.

E. Conceal all pipe installations in walls, pipe chases, utility spaces, above ceilings, below grade or floors, unless indicated to be exposed to view.

F. Install horizontal piping as high as possible allowing for proper slope and coordination with other components. Install vertical piping tight to columns or walls. Provide space to permit insulation applications, with 1-inch clearance outside the insulation. Allow sufficient space above removable ceiling panels to allow for panel removal.

G. Locate groups of pipes parallel to each other, spaced to permit applying full insulation and servicing of valves.

H. Install drains at low points in mains, risers, and branch lines consisting of a tee fitting, 3/4-inch ball valve, and short 3/4-inch threaded nipple and cap.

I. Fire Barrier Penetrations: Where pipes pass though fire-rated walls, partitions, ceilings, and floors, maintain the fire-rated integrity. Refer to Division 22 Section "Common Work Results for Plumbing" for special sealers and materials.

J. Exterior Wall Penetrations: Seal pipe penetrations through exterior wall constructions with sleeves packing, and sealant. Refer to Division 22 Section "Basic Piping Materials and Methods" for additional information.

K. Underground Exterior Wall Penetrations: Seal pipe penetrations through underground exterior walls with sleeves and mechanical sleeve seals. Refer to Division 22 Section "Basic Piping Materials and Methods" for additional information.

L. Elevated Floor Penetrations of Waterproof Membrane, Interior Penetrations of Non-Fire Rated Walls and Concrete Slab on Grade Penetrations: Provide sleeves and seal pipes that pass through waterproof floors, non-fire rated walls, partitions

and ceilings or concrete slab on grade. Refer to Division 22 Section "Basic Piping Materials and Methods" for special sealers and materials.

M. Install piping level with no pitch.

3.06 HANGERS AND SUPPORTS

A. General: Hanger, support, insulation protection shield and anchor components and installation procedures conforming to MSS SP-58 and SP-69 are specified in Division 22 Section "Hangers and Supports for Plumbing Piping". Conform to the table below for maximum spacing of supports.

B. Pipe Attachments: Install the following:

1. Adjustable steel clevis hangers, MSS SP-69 Type 1, for individual horizontal runs.
2. Riser clamps, MSS SP-69 Type 8, for individual vertical runs. Provide copper coated riser clamps when in contact with copper tube.
3. Insulation protection shields and high density insulation at each hanger for insulated pipe as specified in Division 22 Sections "Supports and Anchors" and "Plumbing Insulation".
4. Copper coated extension split ring pipe clamp, MSS SP-69 Type 12, for individual vertical exposed runs of copper tube 2" and smaller on walls and for securing 1-1/4" to 2" copper tube inside walls and chases for battery fixtures. Secure clamp to the copper tube.
    a) Seal each joint with insulation and split ring pipe to maintain the insulation barrier. Refer to Section "Plumbing Insulation" for requirement for maintenance of the vapor barrier and vapor barrier seal method.
5. Extension split ring pipe clamp, MSS SP-69 Type 12, for individual vertical exposed runs of stainless steel tube 2" and smaller on walls or for securing tube inside walls for connection to faucets.
6. Support copper tube in chases and walls at plumbing fixtures with plastic or copper brackets secured to structure and U-bolts sized to bare on the pipe.
7. Engineered strut support system may be provided, at the contractor's option, in lieu of individual hangers for horizontal pipes as specified in Division 22 "Hangers and Supports for Plumbing Piping". Provide two piece straps for uninsulated pipe secured to the bare pipe and provide plastic galvanic isolators for bare copper tube. Provide two piece straps and 360° insulation protection shields sized for the insulation thickness used for the pipe for all insulated pipes.
8. Secure copper tube rough-in for individual fixtures with sheet stud brackets attached to the wall studs or pipe mounting brackets attached to the fixture waste & vent pipe at each plumbing fixture.
9. Secure 1" and smaller copper water tubing in stud walls at stud penetrations with tube suspension clamps.

a) Cut hole through non-supporting studs with a minimum 1/8" clearance around each uninsulated copper tube or insulated copper tube.

b) Seal each joint of insulation and tube suspension clamp to maintain the insulation barrier. Refer to Division 22 "Plumbing Insulation" for requirement for maintenance of the vapor barrier similar to insulation butted against insulation inserts and vapor barrier seal method.

10. Secure copper tubes for flush valve wall mounted water closets to the chair carrier with carrier brackets.

11. Provide roll hangers for individual horizontal runs 100 feet or longer.

C. Install hangers with maximum horizontal spacing and minimum rod diameters, to comply with MSS-58, locally enforced codes, this specification, and authorities having jurisdiction requirements, whichever are most stringent. Install hangers for horizontal piping with the following maximum spacing and minimum rod diameters:

Nom. Pipe Size - In.	Copper Tube Max. Span - Ft.	Min. Rod Dia. - In.
Up to 1-1/4	6	3/8
1-1/2 to 2	10	3/8
2-1/2 to 4	10	3/8
5	10	1/2
6	10	1/2
8	10	1/2

1. Support vertical copper tube at each floor and in intervals not to exceed 10 feet.

D. Support water piping within 12" of each elbow or tee and for water piping 2-1/2" and larger at each valve or strainer.

E. Support water piping above the floor with pipe supports attached to the floor with anchor bolts where indicated on the drawings. Conform to the table above for maximum spacing of supports.

F. Provide vibration isolation for piping connected to rotating equipment. Vibration isolators are specified in Division 22 specification Section "Vibration Isolation for Plumbing Piping and Equipment".

3.07 PIPE AND TUBE JOINT CONSTRUCTION

A. Soldered Joints: Comply with the procedures contained in the AWS "Soldering Manual."

B. Brazed Joints: Comply with the procedures contained in the AWS "Brazing Manual."

1. CAUTION: Remove stems, seats, and packing of valves and accessible internal parts of piping specialties before soldering and brazing.
2. Fill the tubing and fittings during brazing with an inert gas (nitrogen or carbon dioxide) to prevent formation of scale.
3. Heat joints to proper and uniform temperature.

C. Threaded Joints: Conform to ASME B1.20.1, tapered pipe threads for field-cut threads. Join pipe fittings and valves as follows:

1. Note the internal length of threads in fittings or valve ends, and proximity of internal seat or wall, to determine how far pipe should be threaded into joint.
2. Align threads at point of assembly.
3. Apply appropriate tape or thread compound to the external pipe threads (except where dry seal threading is specified).
4. Assemble joint wrench tight. Wrench on valve shall be on the valve end into which the pipe is being threaded.

a) Damaged Threads: Do not use pipe with corroded or damaged threads. If a weld opens during cutting or threading operations, that portion of pipe shall not be used.

D. Flanged Joints: Align flange surfaces parallel. Assemble joints by sequencing bolt tightening to make initial contact of flanges and gaskets as flat and parallel as possible. Use suitable lubricants on bolt threads. Tighten bolts gradually and uniformly with a torque wrench.

E. Joints Containing Dissimilar Metals: Provide dielectric unions for 2” and smaller and dielectric flanges for piping 2-1/2” and larger. Provide dielectric waterway fittings for 2” and smaller in concealed locations. Dielectric unions, waterway fittings and flanges are specified in Section “Basic Piping Materials and Methods”.

F. Joints at Valve Assemblies or Connections to Equipment: Provide unions downstream of shutoff valves at valve assemblies or equipment connections. Unions are not required at flanged connections. Unions are specified in Division 22 section “Basic Piping Materials and Methods”.

3.08 SERVICE ENTRANCE

A. Extend water distribution piping to connect to water service piping, of size and in location indicated for service entrance to building. Water service piping is specified in a separate section of Division 2.

B. Underground exterior water distribution piping to be a depth as required by local conditions, in accordance with authority having jurisdiction’s requirements and at depth no less than 18” below grade.

C. Install sleeve and mechanical sleeve seal at penetrations through foundation wall for watertight installation.

D. Install sleeve and caulk at penetrations through building floor for watertight installation.

E. Install shutoff valve at service entrance inside building; complete with strainer, pressure gauge, and test tee with valve.

F. Ductile-Iron Pipe: Install in accordance with AWWA C-600. Pipe below ground inside building and to a point 5 feet outside of building shall have restrained joints.

3.09 VALVE APPLICATIONS

A. General-Duty Valve Applications: The Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:

1. Shut-off duty: Use ball and butterfly valves.

3.010 INSTALLATION OF VALVES

A. Sectional Valves: Install sectional valves on each branch and riser, close to main, where branch or riser serves 2 or more plumbing fixtures or equipment connections, and elsewhere as indicated. For sectional valves 2 inches and smaller, use ball valves; for sectional valves 2-1/2 inches and larger, use ball or butterfly valves.

B. Shutoff Valves: Install shutoff valves on inlet of each plumbing equipment item, on each supply to each plumbing fixture, and elsewhere as indicated. For shutoff valves 2 inches and smaller, use ball valves; for shutoff valves 2-1/2 inches and larger, use ball or butterfly valves.

C. Drain Valves: Install drain valves on each plumbing equipment item, located to drain equipment completely for service or repair. Install drain valves at the base of each riser, at low points of horizontal runs, and elsewhere as required to drain distribution piping system completely. For drain valves 2 inches and smaller, use ball valves; for drain valves 2-1/2 inches and larger, use ball butterfly valves.

D. Check Valves: Install swing check valves on discharge side of each pump and elsewhere as indicated.

E. Hose Bibbs: Install on exposed piping where indicated with vacuum breaker.

F. Wall Hydrants: Install where indicated with vacuum breaker.

G. Emergency Mixing Valves: Install where indicated on the plans with hot and cold water branch lines connecting to the mains without any shutoff valves. No other fixtures shall connect to the branch lines feeding the emergency mixing valve. Install ball valves with locking handles at the emergency mixing valve as indicated on the plans.

H. Point-of-Use Thermostatic Mixing Valve: Install valve complying with ASSE 1070 on all public lavatories and handwashing sink locations. Install valve to be accessible by maintenance staff. Set temperature limit to 110F for dual temperature faucet or 100F for single temperature faucet."

3.011 INSTALLATION OF FLOW CONTROL VALVES

A. Install automatic flow control valves in each hot water recirculating loop, and elsewhere as indicated. Install a shutoff valve and strainer upstream and a union, check valve and shutoff valve downstream of each flow control or automatic flow control valve.

B. Set flow control valve flow rate as follows:

1. Preliminary Procedures For Hot Water Return System Balancing:

a) Before operating the system perform these steps:

1) Open valves at recirculation pump and flow control valves to full open position.
2) Remove and clean all strainers.
3) Check recirculation pump rotation.
4) Set water heater temperature as indicated on the drawings.

C. Reports: Prepare hot water return system balancing reports signed and submit to the Architect upon completion of the project. Include the following information:

a) Valve tag number and description of location
b) Valve body size
c) Differential pressure reading from instrument in psi
d) Actual flow rate derived from the manufacturer's charts and tables for the valve size and measured differential pressure.

3.012 INSTALLATION OF PIPING SPECIALTIES

A. Install backflow preventers at each connection to mechanical equipment and systems and in compliance with the plumbing code and authority having jurisdiction. Locate in same room as equipment being connected. Install air gap fitting and pipe relief outlet drain without valves to nearest floor drain.

B. Install pressure reducing valves with inlet and outlet shutoff valves and balance cock bypass. Install pressure gauge on valve outlet.

3.013 EQUIPMENT CONNECTIONS

A. Piping Runouts to Fixtures: Provide hot and cold water piping runouts to fixtures of sizes indicated, but in no case smaller than required by plumbing code.

B. Mechanical Equipment Connections: Connect hot and cold water piping system to mechanical equipment as indicated. Provide shutoff valve and union for each

connection; provide drain valve on drain connection. For connections 2-1/2 inches and larger, use flanges instead of unions.

3.014 FIELD QUALITY CONTROL

A. Inspections: Inspect water distribution piping as follows:

1. Do not enclose, cover, or put into operation water distribution piping system until it has been inspected and approved by the authority having jurisdiction.
2. During the progress of the installation, notify the plumbing official having jurisdiction at least 24 hours prior to the time such inspection must be made. Perform tests specified below in the presence of the plumbing official.

    a) Rough-in Inspection: Arrange for inspection of the piping system before concealed or closed in after system is roughed in and prior to setting fixtures.
    b) Final Inspection: Arrange for a final inspection by the plumbing official to observe the tests specified below and to ensure compliance with the requirements of the plumbing code.
    c) Reinspections: Whenever the plumbing official finds that the piping system will not pass the test or inspection, make the required corrections and arrange for reinspection by the plumbing official.
    d) Reports: Prepare inspection reports signed by the plumbing official and turn over to the Architect upon completion of the project.

B. Piping System Test: Test water distribution systems in accordance with the procedures of the authority having jurisdiction, or in the absence of a published procedure, as follows:

1. Test for leaks and defects all new water distribution piping systems and parts of existing systems that have been altered, extended or repaired. If testing is performed in segments, submit a separate report for each test, complete with a diagram of the portion of the system tested.
2. Leave uncovered and unconcealed all new, altered, extended, or replaced water distribution piping until it has been tested and approved. Expose all such work for testing that has been covered or concealed before it has been tested and approved.
3. Cap and subject the piping system to a static water pressure of 50 psig above the operating pressure without exceeding the pressure rating of the piping system materials. Isolate the test source and allow to stand for 4 hours. Leaks and loss in test pressure constitute defects that must be repaired.
4. Repair all leaks and defects with new materials and retest system or portion thereof until satisfactory results are obtained.
5. Reports: Prepare inspection reports and required corrective action signed by the plumbing official and turn over to the Architect upon completion of the project.

3.015 ADJUSTING AND CLEANING

A. Clean and disinfect water distribution piping as follows:

1. Purge all new water distribution piping systems and parts of existing systems that have been altered, extended, or repaired prior to use.
2. Use the purging and disinfecting procedure proscribed by the authority having jurisdiction or, in case a method is not prescribed by that authority, the procedure described in either AWWA C651, or AWWA C652, or as described below:

    a) Flush the piping system with clean, potable water until dirty water does not appear at the points of outlet.
    b) Fill the system or part thereof with a water/chlorine solution containing at least 50 parts per million of chlorine. Isolate (valve off) the system or part thereof and allow to stand for 24 hours.
    c) Drain the system or part thereof of the previous solution and refill with a water/chlorine solution containing at least 200 parts per million of chlorine and isolate and allow to stand for 3 hours.
    d) Following the allowed standing time, flush the system with clean, potable water until chlorine residual is lowered to incoming city water level.
    e) Submit water samples in sterile bottles to the authority having jurisdiction. Repeat the procedure if the biological examination made by the authority shows evidence of contamination.

3. Reports: Prepare disinfection reports signed by the authority having jurisdiction and turn over to the Architect upon completion of the project.

3.016 COMMISSIONING

A. Fill the system. Check compression tanks to determine that they are not air bound and that the system is completely full of water.

B. Before operating the system, perform these steps:

1. Close drain valve, hydrants, and hose bibbs.
2. Open valves to full open position.
3. Remove and clean strainers.
4. Check pumps for proper direction of rotation. Correct improper wiring.
5. Lubricate pump motors and bearings.

END OF SECTION

PART 1 - GENERAL REQUIREMENTS

1.01 SUMMARY

A. This Section only applies to Mechanically Joined Plumbing Piping Systems for joining piping for Plumbing applications as defined in Division Section 22 “Water Distribution Piping and Specialties”.

B. The Division 22 contractor may provide mechanically joined, couplings, fittings, valves and related components as an option in lieu of, in whole or in part, copper sweat, brazing, threaded or flanged piping methods.

C. Mechanically joined couplings, fittings, valves and related components specified in this section shall not be provided for natural gas piping in lieu of welded, threaded or flanged piping methods.

1.02 DEFINITIONS

A. Lead Free: Refers to the wetted surface of pipe, fittings and fixtures in potable water systems that have a weighted average lead content ≤0.25% per Safe Drinking Water Act as amended January 4th, 2011 Section 1417.

B. CWP: Cold working pressure in psi.

C. CTS: Copper tube size.

1.03 RELATED SECTIONS INCLUDE THE FOLLOWING:

A. Division 22 section “Basic Plumbing Piping Materials and Methods” for materials for dielectric waterway fittings and flange kits.

B. Division 22 Section “Water Distribution Piping and Specialties” for related sections.

1.04 SUBMITTALS

A. Product Data: Submit data for each type of coupling, fitting and special-duty valve indicated. Include flow and pressure drop curves based on manufacturer's testing.

B. Shop Drawings: Detail fabrication of pipe anchors, hangers, special pipe support assemblies, alignment guides, expansion joints and loops, and their attachment to the building structure.

1. If an assembly of flexible couplings are used for seismic vibration, thermal expansion, or noise and vibration reduction, submit shop drawings indicating location of assembly, including anchors and guides. Include movement analysis of the assembly, and performance data of the assembly.

C. Maintenance Data: Include for each piping specialty and valve in Maintenance Manual specified in Division 01 and Division 22 Section "General Plumbing Requirements."

D. Field Test Reports: Written reports of tests specified in Part 3 of this Section. Include the following:

1. Test procedures used.
2. Test results that comply with requirements.
3. Failed test results and corrective action taken to achieve requirements.

E. Submit a schedule of dissimilar metal joints and adaptor flanges and flange kits. Include joint type material, connection method and proposed flange kits to isolate dissimilar metals. Include minimum and maximum torque requirements for flange connections to valves. Dielectric flange kits are specified in Division 22 section “Basic Plumbing Piping Materials and Methods”.

F. Submit certification that valves and fittings for domestic water distribution comply with NSF 61 Annex G and / or NSF 372.

G. Submit certification that pipe, pipe fittings, pipe specialties, and valves and fittings are manufactured in plants located in the United States or certified that they comply with applicable ANSI, ASTM and MSS standards.

H. Submit contractor certificates indicating completion of installation training course from manufacturer of piping to be used.

1.05 QUALITY ASSURANCE

A. All grooved and press to connect components shall be of one manufacturer, be date and origin stamped for quality assurance and traceability.

B. Grooved mechanical piping shall conform to local code approval and/or as listed by ANSI-B-31.1, B-31.3, B-39.1, ASME, UL/ULC, FM, IAPMO or ICC.

1. Components shall be capable of providing system rigidity to accommodate hanging and support in accordance with ANSI B31.1 and ANSI B31.9.

C. Grooved and press to connect end product manufacturer shall be ISO certified.

D. Grooved couplings shall meet the requirements of ASTM F-1476.

E. Grooving tools shall be of an approved manufacturer by the grooved fittings manufacturer. Verify tolerances of and maintain grooving tool components for duration of grooving processes. Replace grooving tool components that are found out of tolerance with new as required.

F. Obtain training from the grooved and press to connect manufacturer for all workers that will be installing or handling the grooved or press to connect piping systems.

G. Comply with NSF 61 Annex G and / or NSF 372 for wetted surfaces of valves and fittings containing no more than 0.25% lead by weight for domestic water distribution.

H. Pipe, fittings, specialties, and valves shall be manufactured in plants located in the United States or certified to meet the specified ASTM, ANSI, and MSS standards.

1.06 COORDINATION

A. Reference Division 22 Section "Water Distribution Piping and Specialties" for coordination.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Refer to manufacturer's current literature for comparable products and pressure ratings of couplings and standard fittings for various pipe sizes and pipe schedules. Products identified by model number are based on available size ranges from that manufacturer. Products offered by manufacturers with extended ranges are acceptable provided they meet the specified requirements.

B. Copper Grooved Copper Tubing System

1. ASC Engineered Solutions "Gruvlok".
2. Shurjoint Piping Products.
3. Victaulic Company of America.

C. Press to Connect Copper Tubing System

1. Apollo "Xpress"
2. GRINNELL Mechanical Products "G-Press"
3. NIBCO Inc., Press System.
4. Viega ProPress

2.02 COPPER GROOVED TUBING SYSTEM

A. Pipe:

1. 2 inch through 8 inch: CTS, ASTM B88 Type K or L, hard drawn.
2. Ends: Roll grooved only in accordance to manufacturer's current listed standards. Flaring of tube ends to IPS dimensions or to accommodate alternate sized couplings is not allowed.

B. General requirements for couplings, adapters, and standard fittings:

1. Full-flow type, compatible with ASTM B75 or B88 CTS grooved joints.
2. Flaring of tube ends to IPS dimensions or to accommodate alternate sized couplings is not allowed.

C. Couplings:

1. Material: Cast of ductile iron conforming to ASTM A536, Grade 65-45-12 or ASTM A395 Grade 65-45-15, coated with suitable enamel or epoxy.
2. Constructed of two-piece housing attached with bolts and nuts with pressure responsive elastomeric gasket, with pressure rating of 300 PSI at 180F. Provide washers where required by the manufacturer.
3. Rigid Type:
    a) ASC Engineered Solutions Gruvlok Series # 6402.
    b) Shurjoint Piping Products Styles #305, #306, and #307.
    c) Victaulic Style # 607.
4. Bolts, nuts, and washers:
    a) Track-head bolts of heat treated carbon or manganese steel conforming to ASTM A183 or A449 with a minimum tensile strength of 110,000 psi.
    b) Heavy-duty hexagonal nuts conforming to ASTM A563, Grade B.
    c) Plated carbon steel flat washers conforming to ASTM F436.
    d) Zinc-electroplated conforming to ASTM B633.
    e) Type 304 or 316 stainless steel bolts and nuts conforming to ASTM A193, Grade B8/B8M, Class 2 or ASTM F593 and F594, Group 2, Condition CW.
    f) Type 304 or 316 stainless steel washers.

D. Flange Adapters:

1. For connection to ANSI class components according to ANSI B16.1 (steel) or ANSI B16.24 (copper).
2. Material: Cast of ductile iron conforming to ASTM A536, Grade 65-45-12 or ASTM A395 Grade 65-45-15, coated with suitable enamel or epoxy.
3. 2 inch-6 inch (ANSI class 125/150):
    a) ASC Engineered Solutions Gruvlok Series # 6084.
    b) Shurjoint Piping Products Styles # C341.
    c) Victaulic Style # 641.

E. Fittings:

1. Materials:
    a) Wrought copper conforming to ASTM B75 alloy C12200 or ASTM B152 alloy C1100.
    b) Lead free bronze sand cast conforming to ASTM B584 alloy UNS C89836.

F. Gaskets:

1. EPDM Gaskets:

a) Grade “E”, “EHP” or “EHT” EPDM compound (green or red/green color coded, respectively) conforming to ASTM D2000 designation 2CA615A25B24F17Z.
b) Temperature operating range: -30 degrees F to +230 degrees F.
c) Style suitable for the application.

2. Fluoroelastomer Gaskets

a) Fluoroelastomer compound specifically formulated for compatibility with potable water systems resistant to chlorine and chloramine disinfectants (red and blue stripe color code).
b) Temperature operating range: 0 degrees F to +180 degrees F.
c) Style suitable for the application.

G. Valves:

1. Provide valves as specified in Division 22 section “General Duty Valves for Plumbing Piping.”

2. 2 Inch through 6 Inch Butterfly Valve:

a) 300 psig CWP, CTS grooved ends, MSS SP-68, suitable for bidirectional and dead-end service at full rated pressure. Conform to Class IV leakage requirements per FCI/ANSI 70-2.
b) Body: Lead free, cast brass to UNS C87850, C90500, or cast bronze per ASTM B584.
c) Disc: Aluminum bronze disc or elastomer encapsulated ductile iron disc per ASTM A536 Grade 65-45-12.
d) Stem: Stainless steel.
e) Seat: Pressure responsive and of a grade suitable for the intended service.
f) Operator: Lever operators (10 position minimum) with locks and stops. Provide chain wheel for valves installed 72 inches or higher above finished floor elevation in mechanical rooms. Extend chains to an elevation of 5’-0” above finished floor elevation.

a. ASC Engineered Solutions Gruvlok Series # 6700
g) Shurjoint Piping Products Style # SJ-C300
h) ASC Engineered Solutions Gruvlok Series #B6700Victaulic # 608N

H. Adapters – Grooved X Plain Copper

1. Wrought copper conforming to ASTM B75 alloy C12200 or ASTM B152 alloy C1100. CTS grooved end x plain end for press or sweat connection.

a) ASC Engineered Solutions Gruvlok Series #652
b) Shurjoint #C52

2.03 PRESS TO CONNECT COPPER TUBING SYSTEM

A. Copper Tube:

1. CTS ½ inch through 4 inch: ASTM B-88 Type K or L.

B. General requirements for couplings, adapters, and standard fittings:

1. Acceptable body materials:

a) Wrought copper conforming to ASTM B75 alloy C12200 or ASTM B152 alloy C1100.
b) Cast copper conforming to ASTM B584 alloy C87600 or C84400.

2. Coupling and fitting housings with soldered ends shall conform to ASME B16.18 and B16.22.
3. Coupling and fitting housings with flared ends shall conform to ASME B16.26.
4. Coupling and fitting housings with threaded ends shall conform to ASME B1.20.1.
5. Coupling and fitting housings for press ends shall have self-contained O-ring seals in the coupling/fitting ends.
6. Rated for 200 psi CWP up to 250 degrees F maximum.

C. O-Ring Seals: EPDM compound conforming to ASME B16.51, style suitable for the application.

D. Flange Adapters:

1. For connection to ANSI class components according to ANSI B16.1 (steel) or ANSI B16.24 (copper).
2. 2-1/2 inch through 4 inch (ANSI class 125/150):

a) Steel flange with NSF 14 compliant fused epoxy coating, copper or brass press to connect joint with copper face ring and plastic or rubber dielectric isolating ring separating the flange from the press to connect joint.

3. Rated for 200 psi CWP up to 250 degrees F maximum.

E. Valves:

1. Provide 2 inch and smaller press to connect valves listed in this section or lead free cast bronze valves 2 inch and smaller listed in Division 22 section "Water Distribution Piping and Specialties" may be used with sweat connections or sweat X press adapters.
2. Ball Valve:

a) Rated for 200 psi CWP up to 250 degrees F maximum, conforming to MSS SP-110.
b) Body and trim: Lead free cast bronze conforming to ASTM B62 or B584.
c) Ends: Female press to connect ends of copper material.
d) Ball: Full port, chrome-plated brass ball.

e) Stem: Blow-out proof, of material silicon bronze conforming to ASTM B371 or ASTM B99, or stainless steel.
f) Seat: PTFE or TFE, suitable for intended service.
g) Operator: Lever handle with non-thermal conductive material for insulated piping. Provide with 2 inch extended sleeve to allow valve operation without disturbing the insulation and with memory stop for throttling, metering or balancing service.

1) Apollo # 77WLF
2) NIBCO # PC-585-LF
3) Milwaukee # UPBA-450-12

3. Ball Valve:

a) Rated for 200 psi CWP up to 250 degrees F maximum, conforming to MSS SP-110.
b) Body and trim: Lead free cast bronze conforming to ASTM B62 or B584.
c) Ends: Female press to connect ends of copper material.
d) Ball: Full port, stainless steel ball.
e) Stem: Blow-out proof, of material silicon bronze conforming to ASTM B371 or ASTM B99, or stainless steel.
f) Seat: PTFE or TFE, suitable for intended service.
g) Operator: Lever handle with non-thermal conductive material for insulated piping. Provide with 2 inch extended sleeve to allow valve operation without disturbing the insulation and with memory stop for throttling, metering or balancing service.
h) 2 inch and smaller:

1) Apollo # 77WLF-140
2) NIBCO # PC-585-66-LF
3) Milwaukee # UPBA-450S-12
4) Viega # 2971.1 ZL

4. Gate Valves

a) Rated for 200 psig CWP up to 250 degrees F maximum, conforming to MSS SP-80.
b) Body and trim: Lead free cast bronze body conforming to ASTM B62 or B584 with threaded bonnet and solid wedge.
c) Ends: Female press to connect ends of copper or brass material.
d) Stem: Silicon bronze conforming to ASTM B371 or ASTM B99, or stainless steel, rising type with brass packing gland and non-asbestos packing.
e) Operator: Malleable or ductile iron hand-wheel.
f) 2 inch and smaller:

1) Apollo # 101T-PRLF
2) Hammond # UP645 P2
3) Milwaukee UP105 P2

4) NIBCO # PC-113-LF

5. Globe Valves

a) Rated for 200 psig CWP up to 250 degrees F maximum, conforming to MSS SP-80.
b) Body and trim: Lead free cast bronze conforming to ASTM B62 or B584 with threaded bonnet.
c) Disc: PTFE renewable seat and disc.
d) Ends: Female press to connect ends of copper or brass material.
e) Stem: Silicon bronze conforming to ASTM B 99, or stainless steel, rising type with brass packing gland and non-asbestos composition packing.
f) Operator: Malleable or ductile iron hand-wheel.
g) 2 inch and smaller:

1) Apollo # 120T-PRLF
2) Hammond # UP440 P2
3) Milwaukee # UP502 P2

6. Check Valves (Y pattern, swing type or in-line)

a) Rated for 200 psig CWP up to 250 degrees F maximum, conforming to MSS SP-80.
b) Body and trim: Cast bronze conforming to ASTM B62.
c) Disc: PTFE renewable seat and disc.
d) Ends: Female press to connect ends of copper or brass material.
e) 2 inch and smaller:

1) Apollo # 163T-PRLF
2) Hammond # UP904 P2
3) NIBCO # PF-413-Y-LF
4) Milwaukee # UP509 P2

7. Check Valves (lift type, in-line)

a) Rated for 250 psig CWP up to 250 degrees F maximum, conforming to MSS SP-80.
b) Body: Cast bronze conforming to ASTM B584.
c) Spring: 316 stainless steel.
d) Ends: Female press to connect ends of copper or brass material.
e) 2 inch and smaller:

1) Apollo # 61LF
2) Milwaukee # UP548T P2

8. Gate Valves -2-1/2 inch and Larger

a) MSS SP-70; Class 125, 200-psi CWP, iron body, bronze mounted, with body and bonnet conforming to ASTM A 126 Class B; with flanged ends, non-asbestos composition packing, and two-piece

packing gland assembly. Provide with factory installed press to connect flange adapters, as described herein, with bolts, nuts and washers.

1) NIBCO

9. Butterfly Valves – 2-1/2 inch and Larger

a) MSS SP-67; 200-psi CWP; lug-type body constructed of ductile iron conforming to ASTM A 126, Class B or ductile iron conforming to ASTM A 536. Provide valves with field replaceable EPDM sleeve/seat, aluminum-bronze disc, 416 stainless steel stem, and EPDM O-ring stem seals. Provide lever operators, (10 position minimum), with lock and stops with locks. Drill and tap valves on dead-end service or requiring additional body strength. Valves must be rated for dead end service at 150 psi with no downstream flange required. Provide with factory installed press to connect flange adapters, as described herein, with bolts, nuts and washers.

1) NIBCO # PFD2000

1) NIBCO # PFD2022

2) Viega # 2873.81

F. Strainers:

1. Provide 2 inch and smaller press to connect strainers listed in this section or lead free cast bronze strainers 2 inch and smaller listed in Division 22 section "Basic Piping Materials and Methods" may be used with sweat connections or sweat X press adapters.
2. Strainers (Y pattern)

a) Rated for 250 psig CWP up to 250 degrees F maximum.
b) Body: Cast bronze conforming to ASTM B584.
c) Screen: Stainless steel mesh with 0.062" perforations.
d) Ends: Female press to connect ends of copper or brass material.
e) 2 inch and smaller:

1) Apollo # 59LF

PART 3 - EXECUTION

3.01 PIPING INSTALLATIONS

A. Install pipe, fittings, valves and specialties in accordance with manufacturer's installation instructions.

B. Water distribution piping installations shall be installed subject to Division 22 Section "Water Distribution Systems and Specialties" in addition to those requirements specified in this Section.

C. Locations and Arrangements: Drawings (plans, schematics, and diagrams) indicate the general location and arrangement of piping systems. Locations and arrangements of piping take into consideration pipe sizing and friction loss, expansion, pump sizing, and other design considerations. So far as practical, install piping as indicated.

3.02 PIPE APPLICATIONS ABOVE GRADE

A. Water piping in sizes 2-1/2 to 8 inches shall be Type L drawn copper tube with roll-grooved ends and copper tube dimensioned mechanical couplings and fittings or water piping sizes 2-1/2 inch to 4 inch shall be Type L drawn copper tube with plain ends and copper tube dimensioned press to connect fittings.

B. Water piping in sizes 4 inches and smaller shall be Type L drawn copper tube with plain ends and copper tube dimensioned press to connect copper couplings and fittings.

3.03 HANGERS AND SUPPORTS

A. Support of piping must account for expansion and contraction, vibration, and the dead load of the piping and its contents.

B. General: Hanger supports, and anchors devices are specified in Division 22 Section "Hangers and Supports for Plumbing Piping." Reference Division 22 Section “Water Distribution Systems and Specialties” for pipe spacing limitations.

3.04 PIPE JOINT CONSTRUCTION

A. Copper Grooved tubing System

1. Pipe ends shall be clean and free from oils, indentations, projections and roll marks in the area from pipe end to groove for proper gasket sealing.
2. Roll and cut groove ends in accordance to manufacturer’s current listed standards. Use rolls sets designed and intended for use on the appropriate pipe material when grooving pipe.
3. Flaring of CTS tube ends to IPS dimensions or to accommodate alternate sized couplings is not allowed.
4. Verify the gasket style and elastomeric material (grade) is suitable for the intended service as specified and in combination with any system chemical additive.
5. Reference latest published manufacturer’s product data for additional pressure ratings and application information.
6. Reference latest published manufacturer’s field installation instructions or other included installation instruction prior to attempting assembly.
7. Ream, deburr and clean tube ends and verify they are free from indentations, projections and roll marks in the area from tube end to groove for proper gasket sealing.

8. All grooved components (couplings, fittings, valves, gaskets, bolts and nuts) shall be of one manufacturer. All grooving tools shall be of one manufacturer, though not necessarily the same as the grooved component manufacturer.
9. Install gaskets with lubricant suitable for all piping services. Lubricant shall be by one manufacturer.

B. Press to connect Copper Tubing System

1. Ream, deburr and clean tube ends and verify they are free from indentations, projections, burrs and foreign matter.
2. Install permanent inspection mark on tube.
3. Clean tube and fittings of all dirt and oil. Verify O-ring is in place and free of oil, grease or dirt.
4. Push copper tube into fittings with twisting action to all the way to the fitting stop or shoulder.
5. Mark tube with permanent marker to indicate proper tube insertion depth.
6. Verify press tool has correct size jaw set for tube size used.
7. Complete one tool cycle with empty jaw to calibrate tool for each time new jaw is inserted into tool.
8. Squeeze jaw arms to open tool jaws and place jaws around the contour of the fitting. Verify tool is perpendicular to the fitting and depress tool switch.
9. Squeeze jaw open to remove the tool and observe witness mark.
10. Verify crimped fitting connection for misalignment of the copper tube, misalignment of the tool or improper insertion of the tube. If any of these conditions are found cut out the joint and provide a new joint.
11. Maintain minimum distance between joints per the manufacturer's published installation instructions.

C. Dielectric Isolation Requirements for Copper Grooved Connections: Provide dielectric grooved waterway fittings or couplings at grooved galvanized steel, stainless steel or ductile iron to grooved copper joints. Dielectric waterway fittings are specified in Section "Basic Piping Materials and Methods".

D. Dielectric Isolation Requirements for Press to Connect Adapter Flange Connections: Provide dielectric flanges or flange kits for the following joint types:

1. Adapter Flanges to Iron, Ductile Iron or Steel Body Valves and Fittings (Except Butterfly Valves with EPDM Sleeve/Seats): Provide full face gaskets between flanges and adapter flanges. At each bolt provide, steel washers, thermoplastic washers and bolt isolation sleeves or thermoplastic combination washers and bolt sleeves on valve and adapter flanges.
2. Adapter Flanges to Butterfly Valves with EPDM Sleeve/Seats in Series with Iron, Ductile Iron or Steel Body Valves and Fittings: At each bolt provide, steel washers, thermoplastic washers and bolt isolation sleeves or thermoplastic combination washers and bolt sleeves on adapter flange. Provide steel bolts on butterfly valve flange.

3. Adapter Flanges to Butterfly Valves in Copper Tubing: Install flat washers at each bolt on adapter flange. Provide full face gasket only for butterfly valves without integral liner acting as a gasket.
4. Full face gaskets, thermoplastic washers and bolt isolation sleeves or thermoplastic combination washers and bolt sleeves are specified in Section "Basic Piping Materials and Methods".

E. Flange Adapters:

1. Install flange adapter washers when flange adapters are used against the following surfaces:

a) Rubber.
b) Adapting to ANSI/AWWA cast flanges.
c) Rubber faced lug valves.
d) Serrated flanged surfaces.

2. Do not install flange adapters for applications that incorporate tie rods for anchoring or on standard grooved-end fittings within 90 degrees of each other.

3.05 VALVE APPLICATIONS

A. Reference Division 22 Section "Water Distribution Piping and Specialties" for valve applications.

3.06 EQUIPMENT CONNECTIONS

A. Grooved flexible style couplings may be used at equipment connections where specified for vibration isolation control only.

B. Press to connect joints shall not be provided for equipment connections. Provide flanges, unions, di-electric unions or waterway fittings. Flanges, unions, di-electric unions and waterway fittings are specified in Division 22 specification section "Basic Piping Materials and Methods"

3.07 EXPANSION JOINTS:

A. Provide expansion joints where indicated. Expansion joints and their installation requirements are specified in Division 22 specification section "Expansion Fittings and Loops for Plumbing Piping".

1. Provide with copper press to connect ends or copper press to connect X screwed NPT adapters for 2 inches and smaller.
2. Provide with copper press to connect ends or press to connect adapter flanges for 2-1/2 inches to 4 inches.
3. Provide copper grooved adapter flanges for 2-1/2 inches to 8 inches.

B. Where field conditions allow and as a contractor's option, provide expansion joints consisting of an assembly of flexible couplings: Fabricated from a combination of

couplings and nipples with rolled groove short type “K” or “L” copper tube nipples and flexible CTS couplings. Install with removable ties to hold joint compressed or expanded during piping fabrication. Provide the same gaskets as specified above for rigid couplings. Provide expansion joints of an assembly of flexible couplings with displacement identical expansion joints as indicated.

3.08 STRAINERS

A. Provide strainers as specified in part 2 of this specification section or Division 22 specification section “Basic Piping Materials and Methods”.

1. Provide manufacturer strainer with press to connect ends for 2 inches and smaller.
2. Provide copper press to connect X screwed NPT adapters for 2 inches and smaller.
3. Provide press to connect adapter flanges for 2-1/2 inches to 4 inches.
4. Provide copper grooved adapter flanges for 2-1/2 inches to 8 inches.

3.09 WATER DISTRIBUTION SPECIALTIES INSTALLATION

A. Reference Division 22 Section “Water Distribution Systems and Specialties” for water distribution specialties and installation requirements.

3.010 FIELD QUALITY CONTROL

A. The following procedures are paraphrased from the ASME B-31.9, code for pressure piping, building services piping.

B. Installing contractor shall schedule training session with the grooved or press to connect manufacturer for all workers that will be installing or handling the grooved or press to connect piping systems. Submit certification letter along with list of attendees to engineer of record within 30-days of mobilization. Include copy of certification letter with closeout documents.

C. Grooved and Press to connect fitting manufacturer shall provide certification training to contractor without cost and without additional cost to Owner.

D. Provide testing procedures as defined in Division 22 Section “Water Distribution Systems and Specialties” and as specified in grooved mechanical piping manufacturer’s installation instructions.

E. Installing contractor shall visually inspect couplings and repair or replace any misaligned couplings and couplings with gaps prior to calling for inspection as defined in Division 22 Section “General Plumbing Requirements.”

F. Grooved and Press to connect fitting manufacturer’s representative shall make periodic visits to the jobsite during construction to ensure the installing contractor is

following the latest published manufacturer's field installation instructions and best practice procedures provided during the training session.

3.011 STARTUP

A. Refer to Division 22 Section "Water Distribution Piping and Specialties" for startup procedures.

END OF SECTION

PART 1 - GENERAL REQUIREMENTS

1.01 SUMMARY

A. This Section includes the following types of plumbing pumps:

1. Inline circulator pumps
2. Inline pumps
3. Packaged domestic booster pumps

B. Related Sections: The following sections contain requirements that relate to this Section:

1. Division 3 Section "Concrete Work" for specifications on concrete and reinforcing materials and concrete placing requirements for equipment pads.
2. Division 22 Section “Coordination” for basic requirements for electrical components that are an integral part of packaged system components.
3. Division 22 Section, “Basic Piping Materials and Methods” for rubber flexible connectors.
4. Division 22 Section "Vibration Isolation for Plumbing Piping and Equipment" for inertia pads, isolation pads, spring supports, and spring hangers.
5. Division 26 Section “Common Work Results for Electrical” required electrical devices.
6. Division 26 Sections "Enclosed Switches and Circuit Breakers" for field-installed disconnects.

1.02 SUBMITTALS

A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections.

1. Product data including standard performance curves, weights (shipping, installed, and operating), furnished specialties, and accessories, plus installation and start-up instructions.
2. Shop drawings showing layout and connections for plumbing pumps. Include setting drawings with templates, and directions for installation of foundation bolts, anchor bolts, and other anchorages.
3. Wiring diagrams detailing wiring for power, signal, and control systems; differentiating between manufacturer-installed wiring and field-installed wiring.
4. Maintenance data for plumbing pumps, for inclusion in Operating and Maintenance Manuals specified in Division 1 and Division 22 Section "General Plumbing Requirements."

5. Submit certification that pumps, valves, fittings and specialties comply with NSF 61 Annex G.

1.03 QUALITY ASSURANCE

A. Hydraulic Institute Compliance: Design, manufacture, and install plumbing pumps in accordance with "Hydraulic Institute Standards."

B. National Electrical Code Compliance: Components shall comply with NFPA 70 "National Electrical Code."

C. UL Compliance: Plumbing pumps shall be listed and labeled by UL and comply UL Standard 778 "Motor Operated Water Pumps."

D. UL Compliance: Control panels shall be listed and labeled by UL and comply with Standard 508A “Control Panels”.

E. NEMA Compliance: Electric motors and components shall be listed and labeled NEMA.

F. Single-Source Responsibility: Obtain plumbing pumps of the same type from a single manufacturer.

G. Design Criteria: The Drawings indicate sizes, profiles, connections, and dimensional requirements of plumbing pumps and are based on the specific manufacturer types and models indicated. Pumps having equal performance characteristics by other manufacturers may be considered, provided that deviations in dimensions and profiles do not change the design concept or intended performance as judged by the Architect. The burden of proof for equality of plumbing pumps is on the proposer.

H. Comply with NSF 61 Annex G (pending) for wetted surfaces of valves, fittings and specialties containing no more than 0.25% lead by weight compliance for valves for domestic water service.

I. Valves, pumps and fittings shall be manufactured in plants located in the United States or certified that they comply with applicable ANSI, ASTM and MSS standards.

1.04 SPARE PARTS

A. Furnish spare parts described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Mechanical Seals: One mechanical seal for each pump.

1.05 WARRANTY

A. Warranty on Pumps: Provide written warranty, signed by manufacturer, agreeing to replace/repair, within warranty period, pumps with inadequate or defective materials and workmanship, including leakage, breakage, improper assembly, or failure to perform as required; provided manufacturer's instructions for handling, installing, protecting, and maintaining units have been adhered to during warranty period. Replacement includes both parts and labor for removal and reinstallation.

1. Warranty Period: One year from date of substantial completion.

PART 2 - PRODUCTS AND MATERIALS

2.01 MANUFACTURERS

A. Products: Subject to compliance with requirements, provide one of the following:

1. Inline Circulator Pumps:

   a) Armstrong Pumps, Inc.
   b) Bell & Gossett, ITT.
   c) Grundfos Pumps, Corp.
   d) Taco, Inc.

2. Inline Pumps:

   a) Armstrong Pumps, Inc.
   b) Bell & Gossett, ITT.
   c) Grundfos Pumps, Corp.
   d) Taco, Inc.

3. Packaged Domestic Booster Pumps – Variable Speed Multistage

   a) Armstrong
   b) Bell & Gossett, ITT
   c) Canariss Corp.
   d) Delta P Carver
   e) Grundfos Pumps, Corp.
   f) QuantumFlo, Inc.

4. Simplex Packaged Domestic Booster Pumps – Variable Speed Multistage

   a) Grundfos Pumps, Corp. with no substitutions
   b) Goulds, ITT

5. Aquastats:

   a) Dayton
   b) Honeywell
   c) Penn
   d) White-Rodgers

2.02 PUMPS, GENERAL

A. Pumps and circulators: factory assembled and factory tested.

B. Preparation for shipping: After assembly and testing, clean flanges and exposed machined metal surfaces and treat with an anticorrosion compound. Protect flanges, pipe openings, and nozzles with wooden flange covers or with screwed-in plugs.

C. Motors: Conform to NEMA standards; single, multiple, or variable speed with type of enclosure and electrical characteristics as indicated; have built-in thermal-overload protection and grease-lubricated ball bearings. Select motors that are nonoverloading within the full range of the pump performance curve.

D. Apply factory finish paint to assembled, tested units prior to shipping.

2.03 INLINE CIRCULATOR PUMPS

A. General Description: Circulators shall be horizontal inline, centrifugal, separately coupled, single-stage, all-bronze, radially split case design, with mechanical seals, permanently lubricated ball bearings and rated for 125 psig working pressure and 225 deg F continuous water temperature.

B. Casings: Cast lead free bronze, with threaded companion flanges for piping connections smaller than 2-1/2 inches, and threaded gauge tappings at inlet and outlet connections.

C. Impeller: Statically and dynamically balanced, closed, overhung, single suction, fabricated from cast lead free bronze conforming to ASTM B 584, and keyed to shaft.

D. Pump Shaft and Sleeve: Steel shaft with oil-lubricated copper sleeve.

E. Mechanical Seals: Carbon steel rotating ring, stainless-steel spring, ceramic seat, and flexible bellows and gasket.

F. Pump Bearings: Oil-lubricated, bronze journal and thrust bearings.

G. Motor Bearings: Oil-lubricated sleeve bearings.

H. Shaft Couplings: Flexible; capable of absorbing torsional vibration and shaft misalignment.

I. Motors: Resiliently mounted to the pump casing.

2.04 INLINE PUMPS

A. General Description: Circulators shall be horizontal inline, centrifugal, separately coupled, single-stage, all-bronze, radially split case design, with mechanical seals, flexible coupling between pump and motor and rated for 125 psig working pressure and 225 deg F continuous water temperature.

B. Casings: Cast lead free bronze, with threaded companion flanges for piping connections smaller than 2-1/2 inches, and threaded gauge tappings at inlet and outlet connections.

C. Impeller: Statically and dynamically balanced, closed, overhung, single suction, fabricated from lead free bronze conforming to ASTM B 584, and keyed to shaft.

D. Pump Shaft and Sleeve: Steel shaft with oil-lubricated copper sleeve.

E. Mechanical Seals: Carbon steel rotating ring, stainless-steel spring, ceramic seat, and Buna-N bellows and gasket.

F. Pump Bearings: Oil-lubricated, bronze journal and thrust bearings.

G. Motor Bearings: Oil-lubricated sleeve bearings.

H. Shaft Couplings: Flexible; capable of absorbing torsional vibration and shaft misalignment.

I. Motors: Resiliently mounted to the pump casing.

2.05 PACKAGED DOMESTIC BOOSTER PUMPS – VARIABLE SPEED MULTISTAGE

A. Packaged, constant pressure type with duplex vertical multiple stage centrifugal pumps, control panel, motors, variable frequency drives, gauges, ball type isolation valves, dielectric isolators, remote accumulator tank, thermal bleed aquastat and solenoid valve and accessories. The packaged system, including all items listed below, shall be factory assembled on a fabricated steel base plate with structural steel framework. The completed package shall be factory tested, adjusted and certified for the specified flow conditions, and shipped as an integral unit ready for plumbing and electrical connections.

B. Pumps: Provide multiple stage vertical multiple stage centrifugal type with close-coupled motors, cast iron suction / discharge chamber, motor stool and pump shaft couplings, mechanical seals, 304 stainless steel and impellers, chambers, straps, suction interconnector and neck rings, 431 stainless steel pump shaft and 316 stainless steel bearings, neck rings retainers, split cones, split cone nuts, wear and lock rings.

C. Motors: Provide variable speed, totally enclosed fan cooled type, operate at 3500 rpm and shall not overload at any point of the pump curve.

D. Piping: Suction and discharge headers shall be 316 stainless steel with ANSI class 150 pressure rating and flanges welded to the headers. Peak velocity in headers shall not exceed 8 feet per second. Furnish with the following valves:

a) Lead Free Ball Valves, 2 Inch and Smaller: Meeting MSS SP-110, Class150, 600-psi CWP; two-piece construction; with ASTM B 584 cast lead free bronze, full port, blowout-proof stem and chrome-plated lead free brass ball with replaceable "Teflon" or "TFE" seats and seals, solder ends and vinyl-covered steel handle.

b) Lead Free Lift Check Valves, 2-Inch and Smaller: Meeting MSS SP-80; Class 125, 300-psi CWP, body, disc holder and cap of ASTM B 584 cast lead free bronze; horizontal or angle pattern, lift-type valve, with stainless steel spring, renewable "Teflon" disc and solder ends. Provide valves capable of being refitted and ground while the valve remains in the line.

E. Accumulator Tank: Provide tank size as scheduled on the drawings with a minimum pressure rating of 125psig; FDA approved elastomer bladder, tank bottom connection and air charge valve. Tank shall be complete with check valves, isolation valves and pressure reducing valve for remote installation.

F. Controls and Instruments: Control panel shall be mounted on the pump package and shall include a NEMA 1 enclosure, through door fusible disconnect, disconnect for each pump, overload relays and indicator lights, 120V control circuit transformer with primary and secondary fuse protection, low suction pressure limit switch, suction and discharge header pressure sensors, programmable logic controller and variable speed drives. Touchscreen operator interface for monitoring and adjustment of the programmable controller variables with virtual on-off-automatic selector switch for each pump, low pressure alarm, high system pressure alarm, pump running indicators and hour meter for each pump. Controls shall be arranged for termination of 1 incoming power feeder. Control panel shall have a unit short circuit current rating equal to or greater than the available short circuit current as indicated on the electrical drawings.

1. Programmable Logic Controller (PLC): Designed specifically for the control of pumps with variable speed drives capable of receiving two analog pressure inputs, analog flow input, automatic pump alternating and On-line field modified data entries for staging pumps, with software memory stored in non-volatile EPROM memory, furnish with user interface keypad with LED display.
2. Variable Frequency Drive: The variable speed drives (VFD) shall be adjustable frequency type which employs a pulse width modulated inverter. The drive shall include built in diagnostics. Diagnostics shall be annunciated through the alpha numeric keypad. The drive shall be listed

UL, ETL and/or CSA. To insure safety of the equipment, the VFD shall include these protective features and options:

a) NEMA 1 enclosure.
b) Static instantaneous over-current and over-voltage trip.
c) Static over-speed (over-frequency) protection.
d) Line or fuse loss and under-voltage protection.
e) Power unit over-temperature protection.
f) Motor inverse time overload protection.
g) Input fused disconnect or circuit breaker.
h) Total voltage harmonic distortion from the VFD shall be less than 5% to meet IEEE requirements.
i) Speed meter.
j) Automatic restart after power failure or minor drive fault. The drive shall attempt a minimum of two restarts before a complete drive shut-down.
k) Power on light.
l) Manual speed potentiometer or control capability through the keypad.
m) Hand/Off/Automatic Switch or Manual/Automatic Switch with start/stop pushbutton.
n) Test switch
o) VFD fault light and reset.
p) Output to the PLC and integral LED display
q) The VFD shall be microprocessor based and utilize digital input for all parameter adjustments. The VFD shall include a digital display for monitoring system parameters and for first fault indication, and digital input programming capability on the main logic board.
r) The VFD shall operate on a frequency range of 1 to 66 Hz with resolution of 0.1% of base speed with analog input or 0.025% with digital input and have accuracy within 0.05% of set point. VFD shall operate in environment of 0 to 40 degrees C, 3,300 feet altitude and 95% non-condensing humidity without derating.
s) All control circuit voltages shall be physically and electrically isolated from power circuit voltages.
t) All VFD's shall be tested/run in the equivalent of NEMA 1 enclosure and burned in at rated ambient (40° C) with a fully loaded motor.
u) Configured for mounting on top of motor or outside of control panel.

3. Pressure Sensors: NEMA 4 water tight enclosure with pressure rating of 2,000psi, stainless steel wetted parts, 0.25" male NPT connection, calibration from 0 to 150 psi with 4-20mA DC signal at 24 VDC. Refer to the floor plans for location of remote pressure sensor.
4. Sequence of Operation: The domestic water booster pump shall be in automatic mode per the design conditions shown on the booster pump schedule. The pump shall modulate its speed to maintain the discharge head

pressure setpoint, as determined by the internal control algorithm, simulating the performance of a system utilizing a remote differential pressure sensor. The pumps shall run in a lead/lag operation based on user defined run-time setpoint. When the flow capacity of the lead pump is exceeded, the lag pump shall start after an adjustable time delay. If the capacity of the lead pump and lag pump is exceeded, the second lag pump (and the N+1 sequencing shall continue based on the number of pumps in the system) shall start.

a) When a single pump operates at minimum flow rate, the pump speed shall be reduced to the minimum discharge header pressure as scheduled. When required flow increases, the pump speed shall increase linearly to the discharge pressure as scheduled at full flow, simulating the performance of a system utilizing a remote differential pressure sensor.

b) When the lead pump is stopped because of required zero flow, the pump speed shall increase linearly to the discharge pressure as scheduled to charge the tank, then stop.

5. Safeties:

a) Low Suction Pressure

1) When the suction pressure drops below the low suction pressure alarm point as determined by the integral suction pressure sensor, the pumps shall be disabled and an audible alarm shall be sent to the BMS or local building alarm system.

b) High Discharge Pressure

1) When the discharge pressure rises above the high discharge pressure alarm point as determined by the integral discharge pressure sensor, the pumps shall be disabled and an audible alarm shall be sent to the BMS or local building alarm system

c) High Flow Shutdown

1) When the discharge flow, as calculated by the control system, rises above the high flow alarm point, the pumps shall be disable and an audible alarm shall be sent to the BMS or local building alarm system.

6. Control Wire: Domestic booster pump manufacturer shall furnish the appropriate type and amount of wire for interlock of the remote sensors with the domestic booster pump control panel.

G. Startup Services: Domestic booster pump manufacturer shall provide factory start-up and check out of the booster pump. The Contractor shall provide the Owner's Representative with certification of proper installation and system operation.

2.06 SIMPLEX PACKAGED DOMESTIC BOOSTER PUMPS – VARIABLE SPEED MULTISTAGE

A. Packaged, constant pressure type with simplex vertical multiple stage centrifugal pump, motor, variable frequency drive, gauges, ball type isolation valves, dielectric isolators, accumulator tank, thermal bleed aquastat and solenoid valve and accessories. The packaged system, including all items listed below, shall be factory assembled on a fabricated steel base plate with structural steel framework. The completed package shall be factory tested, adjusted and certified for the specified flow conditions, and shipped as an integral unit ready for plumbing and electrical connections.

B. Pump: Provide multiple stage vertical multiple stage centrifugal type with close-coupled motors, cast iron suction / discharge chamber, motor stool and pump shaft couplings, mechanical seals, 304 stainless steel and impellers, chambers, straps, suction interconnector and neck rings, 431 stainless steel pump shaft and 316 stainless steel bearings, neck rings retainers, split cones, split cone nuts, wear and lock rings.

C. Motor: Provide variable speed, totally enclosed fan cooled type, operate at 3500 rpm and shall not overload at any point of the pump curve.

D. Piping: Suction and discharge headers shall be 304 stainless steel with ANSI class 150 pressure rating and flanges welded to the headers. Peak velocity in headers shall not exceed 8 feet per second. Furnish with the following valves:

   a) Ball Valves, 2 Inch and Smaller: MSS SP-110, Class 150 saturated steam pressure, 600-psi CWP; two-piece construction; with bronze body conforming to ASTM B 584, conventional port, chrome-plated brass ball, replaceable "Teflon" or "TFE" seats and seals, blowout-proof stem, solder ends and vinyl-covered steel handle.
   b) Lift Check Valves, 2-Inch and Smaller: Class 125; cast-bronze body and cap conforming to ASTM B 62; horizontal or angle pattern, lift-type valve, with stainless steel spring, bronze disc holder with renewable "Teflon" disc, and threaded ends.

E. Accumulator Tank: Provide tank size as scheduled on the drawings with a minimum pressure rating of 125psig; FDA approved elastomer bladder, tank bottom connection and air charge valve. Tank shall be complete with check valves, isolation valves and pressure reducing valve for remote installation.

F. Controls and Instruments: Pump package shall include a disconnect with NEMA 1 enclosure, suction and discharge pressure switches and variable speed drive. Controls shall be arranged for termination of 1 incoming power feeder. Disconnect and VFD shall have a unit short circuit current rating equal to or greater than the available short circuit current as indicated on the electrical drawings.

1. Variable Frequency Drive: Designed specifically for the control of pump with variable speed drive capable of receiving two analog pressure inputs, with software memory stored in non-volatile EPROM memory and with LED display and user remote interface keypad. The variable speed drives (VFD) shall be adjustable frequency type which employs a pulse width modulated inverter. The drive shall include built in diagnostics. Diagnostics shall be annunciated through the LED display and user remote interface keypad. The drive shall be listed UL, ETL and/or CSA. To insure safety of the equipment, the VFD shall include these protective features and options:

   a) NEMA 1 enclosure.
   b) Static instantaneous over-current and over-voltage trip.
   c) Static over-speed (over-frequency) protection.
   d) Line or fuse loss and under-voltage protection.
   e) Power unit over-temperature protection.
   f) Motor inverse time overload protection.
   g) Input fused disconnect or circuit breaker.
   h) Total voltage harmonic distortion from the VFD shall be less than 5% to meet IEEE requirements.
   i) Speed meter.
   j) Automatic restart after power failure or minor drive fault. The drive shall attempt a minimum of two restarts before a complete drive shut-down.
   k) Power on light.
   l) Manual speed potentiometer or control capability through the keypad.
   m) Hand/Off/Automatic Switch or Manual/Automatic Switch with start/stop pushbutton.
   n) Test switch
   o) VFD fault light and reset.
   p) Output to the PLC and integral LED display
   q) The VFD shall be microprocessor based and utilize digital input for all parameter adjustments. The VFD shall include a digital display for monitoring system parameters and for first fault indication, and digital input programming capability on the main logic board.
   r) The VFD shall operate on a frequency range of 1 to 66 Hz with resolution of 0.1% of base speed with analog input or 0.025% with digital input and have accuracy within 0.05% of set point. VFD shall operate in environment of 0 to 40 degrees C, 3,300 feet altitude and 95% non-condensing humidity without derating.
   s) All control circuit voltages shall be physically and electrically isolated from power circuit voltages.
   t) All VFD's shall be tested/run in the equivalent of NEMA 1 enclosure and burned in at rated ambient (40° C) with a fully loaded motor.
   u) Configured for mounting on top of motor or outside of control panel.
   v) Low pressure limit automatic shutdown and alarm.

w) High pressure automatic shutdown and alarm.

2. Pressure Sensors: NEMA 4 water tight enclosure with pressure rating of 2,000psi, stainless steel wetted parts, 0.25" male NPT connection, calibration from 0 to 150 psi with 4-20mA DC signal at 24 VDC. Refer to the floor plans for location of remote pressure sensor.
3. Sequence of Operation: Each sensor/transmitter shall send a 4-20mA signal to the VFD, indicative of process variable condition. The VFD shall compare each signal to the independent, user determined set points. Single pump speed shall remain constant at optimum energy consumption level when all set points are satisfied. The VFD shall continuously scan and process variable to its individual set point. The VFD shall speed up or slow down the pump/motor as the worst case zone deviates from set point.
4. Control Wire: Domestic booster pump manufacturer shall furnish the appropriate type and amount of wire for interlock of the remote sensors with the domestic booster pump control panel.

G. Startup Services: Domestic booster pump manufacturer shall provide factory start-up and check out of the booster pump. The Contractor shall provide the Owner's Representative with certification of proper installation and system operation.

2.07 AQUASTATS:

A. Remote sensing bulb type, non-modulating, single pole double pole throw with surface mount sensing bulb and mounting bracket, adjustable direct reading scale for set point with adjustable differential.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install pumps in accordance with manufacturer's installation instructions.

B. General: Comply with the manufacturer's written installation and alignment instructions.

C. Install pumps in locations and arrange to provide access for periodic maintenance, including removal of motors, impellers, couplings, and accessories.

D. Support pumps and piping separately so that the weight of the piping system does not rest on the pump.

E. Suspend inline pumps with althread hanger rod and vibration isolation hangers of sufficient size to support the weight of the pump independent from the piping system.

3.02 EXAMINATION

A. Examine areas, equipment foundations, and conditions with Installer present, for compliance with requirements for installation and other conditions affecting performance of plumbing pumps. Do not proceed with installation until unsatisfactory conditions have been corrected.

B. Examine rough-in for plumbing piping systems to verify actual locations of piping connections prior to installation.

3.03 CONCRETE EQUIPMENT BASES

A. Refer to Division 22 Section “Basic Mechanical Materials and Methods” for concrete equipment bases.

1. Form concrete equipment bases by using framing lumber with form release compounds. Chamfer top edge and corners of pad.
2. Install reinforcing bars, tied to frame, and place anchor bolts and sleeves using manufacturer's installation template.
3. Place concrete and allow to cure before installation of pumps.

3.04 ALIGNMENT

A. Align pump and motor shafts and piping connections after setting on foundations, after grout has been set and foundations bolts have been tightened, and after piping connections have been made.

1. Adjust alignment of pump and motor shafts for angular and parallel alignment by one of the two methods specified in the Hydraulic Institute "Centrifugal Pumps - Instructions for Installation, Operation and Maintenance."

B. After alignment is correct, tighten the foundation bolts evenly but not too firmly. Fill the base plate completely with nonshrink, nonmetallic grout, with metal blocks and shims or wedges in place. After grout has cured, fully tighten foundation bolts.

1. Alignment tolerances shall meet manufacturers recommendations.

3.05 CONNECTIONS

A. General: Install valves that are same size as the piping connecting the pump.

B. Install suction and discharge pipe sizes equal to or greater than the diameter of the pump nozzles.

C. Install a nonslam check valve and shutoff valve on the discharge side of pumps.

D. Install a gate valve and strainer on the suction side of inline pumps.

E. Install pressure gauges on the suction and discharge of each pump at the integral pressure gauge tappings provided.

F. Install pressure gauge connector plugs in suction and discharge piping around pump. Pressure gauge connector plugs are specified in Division 22 Section "Meters and Gauges for Plumbing Piping."

G. Install surface mounted aquastat on bare metal pipe, fastened securely to pipe upstream of circulator pump when indicated on the drawings.

H. Interlock aquastat and or timer with hot water recirculation pump motor. Electrical wiring and connections are specified in Division 26 section “Common Work Results for Electrical”.

I. Electrical wiring and connections are specified in Division 26 section “Common Work Results for Electrical”.

J. Install domestic booster pump remote sensors as recommended by the manufacturer. Coordinate interlock of the sensors and domestic booster pump. Install control wire furnished with the domestic booster pump for interlock with the sensors. Electrical wiring and connections are specified in Division 26 section “Common Work Results for Electrical”.

K. Install flexible connectors at the header inlet and outlet of domestic booster pump, refer to Division 22 Section “Basic piping Materials and Methods”.

L. Provide concrete inertia base and vibration isolators, refer to Division 22 Section “Vibration Isolation for Plumbing Piping and Equipment”.

1. Provide an equipment pad, separate from the inertia pad, to 2” beyond elbows, shutoff valves and flexible connectors. Anchor base elbows and shutoff valves to equipment pad.

M. Coordinate interlock of high flow rate, low suction pressure and high discharge pressure level alarms with the building automation system. Alarm wiring and alarm interlock with the building automation system are specified in Division 23 Section “Direct-Digital Control for HVAC”.

3.06 FIELD QUALITY CONTROL

A. Check suction lines connections for tightness to avoid drawing air into the pump.

3.07 STARTUP

A. Final Checks Before Start-Up: Perform the following preventative maintenance operations and checks before start-up:

1. Lubricate oil-lubricated bearings.

2. Remove grease-lubricated bearing covers and flush the bearings with kerosene and thoroughly clean. Fill with new lubricant in accordance with the manufacturer's recommendations.
3. Disconnect coupling and check motor for proper rotation. Rotation shall match direction of rotation marked on pump casing.
4. Check that pump is free to rotate by hand. For pumps handling hot liquids, pump shall be free to rotate with the pump hot and cold. If the pump is bound or even drags slightly, do not operate the pump until the cause of the trouble is determined and corrected.

B. Starting procedure for pumps with shutoff power not exceeding the safe motor power:

1. Prime the pump, opening the suction valve, closing the drains, and prepare the pump for operation.
2. Open the valve in the cooling water supply to the bearings where applicable.
3. Open the sealing liquid supply valve if the pump is so fitted.
4. Open the warm-up valve of a pump handling hot liquids if the pump is not normally kept at operating temperature.
5. Open the recirculating line valve if the pump should not be operated against dead shutoff.
6. Start motor.
7. Open the discharge valve slowly.
8. Observe the leakage from the stuffing boxes and adjust the sealing liquid valve for proper flow to ensure the lubrication of the packing. Do not tighten the gland immediately, but let the packing run in before reducing the leakage through the stuffing boxes.
9. Check the general mechanical operation of the pump and motor.
10. Close the recirculating line valve once there is sufficient flow through the pump to prevent overheating.

C. If the pump is to be started against a closed check valve with the discharge gate valve open, the steps are the same except that the discharge gate valve is opened some time before the motor is started.

D. Start Up Services for Booster Pump:

1. Certification: Prepare certificates for factory compliance of the installation and completion of factory training signed by the factory-authorized service representative and turn over to the Architect upon completion of the project.

END OF SECTION

PART 1 - GENERAL REQUIREMENTS

1.01 SUMMARY

A. This Section includes building sanitary drainage and vent piping systems, including drains and drainage specialties.

B. Related Sections: The following sections contain requirements that relate to this Section:

1. Division 22 Section "General Plumbing Requirements," for trenching and backfilling materials and methods for underground piping installations.
2. Division 33 Section "Sanitary Sewage Systems," for sanitary drainage piping beginning from 5'-0" outside the building.
3. Division 7 Section "Joint Sealers," for materials and methods for sealing pipe penetrations through basement and foundation walls, and fire and smoke barriers.
4. Division 11 Section “Kitchen and Food Service Equipment,” for drains and trim furnished with the food service and kitchen equipment.
5. Division 22 Section "Plumbing Identification," for labeling and identification of drainage and vent piping.
6. Division 22 Section "Common Work Results for Plumbing," for materials and methods for fire barrier penetrations, wall and floor penetrations and equipment pads.
7. Division 22 Section "Basic Piping Material and Methods," for materials and methods for mechanical sleeve seals.
8. Division 22 Section "Hangers and Supports for Plumbing Piping," for materials and methods for hanging and supporting drainage and vent piping.
9. Division 22 Section "Plumbing Insulation," for materials and methods for insulating drainage piping.
10. Division 22 Section “Water Distribution Piping and Specialties,” for material and methods for trap primers and trap primer inlet piping.

1.02 DEFINITIONS

A. Sanitary Building Drain: That part of the lowest piping of a drainage system which receives the discharge from soil, waste, and other drainage pipes inside the walls of the building and conveys it to the building sewer.

B. Sanitary Building Sewer: That part of the drainage system which extends from the end of the building drain and conveys its discharge to a public sewer, private sewer, individual sewage disposal system, or other point of disposal.

C. Drainage System: Includes all the piping within a public or private premises which conveys sewage or other liquid wastes to a point of disposal. It does not include

the mains of public sewer systems or a private or public sewage treatment or disposal plant.

D. Vent System: A pipe or pipes installed to provide a flow of air to or from a drainage system, or to provide a circulation of air within such system to protect trap seals from siphonage and back pressure.

1.03 SUBMITTALS

A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specifications Sections.

B. Product data for the following products:

1. Drainage piping
2. Drainage piping specialties
3. Floor drains
4. Interceptors
5. No-hub fitting restraints

C. Test reports specified in Part 3 of this Section.

1.04 QUALITY ASSURANCE

A. Comply with the installation requirements for CPVC pipe and CPVC CTS tube per the Lubrizol "FlowGuard Gold and CORZAN Design and Installation Manual" and the installed manufacturer's installation manual.

B. Regulatory Requirements: Comply with the provisions of the following codes:

1. 2018 Arkansas Plumbing Code

PART 2 - PRODUCTS AND MATERIALS

2.01 MANUFACTURERS

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

1. Drainage Piping Specialties, including backwater valves, cleanouts, and floor drains:

a) Jay R. Smith Mfg. Co.
b) Josam Mfg. Co.
c) Mifab Manufacturing Co.
d) Sioux Chief Manufacturing Co. Inc.
e) Tyler Pipe/Wade Div.; Subs. of Tyler Corp.
f) Watts Industries, Inc.
g) Zurn Industries, Inc.; Hydromechanics Div.

2. Heavy Duty Hubless Couplings

    a) Anaco Husky HD-2000
    b) Clamp-All 80in. lb.
    c) Ideal Tridon “HD”
    d) Mission Rubber Company, “Heavy Weight”
    e) ProFlo “HD”

3. Cast Iron Soil Pipe and Fittings

    a) AB & I Foundry
    b) Charlotte Pipe and Foundry Company
    c) Tyler Pipe / Soil Pipe Division

4. Shielded Transition Couplings

    a) FERNCO, “Proflex 3000 Series”
    b) Mission Rubber Company, “Band Seal Specialty Couplings”

5. Underground Shielded Adapter Couplings

    a) FERNCO, “1056 Series with SR73 Shear Ring”
    b) Mission Rubber Company, “MR56 Series”

6. Trap Seals

    a) Green Drain, Inc.
    b) Jay R. Smith Mfg. Co.
    c) Mifab Manufacturing, Inc.
    d) Proset Systems “Trap Guard”
    e) Rector Seal, Inc.
    f) Zurn Industries, Inc.; Hydromechanics Div.

7. Hubless Couplings:

    a) Anaco
    b) Ideal Tridon
    c) Mission Rubber Company
    d) ProFlo “PFNH”
    e) Tyler Pipe / Soil Pipe Division

8. Plastic Gravity Interceptors

    a) Green Turtle, Inc.
    b) Mifab Manufacturing, Inc.
    c) Schier Products
    d) Thermaco, Inc.
    e) Xerxes Corp.

9. No-Hub Fitting Restraints

    a) Holdrite

10. Backwater Valves

    a) Cleancheck

b) Mainline Backflow Products
c) Mifab Manufacturing Co.
d) Sioux Chief
e) Spears

2.02 ABOVE GROUND DRAINAGE AND VENT PIPE AND FITTINGS

A. Pipe and Tube: Refer to Part 3, Article "Pipe Applications – Above Ground, Within Building" for identification of systems where the materials listed below are used.

B. Cast-Iron Soil Pipe: CISPI 301 and ASTM A888, no-hub pipe and fittings and bearing the trademark of CISPI and NSF.

1. Couplings and compression gaskets, NSF certified: ASTM C564 and CISPI 310.
2. Heavy duty couplings and compression gaskets: ASTM C1540 and meeting FM 1680.

C. Copper Tube: ASTM B306, Type DWV, hard drawn for pipe, and cast copper alloy solder joint drainage fittings (DWV) meeting ASME / ANSI B16.23.

1. Solder Filler Materials: ASTM B32, 95-5 tin-antimony solder.

D. Copper Tube: ASTM B88, Type M, hard drawn for pipe and wrought copper fittings with soldered joints.

1. Solder Filler Materials: ASTM B32, 95-5 tin-antimony solder.

E. PVC Pressure Pipe and Fittings: Schedule 40 pipe meeting ASTM D1785 with “solid wall” PVC meeting ASTM D1784 with cell class 12454.

1. Solvent: ASTM D2564.
2. Fittings: Schedule 40 meeting ASTM D2467 with solvent cement socket

F. Shielded Transition Couplings: ASTM C1460 with neoprene adapter gasket with stainless steel Shield and hose clamps.

2.03 UNDERGROUND BUILDING DRAIN AND VENT PIPE AND FITTINGS

A. Pipe and Fittings: Refer to Part 3, Article "Pipe Applications – Below Ground, Within Building" for identification of systems where the materials listed below are used.

B. PVC DWV Pipe and Fittings: Schedule 40 pipe meeting ASTM D1785 and ASTM D2665 with “solid wall” PVC meeting ASTM D1784 with cell class 12454-B.

1. Fittings: DWV pattern meeting ASTM D2665 with solvent cement socket joints.
2. Solvent: ASTM D2564.

C. PVC Pressure Pipe and Fittings: Schedule 40 pipe meeting ASTM D1785 with "solid wall" PVC meeting ASTM D1784 with cell class 12454.

1. Solvent: ASTM D2564.
2. Fittings: Schedule 40 meeting ASTM D2467 with solvent cement socket joints.

D. Underground Shielded Adapter Couplings: ASTM C1173 with neoprene adapter gasket with stainless steel shield and stainless steel hose clamps.

2.04 DRAINAGE PIPING SPECIALTIES

A. Backwater Valves: Valve assembly shall be bronze fitted cast-iron, with bolted cover. Flapper shall provide a maximum 1/4 inch clearance between flapper and seat for air circulation. Valve ends shall suit piping material.

B. Cleanout Plugs: As specified on the drawings.

C. Floor Cleanouts: As specified on the drawings.

D. Wall Cleanouts: As specified on the drawings.

E. Floor Drains: As specified on the drawings.

F. Trap seals: Provide trap seals meeting either description below:

1. Smooth, soft, flexible, elastomeric PVC material molded into shape of duck's bill, open on top with curl closure at bottom. The flow of wastewater allows duck's bill to open and adequately discharge to floor drain through its interior. The duck's bill closes and returns to original molded shape after wastewater discharge is complete. Or, smooth, soft, flexible, elastomeric PVC material with a flapper closure. The flow of wastewater allows flapper to open and adequately discharge to floor drain through its interior. The flapper closes and returns to original molded shape after wastewater discharge is complete.

2.05 NO-HUB FITTING RESTRAINTS

A. Pre-engineered kits of galvanized steel pipe straps with stainless steel band clamps and tee bolts, meeting requirements of the CISPI Installation Handbook.

2.06 INTERCEPTORS

A. Interceptor type designations, flow rates, and capacities are indicated on the drawings.

B. Gravity Grease Interceptor: As shown on the drawings.

PART 3 - EXECUTION

3.01 INSTALLATION, GENERAL

A. Install pipe and specialties in accordance with manufacturer's installation instructions.

3.02 PREPARATION FOUNDATION FOR UNDERGROUND SANITARY BUILDING DRAINS

A. Pipe Beds:

1. PVC Pipe: Support pipe in trench with sand bags level and true to prevent sand, gravel or debris from interfering with the solvent cement process. After pressure testing is complete, gradually install bedding to maintain continuous pipe slope and prevent pipe deflection and then install subbase. Refer to Section "General Plumbing Requirements" for bedding and subbase materials, excavation, trenching, backfill and compaction requirements and refer to ASTM D2321 "Underground Installation of Thermoplastic Pipe for Sewers and Gravity-flow Applications" for additional requirements.

3.03 PIPE APPLICATIONS - ABOVE GROUND, WITHIN BUILDING

A. Install hubless, cast-iron soil pipe and fittings for 15" and smaller soil, waste, and vent pipe.

B. Install Type DWV copper tube with cast copper alloy solder joint drainage fittings (DWV) fittings, copper sweat X screwed with solder joints, for waste connections from urinals, lavatories, sinks, water coolers, and kitchen equipment to cast iron drainage piping.

C. Install Type M copper tube with wrought copper fittings with solder joints, 1" and smaller, with ¾" minimum size and install Type DWV copper tube with cast copper alloy solder joint drainage fittings (DWV) fittings for 1-1/4" and larger for waste connections from kitchen equipment and terminate over floor receptors with air gap.

D. Condensate drain piping and pumped condensate drain piping inside the building: Provide ¾" minimum size or as indicated on the drawings. Slope gravity drainage condensate piping from mechanical equipment at 1/8" per foot minimum slope. Discharge to floor receptor with air gap.

1. Install Type M copper tube with wrought copper fittings with solder joints, 1" and smaller and install Type DWV copper tube with cast copper alloy solder joint drainage fittings (DWV) fittings for 1-1/4" and larger. Provide galvanic isolators as specified in Division 22 "Basic Piping Materials and Methods".

E. Install PVC Type DWV Plastic pipe and fittings for drainage and vent pipe, except install no plastic pipe in return air plenums.

F. Install PVC pressure pipe and fittings for sump pump discharge, except install no plastic pipe in return air plenums.

G. Install 1/2" type L copper tube for trap primer outlet piping.

3.04 PIPE APPLICATIONS - BELOW GROUND, WITHIN BUILDING

A. Install PVC Type DWV Plastic pipe and fittings for drainage and vent pipe for 24" and smaller. Install fabricated fittings for 16 inch and larger.

B. Install PVC pressure pipe and fittings for sump pump discharge.

C. Install 1/2" type K soft copper tube for trap primer outlet piping.

3.05 PIPE AND TUBE JOINT CONSTRUCTION

A. Copper Tubing: Solder joints in accordance with the procedures specified in AWS "Soldering Manual."

B. Cast-Iron Soil Pipe: Make hubless joints in accordance with the Cast-Iron Soil Pipe & Fittings Handbook, Chapter IV. Install Couplings as followings:

1. Install hubless couplings complying with CISPI 310 on soil and waste piping 3" and smaller and all vent piping.
2. Install heavy duty hubless couplings on soil or waste stacks, soil and waste piping connections to soil or waste stacks and all soil and waste piping 4" and larger.
3. Install No-Hub fitting restraints on joints 5" and larger at:

    a) Changes of direction from vertical to horizontal
    b) 4" branch connections, including tees, wyes and wye combination fittings to soil and waste piping 5" and larger
    c) Horizontal changes of direction 22-1/2 degrees and greater
    d) Changes in diameter of two pipe sizes or greater.

C. PVC DWV Pipe: Joining and installation of PVC drainage pipe and fittings shall conform to ASTM D2665.

D. Cast Iron to PVC Above Grade: Join cast iron to PVC with shielded transition couplings.

E. Cast Iron to PVC Below Grade: Join cast iron to PVC with underground shielded adapter couplings.

3.06 INSTALLATION

A. General Locations and Arrangements: Drawings (plans, schematics, and diagrams) indicate the general location and arrangement of the piping systems. Location and arrangement of piping layout take into consideration pipe sizing, slope, expansion, and other design considerations. So far as practical, install piping as indicated.

B. Use fittings for all changes in direction and all branch connections.

C. Install piping at right angles or parallel to building walls. Diagonal runs are not permitted, unless expressly indicated.

D. Install piping free of sags or bends and with ample space between piping to permit proper insulation applications.

E. Conceal all pipe installations in walls, pipe chases, utility spaces, above ceilings, below grade or floors, unless indicated to be exposed to view.

F. Install horizontal piping as high as possible allowing for proper slope and coordination with other components. Install vertical piping tight to columns or walls. Provide space to permit insulation applications, with 1-inch clearance outside the insulation. Allow sufficient space above removable ceiling panels to allow for panel removal.

G. Paint exposed copper drain lines serving kitchen equipment with a minimum of two coats of chromium-based paint.

H. Exterior Wall Penetrations: Seal pipe penetrations through exterior walls using sleeves and sealer. Refer to Division 22 Section " Basic Piping Material and Methods" for special sealers and materials.

I. Underground Exterior Wall Penetrations: Seal pipe penetrations through underground exterior walls using sleeves and mechanical sleeve sealers. Refer to Division 22 Section "Basic Piping Material and Methods" for additional information.

J. Fire Barrier Penetrations: Where pipes pass through fire rated walls, partitions, ceilings and floors, maintain the fire rated integrity. Refer to Division 22 Section " Basic Piping Material and Methods" for special sealers and materials.

K. Foundation Penetrations: Where pipes pass through foundation walls above strip footings or under strip footings, protect pipes from building load with cast iron soil pipe sleeves two pipe sizes larger than the pipe. Sleeves installed under the strip footing shall be encased in concrete.

L. Elevated Floor Penetrations of Waterproof Membrane, Interior Penetrations of Non-Fire Rated Walls and Concrete Slab on Grade Penetrations: Provide sleeves and seal pipes that pass through waterproof floors, non-fire rated walls, partitions

and ceilings or concrete slab on grade. Refer to Division 22 Section "Common Work Results for Plumbing" for special sealers and materials.

M. Make changes in direction for drainage and vent piping using appropriate 45 degree wyes, combination wye and eighth bend, or long sweep, quarter, sixth, eighth, or sixteenth bends. Sanitary tees or quarter bends may be used on vertical stacks of drainage lines where the change in direction of flow is from horizontal to vertical, except use long-turn pattern combination wye and eighth bends where two fixtures are installed back to back and have a common drain. Straight tees, elbows, and crosses may be used on vent lines. Double wyes or double wye combinations shall not be used in the horizontal. No change in direction of flow greater than 90 degrees shall be made. Where different sizes of drainage pipes and fittings are connected, use proper sized standard increasers and reducers. Reduction of the size of drainage piping in the direction of flow is prohibited.

N. Install underground building drains to conform with the plumbing code, and in accordance with the Cast Iron Soil Pipe Institute Engineering Manual. Lay underground building drains beginning at low point of systems, true to grades and alignment indicated with unbroken continuity of invert. Place bell ends of piping facing upstream. Install required gaskets in accordance with manufacturer's recommendations for use of lubricants, cements, and other special installation requirements. Maintain swab or drag in line and pull past each joint as it is completed.

O. Install drainage piping pitched down at a minimum slope of 1/4 inch per foot (2 percent) for piping 3 inch and smaller, and 1/8 inch per foot (1 percent) for piping 4 inch and larger. Install vent piping pitched to drain back by gravity to the sanitary drainage piping system.

P. Install condensate drains pitched down at a minimum slope of 1 to 10 for piping 3 inches and smaller.

Q. Extend building drain to connect to service piping, of size and in location indicated for service entrance to building. Sewer service piping is specified in a separate section of Division 2.

R. Install 1 inch thick extruded polystyrene over underground building drain piping not under building. Width of insulation shall extend minimum of 12" beyond each side of pipe. Install directly over, and center on pipe center line.

3.07 HANGERS AND SUPPORTS

A. General: Hanger, support, insulation protection shields, and anchor components and installation procedures conforming to MSS SP-58 and SP-69 are specified in Division 22 Section "Hangers and Supports for Plumbing Piping". Conform to the table below for maximum spacing of supports.

B. Install the following pipe attachments:

1. Adjustable clevis hangers, MSS SP-69 Type 1, for individual horizontal runs.
2. Riser clamps, MSS SP-69 Type 8, for individual vertical runs.
3. Insulation protection shields and high density insulation at each hanger for insulated pipe as specified in Division 22 Sections "Hangers and Supports for Plumbing Piping" and "Plumbing Insulation".

   a) Install high density insulation on insulated pipe.

4. Provide vinyl coated hangers and riser clamps for use with PVC pipe.

1. Provide roll hangers for individual horizontal runs 100 feet or longer.
2. Provide ceiling flanges attached to the floor, all thread rod and split ring pipe clamps for indirect drains and condensate drains supported from the floor 2" and smaller.

C. Install hangers with maximum horizontal spacing and minimum rod diameters, to comply with MSS-58, locally enforced codes, this specification, and authorities having jurisdiction requirements, whichever are most stringent. Install hangers for horizontal piping with the following maximum spacing and minimum rod diameters:

Nom. Pipe Size – In.	Steel Pipe Max. Span – Ft.	Copper Tube Max. Span – Ft.	Min. Rod Dia. - In.
Up to 1-1/4	12	6	3/8
1-1/2 to 2	12	10	3/8
2-1/2 to 4	12	10	3/8
5	12	10	1/2
6	12	10	1/2
8	12	10	1/2
10 to 12	12	10	5/8
14 to15	12	N/A	3/4

1. Support all sizes of horizontal cast iron piping every five feet, except up to ten feet where ten foot sections are installed. Support all sizes of hubless horizontal cast iron piping every other joint, unless over four feet, then support each joint. Provide support adjacent to joint, not to exceed 18". Provide support at each horizontal branch.
2. Support all sizes of vertical cast iron piping every ten feet.
3. Support all sizes of vertical steel piping every other floor, not to exceed twenty-five feet.
4. Support all sizes of horizontal of PVC piping every four feet.
5. Support all sizes of vertical of PVC piping every floor, but not to exceed ten feet. For sizes 2 inches and smaller, provide guide midway between required vertical supports.
6. Support piping within 12" of each elbow or tee.
7. Support each P-trap.

D. Support condensate piping located on roof with pre-engineered roof supports, pre-engineered roof supports are specified in Division 22 Section "Hangers and Supports for Plumbing Piping". Conform to the table above for maximum spacing of supports. Adjust pipe support to maintain minimum pipe slope.

E. Sway bracing:

1. Provide rigid sway bracing for pipe 4" and larger at changes of direction greater than 45 degrees.

F. Bracing for above floor base of stacks 4" and larger and higher than three stories:

1. Secure horizontal base of stack to structure with riser clamp within at the fitting changing direction of flow from vertical to horizontal. Provide rods of size equal to cast iron pipe size scheduled above in pipe hanger schedule.

3.08 INSTALLATION OF PIPING SPECIALTIES

A. Install backwater valves in sanitary building drain piping as indicated, and as required by the plumbing code. For interior installation, provide cleanout cover flush to floor centered over backwater valve cover and of adequate size to remove valve cover for service.

B. Provide PVC DWV expansion joints every 30' on straight vertical PVC waste or sanitary stacks receiving hot water waste. Install expansion joint at middle travel for equal expansion and contraction travel. Provide riser clamps within 18" of each end of expansion joint. Install expansion joint per manufacturer's installation instructions.

C. Above Ground Cleanouts: Install in above ground piping and building drain piping as indicated, and:

1. as required by plumbing code;
2. at each change in direction of piping greater than 45 degrees;
3. at minimum intervals of 50' for piping 4" and smaller and 100' for larger piping;
4. at base of each vertical soil and waste stack.

D. Cleanout Covers: Install floor and wall cleanout covers for concealed piping, types as indicated.

E. Floor Cleanouts: Install in below floor building drain piping as indicated, and:

1. as required by plumbing code;
2. at each change in direction of piping greater than 45 degrees;
3. Install in below floor building drain piping at minimum intervals of 50' for piping 4" and smaller and 75' for larger piping;
4. Install floor cleanouts in waterproof floors with waterproof membrane securely flashed with cleanout body flashing clamp so that no leakage

occurs between cleanout body and adjoining flooring. Maintain integrity of waterproof membranes, where penetrated.

F. Exterior Cleanouts: Install exterior cleanouts embedded in a 18" x 18" x 8" block of concrete, flush with finished grade.

3.09 INSTALLATION OF FLOOR DRAINS AND FLOOR SINKS

A. Install floor drains and floor sinks in locations indicated.

B. Install floor drains at low points of surface areas to be drained, or as indicated. Set tops of drains flush with finished floor. Set floor sinks and floor troughs flush with the level finish floor.

C. Refer to architectural documents for floor slope requirements and set floor drain elevation to match.

D. Provide P-traps for drains connected to the sanitary sewer.

E. Install floor drains and floor sinks in waterproof floors with waterproof membrane securely flashed with drain flashing clamp so that no leakage occurs between drain and adjoining flooring. Maintain integrity of waterproof membranes, where penetrated.

F. Position drains so that they are level, accessible and easy to maintain.

3.010 INSTALLATION OF TRAP PRIMERS

A. Install trap primer outlet piping with 1/32” per foot slope towards drain trap where possible.

B. Connect trap primer outlet piping only to factory installed taps on the drain body or P-trap assembly or provide an auxiliary inlet fitting with factory installed trap primer tap.

C. Install trap primer outlet piping in elevated slabs or slabs on grade below concrete reinforcing bars. Wrap with 1/2” thick flexible unicellular insulation, attach to the reinforcing bars with plastic ties and spacers every five feet to eliminate galvanic corrosion. Refer to Division 22 Section "Plumbing Insulation” for flexible unicellular insulation.

D. Where proper trap primer outlet piping slope can be maintained and the trap primer outlet line would not be subject to freezing, trap primer outlet lines may be installed as follows:

1. Install below elevated floor slabs.
2. Install in the sub grade of slab on grade.

E. Install sleeves and caulk at penetrations through building floor for watertight installation. In an elevated floor slab installation, bracket the piping to bottom of floor once the slab is poured.

F. Refer to Division 22 Section "Water Distribution Piping and Specialties" for trap primer and trap primer inlet pipe requirements.

3.011 INSTALLATION TRAP SEALS:

A. Install trap seals in accordance with manufacturer's written instructions and in locations indicated.

B. Make watertight seal using an adhesive type caulk along bottom of trap seal, if required by the manufacturer.

C. Employ a test plug for testing and remove before normal floor drain use. Clean inside of drain tailpiece and install trap seal after testing.

D. Do not touch elastomeric plug or allow contact with primer or solvent cement.

3.012 CONNECTIONS

A. Piping Runouts to Fixtures: Provide drainage and vent piping runouts to plumbing fixtures and drains, with approved trap, of sizes indicated; but in no case smaller than required by the plumbing code.

B. Locate piping runouts as close as possible to bottom of floor slab supporting fixtures or drains.

3.013 FIELD QUALITY CONTROL

A. Inspections

1. Do not enclose, cover, or put into operation drainage and vent piping system until it has been inspected and approved by the authority having jurisdiction.
2. During the progress of the installation, notify the plumbing official having jurisdiction, at least 24 hours prior to the time such inspection must be made. Perform tests specified below in the presence of the plumbing official.

    a) Rough-in Inspection: Arrange for inspection of the piping system before concealed or closed-in after system is roughed-in, and prior to setting fixtures.

    b) Final Inspection: Arrange for a final inspection by the plumbing official to observe the tests specified below and to insure compliance with the requirements of the plumbing code.

    c) Reinspections: Whenever the piping system fails to pass the test or inspection, make the required corrections, and arrange for reinspected by the plumbing official.

d) Reports: Prepare inspection reports, signed by the plumbing official.

B. Piping System Test: Test drainage and vent system in accordance with the procedures of the authority having jurisdiction, or in the absence of a published procedure, as follows:

1. Test for leaks and defects all new drainage and vent piping systems and parts of existing systems, which have been altered, extended or repaired. If testing is performed in segments, submit a separate report for each test, complete with a diagram of the portion of the system tested.
2. Leave uncovered and unconcealed all new, altered, extended, or replaced drainage and vent piping until it has been tested and approved. Expose all such work for testing, that has been covered or concealed before it has been tested and approved.
3. Rough Plumbing Test Procedure: Except for outside leaders and perforated or open jointed drain tile, test the piping of plumbing drainage and venting systems upon completion of the rough piping installation. Tightly close all openings in the piping system, and fill with water to the point of overflow, but not less than 10 feet head of water. Water level shall not drop during the period from 15 minutes before the inspection starts, through completion of the inspection. Inspect all joints for leaks.
4. Final Plumbing Test Procedure: After the plumbing fixtures have been set and their traps filled with water, their connections shall be tested and proved gas and water-tight. Tightly close all openings, initially except vents thru the roof, in the system and fill the system with smoke from one or more smoke machines designed for smoke testing of plumbing systems. When smoke appears at a vent thru the roof, seal the vent thru roof with a test plug. Pressurize the system with 1” water column of smoke for 15 minutes. Use a "U" tube or manometer inserted in the trap of a water closet to measure this pressure. Visually verify all joints for leaks.
5. Repair all leaks and defects using new materials and retest system or portion thereof until satisfactory results are obtained.
6. Reports: Prepare inspection reports and required corrective action signed by the plumbing official and turn over to the Architect upon completion of the project.

3.014 ADJUSTING AND CLEANING

A. Clean interior of piping system. Remove dirt and debris as work progresses.

B. Clean drain strainers, domes, and traps. Remove dirt and debris.

3.015 PROTECTION

A. Protect drains during remainder of construction period, to avoid clogging with dirt and debris, and to prevent damage from traffic and construction work.

B. Place plugs in ends of uncompleted piping at end of day or whenever work stops.

C. Exposed PVC Piping: Protect plumbing vents exposed to sunlight with 2 coats of a water based latex paint.

END OF SECTION

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PART 1 - GENERAL REQUIREMENTS

1.01 SUMMARY

A. This Section includes the following types of plumbing pumps:

1. Condensate pumps for HVAC equipment

B. Related Sections: The following sections contain requirements that relate to this Section:

1. Division 22 Section “Coordination” for basic requirements for electrical components that are an integral part of packaged system components.
2. Division 22 Section “Sanitary Drainage and Vent Piping and Specialties” for condensate pipe material and installation requirements.
3. Division 23 Section “Direct-Digital Control for HVAC” for interlock with HVAC equipment and interlock of alarms with building automation system and alarm wiring.
4. Division 26 Section “Common Work Results for Electrical” required electrical devices.
5. Division 26 Sections "Enclosed Switches and Circuit Breakers" for field-installed disconnects.

1.02 SUBMITTALS

A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections.

1. Product data including standard performance curves, weights (shipping, installed, and operating), furnished specialties, and accessories, plus installation and start-up instructions.
2. Wiring diagrams detailing wiring for power, signal, and control systems; differentiating between manufacturer-installed wiring and field-installed wiring.
3. Maintenance data for condensate pumps, for inclusion in Operating and Maintenance Manuals specified in Division 1 and Division 22 Section "General Plumbing Requirements."

1.03 QUALITY ASSURANCE

A. Hydraulic Institute Compliance: Design, manufacture, and install condensate pumps in accordance with "Hydraulic Institute Standards."

B. National Electrical Code Compliance: Components shall comply with NFPA 70 "National Electrical Code."

C. UL Compliance: Plenum rated condensate pumps shall be listed and labeled by UL and comply with Standard 2043 “Fire Test for Heat and Visible Smoke Release for Discrete Products and Their Accessories Installed in Air Handling Spaces”.

D. NEMA Compliance: Electric motors and components shall be listed and labeled NEMA.

E. Single-Source Responsibility: Obtain plumbing pumps of the same type from a single manufacturer.

F. Design Criteria: The Drawings indicate capacity, connections, and power requirements of condensate pumps and are based on the specific manufacturer types and models indicated. Pumps having equal performance characteristics by other manufacturers may be considered, provided that deviations in dimensions and profiles do not change the design concept or intended performance as judged by the Architect. The burden of proof for equality of plumbing pumps is on the proposer.

1.04 WARRANTY

A. Warranty on Pumps: Provide written warranty, signed by manufacturer, agreeing to replace/repair, within warranty period, pumps with inadequate or defective materials and workmanship, including leakage, breakage, improper assembly, or failure to perform as required; provided manufacturer's instructions for handling, installing, protecting, and maintaining units have been adhered to during warranty period. Replacement includes both parts and labor for removal and reinstallation.

1. Warranty Period: One year from date of substantial completion.

PART 2 - PRODUCTS AND MATERIALS

2.01 MANUFACTURERS

A. Products: Subject to compliance with requirements, provide one of the following:

1. Non-Plenum Rated HVAC Condensate Pump:

a) Little Giant
b) Liberty Pumps

2.02 PUMPS, GENERAL

A. Condensate Pumps: Factory assembled and factory tested.

B. Preparation for shipping: Provide suitable packaging to protect pump from damage during shipping.

2.03 CONDENSATE PUMPS FOR HVAC EQUIPMENT

A. General Description: Pumps shall be direct connected, single stage type with body and reservoir of a material suitable for plenum or non-plenum installation as scheduled on plans, normally open safety overflow switch with two dry contacts, integral check valve and power cord with ground.

B. Non-plenum rated: Reservoir and body shall be either ABS or PE plastic.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer's installation instructions.

B. Install pumps in locations and arrange to provide access for periodic maintenance.

C. Support pumps and piping separately so that the weight of the piping system does not rest on the pump.

3.02 EXAMINATION

A. Examine areas, equipment foundations, and conditions with Installer present, for compliance with requirements for installation and other conditions affecting performance of plumbing pumps. Do not proceed with installation until unsatisfactory conditions have been corrected.

B. Examine rough-in for plumbing piping systems to verify actual locations of piping connections prior to installation.

3.03 CONNECTIONS

A. Piping between the HVAC unit and the pump shall be the greater of the discharge port size on the HVAC equipment or 3/4" pipe size or as shown on plans, whichever is larger. Discharge piping from the condensate pump shall be equal to or greater than the diameter of the pump nozzle, minimum 3/4", or as shown plans, whichever is larger. Condensate pump discharge pipe material is specified in Division 22 Section "Sanitary Drainage and Vent Piping and Specialties".

B. Electrical wiring and connections are specified in Division 26 section "Common Work Results for Electrical".

C. Coordinate interlock of condensate pump safety overflow switch with unit served to disable unit if safety overflow switch closes as noted on plans and schedules. HVAC interlock wiring and alarm interlock with the building automation system are specified in Division 23 Section "Direct-Digital Control for HVAC".

D. Coordinate interlock of condensate pump failure alarm with Building Automation System. HVAC interlock wiring and alarm interlock with the building automation system are specified in Division 23 Section “Direct-Digital Control for HVAC”.

3.04 STARTUP

A. Final Checks Before Start-Up: Perform the following preventative maintenance operations and checks before start-up:

1. Ensure pump is connected to the condensate discharge system.
2. Verify all power wiring is in place and power is provided to pump.

B. Testing procedure for condensate pumps:

1. Pour water into the pump reservoir until the water sensing switch is activated.
2. Verify water is pumped out of the reservoir and that there are no leaks in the condensate piping or at the connection point to the pump.
3. Verify integral check valve is operating properly, replace with new if found to be defective.

END OF SECTION

SECTION 221329

SANITARY SEWERAGE PUMPS

PART 1 - GENERAL REQUIREMENTS

1.01 SUMMARY

A. This Section includes the following types of plumbing pumps:

1. Sewage ejectors

B. Related Sections: The following sections contain requirements that relate to this Section:

1. Division 3 Section "Concrete Work" for specifications on concrete and reinforcing materials and concrete placing requirements for sump basins and covers.
2. Division 22 Section “Coordination” for basic requirements for electrical components that are an integral part of packaged system components.
3. Division 22 Section "Basic Piping Material and Methods," for materials and methods for mechanical sleeve seals.
4. Division 22 Section “Sanitary Drainage and Vent Piping and Specialties” for sewage ejector discharge pipe material and installation requirements.
5. Division 23 Section “Direct-Digital Control for HVAC” for interlock of alarms with building automation system and alarm wiring.
6. Division 26 Section “Common Work Results for Electrical” required electrical devices.
7. Division 26 Sections "Enclosed Switches and Circuit Breakers" for field-installed disconnects.

1.02 SUBMITTALS

A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections.

1. Product data including standard performance curves, weights (shipping, installed, and operating), furnished specialties, and accessories, plus installation and start-up instructions.
2. Shop drawings showing layout and connections for plumbing pumps. Include setting drawings with templates, and directions for installation of foundation bolts, anchor bolts, and other anchorages.
3. Wiring diagrams detailing wiring for power, signal, and control systems; differentiating between manufacturer-installed wiring and field-installed wiring.
4. Maintenance data for plumbing pumps, for inclusion in Operating and Maintenance Manuals specified in Division 1 and Division 22 Section "General Plumbing Requirements."

5. Shop drawings showing basins with depth, inlet, outlet and vent locations, pit covers, float switches, non-clog check valves and shutoff valves.

1.03 QUALITY ASSURANCE

A. Hydraulic Institute Compliance: Design, manufacture, and install plumbing pumps in accordance with "Hydraulic Institute Standards."

B. National Electrical Code Compliance: Components shall comply with NFPA 70 "National Electrical Code."

C. UL Compliance: Control panels shall be listed and labeled by UL and comply with Standard 508A “Control Panels”.

D. NEMA Compliance: Electric motors and components shall be listed and labeled NEMA.

E. SSPMA Compliance: Test and rate sewage pumps in accordance with the Sump and Sewage Pump Manufacturers Association (SSPMA) Standards.

F. Single-Source Responsibility: Obtain plumbing pumps of the same type from a single manufacturer.

G. Manufacturers Standardization Society of the Valve and Fittings Industry (MSS) Compliance: Comply with the MSS Standard Practices below:

1. MSS SP 72 “Ball Valves with Flanged or Butt Welding Ends”
2. MSS SP 110 “Ball Valves, Threaded, Socket Welding, Solder Joint, Grooved and Flared Ends”

H. Valves shall be manufactured in plants located in the United States or certified that they comply with applicable ANSI, ASTM and MSS standards.

I. Design Criteria: The Drawings indicate sizes, profiles, connections, and dimensional requirements of plumbing pumps and are based on the specific manufacturer types and models indicated. Pumps having equal performance characteristics by other manufacturers may be considered, provided that deviations in dimensions and profiles do not change the design concept or intended performance as judged by the Architect. The burden of proof for equality of plumbing pumps is on the proposer.

1.04 SPARE PARTS

A. Furnish spare parts described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Mechanical Seals: One mechanical seal for each pump.

1.05 WARRANTY

A. Warranty on Pumps: Provide written warranty, signed by manufacturer, agreeing to replace/repair, within warranty period, pumps with inadequate or defective materials and workmanship, including leakage, breakage, improper assembly, or failure to perform as required; provided manufacturer's instructions for handling, installing, protecting, and maintaining units have been adhered to during warranty period. Replacement includes both parts and labor for removal and reinstallation.

1. Warranty Period: One year from date of substantial completion.

PART 2 - PRODUCTS AND MATERIALS

2.01 MANUFACTURERS

A. Products: Subject to compliance with requirements, provide one of the following:

1. Sewage Pump High Level Alarms:

   a) Weil Pump Company
   b) Zoeller Pump Company
   c) SJE Rhombus

2. Submersible Sewage Ejectors:

   a) ABS Pump, Inc.
   b) FLYGT
   c) Weil Pump Company

3. Full Port Bronze Ball Valves – 2" and smaller:

MANUFACTURER	THREADED ENDS	SOLDER ENDS
Apollo	77C-100	77C-200
Hammond	8301A	8311A
Milwaukee	BA-400	BA-450
Nibco	T-585-70	S-585-70

4. Non-Clog "Flapper Type" Check Valves:

   a) Liberty Pumps "Series CVXXXC"
   b) Little Giant Pump Company "Series CV-SE"
   c) Zoeller Pump Company "Series 30"

5. Cast Iron "Sinking Ball Type" Non-Clog Check Valves - 2" and smaller:

   a) Flomatic"208".
   b) FLYGT "2002"
   c) GW Industries, Inc. "240T"

6. Basin Covers:

   a) Bilco
   b) U.S.F. Fabrication

7. Epoxy Basin Liner:

a) TNEMEC "PERMA-SHIELD H_2S" #Series 434 TNEMEC Liner or as specified by the Architect

2.02 PUMPS, GENERAL

A. Pumps: factory assembled and factory tested.

B. Preparation for shipping: After assembly and testing, clean flanges and exposed machined metal surfaces and treat with an anticorrosion compound. Protect flanges, pipe openings, and nozzles with wooden flange covers or with screwed-in plugs.

C. Motors: Conform to NEMA standards; single, multiple, or variable speed with type of enclosure and electrical characteristics as indicated; have built-in thermal-overload protection and grease-lubricated ball bearings. Select motors that are non-overloading within the full range of the pump performance curve.

D. Apply factory finish paint to assembled, tested units prior to shipping.

2.03 SIMPLEX SEWAGE PUMPS – ¾ HP AND SMALLER

A. General Description: Pumps shall be simplex centrifugal, direct connected, floor mounted, single stage type with cast iron body, stainless steel shaft, cast iron impeller, mechanical seal, permanently lubricated upper and lower ball bearings complete with integral inlet strainer, mechanical float switch, and power cord with ground.

B. Casing: Cast iron with integral cast-iron inlet strainer and legs to elevate the pump to permit flow into the impeller. Pump casing, volute and impeller shall pass a 2" diameter sphere. Vertical discharge with screwed female connection.

C. Impeller: Statically and dynamically balanced, open or semiopen, overhung, single suction, fabricated from cast iron, keyed to shaft and secured by a locking capscrew.

D. Pump and Motor Shaft: Stainless steel, with factory-sealed, upper and lower grease-lubricated ball bearings.

E. Seals: Single mechanical seal with carbon steel rotating ring, stainless-steel spring, ceramic seat, and Buna-N bellows and gasket.

F. Motor: NEMA 6 with class F insulation, hermetically sealed, 1750 RPM, capacitor start, air filled with built-in overload protection, with 3-conductor, waterproof cable and grounding plug.

G. Basin: Cast in place concrete or pre-cast concrete, refer to structural drawings.

1. Coat basin with two part epoxy basin liner.

H. Cover: Epoxy coated steel or aluminum gasketed round cover with holes for discharge piping, vent and conduits. Access cover shall be completely flush for all for discharge piping, vent and conduits entering or exiting the sump pit under the slab as indicated on the drawings.] [Provide integral or separate cover for valves.] [Provide cover rated for AASHTO H-20 loading.

I. Controls: NEMA 1, tethered float switch for "on-off" control with "piggy back" power cord connection for sump pump power cord.

2.04 SEWAGE PUMP HIGH LEVEL ALARMS

A. Alarm: Remote type 120V single phase with NEMA 4X enclosure, terminal block, 5 amp isolated alarm contact, alarm horn, alarm light, test-automatic-silence switch and mechanical float switch.

2.05 SEWAGE EJECTORS

A. General Description: Pumps shall be duplex centrifugal, direct connected, floor mounted, single stage grinder type with cast iron body, stainless steel shaft, cast iron impeller, mechanical seal, permanently lubricated upper and lower ball bearings complete, control panel, mechanical float switch, and power cords with grounds.

B. Casing: Cast iron with integral cast-iron legs to elevate the pump to permit flow into the impeller. Pump casing, volute and impeller shall pass a 2" diameter sphere. Horizontal discharge companion flange and rail retrieval system.

C. Rail Retrieval System: Provide with cast iron floor elbow, gasket, anchor bolts, yoke, pipe guides, stainless steel rope, and upper guide bracket.

D. Impeller: Statically and dynamically balanced, open or semiopen, overhung, single suction, fabricated from cast iron, keyed to shaft and secured by a locking capscrew.

E. Impeller: Statically and dynamically balanced enclosed, overhung, single suction, fabricated from bronze, keyed to shaft and secured by a locking capscrew. Grinder shall be a 440c stainless steel rotating cutter attached to the motor shaft with stationary shredder ring attached to the pump inlet.

F. Pump and Motor Shaft: Stainless steel, with factory-sealed, upper and lower grease-lubricated ball bearings.

G. Seals: Single mechanical seal with carbon steel rotating ring, stainless-steel spring, ceramic seat, and Buna-N bellows and gasket.

H. Seals: Tandem mechanical seals mounted in cast iron body seal chamber with upper seal of carbon rotating ring, stainless-steel spring, ceramic seat, and Buna-N bellows and gasket and lower seal of silicon carbide rotating ring, stainless-steel spring, silicon carbide seat, and Buna-N bellows and gasket.

I. Motor: Hermetically sealed, with built-in overload protection, air filled, 1750 RPM, NEMA class B insulation capable of a maximum continuous operating temperature of 120F, 3-conductor and waterproof cable.

J. Basin: Fiberglass reinforced plastic, PVC plastic is not acceptable, with a minimum wall thickness of 3/16", 2" wide retainer ring at the basin bottom and every four feet and factory pipe penetration connection kits. Refer to the drawings for basin dimensions.

K. Basin: Cast in place concrete or pre-cast concrete, refer to structural drawings.

1. Coat basin with two part epoxy basin liner.

L. Cover: Epoxy coated steel or aluminum gasketed round cover with holes for discharge piping, vent and conduits. Access cover shall be completely flush for all for discharge piping, vent and conduits entering or exiting the sump pit under the slab as indicated on the drawings.] [Provide integral or separate cover for valves.] [Provide cover rated for AASHTO H-20 loading.

M. Controls: NEMA 4X fiberglass dead front door enclosure, complete with lockable combination circuit breaker magnetic motor starter and 3 leg overload protection for each motor; internal test-off-automatic selector switches, overload relays and indicator lights, resets, 120V control circuit transformer fused on primary and secondary, automatic alternator for alternating lead-lag pump selection and to provide for both pumps to operate simultaneously under high level condition, hour meter for each pump, high level alarm horn and light with test-off-automatic switch, moisture sensor alarm light for each pump, auxiliary alarm contacts for each alarm condition and terminal board for connection of lines, pumps, and level sensors. Circuit breakers shall have minimum AIC rating as indicated on the Electrical Drawings. Control panel shall have a unit short circuit current rating equal to or greater than the available short circuit current as indicated on the electrical drawings. [Controls shall be configured for terminating one incoming power feeder. Refer to control drawings for interlock of alarm contacts with the building automation system.

N. VFD Controls: NEMA 4 enclosure with dead front door with lockable through door disconnect, programmable logic controller (PLC), lockable combination circuit breaker magnetic motor starter and 3 leg overload protection with reset for each motor, internal test-off-automatic pump run switches, 120V control circuit transformer fused on primary and secondary, terminal board for connection of pumps and level sensors and lightening arrestor. Provide with power "on" indicator light, overload relays, high level alarm relay, light and horn, second pump running alarm relay, failsafe relay, PLC Failure alarm relay, moisture sensor alarm for each pump, temperature limiter circuit alarm for each pump, auxiliary alarm contacts for each alarm condition. Provide with level transmitter with base and (3) redundant float switches. Circuit breakers shall have minimum AIC rating as indicated on the Electrical Drawings. Control panel shall have a unit short circuit current rating equal to or greater than the available short circuit current as indicated on the

electrical drawings. Controls shall be configured for terminating one incoming power feeder. Refer to control drawings for interlock of alarm contacts with the building automation system.

1. Touchscreen operator interface for monitoring and adjustment of the programmable controller variables with virtual on-off-automatic selector switch for each pump, high level alarm, pump running indicators, thermal overload indicator for each pump, moisture indicator for each pump and virtual hour meter for each pump. Second pump running alarm. PLC shall alternate lead-lag pump selection and to provide for two pumps to operate simultaneously under high level condition with third pump as standby. PLC shall alternate standby pump as "first "on" pump" after end of each pumping cycle.
2. Programmable Logic Controller (PLC): Designed specifically for the control of pumps with variable speed drives capable of receiving two analog pressure inputs, analog flow input, automatic pump alternating and On-line field modified data entries for staging pumps, with software memory stored in non-volatile EPROM memory, furnish with user interface keypad with LED display.
3. Variable Speed Drive: The variable speed drives (VFD) shall be adjustable frequency which employ a pulse width modulated inverter. The drive shall include built in diagnostics. Diagnostics shall be annunciated through the alpha numeric keypad. The drive shall be listed UL, ETL and/or CSA. To ensure safety of the equipment, the VFD shall include these protective features and options:

a) NEMA 1 enclosure.
b) Static instantaneous over-current and over-voltage trip.
c) Static over-speed (over-frequency) protection.
d) Line or fuse loss and under-voltage protection.
e) Power unit over-temperature protection.
f) Motor inverse time overload protection.
g) Input fused disconnect or circuit breaker.
h) Total voltage harmonic distortion from the VFD shall be less than 5% to meet IEEE requirements.
i) Speed meter.
j) Automatic restart after power failure or minor drive fault. The drive shall attempt a minimum of two restarts before a complete drive shut-down.
k) Power on light.
l) Manual speed potentiometer or control capability through the keypad.
m) Hand/Off/Automatic Switch or Manual/Automatic Switch with start/stop pushbutton.
n) Test switch
o) VFD fault light and reset.
p) Output to the PLC and integral LED display
q) The VFD shall be microprocessor based and utilize digital input for all parameter adjustments. The VFD shall include a digital display for monitoring system

parameters and for first fault indication, and digital input programming capability on the main logic board.

r) The VFD shall operate on a frequency range of 1 to 66 Hz with resolution of 0.1% of base speed with analog input or 0.025% with digital input and have accuracy within 0.05% of set point. VFD shall operate in environment of 0 to 40 degrees C, 3,300 feet altitude and 95% non-condensing humidity without derating.

s) All control circuit voltages shall be physically and electrically isolated from power circuit voltages.

4. All VFD's shall be tested/run in the equivalent of NEMA 1 enclosure and burned in at rated ambient (40° C) with a fully loaded motor.

5. Sequence of operation:

a) Minimum run speed is 48Hz or 1400 rpm

b) The sewage ejector shall be in automatic mode.

c) When the water level rises from the level of pumps "off" to the level of first pump "on", the PLC shall start the lead pump. The PLC shall modulate the pump speed to maintain the water level in the pit at the level of first pump "on".

d) If water level rises to the water level of second pump "on", the PLC shall start the lag pump with a minimum run speed of 1400 rpm and the first pump will run with a minimum run speed of 1400 rpm. The PLC shall modulate the pumps speed to maintain the water at the level of second pump "on". When water level drops to the level of first pump "on", the PLC shall stop the lead pump.

e) When the PLC runs the pump at 48Hz or 1400 rpm and the water level drops to the level of pump "off", the PLC shall stop the pump. The lag pump shall start for the next control sequence. If a pump runs continuously for 24 hours, the PLC shall stop the lead pump and start the lag pump.

6. Safeties:

a) High Level Alarm

1) When the water level rises to the level of "high level alarm" an audible alarm shall sound and an alarm signal shall be sent to the BMS or local building alarm system.

b) Second Pump Running Alarm

1) When the water level rises to the level of second pump "on", an alarm signal shall be sent to the BMS or local building alarm system.

c) Moisture Sensor Alarm

1) When the moisture sensor in each pump senses moisture, an alarm "light" shall appear in the touch screen and an alarm

signal shall be sent to the BMS or local building alarm system.

d) High Temperature Sensor Alarm

1) When the temperature sensor in each pump senses moisture, an alarm "light" shall appear in the touch screen and an alarm signal shall be sent to the BMS or local building alarm system.

e) Level Transmitter Failure and Alarm

1) If the level transmitter fails to send control signal to the PLC, the PLC shall shift control of the pumps via the failsafe relay to use the float switches to control the pumps at full speed. When water level rises to the water level of first pump "on", lead pump shall start. When water level drops to the level of pumps "off" the lead pump shall stop. The lag pump shall start for the next control sequence

2) When the level transmitter fails to send control signal to the PLC, an alarm "light" shall appear in the touch screen and an alarm signal shall be sent to the BMS or local building alarm system.

f) PLC Failure and Alarm

1) If the PLC has loss of power or logic failure, the failsafe relay shall use the float switches to control the pumps at full speed. When water level rises to the water level of first pump "on", lead pump shall start. When water level drops to the level of pumps "off" the lead pump shall stop. The lag pump shall start for the next control sequence

2) The failsafe relay shall send a "PLC Failure Alarm" alarm signal to the BMS or local building alarm system.

O. Level Controls: Pole mounted tethered float switches with chord grips, pole mounting plate and cover. Float switches shall be 120V 3 amp single pole normally open that closes on the rise for pump "off", first pump "on" second pump "on" and high level alarm.

P. Junction Box: NEMA 6P enclose of fiberglass reinforced polyester with fully gasketed cover, terminal strip and inlets and outlets for four control and two power connections.

Q. Remote Alarm Panel: NEMA 1 enclosure with individual 115v power source, alarm lights for high water alarm, standby pump running and control power failure with alarm buzzer with silencing switch and auxiliary alarm contacts for each alarm condition. Refer to control drawings for interlock of alarm contacts with the building automation system.

R. Disconnect: Disconnect is provided under Division 26 Section “Enclosed Switches and Circuit Breakers”.

2.06 BALL VALVES

A. Ball Valves, 2 Inch and Smaller: Meeting MSS SP 110, Class 150, 600-psi CWP; two-piece construction; with ASTM B 584 cast bronze, full port, blowout-proof stem and chrome-plated brass ball, with replaceable "Teflon" or "TFE" seats and seals, solder or threaded ends and vinyl-covered steel handle.

B. Cast Iron Body Ball Valves, 2-1/2” and larger: Meeting MSS SP 72, 200-psi CWP, maximum operating temperature of 140F; two piece cast iron body meeting ASTM A126 Class B with flanged ends, 304 stainless steel full port ball and shaft, ductile iron handle, PTFE gasket, stem seal and seat.

2.07 CHECK VALVES

A. Non Clog “Flapper Type” Check Valves, 2 Inch and Smaller: Flapper type with PVC body compression end fittings with Buna-N “O” ring and Buna-N flapper with PVC shields.

B. Non Clog “Sinking Ball Type” Check Valves: Sinking ball type with cast iron body, steel ball with hollow core and Buna-N coating. Valve body shall be configured for unobstructed flow. Valves 2” and smaller with screwed ends and valves 2-1/2” and larger with flanged ends.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer’s installation instructions.

B. General: Comply with the manufacturer's written installation and alignment instructions.

C. Install pumps in locations and arrange to provide access for periodic maintenance, including removal of motors, impellers, couplings, and accessories.

D. Support pumps and piping separately so that the weight of the piping system does not rest on the pump.

3.02 EXAMINATION

A. Examine areas, equipment foundations, and conditions with Installer present, for compliance with requirements for installation and other conditions affecting performance of plumbing pumps. Do not proceed with installation until unsatisfactory conditions have been corrected.

B. Examine rough-in for plumbing piping systems to verify actual locations of piping connections prior to installation.

3.03 CONNECTIONS

A. General: Install valves that are same size as the piping connecting the pump.

B. Install discharge pipe sizes equal to or greater than the diameter of the pump nozzles. Sewage ejector discharge pipe material is specified in Division 22 Section "Sanitary Drainage and Vent Piping and Specialties".

C. Install a non-clog check valve in an accessible location or where indicated on the drawings. Install a full port ball valve on the discharge side of sewage ejectors downstream of the check valve.

D. Electrical wiring and connections are specified in Division 26 Section "Common Work Results for Electrical".

E. Install sewage ejector inlets or outlets to sump basins in the field at the required elevation. Seal penetrations with mechanical link seals. Mechanical link seals are specified in Division 22 Section "Basic Piping Material and Methods." See drawings for inlet and outlet elevations.

F. Coordinate interlock of sewage pump high level, two moisture sensor, two high temperature shutdown, and two overload alarms with building automation system. Alarm wiring and alarm interlock with the building automation system are specified in Division 23 Section "Direct-Digital Control for HVAC".

G. Coordinate interlock of sewage pump high level, two moisture sensor, two high temperature shutdown, two overload alarms, second pump running alarm, PLC failure alarm and level transmitter failure alarm with building automation system. Alarm wiring and alarm interlock with the building automation system are specified in Division 23 Section "Direct-Digital Control for HVAC".

3.04 FIELD QUALITY CONTROL

A. Pressure Testing: Perform a pressure test on the discharge assembly. The test pressure shall be twice that of the shut off head of the pump.

B. Valve Testing: After piping systems have been tested and put into service, but before final adjusting and balancing, inspect valves for leaks. Adjust or replace packing to stop leaks; replace valves if leak persists.

3.05 STARTUP

A. Final Checks Before Start-Up: Perform the following preventative maintenance operations and checks before start-up:

1. Lubricate oil-lubricated bearings.

2. Remove grease-lubricated bearing covers and flush the bearings with kerosene and thoroughly clean. Fill with new lubricant in accordance with the manufacturer's recommendations.
3. Disconnect coupling and check motor for proper rotation. Rotation shall match direction of rotation marked on pump casing.
4. Check that pump is free to rotate by hand. For pumps handling hot liquids, pump shall be free to rotate with the pump hot and cold. If the pump is bound or even drags slightly, do not operate the pump until the cause of the trouble is determined and corrected.

B. Starting procedure for pumps with shutoff power not exceeding the safe motor power:

1. Prime the pump, opening the suction valve, closing the drains, and prepare the pump for operation.
2. Start motor.
3. Open the discharge valve slowly.
4. Observe the leakage from the stuffing boxes and adjust the sealing liquid valve for proper flow to ensure the lubrication of the packing. Do not tighten the gland immediately, but let the packing run in before reducing the leakage through the stuffing boxes.
5. Check the general mechanical operation of the pump and motor.

C. If the pump is to be started against a closed check valve with the discharge shut-off valve open, the steps are the same except that the discharge shut-off valve is opened some time before the motor is started.

END OF SECTION

PART 1 - GENERAL REQUIREMENTS

1.01 SUMMARY

A. This Section includes building storm drainage piping systems, including drains and drainage specialties.

B. Related Sections: The following sections contain requirements that relate to this Section:

1. Division 22 Section "General Plumbing Requirements," for trenching and backfilling materials and methods for underground piping installations.
2. Division 33 Section "Storm Systems," for storm drainage piping beginning from 5'-0" outside the building.
3. Division 33 Section "Foundation Drainage," for foundation drainage piping.
4. Division 7 Section "Joint Sealers," for materials and methods for sealing pipe penetrations through basement and foundation walls, and fire and smoke barriers.
5. Division 22 Section "Identification for Plumbing Piping and Equipment," for labeling and identification of drainage piping.
6. Division 22 Section "Common Work Results for Plumbing," for materials and methods for fire barrier penetrations, wall and floor penetrations and equipment pads
7. Division 22 Section "Basic Piping Material and Methods," for materials and methods for mechanical sleeve seals.
8. Division 22 Section "Hangers and Supports for Plumbing Piping," for materials and methods for hanging and supporting drainage piping.
9. Division 22 Section "Plumbing Insulation," for materials and methods for insulating drainage piping.

1.02 DEFINITIONS

A. Storm Building Drain: That part of the lowest piping of a drainage system which receives the discharge from storm drainage pipes inside the walls of the building and conveys it to the building sewer.

B. Storm Building Sewer: That part of the drainage system which extends from the end of the building drain and conveys its discharge to a public sewer or private sewer or other point of disposal.

C. Drainage System: Includes all the piping within a public or private premises which conveys storm water or other liquid wastes to a point of disposal. It does not include the mains of public sewer systems or a private or public sewage treatment or disposal plant.

1.03 SUBMITTALS

A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specifications Sections.

B. Product data for the following products:

1. Drainage piping
2. Drainage piping specialties
3. Area drains
4. Roof drains
5. Hubless fitting restraints
6. Interceptors

C. Test reports specified in Part 3 of this Section.

1.04 QUALITY ASSURANCE

A. Regulatory Requirements: Comply with the provisions of the following codes:

1. 2018 Arkansas Building Code

PART 2 - PRODUCTS AND MATERIALS

2.01 MANUFACTURERS

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

1. Drainage Piping Specialties, including backwater valves, cleanouts, area/roof drains, and downspout nozzles:

a) Josam Mfg. Co.
b) Sioux Chief Manufacturing Co. Inc.
c) Smith (Jay R) Mfg. Co.
d) Tyler Pipe/Wade Div.; Subs. of Tyler Corp.
e) Watts Industries, Inc.
f) Zurn Industries, Inc.; Hydromechanics Div.

2. Heavy Duty Hubless Couplings

a) Anaco Husky HD-2000
b) Clamp-All 80in. lb.
c) Ideal Tridon “HD”
d) Mission Rubber Company “Heavyweight”
e) ProFlo “HD”

3. Downspout Boots

a) Construction Castings Company
b) Flockart

c) Higgins Foundry
d) Neenah Foundry Company

4. Cast Iron Soil Pipe and Fittings

a) AB & I Foundry
b) Charlotte Pipe and Foundry Company
c) Tyler Pipe / Soil Pipe Division

5. Shielded Transition Couplings

a) FERNCO, "Proflex 3000 Series"
b) Mission Rubber Company, "Band Seal Specialty Couplings"

6. Underground Shielded Adapter Couplings

a) FERNCO, "1056 Series with SR73 Shear Ring"
b) Mission Rubber Company, "MR56 Series"

7. Hubless Fitting Restraints

a) Holdrite

8. Plastic Gravity Sand/Oil Separators

a) Green Turtle, Inc.
b) Mifab Manufacturing, Inc.
c) Striem
d) Xerxes Corp.

9. Backwater Valves

a) Cleancheck
b) Mainline Backflow Products
c) Sioux Chief
d) Spears

10. Heavy Duty Hubless Couplings for Below Slab

a) Anaco Husky HD-4000
b) Clamp-All 125in. lb.

2.02 ABOVE GROUND DRAINAGE PIPE AND FITTINGS

A. Cast-Iron Soil Pipe: CISPI 301 and ASTM A888, hubless pipe and fittings, and bearing the trademark of CISPI and NSF.

1. Heavy duty couplings and compression gaskets: ASTM C564, ASTM C1540 and meeting FM 1680.

B. PVC DWV Pipe and Fittings: Schedule 40 pipe meeting ASTM D1785 and ASTM D2665 with "solid wall" PVC meeting ASTM D1784 with cell class 12454-B.

1. Fittings: DWV pattern meeting ASTM D2665 with solvent cement socket joints. Fittings 16" and larger shall be fabricated type.
2. Solvent: ASTM D2564.

C. Shielded Transition Couplings: ASTM C1460 with neoprene adapter gasket with stainless steel Shield and hose clamps.

2.03 UNDERGROUND BUILDING DRAIN PIPE AND FITTINGS

A. PVC DWV Pipe and Fittings: Schedule 40 pipe meeting ASTM D1785 and ASTM D2665 with "solid wall" PVC meeting ASTM D1784 with cell class 12454-B.

1. Fittings: DWV pattern meeting ASTM D2665 with solvent cement socket joints.
2. Solvent: ASTM D2564.

B. Underground Shielded Adapter Couplings: ASTM C1173 with neoprene adapter gasket with stainless steel shield and stainless steel hose clamps.

2.04 DRAINAGE PIPING SPECIALTIES

A. Backwater Valves: Valve assembly shall be bronze fitted cast-iron, with bolted cover. Flapper shall provide a maximum 1/4 inch clearance between flapper and seat for air circulation. Valve ends shall suit piping material.

B. Cleanout Plugs: As specified on the drawings.

C. Floor Cleanouts: As specified on the drawings.

D. Wall Cleanouts: As specified on the drawings.

E. Area drains: As specified on the drawings.

F. Roof Drains: As specified on the drawings.

2.05 HUBLESS FITTING RESTRAINTS

A. Pre-engineered kits of galvanized steel pipe straps with stainless steel band clamps and tee bolts, meeting requirements of the CISPI Installation Handbook.

2.06 SAND/OIL INTERCEPTORS

A. Interceptor type designations, flow rates, and capacities are indicated on the Drawings.

B. Sand/Oil Interceptor: As scheduled on the drawings

PART 3 - EXECUTION

3.01 INSTALLATION, GENERAL

A. Install pipe and specialties in accordance with manufacturer's installation instructions.

3.02 PREPARATION FOUNDATION FOR UNDERGROUND BUILDING DRAINS

A. Pipe Beds:

1. PVC Pipe: Support pipe in trench with sand bags level and true to prevent sand, gravel or debris from interfering with the solvent cement process. After pressure testing is complete, gradually install bedding to maintain continuous pipe slope and prevent pipe deflection and then install subbase. Refer to Section "General Plumbing Requirements" for bedding and subbase materials, excavation, trenching, backfill and compaction requirements and refer to ASTM D2321 "Underground Installation of Thermoplastic Pipe for Sewers and Gravity-flow Applications" for additional requirements.

3.03 PIPE APPLICATIONS - ABOVE GROUND, WITHIN BUILDING

A. Install hubless, cast-iron soil pipe and fittings 15" and smaller for storm pipe.

B. Install Type DWV copper tube with cast bronze Type DWV fittings 15" and smaller for storm pipe where indicated on the drawings.

C. As a contractor's option with Owner approval, Install PVC Type DWV Plastic pipe and fittings for 12 inch and smaller storm pipe.

3.04 PIPE APPLICATIONS - BELOW GROUND, WITHIN BUILDING

A. Install PVC Type DWV Plastic pipe and fittings for 24 inch and smaller storm pipe.

3.05 PIPE AND TUBE JOINT CONSTRUCTION

A. Cast-Iron Soil Pipe: Make hubless joints in accordance with the Cast-Iron Soil Pipe & Fittings Handbook, Chapter IV. Install Couplings as followings:

1. Install heavy duty hubless couplings on storm drainage piping, including connections to roof drains.
2. Install Hubless fitting restraints on joints 5" and larger at:

a) Changes of direction from vertical to horizontal
b) 4" branch connections, including tees, wyes and wye combination fittings to storm drainage piping 5" and larger
c) Horizontal changes of direction 22-1/2 degrees and greater

B. PVC DWV Pipe: Joining and installation of PVC drainage pipe and fittings shall conform to ASTM D2665.

C. Cast Iron to PVC Above Grade: Join cast iron to PVC with shielded transition couplings.

D. Cast Iron to PVC Below Grade: Join cast iron to PVC with underground shielded adapter couplings.

3.06 INSTALLATION

A. General Locations and Arrangements: Drawings (plans, schematics, and diagrams) indicate the general location and arrangement of the piping systems. Location and arrangement of piping layout take into consideration pipe sizing, slope, expansion, and other design considerations. So far as practical, install piping as indicated.

B. Use fittings for all changes in direction and all branch connections.

C. Install piping at right angles or parallel to building walls. Diagonal runs are not permitted, unless expressly indicated.

D. Install piping free of sags or bends and with ample space between piping to permit proper insulation applications.

E. Conceal all pipe installations in walls, pipe chases, utility spaces, above ceilings, below grade or floors, unless indicated to be exposed to view.

F. Install horizontal piping as high as possible allowing for proper slope and coordination with other components. Install vertical piping tight to columns or walls. Provide space to permit insulation applications, with 1-inch clearance outside the insulation. Allow sufficient space above removable ceiling panels to allow for panel removal.

G. Exterior Wall Penetrations: Seal pipe penetrations through exterior walls using sleeves and sealer. Refer to Division 22 Section "Basic Piping Materials and Methods" for special sealers and materials.

H. Underground Exterior Wall Penetrations: Seal pipe penetrations through underground exterior walls using sleeves and mechanical sleeve sealers. Refer to Division 22 Section "Basic Piping Material and Methods" for additional information.

I. Fire Barrier Penetrations: Where pipes pass through fire rated walls, partitions, ceilings and floors, maintain the fire rated integrity. Refer to Division 22 Section "Common Work Results for Plumbing" for special sealers and materials.

J. Elevated Floor Penetrations of Waterproof Membrane, Interior Penetrations of Non-Fire Rated Walls and Concrete Slab on Grade Penetrations: Provide sleeves and seal pipes that pass through waterproof floors, non-fire rated walls, partitions and ceilings or concrete slab on grade. Refer to Division 22 Section "Common Work Results for Plumbing" for special sealers and materials.

K. Foundation Penetrations: Where pipes pass through foundation walls above strip footings or under strip footings, protect pipes from building load with cast iron soil pipe sleeves two pipe sizes larger than the pipe. Sleeves installed under the strip footing shall be encased in concrete.

L. Make changes in direction for drainage piping using appropriate 45 degree wyes, combination wye and eighth bend, or long sweep, quarter, sixth, eighth, or sixteenth bends. Sanitary tees or quarter bends may be used on vertical stacks of drainage lines where the change in direction of flow is from horizontal to vertical, except use long-turn pattern combination wye and eighth bends where two fixtures are installed back to back and have a common drain. No change in direction of flow greater than 90 degrees shall be made. Where different sizes of drainage pipes and fittings are connected, use proper sized standard increasers and reducers. Reduction of the size of drainage piping in the direction of flow is prohibited.

M. Install underground building drains to conform with the plumbing code, and in accordance with the Cast Iron Soil Pipe Institute Engineering Manual. Lay underground building drains beginning at low point of systems, true to grades and alignment indicated with unbroken continuity of invert. Place bell ends of piping facing upstream. Install required gaskets in accordance with manufacturer's recommendations for use of lubricants, cements, and other special installation requirements. Maintain swab or drag in line and pull past each joint as it is completed.

N. Install drainage piping pitched down at a minimum slope of 1/4 inch per foot (2 percent) for piping 3 inch and smaller, and 1/8 inch per foot (1 percent) for piping 4 inch and larger.

O. Extend building drain to connect to service piping, of size and in location indicated for service entrance to building. Storm service piping is specified in a separate section of Division 2.

P. Install 1 inch thick extruded polystyrene over underground building drain piping not under building. Width of insulation shall extend minimum of 12" beyond each side of pipe. Install directly over, and center on pipe center line.

3.07 HANGERS AND SUPPORTS

A. General: Hanger, support, insulation protection shields, and anchor components and installation procedures conforming to MSS SP-58 and SP-69 are specified in Division 22 Section "Hangers and Supports for Plumbing Piping". Conform to the table below for maximum spacing of supports.

B. Install the following pipe attachments:

1. Adjustable clevis hangers, MSS SP-69 Type 1, for individual horizontal runs.
2. Riser clamps, MSS SP-69 Type 8, for individual vertical runs.
3. Insulation protection shields and high density insulation at each hanger for insulated pipe as specified in Division 22 Sections "Hangers and Supports for Plumbing Piping" and "Plumbing Insulation".

    a) Install high density insulation on insulated pipe.

4. Provide vinyl coated hangers and riser clamps for use with PVC pipe.
5. Provide roll hangers for individual horizontal runs 100 feet or longer.

C. Install hangers with maximum horizontal spacing and minimum rod diameters, to comply with MSS-58, locally enforced codes, this specification, and authorities having jurisdiction requirements, whichever are most stringent. Install hangers for horizontal piping with the following maximum spacing and minimum rod diameters:

Nom. Pipe Size	Steel Pipe Max. Span	Copper Tube Max. Span.	Min. Rod Dia. - Inches
In Inches	In Feet	In Feet	
Up to 1-1/4	12	6	3/8
1-1/2 to 2	12	10	3/8
2-1/2 to 3	12	10	3/8
4	12	10	3/8
5	12	10	1/2
6	12	10	1/2
8	12	10	1/2
10 to 12	12	10	5/8
14	12	N/A	3/4
16	12	N/A	7/8

1. Support all sizes of hubless horizontal cast iron piping every five feet, except up to ten feet where ten foot sections are installed. Support all sizes of hubless horizontal cast iron piping every other joint, unless over four feet, then support each joint. Provide support adjacent to joint, not to exceed 18". Provide sway brace on horizontal piping at not more than 40' intervals to prevent horizontal movement. Provide support at each horizontal branch.
2. Support all sizes of vertical cast iron piping every ten feet.
3. Support all sizes of vertical steel piping every other floor, not to exceed twenty-five feet.
4. Support all sizes of horizontal of PVC piping every four feet.
5. Support all sizes of vertical of PVC piping every floor, but not to exceed ten feet. For sizes 2 inches and smaller, provide guide midway between required vertical supports.
6. Support piping within 12" of each elbow or tee.

D. Sway bracing:

1. Provide rigid sway bracing for pipe 4" and larger at changes of direction greater than 45 degrees.

E. Bracing for above floor base of stacks 4" and larger and higher than three stories:

1. Secure horizontal base of stack to structure with riser clamp within at the fitting changing direction of flow from vertical to horizontal. Provide rods of size equal to cast iron pipe size scheduled above in pipe hanger schedule.

3.08 INSTALLATION OF PIPING SPECIALTIES

A. Install backwater valves in storm building drain piping as indicated, and as required by the plumbing code. For interior installation, provide cleanout cover flush to floor centered over backwater valve cover and of adequate size to remove valve cover for service.

B. Above Ground Cleanouts: Install in above ground piping and building drain piping as indicated, and:

1. as required by plumbing code;
2. at each change in direction of piping greater than 45 degrees;
3. at minimum intervals of 50' for piping 4" and smaller and 100' for larger piping;
4. at base of each vertical soil, waste, or storm water stack.

C. Cleanout Covers: Install floor and wall cleanout covers for concealed piping, types as indicated.

D. Floor Cleanouts: Install in below floor building drain piping as indicated and:.

1. as required by plumbing code;
2. at each change in direction of piping greater than 45 degrees;
3. Install in below floor building drain piping at minimum intervals of 50' for piping 4" and smaller and 75' for larger piping;
4. Install floor cleanouts in waterproof floors with waterproof membrane securely flashed with cleanout body flashing clamp so that no leakage occurs between cleanout body and adjoining flooring. Maintain integrity of waterproof membranes, where penetrated.

E. Exterior Cleanouts: Install exterior cleanouts embedded in a 18" x 18" x 8" block of concrete, flush with finished grade.

3.09 INSTALLATION OF AREA DRAINS

A. Install area drains in locations indicated.

B. Install area drains at low points of surface areas to be drained, or as indicated. Set tops of drains flush with finished floor.

C. Refer to architectural documents for floor slope requirements and set area drain elevation to match.

D. Install area drains in waterproof floors with waterproof membrane securely flashed with drain flashing clamp so that no leakage occurs between drain and adjoining flooring. Maintain integrity of waterproof membranes, where penetrated.

E. Position drains so that they are level, accessible and easy to maintain.

3.010 INSTALLATION OF ROOF DRAINS

A. Install roof drains at low points of roof areas with the roof membrane securely flashed with drain flashing clamp so that no leakage occurs between drain and roof membrane.

B. Install drain flashing collar or flange so that no leakage occurs between roof drain and adjoining roofing. Maintain integrity of waterproof membranes, where penetrated.

C. Position roof drains so that they are accessible and easy to maintain.

3.011 FIELD QUALITY CONTROL

A. Inspections

1. Do not enclose, cover, or put into operation the storm drainage piping system until it has been inspected and approved by the authority having jurisdiction.
2. During the progress of the installation, notify the plumbing official having jurisdiction, at least 24 hours prior to the time such inspection must be made. Perform tests specified below in the presence of the plumbing official.

    a) Rough-in Inspection: Arrange for inspection of the storm drainage piping system before concealed or closed-in after system is roughed-in.
    b) Final Inspection: Arrange for a final inspection by the plumbing official to observe the tests specified below and to ensure compliance with the requirements of the plumbing code.
    c) Reinspections: Whenever the piping system fails to pass the test or inspection, make the required corrections, and arrange for reinspected by the plumbing official.
    d) Reports: Prepare inspection reports, signed by the plumbing official.

B. Piping System Test: Test storm drainage system in accordance with the procedures of the authority having jurisdiction, or in the absence of a published procedure, as follows:

1. Test for leaks and defects all new storm drainage piping systems and parts of existing systems, which have been altered, extended or repaired. If testing is performed in segments, submit a separate report for each test, complete with a diagram of the portion of the system tested.
2. Leave uncovered and unconcealed all new, altered, extended, or replaced storm drainage piping until it has been tested and approved. Expose all such work for testing, that has been covered or concealed before it has been tested and approved.
3. Rough Plumbing Test Procedure: Except for outside leaders and perforated or open jointed drain tile, test the piping of storm drainage piping systems

upon completion of the rough piping installation. Tightly close all openings in the piping system, and fill with water to the point of overflow, but not less than 10 feet head of water. Water level shall not drop during the period from 15 minutes before the inspection starts, through completion of the inspection. Inspect all joints for leaks.

4. Repair all leaks and defects using new materials and retest system or portion thereof until satisfactory results are obtained.
5. Reports: Prepare inspection reports and required corrective action signed by the plumbing official and turn over to the Architect upon completion of the project.

3.012 ADJUSTING AND CLEANING

A. Clean interior of piping system. Remove dirt and debris as work progresses.

B. Clean drain strainers and domes. Remove dirt and debris.

3.013 PROTECTION

A. Protect drains during remainder of construction period, to avoid clogging with dirt and debris, and to prevent damage from traffic and construction work.

B. Place plugs in ends of uncompleted piping at end of day or whenever work stops.

C. Exposed PVC Piping: Protect storm drainage piping exposed to sunlight with 2 coats of a water based latex paint.

END OF SECTION

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PART 1 - GENERAL REQUIREMENTS

1.01 SUMMARY

A. This Section includes the following types of plumbing pumps:

1. Sump pumps

B. Related Sections: The following sections contain requirements that relate to this Section:

1. Division 3 Section "Concrete Work" for specifications on concrete and reinforcing materials and concrete placing requirements for sump basins and covers.
2. Division 22 Section "Basic Piping Material and Methods," for materials and methods for mechanical sleeve seals.
3. Division 22 Section “Coordination” for basic requirements for electrical components that are an integral part of packaged system components.
4. Division 22 Section “Storm Drainage Piping and Specialties” for sump pump discharge pipe material and installation requirements.
5. Division 23 Section “Direct-Digital Control for HVAC” for interlock of alarms with building automation system and alarm wiring.
6. Division 26 Section “Common Work Results for Electrical” required electrical devices.
7. Division 26 Sections "Enclosed Switches and Circuit Breakers" for field-installed disconnects.

1.02 SUBMITTALS

A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections.

1. Product data including standard performance curves, weights (shipping, installed, and operating), furnished specialties, and accessories, plus installation and start-up instructions.
2. Shop drawings showing layout and connections for plumbing pumps. Include setting drawings with templates, and directions for installation of foundation bolts, anchor bolts, and other anchorages.
3. Wiring diagrams detailing wiring for power, signal, and control systems; differentiating between manufacturer-installed wiring and field-installed wiring.
4. Maintenance data for plumbing pumps, for inclusion in Operating and Maintenance Manuals specified in Division 1 and Division 22 Section "General Plumbing Requirements."
5. Shop drawings showing basins with depth, inlet, outlet and vent locations, pit covers, float switches, non-clog check valves and shutoff valves.

1.03 QUALITY ASSURANCE

A. Hydraulic Institute Compliance: Design, manufacture, and install plumbing pumps in accordance with "Hydraulic Institute Standards."

B. National Electrical Code Compliance: Components shall comply with NFPA 70 "National Electrical Code."

C. UL Compliance: Control panels shall be listed and labeled by UL and comply with Standard 508A “Control Panels”.

D. NEMA Compliance: Electric motors and components shall be listed and labeled NEMA.

E. SSPMA Compliance: Test and rate sump pumps in accordance with the Sump and Sewage Pump Manufacturers Association (SSPMA) Standards.

F. Single-Source Responsibility: Obtain plumbing pumps of the same type from a single manufacturer.

G. Manufacturers Standardization Society of the Valve and Fittings Industry (MSS) Compliance: Comply with the MSS Standard Practices below:

1. MSS SP 72 “Ball Valves with Flanged or Butt Welding Ends”
2. MSS SP 110 “Ball Valves, Threaded, Socket Welding, Solder Joint, Grooved and Flared Ends”

H. Valves shall be manufactured in plants located in the United States or certified that they comply with applicable ANSI, ASTM and MSS standards.

I. Design Criteria: The Drawings indicate sizes, profiles, connections, and dimensional requirements of plumbing pumps and are based on the specific manufacturer types and models indicated. Pumps having equal performance characteristics by other manufacturers may be considered, provided that deviations in dimensions and profiles do not change the design concept or intended performance as judged by the Architect. The burden of proof for equality of plumbing pumps is on the proposer.

1.04 SPARE PARTS

A. Furnish spare parts described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Mechanical Seals: One mechanical seal for each pump.

1.05 WARRANTY

A. Warranty on Pumps: Provide written warranty, signed by manufacturer, agreeing to replace/repair, within warranty period, pumps with inadequate or defective materials and workmanship, including leakage, breakage, improper assembly, or failure to perform as required; provided manufacturer's instructions for handling, installing, protecting, and maintaining units have been adhered to during warranty period. Replacement includes both parts and labor for removal and reinstallation.

1. Warranty Period: One year from date of substantial completion.

PART 2 - PRODUCTS AND MATERIALS

2.01 MANUFACTURERS

A. Products: Subject to compliance with requirements, provide one of the following:

1. Elevator Pit Sump Pumps:

   a) ABS Pump, Inc.,
   b) FLYGT
   c) Weil Pump Company

2. Sump Pumps:

   a) ABS Pump, Inc.
   b) FLYGT
   c) Weil Pump Company

3. Submersible Sump Pump High Level Alarms:

   a) Weil Pump Company
   b) Zoeller Pump Company
   c) SJE Rhombus

4. Oil Sensing Sump Pump High Level Alarms

   a) Weil Pump Company
   b) SeeWater, Inc.

5. Full Port Bronze Ball Valves – 2” and smaller:

MANUFACTURER	THREADED ENDS	SOLDER ENDS
Apollo	77C-100	77C-200
Hammond	8301A	8311A
Milwaukee	BA-400	BA-450
Nibco	T-585-70	S-585-70

6. Full Port Cast Iron Ball Valves – 2-1/2” and larger:

   a) Apollo (Conbraco) “6P”
   b) Watts "G4000M1”

7. Non-Clog “Flapper Type” Check Valves:

a) Liberty Pumps “Series CVXXXC”
b) Little Giant Pump Company “Series CV-SE”
c) Zoeller Pump Company “Series 30”

8. Cast Iron “Sinking Ball Type” Non-Clog Check Valves - 2” and smaller:

a) Flomatic ”208”
b) FLYGT “2002”
c) GW Industries, Inc. “240T”

9. Cast Iron “Sinking Ball Type” Non-Clog Check Valves – 2-1/2” and larger:

a) Flomatic “508”
b) FLYGT “5087”
c) GW Industries, Inc. “240D”

10. Basin Covers:

a. Bilco
b. U.S.F. Fabrication

2.02 PUMPS, GENERAL

A. Pumps: factory assembled and factory tested.

B. Preparation for shipping: After assembly and testing, clean flanges and exposed machined metal surfaces and treat with an anticorrosion compound. Protect flanges, pipe openings, and nozzles with wooden flange covers or with screwed-in plugs.

C. Motors: Conform to NEMA standards; single, multiple, or variable speed with type of enclosure and electrical characteristics as indicated; have built-in thermal-overload protection and grease-lubricated ball bearings. Select motors that are non-overloading within the full range of the pump performance curve.

D. Apply factory finish paint to assembled, tested units prior to shipping.

2.03 ELEVATOR PIT SUMP PUMPS – ¾ HP AND SMALLER

A. General Description: Pumps shall be simplex centrifugal, direct connected, floor mounted, single stage type with cast iron body, stainless steel shaft, cast iron impeller, mechanical seal, permanently lubricated upper and lower ball bearings complete with integral inlet strainer, mechanical float switch, and power cord with ground.

B. Casing: Cast iron with integral cast-iron inlet strainer and legs to elevate the pump to permit flow into the impeller. Vertical discharge with screwed female connection.

C. Impeller: Statically and dynamically balanced, open or semiopen, overhung, single suction, fabricated from cast iron, keyed to shaft and secured by a locking capscrew.

D. Pump and Motor Shaft: Stainless steel, with factory-sealed, upper and lower grease-lubricated ball bearings.

E. Seals: Carbon steel rotating ring, stainless-steel spring, ceramic seat, and Buna-N bellows and gasket.

F. Motor: NEMA 6 with class F insulation, hermetically sealed, 1750 RPM, capacitor start, air filled with built-in overload protection, with 3-conductor, waterproof cable and grounding plug.

G. Controls: NEMA 1, tethered float switch for "on-off" control with "piggy back" power cord connection for sump pump power cord.

2.04 SUMP PUMPS

A. General Description: Pumps shall be duplex centrifugal, direct connected, floor mounted, single stage type with cast iron body, stainless steel shaft, cast iron impeller, mechanical seal, permanently lubricated upper and lower ball bearings complete, control panel, mechanical float switch, and power cords with grounds.

B. Casing: Cast iron with integral cast-iron legs to elevate the pump to permit flow into the impeller. Pump casing, volute and impeller shall pass a 2" diameter sphere. Horizontal discharge companion flange and rail retrieval system.

C. Rail Retrieval System: Provide with cast iron floor elbow, gasket, anchor bolts, yoke, pipe guides, stainless steel rope, and upper guide bracket.

D. Impeller: Statically and dynamically balanced, open or semiopen, overhung, single suction, fabricated from cast iron, keyed to shaft and secured by a locking capscrew.

E. Pump and Motor Shaft: Stainless steel, with factory-sealed, upper and lower grease-lubricated ball bearings.

F. Seals: Single mechanical seal with carbon steel rotating ring, stainless-steel spring, ceramic seat, and Buna-N bellows and gasket.

G. Motor: Hermetically sealed, with built-in overload protection, air filled, 1750 RPM, NEMA class B insulation capable of a maximum continuous operating temperature of 120F, 3-conductor and waterproof cable.

H. Basin: Cast in place concrete or pre-cast concrete, refer to structural drawings.

I. Cover: Epoxy coated steel or aluminum gasketed round cover with holes for discharge piping, vent and conduits. Access cover shall be completely flush for all for discharge piping, vent and conduits entering or exiting the sump pit under the slab as indicated on the drawings. Provide integral or separate cover for valves. Provide cover rated for AASHTO H-20 loading.

J. Controls: NEMA 4X fiberglass dead front door enclosure, complete with lockable combination circuit breaker magnetic motor starter and 3 leg overload protection with reset for each motor, internal test-off-automatic pump run switches, 120V control circuit transformer fused on primary and secondary, non-resettable pump run time hour meter for each pump, terminal board for connection of pumps and level sensors and automatic alternator for alternating lead-lag pump selection and to provide for both pumps to operate simultaneously under high level condition. Provide with power "on" indicator light, pump "on" light for each pump, overload relays and indicator lights, high level alarm relay, light and horn, moisture sensor alarm light for each pump, auxiliary alarm contacts for each alarm condition]. Circuit breakers shall have minimum AIC rating as indicated on the Electrical Drawings. Control panel shall have a unit short circuit current rating equal to or greater than the available short circuit current as indicated on the electrical drawings. Controls shall be configured for terminating one incoming power feeder. Refer to control drawings for interlock of alarm contacts with the building automation system.

K. Level Controls: Pole mounted tethered float switches with chord grips, pole mounting plate and cover. Float switches shall be 120V 3 amp single pole normally open that closes on the rise for pump "off", first pump "on" second pump "on" and high level alarm.

L. Junction Box: NEMA 6P enclose of fiberglass reinforced polyester with fully gasketed cover, terminal strip and inlets and outlets for four control and two power connections.

M. Remote Alarm Panel: NEMA 1 enclosure with individual 115v power source, alarm lights for high water alarm, standby pump running and control power failure with alarm buzzer with silencing switch and auxiliary alarm contacts for each alarm condition. Refer to control drawings for interlock of alarm contacts with the building automation system.

N. Disconnect: Disconnect is provided under Division 26 Section "Enclosed Switches and Circuit Breakers".

2.05 SUMP PUMP HIGH LEVEL ALARMS

A. Alarm: Remote type 120V single phase with NEMA 4X enclosure, terminal block, 5 amp isolated alarm contact, alarm horn, alarm light, test-automatic-silence switch and mechanical float switch.

2.06 OIL SENSING SUMP PUMP ALARMS

A. Alarm Panel: Remote type 120V NEMA 3R panel, oil and water sensor, power cord, receptacle for pump power cord, 85 bd alarm horn, oil present alarm light, water present alarm light, silence switch, test switch and alarm contacts for each alarm condition.

2.07 BALL VALVES

A. Ball Valves, 2 Inch and Smaller: Meeting MSS SP 110, Class 150, 600-psi CWP; two-piece construction; with ASTM B 584 cast bronze, full port, blowout-proof stem and chrome-plated brass ball, with replaceable "Teflon" or "TFE" seats and seals, solder or threaded ends and vinyl-covered steel handle.

B. Cast Iron Body Ball Valves, 2-1/2" and larger: Meeting MSS SP 72, 200-psi CWP, maximum operating temperature of 140F; two piece cast iron body meeting ASTM A126 Class B with flanged ends, 304 stainless steel full port ball and shaft, ductile iron handle, PTFE gasket, stem seal and seat.

2.08 CHECK VALVES

A. Non Clog "Flapper Type" Check Valves, 2 Inch and Smaller: Flapper type with PVC body compression end fittings with Buna-N "O" ring and Buna-N flapper with PVC shields.

B. Non Clog "Sinking Ball Type" Check Valves: Sinking ball type with cast iron body, steel ball with hollow core and Buna-N coating. Valve body shall be configured for unobstructed flow. Valves 2" and smaller with screwed ends and valves 2-1/2" and larger with flanged ends.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer's installation instructions.

B. General: Comply with the manufacturer's written installation and alignment instructions.

C. Install pumps in locations and arrange to provide access for periodic maintenance, including removal of motors, impellers, couplings, and accessories.

D. Support pumps and piping separately so that the weight of the piping system does not rest on the pump.

3.02 EXAMINATION

A. Examine areas, equipment foundations, and conditions with Installer present, for compliance with requirements for installation and other conditions affecting performance of plumbing pumps. Do not proceed with installation until unsatisfactory conditions have been corrected.

B. Examine rough-in for plumbing piping systems to verify actual locations of piping connections prior to installation.

3.03 CONNECTIONS

A. General: Install valves that are same size as the piping connecting the pump.

B. Install discharge pipe sizes equal to or greater than the diameter of the pump nozzles. Sump pump discharge pipe material is specified in Division 22 Section “Storm Drainage Piping and Specialties”.

C. Install a non-clog check valve in an accessible location or where indicated on the drawings. Install a full port ball valve on the discharge side of sump pumps downstream of the check valve.

D. Electrical wiring and connections are specified in Division 26 section “Common Work Results for Electrical”.

E. Install sump basin inlets or outlets in the field at the required elevation. Seal penetrations with mechanical link seals. Mechanical link seals are specified in Division 22 Section "Basic Piping Material and Methods." See drawings for inlet and outlet elevations.

F. Coordinate interlock of elevator pit high level alarm with building automation system. Alarm wiring and alarm interlock with the building automation system are specified in Division 23 Section “Direct-Digital Control for HVAC”.

G. Coordinate interlock of sump pump high level, two moisture sensor, two high temperature shutdown, two overload alarms, second pump running alarm, PLC failure alarm and level transmitter failure alarm with building automation system. Alarm wiring and alarm interlock with the building automation system are specified in Division 23 Section “Direct-Digital Control for HVAC”.

3.04 FIELD QUALITY CONTROL

A. Pressure Testing: Perform a pressure test on the discharge assembly. The test pressure shall be twice that of the shut off head of the pump.

B. Valve Testing: After piping systems have been tested and put into service, but before final adjusting and balancing, inspect valves for leaks. Adjust or replace packing to stop leaks; replace valves if leak persists.

3.05 STARTUP

A. Final Checks Before Start-Up: Perform the following preventative maintenance operations and checks before start-up:

1. Lubricate oil-lubricated bearings.
2. Remove grease-lubricated bearing covers and flush the bearings with kerosene and thoroughly clean. Fill with new lubricant in accordance with the manufacturer's recommendations.

3. Disconnect coupling and check motor for proper rotation. Rotation shall match direction of rotation marked on pump casing.
4. Check that pump is free to rotate by hand. For pumps handling hot liquids, pump shall be free to rotate with the pump hot and cold. If the pump is bound or even drags slightly, do not operate the pump until the cause of the trouble is determined and corrected.

B. Starting procedure for pumps with shutoff power not exceeding the safe motor power:

1. Prime the pump, opening the suction valve, closing the drains, and prepare the pump for operation.
2. Start motor.
3. Open the discharge valve slowly.
4. Observe the leakage from the stuffing boxes and adjust the sealing liquid valve for proper flow to ensure the lubrication of the packing. Do not tighten the gland immediately, but let the packing run in before reducing the leakage through the stuffing boxes.
5. Check the general mechanical operation of the pump and motor.

C. If the pump is to be started against a closed check valve with the discharge shut-off valve open, the steps are the same except that the discharge shut-off valve is opened some time before the motor is started.

END OF SECTION

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PART 1 - GENERAL REQUIREMENTS

1.01 SUMMARY

A. This Section includes piping, equipment, and related accessories, for general building, compressed air systems operating at 200 psig and below.

B. Related Sections: The following Sections contain requirements that relate to this Section:

1. Division 3 Section "Concrete Work" for specifications on concrete and reinforcing materials and concrete placing requirements for equipment pads.
2. Division 7 Section "Joint Sealants," for materials and methods for sealing pipe penetrations through basement and foundation walls, and fire and smoke barriers.
3. Division 22 Section "Coordination" for basic requirements for electrical components that are an integral part of packaged system components.
4. Division 22 Section, “Common Work Results for Plumbing” for materials and methods for fire barrier penetrations, wall and floor penetrations and concrete equipment pads.
5. Division 22 Section "Basic Piping Materials and Methods" for flexible metal braid connectors, pipe joining materials, specialties, unions, dielectric unions, dielectric flanges, dielectric flange kits and basic installation requirements.
6. Division 22 Section "Meters and Gauges for Plumbing Piping" for thermometers, pressure gauges, and fittings.
7. Division 22 Section "Hangers and Supports for Plumbing Piping" for equipment and piping hangers and supports.
8. Division 22 Section "Vibration Isolation for Plumbing Piping and Equipment" for inertia pads, isolation pads, spring supports, and spring hangers.
9. Division 22 Section "Seismic Controls for Plumbing Piping and Equipment" for field-installed seismic restraint devices used for equipment and piping systems.
10. Division 26 Section “Common Work Results for Electrical” required electrical devices.
11. Division 26 Sections "Enclosed Switches and Circuit Breakers" for field-installed disconnects.

1.02 DEFINITIONS

A. Low-Pressure Compressed Air Systems: ASME B31.9 "Building Services Piping" for systems operating at pressure of 125 psig or less, and temperature 200 deg F or less.

B. Medium-Pressure Compressed Air Systems: ASME B31.1 "Power Piping" for systems operating at pressure between 125 psig and 200 psig, or operating at temperature of more than 200 deg F.

C. High-Pressure Compressed Air Systems: ASME B31.1 "Power Piping" for systems operating at pressure greater than 200 psig.

1.03 SUBMITTALS

A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections.

B. Product data including rated capacities of selected models, weights (shipping, installed, and operating), furnished specialties, and accessories for all equipment; indicating dimensions, required clearances, and methods of assembly of components, and piping and wiring connections.

C. Wiring diagrams from manufacturers detailing electrical requirements for electrical power supply wiring to equipment. Include ladder-type wiring diagrams for interlock and control wiring required for final installation. Differentiate between portions of wiring that are factory-installed and portions that are field-installed.

D. Certificates of shop inspection and data report as required by provisions of the ASME Boiler and Pressure Vessel Code.

E. Coordination drawings for compressed air systems in accordance with Division 22 Section "General Plumbing Requirements."

F. Maintenance data for inclusion in Operating and Maintenance Manual specified in Division 1 and Division 22 Section "General Plumbing Requirements."

1.04 QUALITY ASSURANCE

A. Electrical Component Standard: NFPA 70 "National Electrical Code."

B. Listing and Labeling: Provide equipment that is listed and labeled.

1. Terms "Listed" and "Labeled": As defined in the National Electrical Code, Article 100.

2. Listing and Labeling Agency Qualifications: A "Nationally Recognized Testing Laboratory" (NRTL) as defined in OSHA Regulation 1910.7.

3. Furnish control panels manufactured in accordance with UL 508A.

C. ASME Code Compliance: Provide system components complying with the following:

1. Receiver Tanks: Comply with ASME Boiler and Pressure Vessel Code, Section VIII, Pressure Vessels, and bear the appropriate code symbols.

2. Safety Valves: ASME Boiler and Pressure Vessel Code, Section VIII, Pressure Vessels, National Board certified, bear the appropriate labeling, and have been factory-sealed after testing.
3. Low-Pressure Systems Piping: ASME B31.9, Building Services Piping.
4. Medium-Pressure Systems Piping: ASME B31.1, Power Piping.
5. High-Pressure Systems Piping: ASME B31.1, Power Piping.

D. Aluminum Tubing Systems:

1. All Aluminum tubing system components shall be of one manufacturer, be date and origin stamped for quality assurance and traceability.
2. Aluminum Tubing system mechanical piping shall conform to local code approval and/or as listed by ANSI-B-31.1, B-31.3, B-39.1, ASME, UL/ULC, IAPMO or ICC.
    a) Components shall be capable of providing system rigidity to accommodate hanging and support in accordance with ANSI B31.1 and ANSI B31.9.
3. Aluminum tubing system product manufacturer shall be ISO certified.
4. Aluminum tubing system grooving and cutting tools shall be of an approved manufacturer by the grooved fittings manufacturer. Verify tolerances of and maintain grooving tool components for duration of grooving processes. Replace grooving tool components that are found out of tolerance with new as required.
5. Obtain training from the Aluminum Tubing system manufacturer for all workers that will be installing or handling the Aluminum Tubing system.

E. Pipe, pipe fittings and pipe specialties shall be manufactured in plants located in the United States or certified to meet the specified ASTM and ANSI standards.

F. Design Concept: The Drawings indicate capacities, sizes, and dimensional requirements of system components. Components having equal performance characteristics that deviate from the indicated size and dimensions may be considered, provided deviations do not change the design concept or intended performance. The burden of proof for equality of products is on the proposer. Refer to Division 1.

G. Design Concepts: The Drawings indicate capacities, sizes, and dimensional requirements of system components and are based on the specific types, manufacturers, and models indicated. Components having equal performance characteristics by other manufacturers may be considered provided that deviations in dimensions, operation, and other characteristics are minor and do not change the design concept or intended performance as judged by the Architect. The burden of proof of equality of products is on the proposer. Refer to Division 1.

H. Design Concepts: The Drawings indicate sizes, profiles, and dimensional requirements of system components specified. Components having equal

performance characteristics by other manufacturers may be considered provided that deviations in dimensions, operation, and other characteristics are minor and do not change the design concept or intended performance as judged by the Architect. The burden of proof of equality of products is on the proposer. Refer to Division 1.

PART 2 - PRODUCTS AND MATERIALS

2.01 MANUFACTURERS

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

1. Oil-Flooded, Rotary Screw Air Compressors:

   a) Bauer Compressed Air, Inc.
   b) Champion Pneumatic Machinery Co., Inc.
   c) Gardner-Denver Products, Industrial Machinery; Cooper Industries.
   d) GrimmerSchmidt Corp.
   e) Ingersoll-Rand Co.
   f) Kaeser Compressors, Inc.
   g) LeROI Div.; Dresser Industries, Inc.
   h) Quincy Compressor Div.; Coltec Industries, Inc.
   i) Sullair Corp. Subsid.; Sundstrand Corp.

2. Oil-Free, Rotary Screw Air Compressors:

   a) Atlas Copco.
   b) GrimmerSchmidt Corp.
   c) Hitachi America, Ltd.

3. Liquid-Ring Air Compressors:

   a) Nash U.S., Inc.
   b) SIHI Pumps, Inc.

4. Aftercoolers, Air Cooled:

   a) Arrow Pneumatics, Inc.
   b) Curtis-Toledo, Inc.
   c) Hankison Div.; Hansen, Inc.
   d) Ingersoll-Rand Co.
   e) Saylor-Beall Manufacturing Co.
   f) Van Air Systems, Inc.
   g) Zeks Air Drier Corp.

5. Air Dryers:

   a) Arrow Pneumatics, Inc.
   b) Champion Pneumatic Machinery Co., Inc.
   c) Deltech Engineering, L.P.
   d) Hankison Div.; Hansen, Inc.

e) Ingersoll-Rand Co.
f) Saylor-Beall Manufacturing Co.
g) Sullair Corp. Subsid.; Sundstrand Corp.
h) Ultrafilter, Inc.
i) Van Air Systems, Inc.
j) Zeks Air Drier Corp.

6. Air Filters:

a) Deltech Engineering, L.P.
b) Hankison Div.; Hansen, Inc.
c) Ingersoll-Rand Co.
d) Ultrafilter, Inc.
e) Zurn Industries

7. Air Regulators & Lubricators:

a) Arrow Pneumatics, Inc.
b) Champion Pneumatic Machinery Co., Inc.
c) Wilkerson.

8. Automatic Drain Valves:

a) Arrow Pneumatics, Inc.
b) Deltech Engineering, L.P.
c) Ingersoll-Rand Co.
d) Zurn Industries

9. Quick Connect/Disconnect Hose Couplings:

a) Aeroquip Corp.; Industrial Connectors Div.
b) Bowes Manufacturing, Inc.
c) Amflo Products Div.; Bridge Products Inc.
d) Foster Manufacturing Co., Inc.
e) Hansen Coupling Div.; Tuthill Corp.
f) Milton Industries, Inc.
g) OBAC Corp.
h) Schrader Automotive, Inc.
i) Snap-Tite, Inc.

10. Air Hose Reels

a) COXREELS
b) Hannay Reels, Inc.
c) Reelcraft Industries

11. Ball Valves – 2" and smaller:

MANUFACTURER	THREADED ENDS	SOLDER ENDS
Apollo	77C-100	77C-200
Hammond	8301A	8311A
Milwaukee	BA-400	BA-450
Nibco	T-585-70	S-585-70

12. Ball Valves – 2" to 4":

MANUFACTURER	THREADED ENDS	SOLDER ENDS
Apollo	82-100	82-200
Hammond	8604	8614
Milwaukee	BA-300	BA-350
Nibco	T-595-Y	S-595-Y

13. Check Valves – 2" and smaller:

MANUFACTURER	THREADED ENDS	SOLDER ENDS
Apollo	161S	161T
Hammond	IB940	IB945
Milwaukee	509-T	1509-T
Nibco	T-413-Y	S-413-Y

14. Check Valves – 2" to 4":

MANUFACTURER	
Apollo	910F
Hammond	IR1124
Milwaukee	F2974
Nibco	F-918-B

15. Aluminum Tube Systems

    a) AIRPipe USA
    b) Applied Systems Technologies, "INFINITY" for 2-1/2" and smaller, "ELEVATION" for 3" and larger
    c) Atlas-Copco "AIRNet"
    d) Ingersol-Rand "SimplAir"
    e) Transair

2.02 PIPE AND TUBE MATERIALS

A. Steel Pipe: ASTM A 53, Type E, Electric-Resistance Welded or Type S, Seamless, Grade B, Schedule 40, black or hot-dipped, zinc-coated.

B. Copper Tube: ASTM B 88, Type K or Type L, Seamless, Water Tube, hard-drawn temper.

C. Copper Tube: ASTM B 88, Type K or Type L, Seamless, Water Tube, hard-drawn temper, factory-cleaned, purged, and sealed, and marked or labeled "cleaned for medical gas service," "cleaned for oxygen service," "acr/oxy," or "nitrogenized.".

D. Aluminum Tube: ASTM B241, Aluminum 6063-T5 (through the full wall thickness), rigid grade, blue in color, T5 thermal hardness treatment, powder coated.

2.03 PIPE AND TUBE FITTINGS

A. Malleable-Iron Pipe Fittings: ASME B16.3, Class 150, threaded, galvanized.

B. Wrought-Steel Pipe Fittings: ASME B16.9, Schedule 40, butt weld.

C. Forged-Steel Pipe Fittings: ASME B16.11, socket type.

D. Steel Pipe Flanges: ASME B16.5, Classes 150 and 300, carbon steel.

E. Copper Tube Fittings: ASME B16.22, wrought copper or copper alloy, solder-joint, pressure type.

F. Bronze Tube Flanges: ASME B16.24, Classes 150 and 300.

G. Copper Tube Fittings: ASME B16.22, wrought copper or copper alloy, solder-joint, pressure type, factory-cleaned, purged, and sealed, and marked or labeled "cleaned for medical gas service," "cleaned for oxygen service," "acr/oxy," or "nitrogenized."

H. Aluminum Tube System Fittings:

1. 2-1/2" and smaller: Polyamide with fiberglass reinforcement meeting UL94HB with compression joints with nitrile rubber O-ring seals.
2. 3" and larger: Aluminum body with compression joints with nitrile rubber O-ring seals.
3. 2" and smaller rated at maximum pressure of 232 psi at 188F.
4. 2-1/2" and larger rated at maximum pressure of 188 psi at 158F.

2.04 VALVES

A. Valves For Laboratory Service: Three piece ball valves cleaned and rated for oxygen service with bronze-body, full-port, with chrome-plated brass ball, with TFE seat seals and stem seals, blow-out proof stem, tube extensions suitable for brazing, designed for quarter turn between open and closed positions and for 300 psig working pressure.

B. Ball Valves, 2 Inch and Smaller: MSS SP-110, Class 150 saturated steam pressure, 600-psi CWP; two-piece construction; with bronze body conforming to ASTM B 584, full port, chrome-plated brass ball, replaceable PTFE (Teflon) seats and seals, blowout-proof stem, and vinyl-covered steel handle. Provide solder ends for use with copper tubing or threaded ends for use with steel piping. Provide Class 150 valves meeting the above where system pressure requires. Provide with side vented ball where required.

C. Ball Valves, 2-1/2 Inch to 4 Inch: MSS SP-110, Class 150, 600-psi CWP; 3-piece construction; with bronze body conforming to ASTM B 584, full port, chrome-plated brass ball, replaceable PTFE (Teflon) seats and seals, blowout proof stem, and vinyl-covered steel handle. Provide solder ends for use with copper tubing or threaded ends for use with steel piping.

D. Swing Check Valves, 2-Inch and Smaller: MSS SP-80; Class 125, 200-psi CWP, cast-bronze body and cap conforming to ASTM B 62; with horizontal swing, Y-pattern, and PTFE (Teflon) disc; and having threaded or solder ends. Provide valves capable of being reground while the valve remains in the line. Provide Class 150, 300-psi CWP, valves meeting the above specifications, with threaded end connections, where system pressure requires or where Class 125 valves are not available.

E. Swing Check Valves, 2-1/2-Inch and Larger: MSS SP-71; Class 125 200-psi CWP, cast iron body and bolted cap conforming to ASTM A 126, Class B; with horizontal swing, bronze disc or ductile iron disc with bronze disc face ring, and bronze seat ring; and flanged ends. Provide valves capable of being refitted while the valve remains in the line.

2.05 JOINING MATERIALS

A. Screwed Joint Pipe Tape: Polytetrafluoroethylene (PTFE) plastic.

B. Gasket Material: ASME B16.21, nonmetallic, flat, asbestos-free composition.

C. Solder Filler Metal: ASTM B 32, Alloy Sb5 (95 percent tin and 5 percent antimony), with 0.20 percent maximum lead content.

D. Brazing Filler Metals: AWS A5.8, AWS A5.8, BAg-5, with a cadmium content of zero.

E. Brazing Filler Metals: AWS A5.8, AWS A5.8, BCuP-5, with a minimum silver content of 15%. Flux is prohibited.

F. Aluminum Tubing System: Nitrile rubber O-ring seals.

2.06 DUPLEX RECIPROCATING AIR COMPRESSORS

A. Provide factory-assembled and tested, duplex, packaged, air-cooled, continuous duty, piston-type, motor-driven air compressors as indicated, of capacities and having electrical characteristics indicated on the drawings, and with the following features:

1. Belt guards totally enclosing pulleys and belts.
2. Receivers: [150psi] [250psi] ASME-code-construction horizontal receiver with safety valve, pressure gauge, and automatic drain.
3. Inlet silencer filters
4. Safety valves
5. Shutoff valve.
6. Factory tank mounted air dryer
7. Factory tank mounted air filters and pressure regulator

B. Controls: NEMA 1 enclosure, lockable combination circuit breaker magnetic motor starter and 3 leg overload protection for each motor; internal test-off-automatic selector switches, overload relays, resets, 120V control circuit transformer fused on primary and secondary, automatic alternator for alternating lead-lag compressor selection and to provide for both compressors to operate simultaneously under high load condition, low oil level shutdown switch and alarm light, high temperature shutdown switch and alarm light and run time clock for each compressor. Circuit breakers shall have minimum AIC rating as indicated on the Electrical Drawings. Control panel shall have a unit short circuit current rating equal to or greater than the available short circuit current as indicated on the electrical drawings. Controls shall be configured for terminating one incoming power feeder.

C. Controls: NEMA 1 enclosure, lockable combination circuit breaker magnetic motor starter and 3 leg overload protection for each motor, compressor hand-off-automatic selector switches, overload relays, resets, automatic alternator for alternating lead-lag compressor selection and to provide for both compressors to operate simultaneously under high load condition, low oil level shutdown switch and alarm light, high temperature shutdown switch and alarm light and run time clock for each compressor. Circuit breakers shall have minimum AIC rating as indicated on the Electrical Drawings. Control panel shall have a unit short circuit current rating equal to or greater than the available short circuit current as indicated on the electrical drawings. Controls shall be configured for terminating one incoming power feeder.

D. Disconnect: Disconnect is provided under Division 26.

E. Tank-Mounted, Reciprocating Air Compressors: Two stage, single acting, splash lubricated with centrifugal unloader for loadless starting, crank shaft roller bearings and belt guard mounted air cooled aftercooler. Each compressor shall be equipped with a belt driven, high efficiency, dripproof, continuous duty, ball bearing, induction type motor mounted on adjustable slide base and provided with a totally enclosed drive guard.

F. Tank-Mounted, Reciprocating Air Compressors: Two stage, single acting, pressure lubricated with gear type oil pump, oil pressure gauge, centrifugal unloader for loadless starting, crank shaft roller bearings and belt guard mounted air cooled aftercooler. Each compressor shall be equipped with a belt driven, high efficiency, dripproof, continuous duty, ball bearing, induction type motor mounted on adjustable slide base and provided with a totally enclosed drive guard.

G. Tank-Mounted, Oil-Free, Reciprocating Air Compressors: single stage, single acting, non-lubricated type, with TFE piston rings and sealed, oil-free crank shaft and piston bearings, centrifugal unloader for loadless starting, oil-free crank shaft and piston bearings and belt guard mounted air cooled aftercooler. Each compressor shall be equipped with a belt driven, high efficiency, dripproof,

continuous duty, ball bearing, induction type motor mounted on adjustable slide base and provided with a totally enclosed drive guard.

H. Tank-Mounted, Oil-Less, Reciprocating Air Compressors: Two stage, single acting, double acting, oil free type, with TFE piston rings and exposed separation spacer and shaft with oil stop collar and sealed crank case with pressure lubricated crank shaft roller bearings with gear type oil pump, oil pressure gauge and belt guard mounted air cooled aftercooler. Each compressor shall be equipped with a belt driven, high efficiency, dripproof, continuous duty, ball bearing, induction type motor mounted on adjustable slide base and provided with a totally enclosed drive guard.

I. Air Dryers, Refrigerated Type: Provide with capacities and characteristics as indicated on the drawings. Equip with drain connection.

J. Filters and regulators: Air line filtration system for removal of liquids and particulate matter shall include coalescing prefilter with automatic drain, particulate filter and final charcoal adsorption filter, air line pressure regulators with gauges, final pressure relief valve installed on discharge side of air dryers.

2.07 SIMPLEX RECIPROCATING AIR COMPRESSORS

A. Provide factory-assembled and tested, simplex, packaged, air-cooled, continuous duty, piston-type, motor-driven air compressors as indicated, of capacities and having electrical characteristics indicated on the drawings, and with the following features:

1. Belt guard totally enclosing pulleys and belts.
2. Receivers: 150psi 250psi ASME-code-construction horizontal, vertical receiver with safety valve, pressure gauge, and automatic drain.
3. Inlet silencer filter
4. Safety valves
5. Shutoff valve.

B. Controls: NEMA 1 enclosure, lockable combination circuit breaker magnetic motor starter and 3 leg overload protection for each motor, compressor hand-off-automatic selector switch, overload relay, reset, 120V control circuit transformer fused on primary and secondary, low oil level shutdown switch and alarm light, high temperature alarm shutdown switch and alarm light and run time clock. Circuit breaker shall have minimum AIC rating as indicated on the Electrical Drawings. Control panel shall have a unit short circuit current rating equal to or greater than the available short circuit current as indicated on the electrical drawings. Controls shall be configured for terminating one incoming power feeder.

C. Controls: NEMA 1 enclosure, lockable combination circuit breaker magnetic motor starter and 3 leg overload protection for each motor, compressor hand-off-automatic selector switch, overload relays, reset, low oil level shutdown switch and alarm light, high temperature shutdown switch and alarm light and run time clock.

Circuit breaker shall have minimum AIC rating as indicated on the Electrical Drawings. Control panel shall have a unit short circuit current rating equal to or greater than the available short circuit current as indicated on the electrical drawings. Controls shall be configured for terminating one incoming power feeder.

D. Disconnect: Disconnect is provided under Division 26.

E. Tank-Mounted, Reciprocating Air Compressors: Two stage, single acting, splash lubricated with centrifugal unloader for loadless starting, crank shaft roller bearings and belt guard mounted air cooled aftercooler. Each compressor shall be equipped with a belt driven, high efficiency, dripproof, continuous duty, ball bearing, induction type motor mounted on adjustable slide base and provided with a totally enclosed drive guard.

F. Tank-Mounted, Reciprocating Air Compressors: Two stage, single acting, pressure lubricated with gear type oil pump, oil pressure gauge, centrifugal unloader for loadless starting, crank shaft roller bearings and belt guard mounted air cooled aftercooler. Each compressor shall be equipped with a belt driven, high efficiency, dripproof, continuous duty, ball bearing, induction type motor mounted on adjustable slide base and provided with a totally enclosed drive guard.

G. Tank-Mounted, Oil-Free, Reciprocating Air Compressors: single stage, single acting, non-lubricated type, with TFE piston rings and sealed, oil-free crank shaft and piston bearings, centrifugal unloader for loadless starting, oil-free crank shaft and piston bearings. Each compressor shall be equipped with a belt driven, high efficiency, dripproof, continuous duty, ball bearing, induction type motor mounted on adjustable slide base and provided with a totally enclosed drive guard.

H. Tank-Mounted, Oil-Less, Reciprocating Air Compressors: Two stage, single acting, double acting, oil free type, with TFE piston rings and exposed separation spacer and shaft with oil stop collar and sealed crank case with pressure lubricated crank shaft roller bearings with gear type oil pump, oil pressure gauge and belt guard mounted air cooled aftercooler. Each compressor shall be equipped with a belt driven, high efficiency, dripproof, continuous duty, ball bearing, induction type motor mounted on adjustable slide base and provided with a totally enclosed drive guard.

2.08 ROTARY SCREW AIR COMPRESSORS

A. General: Provide factory-assembled and tested, packaged, single-stage, heavy-duty, asymmetrical, rotary screw air compressors as indicated, of capacities and having electrical characteristics as indicated.

B. Bearings: Separate axial and thrust anti-friction bearings.

C. Coupling: Nonlubricated flexible type.

D. Cooling/Lubrication System: Unit-mounted, air-cooled exchanger package, prepiped to unit with air pressure circulation system, with coolant stop valve, full flow coolant filter, and thermal bypass valve.

E. Air Filter: Dry type, with maintenance indicator and cleanable replaceable filter element.

F. Air/Coolant Receiver and Separation System: 150-psig-rated tank with ASME safety valve; coolant level gauge; multistage, air coolant separator element; minimum pressure valve; blowdown valve; discharge check valve; and coolant stop valve, full flow coolant filter, and thermal bypass valve.

G. Capacity Control: Capacity modulation between 0 and 100 percent air delivery, with operating pressures between 50 and 125 psig using manufacturer's standard control. Control inlet butterfly valve by diaphragm and pressure regulator to hold a constant pressure. When air demand is zero, unload compressor by use of pressure switch and blowdown valve.

H. Control Panel: Include air receiver pressure gauge, discharge line pressure gauge, air filter maintenance indicator, hourmeter, compressor discharge air and coolant temperature gauge, control transformer, start-stop switches, and numbered wiring terminal strip.

1. Provide automatic alternator to switch lead compressor at each start, for duplex air compressor units.

I. Motor Starter: Full-voltage, magnetic starter with NEMA 12 enclosure. Factory mount starter on compressor package and wire to motor and control panel.

J. Receiver Tank: ASME stamped.

K. Prepipe entire unit at factory.

L. Oil-Flooded, Rotary Screw Air Compressors: Oil-cooled and oil-flooded lubricated screws.

M. Oil-Free, Rotary Screw Air Compressors: Nonlubricated screws and air cooled; with construction to prohibit oil from entering compression chamber.

N. Disconnect: Disconnect is provided under Division 26.

2.09 LIQUID-RING AIR COMPRESSORS

A. Liquid-Ring Air Compressors: Provide factory-assembled and tested, packaged, nonpulsating, rotary, liquid ring, air compressors; of capacities and having electrical characteristics as indicated.

B. Construction: Cast-iron body and rotor, cast-iron body with bronze rotor, or bronze body and rotor.

C. Sealing Fluid: Potable water, with recirculation of up to 90 percent.

D. Bearings: Separate axial and thrust anti-friction bearings.

E. Coupling: Nonlubricated, flexible type.

F. Air Filter: Dry type, with maintenance indicator and cleanable replaceable filter element.

G. Controls: NEMA 1 enclosure, lockable combination circuit breaker magnetic motor starter and 3 leg overload protection for each motor; internal test-off-automatic selector switches, overload relays, resets, 120V control circuit transformer fused on primary and secondary, automatic alternator for alternating lead-lag compressor selection and to provide for both compressors to operate simultaneously under high load condition, compressor discharge air and coolant temperature gauge and run time clock for each compressor. Circuit breakers shall have minimum AIC rating as indicated on the Electrical Drawings. Control panel shall have a unit short circuit current rating equal to or greater than the available short circuit current as indicated on the electrical drawings. Controls shall be configured for terminating one incoming power feeder.

H. Controls: NEMA 1 enclosure, lockable combination circuit breaker magnetic motor starter and 3 leg overload protection for each motor, compressor hand-off-automatic selector switches, overload relays, resets, automatic alternator for alternating lead-lag compressor selection and to provide for both compressors to operate simultaneously under high load condition, compressor discharge air and coolant temperature gauge and run time clock for each compressor. Circuit breakers shall have minimum AIC rating as indicated on the Electrical Drawings. Control panel shall have a unit short circuit current rating equal to or greater than the available short circuit current as indicated on the electrical drawings. Controls shall be configured for terminating one incoming power feeder.

I. Control Panel: Include air receiver pressure gauge, discharge line pressure gauge, air filter maintenance indicator, hourmeter, compressor discharge air and coolant temperature gauge, control transformer, start stop switches, and numbered wiring terminal strip.

1. Provide automatic alternator to switch lead compressor at each start, for duplex air compressor units.

J. Motor Starter: Full-voltage, magnetic starter with NEMA 12 enclosure. Factory mount starter on compressor package and wire to motor and control panel.

K. Receiver Tank: ASME stamped.

L. Prepipe entire unit at factory.

M. Disconnect: Disconnect is provided under Division 26.

2.010 AFTERCOOLERS

A. Aftercoolers, Air Cooled: Tubular, rated at 250 psig and leak-tested at 350-psig minimum air pressure, in capacities indicated. Size units to cool compressed air in compressor-rated capacities to 10 deg F above summertime maximum ambient temperature.

B. Aftercoolers, Water Cooled: Fixed-bundle, tubular intercoolers and aftercoolers, rated at 250 psig and leak-tested at 350-psig minimum air pressure, in capacities indicated. Size units to cool compressed air in compressor rated capacities to 10 deg F above summertime maximum water temperature.

2.011 AIR DRYERS

A. Air Dryers, Refrigerated Type: Provide with capacities and characteristics as indicated on the drawings. Equip with drain connection.

B. Air Dryers, Deliquescent Type: Single tower, charged with an absorbent desiccant, in capacities and with characteristics indicated. Equip with drain connection.

C. Air Dryers, Regenerative Type: Twin towers, charged with an adsorbent desiccant, in capacities and with characteristics indicated. Equip with drain connection.

2.012 ACCESSORIES

A. General: Provide accessories having working pressure rating not less than system pressure at location where used, and compatible with equipment and piping system used.

B. Intercoolers: Air-cooled, fixed-bundle, tubular intercoolers, rated at 250 psig and leak-tested at 350-psig minimum air pressure, in capacities indicated. Size units to cool compressed air in compressor-rated capacities to 10 deg F above summertime maximum ambient temperature.

C. Intercoolers: Water-cooled, fixed-bundle, tubular intercoolers, rated at 250 psig and leak-tested at 350-psig minimum air pressure, in capacities indicated. Size units to cool compressed air in compressor-rated capacities to 10 deg F above summertime maximum water temperature.

D. Separators: Conical shaped, centrifugal air-line separators in sizes and capacities indicated. Equip with water-removal trap and drain. Size units for maximum pressure drop through units of 3 psig from air inlet to outlet.

E. Receivers: ASME stamped, cylindrical, vertical or horizontal installation as indicated, galvanized steel; with safety valves in sizes, working pressures and temperatures indicated, and with drain connection.

1. Pressure rating: Not less than maximum discharge pressure.

F. Safety Valves: ASME Boiler and Pressure Vessel Code, Section VIII, Pressure Vessels construction, National Board certified, labeled, and factory-sealed; constructed of bronze body with poppet safety valve for compressed air service.

1. Pressure Settings: Higher than discharge pressure and same or lower than receiver pressure rating.

G. Pressure Regulators: Bronze body, direct-acting, spring-loaded, manual pressure setting adjustment, and rated for 250-psig inlet pressure except where otherwise indicated.

1. Type: Diaphragm-operated.
2. Type: Pilot-operated.

H. Pressure Regulators (Reducing Valves): Aluminum alloy or plastic body, diaphragm-operated, direct-acting, spring-loaded, manual pressure setting adjustment, and rated for 250-psig inlet pressure except where otherwise indicated.

I. Air-Line Lubricators: Sizes and capacities indicated; equip with drip chamber and sight dome for observing oil drop entering air stream; with oil feed adjustment screw, and quick-release collar for easy bowl removal.

1. Provide with automatic feed device for supplying oil to lubricator.

J. Filters: Capacities and types indicated on the drawings. Equip with cartridges capable of removing particles, water and oil aerosols, and with warning light to indicate when selected maximum pressure drop has been exceeded with characteristics indicated on the drawings.

K. Automatic Drain Valves: Electronic controlled corrosion-resistant metal body and internal parts, rated for 200-psig minimum working pressure, capable of automatic discharge of collected condensate.

L. Hose, Clamps, and Couplings: Provide compatible hose, hose clamps, and hose couplings, suitable for compressed air service, of nominal diameter, and rated for 300-psig minimum working pressure except where otherwise indicated.

1. Quick Connect/Disconnect Hose Couplings: One-way, automatic shutoff, brass body, with O-ring or gasket seal, and stainless steel or nickel-plated steel operating parts. Select socket end with threaded inlet that is considered the fixed end and has a one-way valve.

    a) Plug End: Flow-sensor bleeder, check-valve type, with serrated outlet for hose.
    b) Plug End: Straight-through type, with serrated outlet for hose.

2. Quick Connect/Disconnect Hose Couplings: Straight through, brass body, with stainless-steel or nickel-plated steel operating parts. Select socket end with O-ring or gasket seal, and without valve. Select socket and plug ends with serrated outlets for hose.

3. Hose Coupling: Two-piece, threaded, brass or stainless steel, O-ring or gasket seal, swivel coupling, with serrated ends, 300-psig minimum working pressure.
4. Hose Adapter: One-piece, brass or stainless-steel fitting, with serrated ends.
5. Hose: Reinforced, single- or double-braid, neoprene-covered hose, for compressed air service.
6. Hose Clamps: Stainless steel, clamps, bands, or wire.

M. Air Hose Reels: As specified on the drawings.

PART 3 - EXECUTION

1.1 INSTALLATION, GENERAL

A. Install air compressors, air dryers, accessories, piping, valves and specialties in accordance with manufacturer's installation instructions.

3.01 CONCRETE EQUIPMENT BASES

A. Refer to Division 22 Section "Common Work Results for Plumbing" for concrete equipment bases.

1. Form concrete equipment bases by using framing lumber with form release compounds. Chamfer top edge and corners of pad.
2. Install reinforcing bars, tied to frame, and place anchor bolts and sleeves using manufacturer's installation template.
3. Place concrete and allow to cure before installation of pumps.

3.02 EQUIPMENT INSTALLATION

A. Install air compressors on concrete bases. Set and connect units in accordance with manufacturers' written installation instructions. Install units plumb and level, firmly anchored, in locations indicated, and maintain manufacturers' recommended clearances. Orient so equipment controls and devices needing servicing are accessible. For indirect drain material and installation.

B. Install seismic restrains for equipment as indicated refer to Division 22 Section "Seismic Controls for Plumbing Piping and Equipment".

C. Install flexible connectors where indicated on the drawings. Refer to Division 22 "Basic Piping Material and Methods" for installation.

D. Install indirect drains on air compressor accumulator tank drain valve, air dryer condensate drain and each automatic air drain valve and route to nearest floor drain. Refer to Division 22 Section "Sanitary Drainage and Vent Piping and Specialties".

E. Provide equipment pad and vibration isolation, refer to Division 22 Section "Vibration Isolation For Plumbing Piping & Equipment".

F. Provide equipment pad, concrete inertia base and vibration isolation, refer to Division 22 Section "Vibration Isolation For Plumbing Piping & Equipment".

3.03 PIPING APPLICATIONS

A. Low-Pressure Systems: Use the following pipe and fittings:

1. 2 to 12 Inches: Black steel pipe with threaded, malleable-iron fittings; threaded joints.
2. 1-1/2 Inches and Smaller: Galvanized steel pipe with galvanized, threaded, malleable-iron fittings; threaded joints.
3. 2 Inches and Larger: Black steel with grooved-end, mechanical fittings; mechanical joints.
4. 2-1/2 to 6 Inches: Copper tube with grooved-end copper tube fittings and grooved-end copper couplings; mechanical joints.
5. 2 Inches and Smaller: Copper tube with copper and copper alloy solder fittings; soldered joints.
6. 4 Inches and Smaller: Copper tube with copper, copper alloy, and bronze fittings; soldered joints.
7. 4 Inches and Smaller: Copper tube with copper and bronze fittings; brazed joints.
8. 6 inches and smaller: Aluminum tube with compression fittings.

B. Medium-Pressure Systems: Use the following pipe and fittings:

1. 2 Inches and Larger: Black steel pipe, steel buttwelding fittings, Class 300 carbon steel flanges; welded and flanged joints.
2. 1-1/2 Inches and Smaller: Black steel pipe with forged-steel, socket welding fittings; welded joints.
3. 4 Inches and Smaller: Copper tube, copper fittings, and Class 300 bronze tube flanges; brazed and flanged joints.
4. 2 inches and smaller: Aluminum tube with compression fittings.

3.04 JOINT CONSTRUCTION

A. Threaded Joints: Thread pipe with tapered pipe threads in accordance with ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded ends to remove burrs and restore full inside diameter. Apply pipe tape, suitable for the service for which the pipe is intended, on the male threads at each joint. Tighten joint to leave not more than 3 threads exposed.

B. Welded Joints: Weld pipe joints in accordance with ASME Code for Pressure Piping, B31.9 Building Service Piping for low-pressure systems and B31.1 Power Piping for medium-pressure systems.

C. Brazed and Soldered Joints: For copper tube and fittings, braze and solder joints in accordance with ASME B31 - Standard Code for Pressure Piping.

1. Braze joints in accordance with ASME B31.1 - Power Piping with BAg-5 brazing filler metal
2. Solder joints in accordance with ASME B31.9 - Building Service Piping.
3. Thoroughly clean tube surface and inside surface of the cup of the fittings, using very fine emery cloth, prior to making soldered or brazed joints. Wipe tube and fittings clean and apply flux. Flux shall not be used as the sole means for cleaning tube and fitting surfaces.
4. Mechanical Joints: Follow grooved-end mechanical coupling manufacturer's written instructions.

D. Joints in laboratory piping, except those at valves or equipment regularly provided with threaded connections, shall be made with BCuP brazing alloy high melting point. The outside of the tube and fittings shall be cleaned by washing with hot water after assembly.

E. Brazing For Laboratory Air Copper Tube and Fittings:

1. Braze joints in accordance with ASME B31.1 - Power Piping with BCup-5 brazing filler metal.
2. Thoroughly clean tube surface and inside surface of the cup of the fittings, using very fine emery cloth, prior to making brazed joints. Wipe tube and fittings clean. Prevent the entry of matter into the tube. If matter enters the tube, replace the tube or clean the tube in the field with 1lb of sodium carbonate or trisodium phosphate per 3 gallons of water, rinse with hot potable water. Use of flux is prohibited.
3. Make brazed joints with dry oil-free nitrogen flowing through the pipe to prevent oxidation and scale formation.
4. Clean the outside of the tube and fittings after assembly with hot water.

F. Threaded joints for Laboratory Air Piping: Threaded joints in piping systems shall be made up with polytetrafluorethylne (such as Teflon) tape or other thread sealants for oxygen service. Sealants shall be applied to the male threads only. Leave first thread clean if possible.

G. All brazing shall be done with dry nitrogen flowing through the pipe to prevent oxidation and scale formation. Flow rate shall be 0.5 cfm for ½" tube and 1 cfm for ¾" tube.

3.05 VALVE APPLICATIONS

A. General-Duty Valve Applications: The Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:

1. Shut-off duty - 2" and smaller: Use 2-piece ball valves.
    a) Provide side vented ball valves only at individual equipment connections and air drops to relieve air downstream of ball valve when closed for equipment repair or removal.
2. Shut-off duty - 2-1/2" and larger: Use 3-piece ball valves.

3. Shut-off duty laboratory air: Use 3-piece ball valves with brazing tube extensions.

3.06 INSTALLATION OF VALVES

A. Sectional Valves: Install sectional valves on each branch and riser, close to main, and elsewhere as indicated.

B. Shutoff Valves: Install shutoff valves on outlet of each compressed air equipment item, on each supply to each compressed air outlet, and elsewhere as indicated.

C. Locate valves for easy access and provide separate support where necessary. Provide access doors and fire rated access doors as required.

D. Install valves and unions for each fixture and item of equipment arranged to allow equipment removal without system shutdown. Unions are not required on flanged devices.

E. Install three-valve bypass around each pressure reducing valve using throttling-type valves.

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

G. Install valves in a position to allow full handle rotation.

H. Installation of Check Valves: Install for proper direction of flow as follows:

1. Swing Check Valves: Horizontal position with hinge pin level.

3.07 PIPING INSTALLATION, GENERAL

A. Install air and drain piping with 1/8-inch-per-foot slope downward in direction of air flow.

B. Install eccentric reducers where pipe is reduced in size in the direction of flow, with bottoms of both pipes and reducer flush.

C. Connect branch air piping to mains from top of main. Provide drain leg and drain trap at end of each main, each branch, and each low point in piping system.

D. Install horizontal piping as high as possible. Install vertical piping tight to columns or walls. Provide space to permit insulation applications, with 1 inch clearance outside the insulation. Allow sufficient space above removable ceiling panels to allow for panel removal.

E. Install piping specialties in accordance with Division 22 Section "Basic Piping Materials and Methods."

F. Install supports and anchors in accordance with Division 22 Section "Hangers and Supports for Plumbing Piping."

1. Spacing: Do not exceed 10'-0" spacing between pipe hangers.

G. Install valves in accordance with Division 22 Section "General Duty Valves for Plumbing Piping."

H. Install thermometers and pressure gauges in accordance with Division 22 Section "Meters and Gauges for Plumbing Piping."

I. Fire Barrier Penetrations: Where pipes pass though fire-rated walls, partitions, ceilings, and floors, maintain the fire-rated integrity. Refer to Division 22 Section “Common Work Results for Plumbing” for special sealers and materials.

J. Exterior Wall Penetrations: Seal pipe penetrations through exterior wall constructions with sleeves packing, and sealant. Refer to Division 22 Section “Basic Piping Materials and Methods” for additional information.

K. Underground Exterior Wall Penetrations: Seal pipe penetrations through underground exterior walls with sleeves and mechanical sleeve seals. Refer to Division 22 Section “Basic Piping Materials and Methods” for additional information.

L. Elevated Floor Penetrations of Waterproof Membrane, Interior Penetrations of Non-Fire Rated Walls and Concrete Slab on Grade Penetrations: Provide sleeves and seal pipes that pass through waterproof floors, non-fire rated walls, partitions and ceilings or concrete slab on grade. Refer to Division 22 Section "Common Work Results for Plumbing” for special sealers and materials.

M. Joints Containing Dissimilar Metals: Provide dielectric unions for 2” and smaller and dielectric flanges for piping 2-1/2” and larger. Dielectric unions and flanges are specified in Section “Basic Piping Materials and Methods”.

N. Joints at Valve Assemblies: Provide unions downstream of shutoff valves at valve assemblies. Unions are not required at flanged connections. Unions are specified in Division 22 section “Basic Piping Materials and Methods”.

3.08 HANGERS AND SUPPORTS

A. General: Hanger, support, insulation protection shield, and anchor components and installation procedures conforming to MSS SP-58 and SP-69 are specified in Division 22 Section "Hangers and Supports for Plumbing Piping." Conform to the table below for maximum spacing of supports.

B. Pipe Attachments: Install the following:

1. Adjustable band hangers, MSS SP-69 Type 7, for steel pipe for individual horizontal runs and for copper tube for horizontal runs.

2. Steel riser clamps, MSS SP-69 Type 8, for individual vertical runs of steel pipe.
3. Plastic coated adjustable band hangers with, MSS SP-69 Type 7, for copper tube for horizontal runs.
4. Plastic coated steel riser clamps, MSS SP-69 Type 8, for individual vertical runs of copper tube.
5. Extension split ring pipe clamp, MSS SP-69 Type 12, for individual vertical exposed runs of steel pipe 2" and smaller on walls or for securing steel pipe inside walls.
6. Copper coated extension split ring pipe clamp, MSS SP-69 Type 12, for individual vertical exposed runs of copper tube 2" and smaller on walls or for securing copper tube inside walls.
7. Provide roll hangers for individual horizontal runs 100 feet or longer.
8. Aluminum tubing system fixing clips, clamps, and hangers.

C. Install hangers for horizontal piping with the following maximum spacing and minimum rod sizes:

Nom. Pipe Size - In.	Steel Pipe Max. Span - Ft.	Copper Tube Max. Span - Ft.	Min. Rod Dia. - In.
Up to 1-1/4	12	6	3/8
1-1/2 to 2	12	10	3/8
2-1/2 to 4	12	10	3/8
5	12	10	1/2
6	12	10	1/2

Nom. Pipe Size - In.	Aluminum Tube Max. Span - Ft.	Min. Rod Dia. - In.
Up to 3/4	5	3/8
1	6	3/8
1-1/4	7	3/8
1-1/2	8	3/8
2	8	3/8
2-1/2	9	3/8
3	10	3/8
3-1/2	11	3/8
4	12	1/2
6	13	1/2

1. Support vertical steel pipe at each floor.
2. Support vertical copper tube at each floor and in intervals not to exceed 10 feet.

D. Support piping within 12" of each elbow or tee and for piping 2-1/2" and larger at each valve or strainer.

E. Support piping above the floor with pipe supports attached to the floor with anchor bolts where indicated on the drawings. Conform to the table above for maximum spacing of supports.

F. Provide vibration isolation for piping connected to rotating equipment. Vibration isolators are specified in Division 22 specification Section “Vibration Isolation for Plumbing Piping and Equipment”.

3.09 CONNECTIONS

A. Install piping adjacent to equipment to allow servicing and maintenance.

B. Connect air piping to units with shutoff valves and unions.

1. Where air piping connections are dissimilar metals, install dielectric waterway fittings or dielectric unions for joints 2” and smaller and dielectric flanges for joints 2-1/2” and larger. Dielectric waterway fittings, unions and flanges are specified in Division 22 Section "Basic Piping Materials and Methods."
2. Install thermometers on compressor discharge piping, on receiver tanks, and where indicated.
3. Install pressure gauges on compressor discharge piping, on receiver tanks, and where indicated.

C. Connect water piping to intercooler and aftercooler units with union and reduced-pressure-zone-type backflow-preventer assembly having strainer, gate valves, and air gap fitting for indirect waste. Connect cooler unit drains with union and flow control valve, and discharge over closest floor drain.

1. Where air piping connections are dissimilar metals, install dielectric waterway fittings or dielectric unions for joints 2” and smaller and dielectric flanges for joints 2-1/2” and larger. Dielectric waterway fittings, unions and flanges are specified in Division 22 Section "Basic Piping Materials and Methods."

D. Install safety valves in receiver tanks, in quantity and size to relieve capacity not less than that of connected compressor.

E. Install automatic drain valves on intercoolers, aftercoolers, separators, receivers, dryers, filters and other locations indicated. Discharge condensate over nearest floor drain.

F. Install flexible connectors where indicated in accordance with Division 22 Section "Basic Piping Materials and Methods".

G. Securely attach hose reels to the structure as specified in Division 22 Section "Hangers and Supports for Plumbing Piping."

H. Electrical Connections:

1. Power wiring is specified in Division 26 Section “Common Work Results for Electrical”
2. Field-installed disconnects are specified in Division 26 Sections "Enclosed Switches and Circuit Breakers".
3. Grounding: Connect unit components to ground in accordance with the National Electrical Code.

3.010 AIR HOSE REELS

A. Install horizontal hanging hose reels with “I” or “H” beam brackets

B. Install vertical hangin hose reels with swing brackets.

3.011 FIELD QUALITY CONTROL

A. General: Provide the services of a factory-authorized service representative to test and inspect unit installation, provide startup service, and to demonstrate and train Owner's maintenance personnel as specified below.

1. Test and adjust operating and safety controls. Replace damaged and malfunctioning controls and equipment.

B. Piping System Tests: Cap and fill new and parts of existing systems that have been modified, with oil-free, dry air or gaseous nitrogen, to pressure of 50 psig above system operating pressure, but not less than 150 psig. Isolate the test source and let stand for 4 hours to equalize temperature. Refill system, if required, to test pressure and hold pressure for 2 hours with no drop in pressure.

1. Repair leaks and defects with new materials and retest system until satisfactory results are obtained.

3.012 STARTUP

A. Preparation: Perform the following final checks before startup:

1. Complete tests of piping systems.
2. Check for piping connection leaks.
3. Check lubricating oil for lubricated-type equipment.
4. Check V-belts for proper tension.
5. Check that compressor inlet filters and piping are clear.
6. Check equipment vibration-control supports and flexible pipe connectors, and that equipment is properly attached to substrate.
7. Check for proper seismic restraints.
8. Check that safety valves have correct setting; greater than compressor discharge pressure, but not greater than pressure rating of system components.
9. Test operation of equipment safety controls and devices.
10. Check water supply to water-cooled equipment.
11. Check water supply to liquid-ring air compressors.

12. Drain receiver tanks.
13. Check for adequate room ventilation.

B. Starting Procedures: Follow the manufacturer's written procedures. If no procedures are prescribed by the manufacturer, proceed as follows:

1. Energize circuits.
2. Start and run equipment through complete sequence of operations.
3. Check for excessive vibration and noise. Correct problems.
4. Check air pressures.
5. Manually operate safety valves.
6. Adjust operating controls including pressure settings.

3.013 TRAINING

A. General: At a time mutually agreed upon between the Owner and Contractor, provide the services of a factory trained and authorized representative to train Owner's designated personnel for a minimum of [two] [four] [eight] hours on the operation and maintenance of the equipment provided under this section.

B. Content: Training shall include but not be limited to:

1. Overview of the system and/or equipment as it relates to the facility as a whole.
2. Operation and maintenance procedures and schedules related to startup and shutdown, troubleshooting, servicing, preventive maintenance and appropriate operator intervention.
3. Review data included in the operation and maintenance manuals. Refer to Division 1 Section "Operating and Maintenance Data."

C. Certification: Contractor shall submit to the Engineer a certification letter stating that the Owner’s designated representative has been trained as specified herein. Letter shall include date, time, attendees and subject of training. The certification letter shall be signed by the Contractor and the Owner’s representative indicating agreement that the training has been provided.

D. Schedule: Schedule training with Owner with at least 7 days' advance notice.

END OF SECTION

PART 1 - GENERAL REQUIREMENTS

1.01 SUMMARY

A. This Section includes commercial water filtering equipment.

1. Control wiring between field-installed controls, indicating devices, and unit control panels.

B. Related Sections: The following Sections contain requirements that relate to this Section:

1. Division 3 Section "Concrete Work" for formwork, reinforcement, and concrete for concrete bases.
2. Refer to Division 22 Section “Basic Piping Materials and Methods” for unions and dielectric unions.
3. Refer to Division 26 Section "Electrical Connections for Equipment" for power-supply wiring including field-installed disconnects and required electrical devices.

C. Related Sections

1. Section 01357 Sustainable Design Project Requirements

1.02 SUBMITTALS

A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections.

1. Product data including rated capacities of selected models, weights (shipping, installed, and operating), dimensions, furnished specialties, and accessories.
2. Wiring diagrams detailing field-installed wiring for power and controls.
3. Maintenance data for inclusion in Operating and Maintenance Manual specified in Division 1 and Division 15 Section "General Mechanical Requirements."

1.03 QUALITY ASSURANCE

A. Electrical Component Standard: Provide components complying with NFPA 70 "National Electrical Code."

B. NSF-61 Compliant Listing and Labeling: Provide water filtering equipment that is listed or labeled.

1. The terms "listed" and "labeled" shall be as defined in the National Electrical Code, Article 100.
2. Listing and Labeling Agency Qualifications: A "Nationally Recognized Testing Laboratory" (NRTL) as defined in OSHA Regulation 1910.7.
3. Provide mineral products for water filters, acceptable under state and local public health control regulations.

C. UL Compliance: Control panels shall be listed and labeled by UL and comply with Standard 508A “Control Panels”.

D. NEMA Compliance: Electric motors and components shall be listed and labeled NEMA.

E. Manufacturer/Product Selection: The Drawings indicate sizes, profiles, and dimensional requirements of water filters and are based on the specific types and models indicated. Water filters having equal performance characteristics by other manufacturers may be considered provided that deviations in dimensions and profiles do not change the design concept or intended performance. The burden of proof of equality is on the proposer.

1.04 WARRANTY

1. A single written warranty must be provided from the manufacturer of the water filter system covering workmanship and materials for the complete system for a minimum of (1) year.

PART 2 - PRODUCTS AND MATERIALS

2.01 APPROVED MANUFACTURERS

A. Point-of-Entry Filtration System

1. Easy Water

2. Harmsco
3. Hayward
4. U.S. Filter
5. Shelco

2.02 GENERAL DESCRIPTION

A. Provide commercial water filters having capacities as scheduled on the drawings.

2.03 POINT-OF-ENTRY FILTRATION SYSTEM (BAG FILTERS)

ToxinShield with No-Salt Conditioner and UV Treatment

a) Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1) EasyWater, Inc. www.easywater.com

b) Description: EasyWater, Model TS-2472-1.5C-TA-NSC-UV-S

1) System must include:

a) 30gpm, twin alternating self-backwashing ToxinShield filtration system

b) 30gpm monitored ultraviolet (UV) sanitization

c) 30gpm Electronic descaling system treatment for all domestic cold water. Electronic descaling technology must include a pre-wrapped and pre-flanged CPVC treatment spool and control panel with heat dissipating fins

d) Skid mounted, pre-plumbed and pre-wired with a single electrical disconnect

PART 3 - EXECUTION

3.01 CONCRETE EQUIPMENT BASES

A. General: Construct concrete equipment bases in accordance with Section "Basic Mechanical Materials and Methods" for setting of equipment.

3.02 WATER FILTER INSTALLATION

A. Install water filtering equipment level and plumb, on concrete bases in accordance with manufacturer's written instructions, layout drawings, the original design, and referenced standards. Maintain manufacturer's recommended clearances. Orient so controls and devices needing servicing are accessible.

B. Install pressure gauges on water inlet and outlet piping of each water softener. Pressure gauges are specified in Division 22 Section "Meters and Gauges."

C. Install water testing sets near water filters, wall-mounted, where indicated.

D. Install vacuum relief valve on supply piping to filter where indicated on the drawings. Vacuum relief valves are specified in Division 22 Section "Water Heaters."

3.03 CONNECTIONS

A. Water Distribution Piping: Piping installation requirements are specified in Division 22 Section "Water Distribution Piping." The Drawings indicate the general arrangement of piping, fittings, and specialties. The following are specific connection requirements:

1. Install piping adjacent to equipment to allow servicing and maintenance.
2. Connect water piping to units with shutoff valves and unions and provide full-size valved bypass around unit.

    a) Where water connections are made with dissimilar metal water distribution piping, make connections with dielectric fittings or dielectric unions specified in Division 15 Section "Basic Piping Materials and Methods."

3. Install drains as indirect wastes to spill into open drains or over floor sinks.

B. Install fittings furnished by manufacturer but not specified to be factory mounted.

1. Grounding: Connect unit components to ground in accordance with the National Electrical Code.

3.04 DEMONSTRATION

A. Start-Up Services: Provide the services of a factory-authorized service representative to provide start-up service and to demonstrate the operation of the equipment, accessories and controls.

1. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

3.05 STARTUP

A. Perform the following before start-up final checks in the presence of an authorized factory representative:

1. Water piping systems tests completed.
2. Check for piping connections leaks.
3. Test operation of safety controls and devices.
4. Start up, test, and adjust water filter. Operate units including service, backwash, and rinsing. Adjust unit to maintain required steady state effluent water quality.

B. Certification: CONTRACTOR shall submit to the Engineer a certification letter stating that the filter has been installed and tested per the manufacturer’s installation instructions and signed by the authorized factory representative.

3.06 TRAINING

A. General: At a time mutually agreed upon between the OWNER and CONTRACTOR, provide the services of a factory trained and authorized representative to train OWNER's designated personnel for a minimum of eight hours on the operation and maintenance of the equipment provided under this section.

B. Content: Training shall include but not be limited to:

1. Overview of the system and/or equipment as it relates to the facility as a whole.
2. Operation and maintenance procedures and schedules related to startup and shutdown, troubleshooting, servicing, preventive maintenance and appropriate operator intervention.
3. Review data included in the operation and maintenance manuals. Refer to Division 1 Section "Operating and Maintenance Data."

4. Testing of effluent.

C. Certification: CONTRACTOR shall submit to the Engineer a certification letter stating that the OWNER's designated representative has been trained as specified herein. Letter shall include date, time, attendees and subject of training. The certification letter shall be signed by the CONTRACTOR and the OWNER's representative indicating agreement that the training has been provided.

D. Schedule: Schedule training with OWNER with at least 7 days' advance notice.

END OF SECTION

PART 1 - GENERAL REQUIREMENTS

1.01 SUMMARY

A. This Section includes electric water heaters.

B. Related Sections: The following Sections contain requirements that relate to this Section:

1. Division 3 Section "Concrete Work" for specifications on concrete and reinforcing materials and concrete placing requirements for equipment pads.
2. Division 22 Section “Common Work Results for Plumbing” for concrete equipment pads.
3. Division 22 Section "Basic Piping Materials and Methods" for pipe joining materials, unions, dielectric unions, dielectric flanges, dielectric flange kits and basic installation requirements.
4. Division 22 Section "Meters and Gauges for Plumbing Piping." for thermometers and their installation requirements.
5. Division 26 Section “Common Work Results for Electrical” required electrical devices.
6. Division 26 Section "Enclosed Switches and Circuit Breakers" for field-installed disconnects.

1.02 SUBMITTALS

A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections.

1. Product data including rated capacities of selected models, weights (shipping, installed, and operating), furnished specialties, and accessories, and indicating dimensions, required clearances, and methods of assembly of components, and piping and wiring connections.
2. Wiring diagrams from manufacturers detailing electrical requirements for electrical power supply wiring to water heaters. Include ladder-type wiring diagrams for interlock and control wiring required for final installation of water heaters and controls. Differentiate between portions of wiring that are factory installed and portions that are to be field installed.
3. Maintenance data for inclusion in Operating and Maintenance Manual specified in Division 1 and Division 22 Section "General Plumbing Requirements."

1.03 QUALITY ASSURANCE

A. UL Standards: Provide water heaters complying with the following:

1. UL 174, "Household Electric Storage Tank Water Heaters."
2. UL 778, "Motor Operated Water Pumps."

3. UL 1453, "Electric Booster and Commercial Storage Tank Water Heaters."

B. Electrical Component Standard: Provide components complying with NFPA 70 "National Electrical Code."

C. Listing and Labeling: Provide water heaters that are listed and labeled.

1. The terms "listed" and "labeled" shall be as defined in the National Electrical Code, Article 100.
2. Listing and Labeling Agency Qualifications: A "Nationally Recognized Testing Laboratory" (NRTL) as defined in OSHA Regulation 1910.7.

D. State Boiler Code Compliance: Provide rated water heaters, safety relief valve and accessories that comply with the state boiler code in effect.

E. ASHRAE Standards: Provide water heaters with performance efficiencies not less than prescribed in ASHRAE 90.1b, "Energy Conservation in New Building Design."

F. Design Concept: The drawings indicate types and capacities of water heaters and are based on specific descriptions and manufacturers indicated. Water heaters having equal performance characteristics by other manufacturers may be considered provided that deviations in capacities, dimensions, operation, or other characteristics are minor and do not change the design concept or intended performance as judged by the Architect. Burden of proof for equality of water heaters is on the proposer.

1.04 WARRANTY

A. Special Project Warranty: Submit a written warranty, executed by manufacturer, agreeing to repair or replace water heater units that fail in materials or workmanship within the specified warranty period. Failures include, but are not limited to, controls, tanks, and coils. This warranty shall be in addition to, and not a limitation of, other rights the Owner may have against the Contractor under the Contract Documents.

1. Commercial Electric Water Heaters:

a) Tank: Three years
b) Controls and Other Components: One year

PART 2 - PRODUCTS AND MATERIALS

2.01 MANUFACTURERS

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

1. Commercial Electric Water Heaters:

a) Bock Waters Heaters, Inc]
b) Bradford-White Corp.
c) Hubbel Water Heater
d) Lochinvar Water Heater Corp.
e) Rheem Mfg.
f) Ruud Mfg. Div of Rheem Mfg.
g) A.O. Smith Water Products Co. Div.; A.O. Smith Corp.
h) State Industries, Inc.
i) HTP Comfort Solutions, LLC

2. Thermal Expansion Tanks

a) Armstrong Pumps, Inc.
b) Amtrol, Inc.
c) Bell & Gosset, ITT
d) Elbi
e) TACO, Inc.
f) Watts
g) Wessels Tank Co.

3. Vacuum Relief Valves

a) Apollo #37
b) Cash ACME #VR-801
c) Watts #N36
d) Wilkins #VR-10

4. Water Heater Drain Pans

a) Holdrite
b) Killarney Metals
c) Oatey

2.02 ELECTRIC WATER HEATERS

A. Description: Automatic, commercial, electric; with vertical, 150-psig-rated storage tank, integral controls, drain valve, and relief valve.

B. Insulation: Fiberglass or polyurethane foam, surrounding tank.

C. Jacket: Steel, with baked-on enamel finish.

D. Tank: Glass-lined steel with anode rods and drain valve.

E. Heating Elements: Screw-in or flanged bolt-in immersion type, in multiples as described on the drawings.

F. Controls: Adjustable surface mounted thermostats.

G. Controls: Adjustable immersion thermostats.

H. Safety Controls: Automatic, high-temperature-limit cutoff.

I. Temperature and Pressure Relief Valve: Lead free brass body meeting ANSI Z21.22.

2.03 THERMAL EXPANSION TANKS

A. Thermal Expansion Tanks: Provide size and number as indicated; construct of welded carbon steel listed for 150 psig working pressure, 200 deg F maximum operating temperature. Separate air charge from system water to maintain design expansion capacity, by means of a FDA approved butyl rubber diaphragm securely sealed into tank. Provide taps for pressure gauge and air charging fitting, and drain fitting. Support vertical tanks with steel legs or base.

2.04 VACUUM RELIEF VALVES

A. Lead free brass body meeting ANSI Z21.22 with silicon disc. Valve shall open at 0.5 inches HG vacuum and be rated for 200 psig working pressure and 250 F operating temperature.

2.05 PRESSURE RELIEF VALVES

A. Pressure Relief Valve: 1/2” lead free brass body meeting ANSI Z21.22 with screwed ends, stainless steel spring and factory set to relieve at 100 psig.

2.06 WATER HEATER DRAIN PANS

A. Galvanized steel or aluminum with outside diameter minimum 2” greater than water heater diameter, with 3/4” screwed drain outlet.

PART 3 - EXECUTION

3.01 WATER HEATER INSTALLATION

A. Install in accordance with manufacturer’s instructions.

B. General: Install water heaters on concrete equipment bases. Set and connect units in accordance with manufacturer's written instructions. Install units plumb and level, firmly anchored in locations indicated, and maintain manufacturer's recommended clearances. Orient so controls and devices needing servicing are accessible.

C. Install thermometers on water heater outlet piping. Thermometers and their installation requirements, are specified in Division 22 Section "Meters and Gauges for Plumbing Piping."

D. Install temperature and pressure relief valve furnished with water heater. The temperature shall be normally set to relieve at 210F and the pressure relief shall be

equal to the tank pressure rating. Install line size relief valve discharge line to discharge to an approved receptor with air gap.

E. Vacuum Relief Valve: Install in cold water supply to each water heater downstream of the shutoff and check valves.

F. Water Heater Drain Pan: Install under water heater on wall or ceiling supports or resting on elevated floor slabs. Install drain pan drain line to discharge to an approved receptor with air gap.

3.02 CONCRETE EQUIPMENT BASES

A. Construct concrete equipment bases in accordance with Division 22 Section "Common Work Results for Plumbing" for concrete and setting of equipment.

3.03 EXPANSION TANK INSTALLATION

A. Install in-line expansion tanks in the vertical position. Install in-line expansion tank in the horizontal position when allowed by manufacturer and provided with required supports.

B. Install stand mounted expansion tanks on concrete equipment bases.

C. Charge expansion tank bladder with air to a pressure equal to the domestic water static pressure.

3.04 CONNECTIONS

A. Piping installation requirements are specified in other Sections of Division 22. The Drawings indicate general arrangement of piping, fittings, and specialties. The following are specific connection requirements:

1. Install piping adjacent to equipment arranged to allow servicing and maintenance.
2. Connect hot and cold water piping to units with shutoff valves and unions. Connect hot water circulating piping to unit with shutoff valve, check valve, and union. Extend relief valve discharge to closest floor drain.
    a) Where water heater piping connections are dissimilar metals, install dielectric waterway fittings or dielectric unions for joints 2" and smaller and install dielectric flanges for joints 2-1/2" and larger. Dielectric waterway fittings, unions and flanges are specified in Division 22 Section "Basic Piping Materials and Methods."
    b) Install vacuum relief valve in cold water inlet piping.
3. Install drain as indirect waste to spill into open drain or over floor drain.
    a) Install drain valve at low point in water piping, for water heaters not having tank drain.

4. Install heat traps at inlet and outlet of each water heater storage tank. Heat trap shall be made of elbows and piping. Heat trap shall turn down to 12" below the outlet or inlet, run 12" horizontal and turn up to the cold water to the heater or hot water from the heater. Where multiple tanks are connected with a manifold, a single heat trap may be provided at the connection of the cold water supply to the cold water manifold together.

B. Electrical Connections:

1. Power wiring is specified in Division 26 Section "Common Work Results for Electrical"
2. Field-installed disconnects are specified in Division 26 Sections "Enclosed Switches and Circuit Breakers".
3. Grounding: Connect unit components to ground in accordance with the National Electrical Code.

3.05 FIELD QUALITY CONTROL

A. General: Provide the services of a factory-authorized service representative to test and inspect unit installation, provide start-up service, and demonstrate operation of equipment as specified below.

1. Test and adjust operating and safety controls. Replace damaged and malfunctioning controls and equipment.

3.06 STARTUP

A. Perform the following before start-up final checks:

1. Fill water heaters with water.
2. Piping systems test complete.
3. Check for piping connections leaks.
4. Test operation of safety controls and devices.

B. Perform the following start-up procedures:

1. Energize circuits.
2. Adjust operating controls.
3. Adjust hot water outlet temperature setting.

3.07 TRAINING

A. General: At a time mutually agreed upon between the Owner and Contractor, provide the services of a factory trained and authorized representative to train Owner's designated personnel for a minimum of two hours on the operation and maintenance of the equipment provided under this section.

B. Content: Training shall include but not be limited to:

1. Overview of the system and/or equipment as it relates to the facility as a whole.
2. Operation and maintenance procedures and schedules related to startup and shutdown, troubleshooting, servicing, preventive maintenance and appropriate operator intervention.
3. Review data included in the operation and maintenance manuals. Refer to Division 1 Section "Operating and Maintenance Data."

C. Certification: Contractor shall submit to the Engineer a certification letter stating that the Owner's designated representative has been trained as specified herein. Letter shall include date, time, attendees and subject of training. The certification letter shall be signed by the Contractor and the Owner's representative indicating agreement that the training has been provided.

D. Schedule: Schedule training with Owner with at least 7 days' advance notice.

END OF SECTION

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PART 1 - GENERAL REQUIREMENTS

1.01 SUMMARY

A. This Section includes commercial gas fired water heaters.

B. Related Sections: The following Sections contain requirements that relate to this Section:

1. Division 3 Section "Concrete Work" for specifications on concrete and reinforcing materials and concrete placing requirements for equipment pads.
2. Division 22 Section “Common Work Results for Plumbing” for concrete equipment pads.
3. Division 22 Section "Basic Piping Materials and Methods" for flexible metal braid connectors, pipe joining materials, specialties, unions, dielectric unions, dielectric flanges, dielectric flange kits and basic installation requirements.
4. Division 22 Section "Meters and Gauges for Plumbing Piping." for thermometers and their installation requirements.
5. Division 22 Section “Natural Gas Piping” for natural gas equipment connections.
6. Division 23 Section "Breechings, Chimneys, and Stacks" for gas-fired water heater vents.
7. Division 26 Section “Common Work Results for Electrical” required electrical devices.
8. Division 26 Sections "Enclosed Switches and Circuit Breakers" for field-installed disconnects.

1.02 SUBMITTALS

A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections.

1. Product data including rated capacities of selected models, weights (shipping, installed, and operating), furnished specialties, and accessories, and indicating dimensions, required clearances, and methods of assembly of components, and piping and wiring connections.
2. Wiring diagrams from manufacturers detailing electrical requirements for electrical power supply wiring to water heaters. Include ladder-type wiring diagrams for interlock and control wiring required for final installation of water heaters and controls. Differentiate between portions of wiring that are factory installed and portions that are to be field installed.
3. Certificates of shop inspection and data report as required by provisions of the ASME Boiler and Pressure Vessel Code.

4. Maintenance data for inclusion in Operating and Maintenance Manual specified in Division 1 and Division 22 Section "General Plumbing Requirements."

1.03 QUALITY ASSURANCE

A. UL Standards: Provide water heaters complying with the following:

1. UL 778, "Motor Operated Water Pumps."

B. NSF Standards: Provide water heaters complying with NSF No. 5, "Standard for Hot Water Generating Equipment for Food Service Establishments using Spray Type Dishwashing Machines," and bearing NSF label.

C. Electrical Component Standard: Provide components complying with NFPA 70 "National Electrical Code."

D. Listing and Labeling: Provide water heaters that are listed and labeled.

1. The terms "listed" and "labeled" shall be as defined in the National Electrical Code, Article 100.
2. Listing and Labeling Agency Qualifications: A "Nationally Recognized Testing Laboratory" (NRTL) as defined in OSHA Regulation 1910.7.

E. AGA Standards: Provide water heaters that bear the label of the American Gas Association.

F. ASME Code Compliance: Provide water heaters and safety relief valves that comply with ASME Boiler and Pressure Vessel Code and that bear the appropriate code symbols.

G. State Boiler Code Compliance: Provide rated water heaters, safety relief valve, gas train and accessories that comply with the state boiler code in effect.

H. ASHRAE Standards: Provide water heaters with performance efficiencies not less than prescribed in ASHRAE 90.1b, "Energy Conservation in New Building Design."

I. Design Concept: The drawings indicate types and capacities of water heaters and are based on specific descriptions and manufacturers indicated. Water heaters having equal performance characteristics by other manufacturers may be considered provided that deviations in capacities, dimensions, operation, or other characteristics are minor and do not change the design concept or intended performance as judged by the Architect. Burden of proof for equality of water heaters is on the proposer.

1.04 WARRANTY

A. Special Project Warranty: Submit a written warranty, executed by manufacturer, agreeing to repair or replace water heater units that fail in materials or workmanship within the specified warranty period. Failures include, but are not limited to, controls, tanks, coils, heat exchangers, and burners. This warranty shall be in addition to, and not a limitation of, other rights the Owner may have against the Contractor under the Contract Documents.

1. Commercial, Finned-Tube, Gas Fired Water Heaters:

a) Heat Exchanger: Five years.
b) Controls and Other Components: One year.
c) Separate Hot-Water Storage Tanks: Five years.

PART 2 - PRODUCTS AND MATERIALS

2.01 MANUFACTURERS

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

1. Commercial Gas-Fired Copper Finned-Tube Water Heaters:

a) A.O. Smith Water Products Co. Div.; A.O. Smith Corp.
b) Laars.
c) Lochinvar Water Heater Corp.
d) Raypak, Inc.
e) RBI.

2. Thermal Expansion Tanks

a) Armstrong Pumps, Inc.
b) Amtrol, Inc.
c) Bell & Gosset, ITT
d) Elbi
e) TACO, Inc.

3. Pressure Relief Valves

a) Apollo #16LF-202
b) Cash ACME #FW
c) Watts #LF53
d) Wilkins #P1520XL

4. Vacuum Relief Valves

a) Apollo #37
b) Cash ACME #VR-801
c) Watts #N36
d) Wilkins #VR-10

B. Temperature and Pressure Relief Valve: Lead free brass body meeting ANSI Z21.22.

2.02 GAS-FIRED COPPER FINNED-TUBE WATER HEATERS

A. Description: Automatic, commercial, gas-fired, ASME labeled, copper finned-tube heat exchanger; with integral controls, draft diverter, gas burner, gas train including gas regulator, ASME labeled storage tank, and circulating pump.

1. Heat Exchanger Headers: ASME Boiler Pressure Vessel Code Section 4 160-psig rated bronze or glass-lined, cast iron.

B. Water Heater Insulation: Manufacturer's standard insulation.

C. Storage Tank: ASME Boiler Pressure Vessel Code Section 8 150-rated, glass-lined steel, with anode rods and temperature and pressure relief valve.

D. Storage Tank Insulation: Fiberglass surrounding tank.

E. Water Heater and Storage Tank Jackets: Steel, with baked-on enamel finish.

F. Circulating Pump: All bronze, inline, centrifugal, single-stage, radially split case design, with mechanical seals, and rated for 125 psig working pressure and 225 deg F continuous water temperature.

G. Controls: Adjustable storage tank temperature control fitting with immersion thermostat and Intermittent electronic ignition.

H. Safety Controls: Automatic gas shutoff device to shut off entire gas supply in event of excessive temperature, low water cutout, low gas pressure, low air pressure and flow switch to verify circulating pump operation.

I. Temperature and Pressure Relief Valve: Lead free brass body meeting ANSI Z21.22.

2.03 THERMAL EXPANSION TANKS

A. ASME Thermal Expansion Tanks: Provide size and number as indicated; construct of welded carbon steel ASME labeled for 150 psig working pressure, 200 deg F maximum operating temperature. Separate air charge from system water to maintain design expansion capacity, by means of a FDA approved butyl rubber diaphragm securely sealed into tank. Provide taps for pressure gauge and air charging fitting, and drain fitting. Support vertical tanks with steel legs or base. Tank, with taps and supports, shall be constructed, tested, and labeled in accordance with ASME Pressure Vessel Code, Section VIII, Division 1.

B. Thermal Expansion Tanks: Provide size and number as indicated; construct of welded carbon steel listed for 150 psig working pressure, 200 deg F maximum

operating temperature. Separate air charge from system water to maintain design expansion capacity, by means of a FDA approved butyl rubber diaphragm securely sealed into tank. Provide taps for pressure gauge and air charging fitting, and drain fitting. Support vertical tanks with steel legs or base.

2.04 VACUUM RELIEF VALVES

A. Lead free brass body meeting ANSI Z21.22 with silicon disc. Valve shall open at 0.5 inches HG vacuum and be rated for 200 psig working pressure and 250 F operating temperature.

2.05 PRESSURE RELIEF VALVES

A. Pressure Relief Valve: ½" lead free brass body meeting ANSI Z21.22 with screwed ends, stainless steel spring and factory set to relieve at 100 psig

PART 3 - EXECUTION

3.01 WATER HEATER INSTALLATION

A. Install in accordance with manufacturer's installation instructions.

B. General: Install water heaters on concrete equipment bases. Set and connect units in accordance with manufacturer's installation-instructions. Install units plumb and level, firmly anchored in locations indicated, and maintain manufacturer's recommended clearances. Orient so controls and devices needing servicing are accessible.

C. Install thermometers on water heater outlet piping. Thermometers are specified in Division 22 Section "Meters and Gauges for Plumbing Piping."

D. NFPA Compliance: Install gas-fired water heaters in compliance with NFPA 54, "National Fuel Gas Code."

E. NFPA Compliance: Install oil-fired water heaters in compliance with NFPA 31, "Installation of Oil Burning Equipment."

F. Install temperature and pressure relief valve furnished with water heater. The temperature shall be normally set to relieve at 210F and the pressure relief shall be equal to the tank pressure rating. Install line size relief valve discharge line to discharge to an approved receptor with air gap.

G. Vacuum Relief Valve: Install in cold water supply to each water heater downstream of the shutoff and check valves.

H. Water Heater Drain Pan: Install under water heater on wall or ceiling supports or resting on elevated floor slabs. Install drain pan drain line to discharge to an approved receptor with air gap.

I. Install pressure relief valve on cold water supply to water heater downstream of shutoff and check valves. The pressure relief shall be factory set to 100 psig. Install line size relief valve discharge line to discharge to an approved receptor with air gap.

J. Install condensate neutralization kit furnished with water heater condensate drain downstream of trap at condensate connection. Fill kit with water heater manufacturer recommended neutralization media.

3.02 CONCRETE EQUIPMENT BASES

A. Construct concrete equipment bases in accordance with Section “Basic Mechanical Materials and Methods” for setting of equipment.

3.03 EXPANSION TANK INSTALLATION

A. Install in-line expansion tanks in the vertical or horizontal position (where allowed by manufacturer). Where tanks are installed in horizontal position, provide supports per manufacturer requirements.

B. Install stand mounted expansion tanks on concrete equipment bases.

C. Charge expansion tank bladder with air to a pressure equal to the domestic water static pressure.

3.04 CONNECTIONS

A. Piping installation requirements are specified in other Sections of Division 22. The Drawings indicate general arrangement of piping, fittings, and specialties. The following are specific connection requirements:

1. Install piping adjacent to equipment arranged to allow servicing and maintenance.
2. Connect hot and cold water piping to units with shutoff valves and unions. Connect hot water circulating piping to unit with shutoff valve, check valve, and union. Extend relief valve discharge to closest floor drain.
    a) Where water heater piping connections are dissimilar metals, install dielectric waterway fittings or dielectric unions for joints 2” and smaller and dielectric flanges for joints 2-1/2” and larger. Dielectric waterway fittings, unions and flanges are specified in Division 22 Section "Basic Piping Materials and Methods."
    b) Install vacuum relief valve in cold water inlet piping.
3. Connect gas supply piping to burner with drip leg, tee, gas cock, and union; minimum size same as inlet connection. Arrange piping to allow unit servicing. Gas piping is specified in Division 22 Section “Natural Gas Piping”.

a) Install vent piping from gas train pressure regulators and valves to outside the building. Terminate vent piping with brass screened vent cap fitting. Do not combine vents except with approval of local authority.

b) Install gas pressure regulators where indicated.

4. Install drain as indirect waste to spill into open drain or over floor drain.

   a) Install drain valve at low point in water piping, for water heaters not having tank drain.

5. Install heat traps at inlet and outlet of each water heater storage tank. Heat trap shall be made of elbows and piping. Heat trap shall turn down to 12" below the outlet or inlet, run 12" horizontal and turn up to the cold water to the heater or hot water from the heater. Where multiple tanks are connected with a manifold, a single heat trap may be provided at the connection of the cold water supply to the cold water manifold together.

B. Electrical Connections:

1. Power wiring is specified in Division 26 Section "Common Work Results for Electrical"
2. Field-installed disconnects are specified in Division 26 Sections "Enclosed Switches and Circuit Breakers".
3. Grounding: Connect unit components to ground in accordance with the National Electrical Code.

C. Vent Connections: Connect gas-fired water heater draft hood to the vent system. Unless otherwise indicated provide vent same size as outlet on heater. Comply with gas utility requirements.

1. Vents are specified in Division 23 Section "Breechings, Chimneys, and Stacks."

3.05 FIELD QUALITY CONTROL

A. General: Provide the services of a factory-authorized service representative to test and inspect unit installation, provide start-up service, and demonstrate operation of equipment as specified below.

1. Test and adjust operating and safety controls. Replace damaged and malfunctioning controls and equipment.

3.06 STARTUP

A. Perform the following before start-up final checks:

1. Fill water heaters with water.
2. Piping systems test complete.
3. Check for piping connections leaks.
4. Check for adequate combustion air.

5. Check for clear vent.
6. Test operation of safety controls and devices.

B. Perform the following start-up procedures:

1. Energize circuits.
2. Adjust operating controls.
3. Adjust hot water outlet temperature setting.

3.07 TRAINING

A. General: At a time mutually agreed upon between the Owner and Contractor, provide the services of a factory trained and authorized representative to train Owner's designated personnel for a minimum of two hours on the operation and maintenance of the equipment provided under this section.

B. Content: Training shall include but not be limited to:

1. Overview of the system and/or equipment as it relates to the facility as a whole.
2. Operation and maintenance procedures and schedules related to startup and shutdown, troubleshooting, servicing, preventive maintenance and appropriate operator intervention.
3. Review data included in the operation and maintenance manuals. Refer to Division 1 Section "Operating and Maintenance Data."

C. Certification: Contractor shall submit to the Engineer a certification letter stating that the Owner’s designated representative has been trained as specified herein. Letter shall include date, time, attendees and subject of training. The certification letter shall be signed by the Contractor and the Owner’s representative indicating agreement that the training has been provided.

D. Schedule: Schedule training with Owner with at least 7 days' advance notice.

END OF SECTION

PART 1 - GENERAL REQUIREMENTS

1.01 SUMMARY

A. This Section includes plumbing fixtures and trim, fittings, and accessories, appliances, appurtenances, equipment, and supports associated with plumbing fixtures.

B. Related Sections: The following Sections contain requirements that relate to this Section:

1. Division 7 Section "Joint Sealers," for materials and methods for sealing between plumbing fixtures and interior walls.
2. Division 10 Section "Service Wall Systems" for wall modules with built-in plumbing fixtures.
3. Division 22 Section "General Duty Valves for Plumbing Piping" for valves used as supply stops.

C. Products furnished but not installed under this Section include:

1. Plumbing fittings (including faucets) and piping indicated, for fixtures, appliances, appurtenances, and equipment provided by Owner.
2. Plumbing fittings (including faucets) and piping indicated, for fixtures, appliances, appurtenances, and equipment specified in other Sections.

D. Products installed but not furnished under this Section include:

1. Owner furnished fixtures, as indicated.
2. Accessories, appliances, appurtenances, and equipment specified in other Sections, requiring plumbing services or fixture-related devices, as indicated.

1.02 DEFINITIONS

A. Accessible: Describes a plumbing fixture, building, facility, or portion thereof that can be approached, entered, and used by physically handicapped people.

B. Accessory: Device that adds effectiveness, convenience, or improved appearance to a fixture but is not essential to its operation.

C. Appliance: Device or machine designed and intended to perform a specific function.

D. Appurtenance: Device or assembly designed to perform some useful function when attached to or used with a fixture.

E. Equipment: Device used with plumbing fixtures or plumbing systems to perform a certain function for plumbing fixtures but that is not part of the fixture.

F. Fitting: Fitting installed on or attached to a fixture to control the flow of water into or out of the fixture.

G. Fixture: Installed receptor connected to the water distribution system, that receives and makes available potable water and discharges the used liquid or liquid-borne wastes directly or indirectly into the drainage system. The term "Fixture" means the actual receptor, except when used in a general application where terms "Fixture" and "Plumbing Fixture" include associated trim, fittings, accessories, appliances, appurtenances, support, and equipment.

H. Roughing-In: Installation of piping and support for the fixture prior to the actual installation of the fixture.

I. Support: Device normally concealed in building construction, for supporting and securing plumbing fixtures to walls and structural members. Supports for urinals, lavatories, and sinks are made in types suitable for fixture construction and the mounting required. Categories of supports are:

1. Carrier: Floor-mounted support for wall-mounted water closet, and support fixed to wall construction for wall-hung fixture.
2. Chair Carrier: Support for wall-hung fixture, having steel pipe uprights that transfer weight to the floor.
3. Chair Carrier, Heavy Duty: Support for wall-hung fixture, having rectangular steel uprights that transfer weight to the floor.
4. Reinforcement: Wood blocking or steel plate built into wall construction, for securing fixture to wall.

J. Trim: Hardware and miscellaneous parts, specific to a fixture and normally supplied with it required to complete fixture assembly and installation.

K. Lead Free: Refers to the wetted surface of pipe, fittings and fixtures in potable water systems that have a weighted average lead content ≤0.25% per Safe Drinking Water Act as amended January 4th 2011 Section 1417.

1.03 SUBMITTALS

A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections.

1. Product data for each type of plumbing fixture specified, including fixture and trim, fittings, accessories, appliances, appurtenances, equipment, supports, construction details, dimensions of components, and finishes.
2. Wiring diagrams for field-installed wiring of electrically operated units.
3. Maintenance data for inclusion in Operating and Maintenance Manual specified in Division 1 and Division 22 Section "General Plumbing Requirements."

B. Submit third party certification that faucets and trim for domestic water distribution for drinking or cooking comply with NSF 61 Annex G and / or NSF 372. The following faucets and trim need not comply:

1. Electronic faucets
2. Service sink faucets
3. Flush valves
4. Shower valves and heads

1.04 QUALITY ASSURANCE

A. Regulatory Requirements: Comply with requirements of ICC Standard A117.1, “Accessible and Usable Buildings and Facilities" and "2010 ADA Standards for Accessible Design" with respect to plumbing fixtures for individuals with disabilities.

B. Regulatory Requirements: Comply with requirements of ATBCB (Architectural and Transportation Barriers Compliance Board) "Uniform Federal Accessibility Standards (UFAS) - 1985-494-187" with respect to plumbing fixtures for the physically handicapped.

C. Listing and Labeling: Provide electrically operated fixtures specified in this Section that are listed and labeled.

1. The terms "listed" and "labeled" shall be as defined in the National Electrical Code, Article 100.

2. Listing and Labeling Agency Qualifications: A "Nationally Recognized Testing Laboratory" (NRTL) as defined in OSHA Regulation 1910.7.

D. Comply with NSF 61 Annex G and / or NSF 372 for wetted surfaces of faucets and trim containing no more than 0.25% lead by weight for domestic water distribution for drinking or cooking.

E. Design Concept: The drawings indicate types of plumbing fixtures and are based on the specific descriptions, manufacturers, models, and numbers indicated. Plumbing fixtures having equal performance characteristics by other manufacturers may be considered provided that deviations in dimensions, operation, color or finish, or other characteristics are minor and do not change the design concept or intended performance as judged by the Architect. Burden of proof for equality of plumbing fixtures is on the proposer.

1.05 SPARE PARTS

A. Deliver spare parts to Owner. Furnish spare parts described below matching products installed, packaged with protective covering for storage, and identified with labels clearly describing contents.

B. Faucet Washers and O-rings: Furnish quantity of identical units not less than 10 percent of amount of each installed.

C. Faucet Cartridges and O-rings: Furnish quantity of identical units not less than 5 percent of amount of each installed.

D. Flushometer Repair Kits: Furnish quantity of identical units not less than 10 percent of amount of each flushometer installed.

E. Provide individual metal boxes or a hinged-top wood or metal box having separate compartments for each type and size of above extra materials.

F. Toilet Seats: Furnish quantity of identical units not less than 5 percent of amount of each type toilet seat installed.

PART 2 - PRODUCTS AND MATERIALS

2.01 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products in each category, by one of the following listed for that category:

1. Water Closets:

   a) American Standard, Inc.
   b) Kohler Co.
   c) Sloan Valve Co.
   d) TOTO KIKI USA, Inc.
   e) Zurn Plumbing Products Group

2. Urinals:

   a) American Standard, Inc.
   b) Kohler Co.
   c) Sloan Valve Co.
   d) TOTO KIKI USA, Inc.
   e) Zurn Plumbing Products Group

3. Lavatories:

   a) American Standard, Inc.
   b) Kohler Co.
   c) Sloan Valve Co.
   d) TOTO KIKI USA, Inc.
   e) Zurn Plumbing Products Group

4. Sinks:

   a) Elkay Manufacturing Co.
   b) Franke
   c) Just Manufacturing Co.

5. Mop Basins:

    a) Acorn Engineering Co.
    b) Fiat Products.
    c) Stern-Williams Co., Inc.

6. Water Coolers:

    a) Acorn / Aqua
    b) Elkay Manufacturing Co.
    c) Halsey Taylor; A Household International Co.
    d) Haws Drinking Faucet Co.

7. Outlet Boxes:

    a) Guy Gray Manufacturing Co., Inc.
    b) Symmons Industries, Inc.
    c) Oatey Co.

8. Emergency Equipment:

    a) Bradley Corp.
    b) Chicago Faucet Co.
    c) ENCON Safety Products
    d) Guardian Equipment.
    e) Haws Drinking Faucet Co.
    f) Speakman Co.
    g) Stingray Systems
    h) Water Saver Faucet Co.

9. Toilet Seats:

    a) Bemis Mfg. Co.
    b) Beneke Div.; Sanderson Plumbing Products, Inc.
    c) Church Seat Co.
    d) Kohler Co.
    e) Olsonite Corp.
    f) Sperzel Industries, Inc.

10. Flushometers:

    a) Sloan Valve Co.
    b) Zurn Industries, Inc.; Flush Valve Operations.

11. Commercial/Industrial Cast-Brass Faucets:

    a) Chicago Faucet Co.
    b) Delta-Commercial
    c) Kohler Co.
    d) Speakman Co.
    e) T & S Brass and Bronze Works, Inc.
    f) Zurn Industries, LTD. “Aqua Spec”

12. Commercial Pressure Balance Bath/Shower Faucets:

a) Acorn Engineering Co.
b) Bradley Corp.
c) Lawler Manufacturing Co., Inc.
d) Leonard Valve Co.
e) Powers Process Controls; A Unit of Mark Controls Corp.
f) Speakman Co.
g) Symmons Industries, Inc.

13. Sensor-Operated Faucets and Devices:

a) Sloan Valve Co.
b) Speakman Co.
c) Toto Kikki, USA
d) Zurn Industries, LTD. “Aqua Spec”

14. Stop Valves & Supplies:

a) Brass Craft Subsidiary; Masco Co.
b) Chicago Faucet Co.
c) Engineered Brass Company
d) Kohler Co.
e) Watts Brass and Tubular
f) Zurn Industries

15. P-traps, Drains & Miscellaneous Fittings:

a) Brass Craft Subsidiary; Masco Co.
b) Dearborn Brass
c) Engineered Brass Company
d) Franke
e) McGuire Manufacturing Co., Inc.
f) PROFLO
g) Watts Brass and Tubular
h) Zurn Industries

16. Supports:

a) Josam Co.
b) Smith (Jay R.) Mfg. Co.
c) Wade Div.; Tyler Pipe.
d) Watts Drainage Products
e) Zurn Industries, Inc.; Hydromechanics Div.
f) Mifab Manufacturing, Inc.

17. Disposers:

a) General Electric Co.
b) Hotpoint; General Electric Co.
c) In-Sink-Erator Div.; Emerson Electric Co.
d) KitchenAid, Inc.

18. Insulation Kits

a) Brocar
b) McGuire
c) Plumberex
d) PROFLO
e) Trap-Wrap
f) Truebro, Inc.

2.02 PLUMBING FIXTURES, GENERAL

A. Provide plumbing fixtures and trim, fittings, other components, and supports as specified on the drawings and below:

2.03 FAUCETS

A. Faucets General: As described on the drawings.

2.04 STOP VALVES & SUPPLIES

A. Supplies General: As described on the drawings.

1. Exposed piping and parts shall be polished chrome plated.

2.05 P-TRAPS, DRAINS AND MISCELLLANEOUS FITTINGS:

A. Fittings General: As described on the drawings, except as listed below.

1. Exposed piping and fittings shall be polished chrome plated.
2. Fittings installed concealed inside a plumbing fixture or within wall construction may be without chrome plate finish.
3. Fitting and faucet bodies for domestic water distribution shall be of lead free brass or lead free cast bronze.

B. Sink Continuous Wastes: Polished chrome-plated, tubular brass, 1-1/2 inches, 17 gauge, with brass nuts on slip inlets, and of configurations indicated.

C. Scullery sink Continuous Wastes: Polished chrome-plated, tubular brass, 2 inches, 17 gauge, with brass nuts on slip inlets, and of configurations indicated.

D. Escutcheons: Wall flange with set screw.

E. Escutcheons: Polished chrome-plated, sheet steel wall flange with friction clips.

2.06 FLUSHOMETERS

A. Provide flushometers compatible with fixtures, with features and of consumption as described on the drawings.

1. Exposed metal parts shall be polished chrome plated.
2. Flush valves installed within wall construction may be without chrome plate finish.

2.07 TOILET SEATS

A. General: As described on the drawings.

2.08 DISPOSERS

A. Disposers: As specified on the drawings.

2.09 PLUMBING FIXTURE SUPPORTS

A. Supports: ASME A112.6.1M, categories and types as required for wall-hanging fixtures specified, and wall reinforcement.

B. Support categories are:

1. Carriers: Supports for wall-hanging water closets and fixtures supported from wall construction. Water closet carriers shall have an additional faceplate and coupling when used for wide pipe spaces. Provide tiling frame or setting gauge with carriers for wall-hanging water closets.
2. Chair Carriers: Supports with steel pipe uprights for wall-hanging fixtures. Urinal chair carriers shall have bearing plates.
3. Chair Carriers, Heavy Duty: Supports with rectangular steel uprights for wall-hanging fixtures.
4. Reinforcement: 2-inch by 4-inch wood blocking between studs or 1/4-inch by 6-inch steel plates attached to studs, in wall construction, to secure floor-mounted and special fixtures to wall.

C. Support Types: Provide support of category specified, of type having features required to match fixture.

D. Provide supports specified as part of fixture description, in lieu of category and type requirements above.

2.010 INSULATION KITS

A. Insulation kits for lavatory and sink waste and supplies of vinyl plastic with reusable fasteners and openings for access to supply stop handles.

PART 3 - EXECUTION

3.01 INSTALLATION, GENERAL

A. Install fixtures, trim and supports in accordance with manufacturer's installation instructions.

3.02 APPLICATION

A. Install plumbing fixtures and specified components, in accordance with designations and locations indicated on Drawings.

B. Install supports for plumbing fixtures in accordance with categories indicated, and of type required:

1. Carriers for following fixtures:

a) Wall-hanging water closets.
b) Wall hanging lavatories
c) Wall hanging electric water coolers.
d) Wall-hanging fixtures supported from wall construction.

2. Chair carriers for the following fixtures:

a) Wall-hanging urinals.
b) Wall-hanging lavatories and sinks.
c) Wall-hanging electric water coolers.

3. Heavy-duty chair carriers for the following fixtures:

a) Accessible lavatories.
b) Fixtures where specified.

4. Reinforcement for the following fixtures:

a) Floor-mounted sinks required to be secured to wall.
b) Wall mounted and mop sink faucets.
c) Urinal flush valve solid pipe ring supports.

3.03 INSTALLATION OF PLUMBING FIXTURES

A. Install plumbing fixtures level and plumb, in accordance with fixture manufacturers' written installation instructions, roughing-in drawings, and referenced standards.

B. Install wall-hanging, back-outlet water closets with support manufacturer's tiling frame or setting gauge.

C. Install wall-hanging, back-outlet urinals with gasket seals.

D. Fasten wall-hanging plumbing fixtures securely to supports attached to building substrate when supports are specified, and to building wall construction where no support is indicated.

E. Fasten floor-mounted fixtures and special fixtures having holes for securing fixture to wall construction, to reinforcement built into walls.

F. Fasten wall-mounted fittings to reinforcement built into walls.

G. Fasten counter-mounting-type plumbing fixtures to casework.

H. Secure supplies behind wall or within wall pipe space, providing rigid installation.

I. Set and mop basins in leveling bed of cement grout.

J. Install stop valve in an accessible location in each water supply to each fixture.

K. Install trap on fixture outlet except for fixtures having integral trap.

L. Install escutcheons at each wall, floor, and ceiling penetration in exposed finished locations and within cabinets and millwork. Use deep pattern escutcheons where required to conceal protruding pipe fittings.

M. Seal fixtures to walls, floors, and counters using a sanitary-type, one-part, mildew-resistant, silicone sealant in accordance with sealing requirements specified in Division 7 Section "Joint Sealers." Match sealant color to fixture color.

N. Install insulation kits on ADA compliant sink and lavatory waste, continuous wastes, hot and cold water supplies where indicated on the drawings and as required by the ADA.

3.04 CONNECTIONS

A. Piping installation requirements are specified in other sections of Division 22. The Drawings indicate general arrangement of piping, fittings, and specialties. The following are specific connection requirements:

1. Install piping connections between plumbing fixtures and piping systems and plumbing equipment specified in other sections of Division 22.

2. Install piping connections indicated between appliances and equipment specified in other sections, direct connected to plumbing piping systems.

3.05 FIELD QUALITY CONTROL

A. Inspect each installed fixture for damage. Replace damaged fixtures and components.

B. Test fixtures to demonstrate proper operation upon completion of installation and after units are water pressurized. Replace malfunctioning fixtures and components, then retest. Repeat procedure until all units operate properly.

3.06 ADJUSTING AND CLEANING

A. Operate and adjust faucets and controls. Replace damaged and malfunctioning fixtures, fittings, and controls.

B. Operate and adjust disposers, hot water dispensers, and controls. Replace damaged and malfunctioning units and controls.

C. Adjust water pressure at drinking fountains, electric water coolers, and faucets, shower valves, and flushometers having controls, to provide proper flow and stream.

D. Replace washers of leaking and dripping faucets and stops.

E. Clean fixtures, fittings, and spout and drain strainers with manufacturers' recommended cleaning methods and materials.

F. Adjust faucet wrist blade handles perpendicular to the spout while in the closed position.

G. Review the data in Operating and Maintenance Manuals. Refer to Division 1 Section "Project Closeout."

H. Set each shower valve temperature limit stop to 110ºF. Perform work after the shower head is installed and the domestic water heater is in operation. Allow the hot water to run for 5 minutes minimum or until temperature reaches equilibrium. Allow cold to run for 5 minutes minimum or until temperature reaches equilibrium. Provide the architect a report and schedule indicating the hot, cold and mixed maximum water temperature at each shower.

3.07 FIXTURE SCHEDULE

A. Provide plumbing fixtures as specified on the drawings.

B. Install rough-in for plumbing fixtures as scheduled on the drawings.

3.08 MOUNTING HEIGHTS SCHEDULE:

A. Refer to the architectural drawings for plumbing fixture mounting heights. Unless indicated otherwise, install plumbing fixtures with the mounting heights as listed below with final approval by the Architect:

FIXTURE	MOUNTING HEIGHT
Ice Maker Outlet Boxes	24” floor to center of box
Washing Machine Outlet Boxes	42" floor to rim
Janitor’s Sink Faucet Fittings	42” floor to centerline
Hose Bibbs	36” AFF to centerline
Non Freeze Wall Hydrant	18” AFG to centerline

END OF SECTION

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PART 1 - GENERAL REQUIREMENTS

1.01 SUMMARY

A. This Section includes oxygen, medical air, medical vacuum, nitrous oxide, nitrogen, carbon dioxide, and waste anesthetic gas disposal (WAGD) systems, including tubing, piping, fittings, equipment, and related accessories. Note that waste anesthetic gas disposal system (WAGD) is indicated as evacuation (EV) on the drawings.

B. This section does not include gases used for the medical simulation spaces.

C. Related Sections: The following sections contain requirements that relate to this Section:

1. Division 22 Section "General Plumbing Requirements" for trenching and backfilling materials and methods for underground piping installations.
2. Division 3 Section "Concrete Work" for specifications on concrete and reinforcing materials and concrete placing requirements for equipment pads.
3. Division 7 Section "Joint Sealers" for materials and methods for sealing pipe penetrations through basement and foundation walls and fire and smoke barriers.
4. Division 11 Section "Equipment" for ceiling-mounted service columns, headwall units, and modular patient services units with medical gas outlets.
5. Division 22 Section “Coordination” for basic requirements for electrical components that are an integral part of packaged system components.
6. Division 22 Section "Identification, for Plumbing Piping and Equipment" for labeling and identification of medical gas and vacuum piping.
7. Division 22 Section "Common Work Results for Plumbing" for materials and methods for fire barrier penetrations, wall and floor penetrations and equipment pads.
8. Division 22 Section "Basic Piping Material and Methods" for materials and methods for strainers, flexible connectors, unions, flanges and flange kits, and mechanical sleeve seals.
9. Division 22 Section "Hangers and Supports for Plumbing Piping" for materials and methods for hanging and supporting medical gas and vacuum piping.
10. Division 22 Section "Vibration Isolation for Plumbing Piping and Equipment" for inertia pads, isolation pads, spring supports, and spring hangers.
11. Division 22 Section “Seismic Requirements for Mechanical and Electrical Equipment” for seismic protection of equipment and piping systems.
12. Division 26 Section “Common Work Results for Electrical” required electrical devices.

13. Division 26 Sections"Enclosed Switches and Circuit Breakers" for field-installed disconnects.

1.02 DEFINITIONS

A. Medical Gas System: The complete system to convey medical gases for direct patient application from central supply systems, including bulk tanks, manifolds, and medical air compressors, with pressure and operating controls, alarm warning systems, related components, and piping networks extending to station outlets at patient use points.

B. Medical Vacuum System: The complete system of central-vacuum-producing equipment with pressure and operating controls, shut-off valves, alarm-warning systems, gauges, and a network of piping extending to and terminating with suitable station inlets at locations where patient suction may be required.

C. Unless otherwise indicated herein, for the purposes of this Section, the term “medical gas system” shall include “medical vacuum system” also.

1.03 SUBMITTALS

A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specifications Sections.

1. Product data for the following products:
   a) Valves
   b) Medical gas system accessories
2. Inspection and test reports specified in “Field Quality Control” in this Section.
3. Certificates of inspections and tests from independent testing agency specified in “Field Quality Control” and ”Project Closeout Documents” in this Section.
4. Certificates indicating that medical gas tubing, fittings, valves, and other pipeline components are cleaned for oxygen service and are marked and sealed per NFPA 99.
5. Maintenance data for inclusion in Operating and Maintenance Manuals.
6. Brazers' qualification certificates, certifying that brazers meet the quality requirements specified under "Medical Gas and Vacuum System Brazers” and “Medical Gas and Vacuum System Installers" below.
7. Brazer brazing specifications indicating the proper procedure for the individual brazers to follow.
8. Verifier and Certifier certificates, certifying that verifiers and certifiers meet the quality requirements as specified under “Medical Gas System Inspector/Verifier” below.

1.04 QUALITY ASSURANCE

A. Installation of the medical gas systems shall comply with the following:

1. 2021 edition of NFPA 99 “Health Care Facilities Code”
2. 2021 International Plumbing Code
3. American Society of Sanitary Engineering (ASSE) Series 6000
4. The Arkansas (State) Department of Health
5. City of Bentonville, AR
6. Owner’s Insurance Underwriter
7. Authority Having Jurisdiction (AHJ)
8. Applicable editions of Compressed Gas Association (CGA) standards:

a) G-4.1 “Cleaning Equipment for Oxygen Service”
b) G-4.3 “Commodity Specification for Oxygen”
c) G-6 “Carbon Dioxide”
d) G-6.1 ”Standard for Low Pressure Carbon Dioxide Systems at Consumer Sites”
e) G-6.2 “Commodity Specification for Carbon Dioxide”
f) C-7 “Compressed Air for Human Respiration”
g) C-7.1 “American National Standard Commodity Specification for Air”
h) G-8.1 “Standard for Nitrous Oxide Systems at Consumer Sites”
i) G-8.2 ”Commodity Specification for Nitrous Oxide”
j) G-10.1 “Commodity Specification for Nitrogen”

B. Electrical wiring of equipment and alarm systems shall comply with the 2020 edition of NFPA 70 “National Electrical Code.”

C. Equipment shall comply with UL 544 “Standard for Medical and Dental Equipment” and installation shall comply with local, state, and federal codes.

D. Equipment shall be listed and labeled by the Nationally Recognized Testing Laboratory. The terms “Listed” and “Labeled” shall be as defined in the “National Electrical Code,” Article 100.

E. Pipe joint make-up shall comply with ANSI/AWS A5.8, “Specifications for Brazing Filler Metal.”

F. Provide compatible accessories, tube, fittings, and valves for each system.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Deliver and store large medical gas accessories on factory-installed shipping skids, tubing with sealing plugs in ends or with end protection, and small accessories in factory-fabricated fiberboard containers.

1. Store precleaned and sealed medical gas tube, fittings, valves, and accessories with sealing plugs and sealing packaging intact.

2. Label medical gas tube, fittings, valves, and accessories that have not been precleaned, and that have been precleaned but have seal or packaging that is not intact, with temporary labels indicating that cleaning is required before installation.
3. Material that has become contaminated and is no longer suitable for oxygen service shall not be installed.
4. Provide a separate designated storage area for all medical gas equipment, piping, outlets, etc. The designated storage area shall be protected, dry, have no construction debris or traffic, and shall be utilized only for the storage of medical clean piping and equipment; shall not be utilized to store any non-medical gas and vacuum piping or equipment. The designated separate storage area shall be labeled as such to prevent non-medical gas and vacuum piping and equipment from being accidently stored there and potentially being mistaken for medical gas piping and equipment.

1.06 MEDICAL GAS SYSTEMS INSPECTOR/VERIFIER

A. The Medical Gas Systems Inspector/Verifier shall be contracted through the Construction Manager or Owner. The inspector/verifier shall not be hired or contracted by the medical gas installer.

B. Verification is required when a medical gas system is breached, pipeline intrusion, or component replacement.

C. The Medical Gas Systems Inspector/Verifier shall be trained and certified in accordance with ASSE Standard 6020, "Professional Qualifications Standard for Medical Gas Systems Inspectors" and ASSE Standard 6030, "Professional Qualifications Standard for Medical Gas Systems Verifiers." Inspector/Verifiers shall have a minimum of two (2) years of documented practical experience in the inspection/verification of medical gas pipe line systems.

D. Medical Vacuum System Inspector/Verifier Certification to Standard 6020 and 6030 shall be through a recognized third party certification agency. Certification shall include the successful completion of a minimum 32-hour training course including a written and a practical examination covering all facets of ASSE Standard 6030, 6020, NFPA 99, and NFPA 55.

E. The Inspector/Verifier shall possess a current certificate of insurance, in the name of the individual or employing verification company, for general liability, completed operations, and as applicable, products liability insurance. The Inspector/Verifier shall provide the Owner and Engineer with a copy of insurance certificate.

F. Inspector/Verifiers shall complete report forms that include at a minimum the following items: date of test, medical gas verifier/installer identification, repairs and service performed, equipment warning systems, master, area and local alarm systems, other items as required by AHJ, pressure regulating valves, pressure relief

valves, retest information, shut-off valves (source, main, riser, zone, service, etc.), source equipment, station outlets and inlets, and visual observation of physical conditions. Refer to ASSE Series 6000 Appendices B, C, and D for required checklist information.

G. Testing shall be conducted and test reports shall be submitted to the Engineer and Owner for approval.

1.07 MEDICAL GAS SYSTEM INSTALLERS

A. All medical gas system installers shall be trained and certified in accordance with ASSE Standard 6010, "Professional Qualifications Standard for Medical Gas Systems Installers." Installers shall have a minimum of four (4) years of documented practical experience in the installation of piping systems.

B. The medical gas systems installers shall be trained and certified to Standard 6010 through a recognized third party certification agency. Certification shall include the successful completion of a minimum 32-hour training course including a written and a practical examination covering all facets of ASSE Standard 6010, NFPA 99, and NFPA 55.

C. Furnish to the Engineer and Owner photocopies of third party ASSE Standard 6010 certification for each and every installer. Certifications shall include installers name, expiration date, certification number, and name of certifying agency. These certifications must be provided before beginning work. A simple list of installers' names shall not be considered acceptable.

D. Installers shall notify an inspector certified in accordance with ASSE Standard 6020 before any and all tests are performed so the results may be witnessed and recorded.

E. Installers shall record performance test results on a form similar to ASSE Series 6000 Appendix I, "Medical Gas System Installer Performance Testing Record". Provide Engineer and Owner with copies of all test reports.

F. All supervisors, crew chiefs, etc. engaged in overseeing and/or directing medical gas systems installation or modification shall also be required to meet these standards.

1.08 MEDICAL GAS SYSTEM BRAZERS

A. The installation of medical gas systems shall be made by qualified, competent brazers who are experienced in making such installations. Brazing shall be performed only by brazers qualified under NFPA 99.

B. Prior to any installation work, furnish to the Engineer and Owner photocopies of the qualification of individual brazers that is required under NFPA 99..

C. Prior to any installation work, furnish to the Engineer and Owner photocopies of the Record of Continuity of Brazer Qualifications for each brazer.

D. Brazing procedures and brazer performance for the installation of medical gas piping shall be qualified in accordance with either Section IX, "Welding and Brazing Qualifications," of the ASME Boiler and Pressure Vessel Code or AWS B2.2, Standard for Brazing Procedure and Performance Qualifications, both as modified by NFPA 99.

1.09 PROJECT CLOSE OUT DOCUMENTS

A. At the completion of the project, furnish the Engineer with the following documentation:

1. Installer and Continuity certification for all project workmen;
2. Verifier and Inspector certifications;
3. A statement that verification equipment used was calibrated at least within the last 12 months by a method traceable to a National Bureau of Standard Reference and certificates or other evidence of such calibrations(s).
4. Verifiers final report;
5. Inspectors weekly and final reports, including purity test results, pressure tests, flow tests, and zone valve tests;
6. Contractors medical gas systems installation guidelines and checklist (refer to example checklist titled "Report 2" at the end of this specification section);
7. Certification that materials purchased for this project are medically clean;
8. Bill of sale for all medical gas piping and pipeline components indicating type of materials purchased for the project; prices may be obscured.
9. Brazer brazing specifications indicating the proper procedure for the individual brazers to follow.

1.010 PROJECT SCHEDULING

A. Refer to Division 1 and General Conditions for work scheduling.

B. Schedule work to ensure all medical gas piping, equipment, outlets, etc. are installed, and that all medical gas systems are tested and certified prior to substantial completion.

PART 2 - PRODUCTS AND MATERIALS

2.01 MANUFACTURERS

A. The manufacturer's products listed herein and provided shall be compatible with the facility's existing medical gas equipment, components, and devices, where applicable, and shall be approved by the Owner.

B. One manufacturer, unless otherwise specified herein or on the Drawings, shall supply the medical gas equipment, components, and devices as listed below. Refer to the Drawings for model numbers.

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

1. Systems Accessories:

a) Amico Corp.
b) Beacon Medaes
c) Patton's Medical
d) Powerex

2. Zone Valve Boxes:

a) Amico Corp.
b) Beacon Medaes
c) Patton's Medical
d) Powerex

3. Wall/Ceiling Outlets:

a) Amico Corp.
b) Beacon Medaes
c) Powerex

4. Medical Gas Flowmeters

a) Beacon Medaes
b) Amico Corp.
c) Ohio Medical
d) Powerex

2.02 COMPONENTS, GENERAL

A. Copper tube, fittings, valves, and other piping components shall be precleaned for oxygen service by the manufacturer in accordance with CGA Pamphlet G-4.1 prior to installation and shall be delivered plugged, capped, or sealed and permanently labeled or marked per NFPA 99.

B. On-site cleaning of the interior surfaces of tubes, valves, fittings, and other piping components prior to brazing shall be limited. Refer to Part 3, Article "Preparation."

C. Copper tube and fitting sizes are nominal inside diameter.

2.03 TUBE MATERIALS

A. Refer to Part 3, Article "Tube Applications", for identification of systems where the materials listed below are used.

B. Precleaned and Sealed Copper Tube: ASTM B819, Type K or L, hard drawn temper, seamless medical gas tubing marked "OXY," "MED," "OXY/MED," "OXY/ACR," or "ACR/MED."

2.04 TUBE FITTINGS

A. Wrought Copper Solder-Joint Fittings: ANSI B16.22, solder-joint, pressure type designed for brazed joints.

B. Bronze Tube Flanges: ANSI B16.24, Class 300, designed for brazed tubing connection.

C. Threaded joints and connections shall be permissible where indicated in NFPA 99.

2.05 TUBE AND FITTING JOINING MATERIALS

A. Screwed Joint Pipe Tape: Polytetrafluoroethylene (PTFE) plastic.

B. Gasket Material: ANSI B16.21, nonmetallic, flat, asbestos-free, and suitable for oxygen use.

C. Brazing Filler Metals: ANSI/AWS A5.8, BAg-5, with a cadmium content of zero, with approved flux suitable for oxygen service.

D. Brazing Filler Metals: ANSI/AWS A5.8, BCuP-5, with a minimum silver content of 15%. Flux is prohibited.

2.06 VALVES

A. Shut-off Valves 4 Inches and Smaller: Bronze-body, three-piece, full-size port, bolted-ball type, with chrome-plated brass ball, with Teflon (TFE) seats, buna or Teflon stem seals, blow-out proof stem, Type K copper tube extensions suitable for brazing and with protective end covers, quarter-turn operation between open and closed positions, designed for working pressures up to 600 psi or vacuum service up to 29 inch Hg, and factory-cleaned for oxygen service. Valves shall be of the locking type where indicated on the Drawings.

2.07 ZONE VALVE BOXES

A. General: Valve rough-in box shall be constructed of minimum 18-gauge steel or extruded aluminum for recessed mounting, with holes for medical gas tubing and anchors. Provide for single or multiple valve installation and in sizes as indicated on the Drawings to permit manual operation of valves.

B. Shut-off Valve(s): Same as described in Part 2, Article "Valves" and shall be provided with color-coded medical gas identification labels and pressure gauge ports in the extension downstream of the valve (upstream for vacuum). The valve body and pipe stubs shall be chrome-plated to beyond the valve rough-in box.

C. Interior Finish: Factory-applied white enamel.

D. Finishing Window Frame: Anodized extruded aluminum sections with mitered welded corners and provided with clear or tinted transparent removable plastic window with pull ring to remove in an emergency and factory or field-installed labeling (including space for rooms served) in accordance with NFPA 99. The window shall be labeled "Caution: Medical Gas Control Valve – Close Only in Emergency."

E. Pressure/Vacuum Gauge(s): Factory-installed with 2 inch dial in accordance with ASME B40.1, Grade B. Gauge range shall be such that the normal operating pressure is within the middle third of the total range.

2.08 MEDICAL GAS SYSTEM ACCESSORIES

A. General: Provide the following medical gas system accessories by the same manufacturer.

B. Quick-Connect Recessed Wall Outlets: Include brass valve and body block with seals in roughing-in and finishing assemblies, color coded front plate, one piece chrome fascia plate with medical gas identification, 1/4-inch inside diameter Type K copper tube brazed to valve, and pressure outlets equipped with a primary and secondary check valve to prevent gas flow when the primary valve is removed. Outlet bodies shall be indexed to prevent interchange between services, constructed to permit one-handed connection and removal of equipment with positive locking ring which retains equipment stem in valve during use. Outlets shall be of modular design and include a gas specific mounting plate to permit ganging of multiple outlets.

C. DISS (Diameter Index Safety System) Type Recessed Ceiling Outlets: Include brass valve and body block with seals in roughing-in and finishing assemblies, color coded front plate, one piece chrome fascia plate with medical gas identification, 1/4-inch inside diameter Type K copper tube brazed to valve, and pressure outlets equipped with a primary and secondary check valve to prevent gas flow when the primary valve is removed. Outlet bodies shall be indexed to prevent interchange between services. Outlets shall be of modular design and include a gas specific mounting plate to permit ganging of multiple outlets. Outlets shall be provided with hose assemblies with 60" long, FDA approved medical grade thermoplastic conductive reinforced rubber hose with color-coding complying with CGA C-9 standard, DISS female inlets and quick-connect outlets, and hose retractor with stainless steel housing and 48" heavy duty cable mounted to outlet cover plate.

D. Vacuum Bottle Slide Brackets: Bottle slide and mounting assembly matching pattern of vacuum outlet. Provide 1 slide bracket for each wall-mounted vacuum inlet, except where no slide bracket requirement is indicated.

E. Power and Medical Gas Columns: Provided under another division of work. Make final medical gas piping connections to columns above ceiling, unless otherwise indicated.

PART 3 - EXECUTION

3.01 INSTALLATION, GENERAL

A. Install medical equipment, alarms, accessories, piping, valves, and specialties in accordance with manufacturer's installation instructions.

3.02 PREPARATION

A. On-site cleaning of the interior surfaces of tubes, valves, fittings, and other piping components shall be limited to recleaning surfaces in the immediate vicinity of the joints that have become contaminated prior to brazing.

B. When precleaned medical gas piping components must be recleaned due to contamination, perform the following procedures:

1. Clean interior surfaces at the joints of piping components free of oil, grease, and other readily oxidizable materials as required for oxygen service.
2. Wash surfaces of components at the joints in a clean, hot water/alkaline solution of sodium carbonate or trisodium phosphate in proportion of one pound of chemical to three gallons of potable water.

a) Thoroughly scrub to ensure complete cleaning.
b) Rinse with clean, hot potable water after washing to remove cleaning solution.

3.03 TUBE APPLICATIONS

A. Install Type L, hard drawn copper tube with wrought copper fittings and brazed joints for sizes 1/2 inch and larger, above ground, within building.

B. Connections to pressure gauges and alarm switches and monitoring line runouts to area alarm panels shall be 1/4 inch in size, unless indicated otherwise, of same material as main and branch tubing.

3.04 PIPING INSTALLATION, GENERAL

A. Install eccentric reducers where pipe is reduced in size in the direction of flow, with bottoms of both pipes and reducer flush.

B. Install horizontal piping as high as possible. Install vertical piping tight to columns or walls. Allow sufficient space above removable ceiling panels to allow for panel removal.

C. Install piping specialties in accordance with Division 22 Section "Basic Piping Materials and Methods."

D. Install thermometers and pressure gauges where indicated on the drawings. Pressure gauge and thermometers are specified in Division 22 Section "Meters and Gauges for Plumbing Piping."

E. Piping exposed to physical damage shall be adequately protected.

F. All piping shall be pitched so as to drain to accessible locations. All branch takeoffs or runouts shall be taken off above the centerline of the main or branch pipe and rise vertically or at an angle of not less than 45 degrees from the vertical.

G. Fire Barrier Penetrations: Where pipes pass though fire-rated walls, partitions, ceilings, and floors, maintain the fire-rated integrity. Refer to Division 22 Section "Common Work Results for Plumbing" for special sealers and materials.

H. Exterior Wall Penetrations: Seal pipe penetrations through exterior wall constructions with sleeves packing, and sealant. Refer to Division 22 Section "Basic Piping Materials and Methods" for additional information.

I. Underground Exterior Wall Penetrations: Seal pipe penetrations through underground exterior walls with sleeves and mechanical sleeve seals. Refer to Division 22 Section "Basic Piping Materials and Methods" for additional information.

J. Elevated Floor Penetrations of Waterproof Membrane, Interior Penetrations of Non-Fire Rated Walls and Concrete Slab on Grade Penetrations: Provide sleeves and seal pipes that pass through waterproof floors, non-fire rated walls, partitions and ceilings or concrete slab on grade. Refer to Division 22 Section "Common Work Results for Plumbing" for special sealers and materials.

K. Joints at Valve Assemblies: Provide bronze unions downstream of shutoff valves at valve assemblies. Unions are not required at flanged connections. Unions are specified in Division 22 section "Basic Piping Materials and Methods".

3.05 TUBING JOINT CONSTRUCTION

A. Particular care shall be exercised in the storage and handling of tube and fittings which shall be capped or plugged to prevent contamination before final assembly. Tools used in cutting or reaming shall be kept free from oil or grease. Contaminated material that is no longer suitable for oxygen service shall not be installed, but shall be replaced with new.

B. Bends: Changes in direction requiring turns or offsets shall be made by brazed wrought copper fittings.

C. Unions shall not be permitted in the medical gas piping distribution system.

D. Threaded Joints: Thread pipe with tapered pipe threads in accordance with ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded ends to remove burrs and restore full inside diameter. Apply pipe tape, suitable for the service for which the pipe is intended, on the male threads at each joint. Tighten joint to leave not more than 3 threads exposed. Leave first thread clean if possible.

E. Openings in the piping system shall be kept capped or plugged during and after installation to prevent loss of purge gas while brazing and to prevent debris or other contaminants from entering the system.

F. Brazing For Copper Tube and Fittings:

1. Braze joints in accordance with NFPA 99 with BCuP-5 brazing filler metal.
2. Thoroughly clean tube surface and inside surface of the cup of the fittings, using very fine emery cloth, prior to making brazed joints. Wipe tube and fittings clean. Prevent the entry of matter into the tube. If matter enters the tube, replace the tube or clean the tube in the field per NFPA 99. Use of flux is prohibited.
3. Continuously purge each with oil-free dry nitrogen during brazing procedures to prevent oxidation and scale formation on the inside surface of the copper tube and joints. The nitrogen flow shall be maintained until the joint is cool to the touch.
4. Clean the outside of the tube and fittings after assembly with hot water.

G. Brazing For Dissimilar Metals:

1. Braze joints in accordance with NFPA 99 with BAg-5 brazing filler metal and approved flux suitable for oxygen service.
2. Thoroughly clean pipe and tube surface and inside surface of the cup of the fittings, using very fine emery cloth, prior to making brazed joints. Wipe tube and fittings clean. Prevent the entry of matter into the tube. If matter enters the tube, replace the tube or clean the tube in the field per NFPA 99.
3. Continuously purge each with oil-free dry nitrogen during brazing procedures to prevent oxidation and scale formation on the inside surface of the copper tube and joints. The nitrogen flow shall be maintained until the joint is cool to the touch.
4. Clean the outside of the tube and fittings after assembly with hot water.

3.06 INSTALLATION OF VALVES

A. Valve Applications:

1. Provide ball valves specified herein for shutoff duties at the medical gas source, main line, base-of-risers, and where indicated on the Drawings.

B. Install zone valves in valve box anchored to structure. Install valves at angle that prevents closure of cover when valve is in closed position. A single box may be used for multiple valves when valves serve same area or same function.

3.07 HANGERS AND SUPPORTS

A. General: Hanger, support, insulation protection shield and anchor components and installation procedures conforming to MSS SP-58 and SP-69 are specified in Division 22 Section "Hangers and Supports for Plumbing Piping". Conform to the table below for maximum spacing of supports.

B. Pipe Attachments: Install the following:

1. Copper plated adjustable band swivel ring type hangers, MSS SP-69 Type 10, for copper tube for individual horizontal runs.
2. Copper plated piping riser clamps, MSS SP-69 Type 8, for individual vertical runs.
3. Copper coated extension split ring pipe clamp, MSS SP-69 Type 12, for individual vertical exposed runs of copper tube 2" and smaller on walls, or for securing copper tube inside walls and chases, or for supporting copper tubing above the floor with pipe supports attached to the floor with anchor bolts. Secure clamp to the copper tube.
4. Support copper tube in chases and walls at wall outlets with plastic or copper brackets secured to structure and plastic coated U-bolts sized to bear on the pipe.
5. Engineered strut support system may be provided, at the contractor's option, in lieu of individual hangers for horizontal pipes as specified in Division 22 "Hangers and Supports for Plumbing Piping". Provide two piece straps secured to the bare pipe and provide plastic galvanic isolators for bare copper tube.
6. Provide roll hangers for individual horizontal runs between pipe anchors at tube crossings of building expansion joints.

C. Install hangers for horizontal piping with the following maximum spacing and minimum rod sizes:

Nom. Pipe Size - In.	Copper Tube Max. Span - Ft.	Min. Rod Dia. - In.
1/4	5	3/8
3/8	6	3/8
1/2	6	3/8
3/4	6	3/8
1	6	3/8
1-1/4	6	3/8
1-1/2	10	3/8
2	10	3/8
2-1/2	10	3/8
3	10	3/8
4	10	3/8
5	10	1/2
6	10	1/2

1. Support vertical copper tube at each floor and at intervals not to exceed 15 feet.

D. Support copper tubing within 12” of each elbow or tee and for tubing 2-1/2” and larger at each valve.

E. Provide vibration isolation for piping connected to rotating equipment. Vibration isolators are specified in Division 22 specification Section “Vibration Isolation for Plumbing Piping and Equipment”.

3.08 ACCESSORIES INSTALLATION

A. Install accessories in accordance with NFPA 99 and manufacturer’s printed installation instructions

3.09 LABELING AND IDENTIFICATION

A. Install labeling on tubing, valves, valve box covers, and alarm panels in accordance with requirements of NFPA 99 (e.g. every 20 feet, per room, per each side of wall and per floor.). Refer to Division 22 Section “Identification for Plumbing Piping and Equipment” for piping within building, tubing, valves, gauges, alarms, and accessories.

B. Captions and Color Coding: Use the following or similar medical gas captions and color coding for accessories, when specified and where required by NFPA 99.

1. Medical Vacuum: Black letters on white background.

C. Where supplementary color identification of piping is used, it shall be in accordance with the gases and colors indicated in CGA Pamphlet C-9, “Standard Color-Marking of Compressed Gas Cylinders Intended for Medical Use.”

D. Label medical gas distribution systems operating at other than standard pressure with system operating pressure.

E. Medical gas valve tags shall meet NFPA 99 requirements.

3.010 FIELD QUALITY CONTROL

A. Installer Testing: Prior to declaring the medical gas system ready for final verification and certification, follow the procedures for verification as indicated in NFPA 99 and ASSE 6010 and can confirm that the following standard has been met:

1. System Clearing: Purge medical gas system tubing using oil-free dry air or nitrogen after installation of tubing but before installation of service outlet valves, alarms, and gauges.
2. Pressure Test: Subject each section of each system to test pressure from 150 psig to 200 psig with oil-free dry air or nitrogen before attachment of system components, after installation of station outlets with test caps (when supplied) in place, and before concealing piping system. Maintain test until joints are examined for leaks by means of soapy water.

3. Cross Connection Test: Determine that each outlet is connected to the appropriate line by flowing gas through each system. Test one system at a time using nitrogen.
4. Initial Piping Purge Test: Purge assembled outlets in each medical gas system with an intermittent high-volume flow of test gas until no discoloration is produced on a clean white cloth.
5. Standing Pressure Test: Install assembled system components after testing individual systems as specified above. Subject systems to 24-hour standing-pressure test at 20 percent above normal line pressure but not less than 66 psig. Subject vacuum system to 12 to 18 inches of mercury minimum vacuum in lieu of pressure test. Test shall be witnessed by AHJ or Designee.
6. Repair leaks and defects with new materials and retest system until satisfactory results are obtained.
7. Repair medical gas systems and replace components that fail tests specified.
8. Provide to the engineer a completed copy of "Medical Gas System Installer Performance Testing Record" (or similar report) as found at the end of this specification section once all requirements of NFPA 99 and ASSE 6000 series have been met.

B. Inspector Performance Requirements: The inspector shall perform all the required duties as indicated in ASSE 6000 Series including but not limited to:

1. Inspector's log: Maintain a log that contains records of site observations and test results required for inspectors.
2. Test and inspection reports: The inspector shall personally witness the various tests and record the results of the tests performed by the installer as require.
3. The inspector shall verify that the following documents are on file at the jobsite: Building permit, shop drawings, manufacturer's literature and data, manufacturerd assembly test documentation for each manufacturer's unit, copper tubing and fittings cleaned for oxygen service documentation, brazing alloy documentation, purge and test gas documentation, qualification of brazing procedure specification, brazer performance qualification record, and qualification of welding procedures and welders if used, medical gas system installer certifications to ASSE Standard 6010 for each medical gas system installer, Medical Gas Systems Verifier certification to ASSE Standard 6030, and bulk medical gas system installers certifications to ASSE Standard 6015.
4. The medical gas systems inspector shall confirm the following: Use of proper piping materials and joining methods, proper handling and installation of materials including supports, brazed piping purged with nitrogen NF while being brazed and capped or plugged during the installation process, welding piping purged with shield gas while being welded and capped or plugged during the installation process, labeling and identification, installation of manifolds, installation of bulk medical gas supply sources, installation of medical compressed air source equipment,

and installation of medical vacuum source equipment, installation of alarm panels.

5. The medical gas systems inspector shall verify the test reports for the following: Visual inspection of brazed and welded joints, inspection of all welded test coupons, initial piping blow-down, initial pressure test, initial cross-connection test, standing pressure test, standing vacuum test, initial piping purge test.
6. The medical gas systems inspector shall obtain a copy of the final system verification report performed in accordance with ASSE 6000 Series.
7. The medical gas systems inspector report data shall include:

    a) Medical gas systems inspector identification
    b) Medical gas systems inspector signature
    c) Date of test

C. Verifier Testing: Once the Installer Checklist is complete, the following is the general list of items per ASSE 6000 Series that the Medical Gas Verifier is to certify, including but not limited to the following:

1. Prepare Test Equipment: All pressure/vacuum gauges, flow meters, adapters, medical gas analyzers, and other test equipment shall be medical gas clean, calibrater, and meet all other requirements of ASSE 6000 series.
2. Standing pressure and vacuum tests: Verify that the distribution piping for positive pressure and vacuum medical gases is still free from leaks since being leak tested by the installer.
3. Cross-connection Test (by individual pressurization or pressure differential: Verify that no cross-connections exist within any of the medical gas, instrument air, vacuum distribution and WAGD systems.
4. Shut-off valve test: Verify that all shut-off valves in a medical gas and vacuum system function properly and are properly labeled.
5. Master, area, and local alarm test: Verify that master, area, and local alarm systems function properly and are properly labeled.
6. Piping purge test: Purge particulate matter from all positive pressure pipelines after construction.
7. Piping particulate test: Verify the cleanliness of each positive –pressure medical gas piping system.
8. Piping Purity test: Verify that the pressurized patient medical gas distribution systems are not contaminated by excessive water vapor (pressure dew point), total hydrocarbons (as methane) and halogenated hydrocarbons.
9. Final tie-in test: Establish test procedures for verifying that where tie-ins are made to existing medical gas and medical support gas piping systems, the outlets downstream from the tie-in, in both the new and the existing piping are ready for acceptance by the AHJ or responsible facility authority.
10. Operational pressure test: Verify that the decreases in line pressure or vacuum are not excessive with prescribed flow rates at the outlets and inlets.
11. Medical gas concentration test: Verify that the proper concentration of system gas is present at each medical gas outlet after the test gas (nitrogen

NF); is purged from the distribution piping. After thorough purging of all test gas, the required concentration of the specific system gases at each outlet shall per ASSE 6030 Table 1 (values as follows):

a) Oxygen: equal to or greater than +99%
b) Nitrous Oxide: equal to or greater than +99%
c) Nitrogen: equal to or greater than +99% nitrogen or equal to or less than 1% oxygen.
d) Synthetic Medical Air USP 19.5% to 23.5% oxygen
e) Compressed Medical Air USP: equal to or greater than 20.9% oxygen
f) Other gases: Concentration as specified by their labeling +/- 1%

12. Labeling of system components: Verify the presence and correctness of the labeling for components of the medical gas and vacuum distribution system (e.g. distribution piping, station outlets and inlets, shut-off valves, pressure gauges, alarm panels, etc.)

D. The medical gas system verifier shall provide their own nitrogen test gas. If the Verifier does not have their own nitrogen purge gas, the Verifier may, at their own expense, purchase nitrogen from the medical gas installer.

E. The General Contractor shall provide the engineer the results of tests.

F. Provide the Owner an operational and functioning medical gas system with all certifications, test reports, observation reports, etc. without qualifications.

END OF SECTION

MEDICAL GAS SYSTEM

INSTALLER PERFORMANCE TESTING RECORD

Testing is done per the requirement of ASSE standard 6010 and NFPA 99. All installer testing shall be performed by certified medical gas installers. The test gas used shall be nitrogen. In Canada: the test gas shall be oi-free dry air or oil-free dry nitrogen.

FACILITY NAME: _____ AREA: _____
Project Manager:_____ Job Foreman:_____
Test Date: __/__/____ Start Time: __:__ AM/PM End Time: __:__ AM/PM

Medical Gas Installer:_____ Certification Number:_____
Medical Gas Brazer:_____ Certification Number:_____
O2 Analyzer: _____ Certification number:_____
Systems Certifications: _____

1. Initial Blow Down Test

   a) Intermittent flow of nitrogen NF through piping.

Medical Gas System	Date	Tested By	Pass/Fail	Test Accepted By
Oxygen				
Medical Air				
Nitrous Oxide				
Carbon Dioxide				
Nitrogen				
Instrument Air				
Medical/Surgical Vacuum				
WAGD				

2. Initial Pressure Test (Joints/Pipe Integrity)

   a) Pressure test of 1-½ times the working pressure, 1035 kPa (150 psig) minimum, nitrogen at 1655 kPa (240 psig) minimum using nitrogen.

Medical Gas System	Date	Tested By	Pass/Fail	Test Accepted By
Oxygen				
Medical Air				
Nitrous Oxide				
Carbon Dioxide				
Nitrogen				

Instrument Air

3. Initial Pressure Test for Vacuum Systems

a) Pressure test of 1035 kPa (150 psig) minimum using nitrogen.

Medical Gas System	Date	Tested By	Pass/Fail	Test Accepted By
Medical/Surgical Vacuum				
WAGD				

4. Cross-Connection Test (Initial)

a) Determine that each outlet is connected to the appropriate line by flowing gas through each system. Test on system at a time using nitrogen.

Medical Gas System	Date	Tested By	Pass/Fail	Test Accepted By
Oxygen				
Medical Air				
Nitrous Oxide				
Carbon Dioxide				
Nitrogen				
Instrument Air				
Medical/Surgical Vacuum				
WAGD				

5. Initial Piping Purge Test

a) High flow through assembled outlets.

Medical Gas System	Date	Tested By	Pass/Fail	Test Accepted By
Oxygen				
Medical Air				
Nitrous Oxide				
Carbon Dioxide				
Nitrogen				

Instrument Air

Medical/Surgical Vacuum

WAGD

6. Standard Pressure Test for Positive Pressure Piping

a) Twenty-four (24) hour standing pressure test at 20% above normal line pressure using nitrogen NF with outlets and other components assembled.

Medical Gas System	Date	Tested By	Pass/Fail	Test Accepted By
Oxygen				
Medical Air				
Nitrous Oxide				
Carbon Dioxide				
Nitrogen				
Instrument Air				

7. Standing Pressure Test for Vacuum Systems

a) Twenty-four (24) hour standing vacuum test at 300 mm (12 inches) gauge HgV with inlets and other components assembled.

Medical Gas System	Date	Tested By	Pass/Fail	Test Accepted By
Medical/Surgical Vacuum				
WAGD				

PART 1 - GENERAL REQUIREMENTS

1.01 SUMMARY

A. This Section includes distribution piping systems for natural gas, liquid petroleum-gas and manufactured gas within the building and extending from the point of delivery to the connections with gas utilization devices. Piping materials and equipment specified in this Section include:

1. Pipes, fittings, and specialties.
2. Special duty valves.
3. Pressure regulators.
4. Service meters.

B. Contractors Option:

1. The Division 22 contractor may provide mechanically joined joints for natural gas systems to connect couplings, fittings, valves, and related components as an option in lieu of, in whole or in part, welded, threaded or flanged piping methods. Mechanically joined natural gas systems where used shall be provided in compliance with specification Section 227011 “Mechanically Joined Natural Gas Systems”.

C. This Section does not apply to liquid petroleum piping; industrial gas applications using such gases as acetylene and acetylenic compounds, hydrogen, ammonia, carbon monoxide, oxygen and nitrogen; gas piping, meters, gas pressure regulators and other appurtenances used by the serving gas supplier in distribution of gas.

D. Related Sections: The following sections contain requirements that relate to this Section:

1. Division 22 Section "General plumbing Requirements," for trenching, excavation, backfill and compaction materials and methods for underground piping installations.
2. Division 7 Section "Joint Sealers," for materials and methods for sealing pipe penetrations through basement and foundation walls.
3. Division 9 Section "Painting," for materials and methods for painting pipe.
4. Division 22 Section "Common Work Results for Plumbing," for materials and methods for fire barrier penetrations and wall and floor penetrations.
5. Division 22 Section "Basic Piping Material and Methods," for materials and methods for strainers, unions, dielectric flanges, and mechanical sleeve seals.
6. Division 22 Section "Hangers and Supports for Plumbing Piping," for materials and methods for hanging and supporting gas distribution piping.
7. Division 26 Section “Common Work Results for Electrical” required electrical devices.

E. Gas pressures for systems specified in this Section are limited to 2 psig.

F. Products furnished under this Section include gas meters and gas service piping, which will be provided by the utility company to the site. The following is the name and address of the utility company:

Company: Black Hills Energy
Address: 655 E. Millsap Rd
Telephone number: (800) 563-0012

1.02 DEFINITIONS

A. Pipe sizes used in this Specification are Nominal Pipe Size (NPS).

B. Gas Distribution Piping: A pipe within the building which conveys gas from the point of delivery to the points of usage.

C. Gas Service Piping: The pipe from the gas main or other source of supply including the meter, regulating valve, or service valve to the gas distribution system of the building served.

D. Point of Delivery: The outlet of the service meter assembly, or the outlet of the service regulator (service shutoff valve when no meter is provided).

1.03 SUBMITTALS

A. Product data for each gas piping specialty and special duty valves. Include rated capacities of selected models, furnished specialties and accessories, and installation instructions.

B. Shop drawings detailing dimensions, required clearances, for connections to gas meter.

C. Coordination drawings for gas distribution piping systems in accordance with Division 22 Section "General Plumbing Requirements."

D. Maintenance data for gas specialties and special duty valves, for inclusion in operating and maintenance manual specified in Division 1 and Division 22 Section "General Plumbing Requirements."

E. Welders' qualification certificates, certifying that welders comply with the quality requirements specified under "Quality Assurance" below.

F. Test reports specified in Part 3 below.

1.04 QUALITY ASSURANCE

A. Installer Qualifications: Installation and replacement of gas piping, gas utilization equipment or accessories, and repair and servicing of equipment shall be performed

only by a qualified installer. The term qualified is defined as experienced in such work (experienced shall mean having a minimum of 5 previous projects similar in size and scope to this project), familiar with precautions required, and has complied with the requirements of the authority having jurisdiction. Upon request, submit evidence of such qualifications to the Architect.

B. Qualifications for Welding Processes and Operators: Comply with the requirements of ASME Boiler and Pressure Vessel Code, "Welding and Brazing Qualification."

C. Regulatory Requirements: Comply with the requirements of the following codes:

1. NFPA 54 - National Fuel Gas Code, for gas piping materials and components, gas piping installation and inspections, testing, and purging of gas piping systems.

D. Local Gas Utility Requirements: Comply with local gas utility installation rules and regulations.

E. Pipe, pipe fittings and pipe specialties shall be manufactured in plants located in the United States or certified to meet the specified ASTM and ANSI standards.

1.05 SPARE PARTS

A. Valve Wrenches: Furnish to Owner, with receipt, 2 valve wrenches for each type of gas valve installed, requiring same.

PART 2 - PRODUCTS AND MATERIALS

2.01 MANUFACTURERS

A. Manufacturer: Subject to compliance with requirements, provide gas piping system products from one of the following:

1. Gas Ball Valves – 2” and Smaller:

a) Apollo Valves # 77F-1XX-01
b) Hammond Valve # 8901
c) Milwaukee Valve # BA-475B
d) Nibco Inc. # T-FP 600A
e) Watts # FBV-3C

2. Gas Cocks – 2” and Smaller:

a) Homestead # 601
b) Milliken #200M
c) RM Energy Systems # D125

3. Gas Cocks – 2-1/2” and Larger:

a) Homestead # 602

b) Milliken #200MF
c) RM Energy Systems “Hercules” # D126

4. CSA Listed Gas Pressure Regulators

a) Karl Dungs, Inc.
b) Maxitrol
c) Pietro-Fiorentini

5. Polyethylene Pipe and Pipe Fittings:

a) Cresline Plastic Pipe Co. PE 2708
b) Charter Plastics PE 2708
c) Chevron Phillips DriscoPlex Series 6500

6. Polyethylene to Steel Pipe Transition Fittings:

a) Perfection Corporation
b) R.W. Lyall
c) Central Plastics

7. Insect Screens

a) Northtown Pipe Protection Products “BUGSCRN Series”

8. Gas Relief Vents

a) Richards “GV Series”

2.02 PIPE AND TUBING MATERIALS

A. General: Refer to Part 3, Article "PIPE APPLICATIONS" for identification of systems where the specified pipe and fitting materials listed below are used.

B. Steel Pipe: ASTM A 53, Grade B, Schedule 40, (Type E electric-resistance welded or Type S seamless, black steel pipe, beveled ends).

C. Plastic Pipe: Medium Density, SDR-11 iron pipe size polyethylene pipe, meeting ASTM D 2513, with heat fusion connections. Pipe shall meet Plastic Pipe Institute Material Designation of PE 2708.

2.03 FITTINGS

A. Malleable-Iron Threaded Fittings: ANSI B16.3, Class 150, standard pattern, for threaded joints. Threads shall conform to ANSI B1.20.1.

B. Steel Fittings: ASTM A 234, seamless or welded, for welded joints.

1. 1-1/4” and smaller shall be socket type
2. 1-1/2” and larger shall be butt weld type.

C. Forged Steel Flanges and Flanged Fittings: ASME B16.5, Class 150, butt weld ends, standard pattern with bolts, nuts and gaskets of material group 1.1.

D. Plastic Fittings: Medium density polyethylene socket fusion fittings, meeting ASTM D 2515 compatible with the piping system.

E. Transition Fittings – Steel to Polyethylene: Factory assembled and pressure tested one piece design, with steel half of Schedule 40 steel pipe with beveled edge for welding and polyethylene half shall be of ample length for making welds. Steel pipe shall have epoxy protective coating.

F. Insect screens: Black steel body with 20 mesh stainless steel screen and MNPT end.

G. Gas Relief Vents: Galvanized steel body with 90 degree inlet to screened outlet, 20 mesh stainless steel screen and FNPT end.

2.04 JOINING MATERIALS

A. Joint Compound: Suitable for the gas being handled.

B. Gasket Material: Thickness, material, and type suitable for gas to be handled, and for design temperatures and pressures.

2.05 PIPING SPECIALTIES

A. Protective Coating: When piping will be in contact with material or atmosphere exerting a corrosive action, pipe and fittings shall be factory-coated with polyethylene tape, having the following properties:

1. overall thickness; 20 mils;
2. synthetic adhesive;
3. water vapor transmission rate, gallons per 100 square inch: 0.10 or less.
4. water absorption, percent: 0.02 or less.

B. Prime pipe and fittings with a compatible primer prior to application of tape.

C. Strike Plates: 16 gauge carbon steel, tested and listed by CSA International.

D. In wall Strike Protection Hose: UL listed spiral wound interlocking galvanized steel reduced wall flexible conduit.

E. Nonmetallic Watertight Conduit: Schedule 80 rigid PVC, UL 651, with fittings to match to conduit type and material.

2.06 VALVES

A. Gas Ball Valves – 2” and Smaller: Full port brass body with brass ball, PTFE seats, threaded ends 150psi steam, 600 WOG, UL listed for natural gas service.

B. Gas Cocks 2 Inch and Smaller: 175 psi, lubricated plug type, ASTM A126 Grade B semi-steel body, brass or semi-steel plug with full area rectangular port, straightaway pattern, square head, threaded ends.

C. Gas Cocks 2-1/2 Inch and Larger: 175 psi, lubricated plug type, ASTM A126 Grade B semi-steel body and plug with full area rectangular port, straightaway pattern, single gland, wrench operated, flanged ends.

D. Solenoid Valves: As specified on the drawings.

E. Gas Line Pressure Regulators: Single stage, steel jacketed, corrosion-resistant gas pressure regulators; with atmospheric vent, elevation compensator; internal relief vent, vent limiter for indoor installation, with threaded ends for 2 inch and smaller, flanged ends for 2-1/2 inch and larger; for inlet and outlet gas pressures, specific gravity, and volume flow as indicated on the drawings.

1. CSA listed for 2 PSI gas systems

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install pipe, fittings, valves and specialties in accordance with manufacturer's installation instructions.

3.02 PREPARATION

A. Conform with the requirements in NFPA 54, for the prevention of accidental ignition.

3.03 PREPARATION FOUNDATION FOR UNDERGROUND GAS SERVICE PIPING

A. Pipe Beds for PE Pipe and PVC Pipe Conduit: Support pipe in trench with sand bags level and true to prevent sand, gravel or debris from interfering with the solvent cement or fusion process. After pressure testing is complete, gradually install bedding to maintain continuous pipe slope and prevent pipe deflection and then install subbase. Refer to Division 22 Section "General Plumbing Requirements" for bedding and subbase materials, excavation, trenching, backfill and compaction requirements and refer to ASTM D2321 "Underground Installation of Thermoplastic Pipe for Sewers and Gravity-flow Applications" for additional requirements.

3.04 PIPE APPLICATIONS

A. Install steel pipe with threaded joints and fittings for 2 inch and smaller, and with welded joints for 2-1/2 inch and larger.

B. Install PE plastic pipe with fusion bond plastic fittings below grade outside the building slab.

3.05 PIPING INSTALLATION

A. General: Conform to the requirements of NFPA 54 - National Fuel Gas Code.

B. Locations and Arrangements: Drawings (plans, schematics, and diagrams) indicate the general location and arrangement of piping systems. Design locations and arrangements of piping take into consideration pipe sizing, flow direction, slope of pipe, expansion, and other design considerations. So far as practical, install piping as indicated.

C. Concealed Locations: As specified below:

1. Inaccessible Above-Ceiling Locations: Install concealed gas piping in inaccessible above-ceiling spaces without valves or unions.
2. Accessible Above-Ceiling Locations: Gas piping may be installed in accessible above-ceiling spaces (subject to the approval of the authority having jurisdiction), whether or not such spaces are used as a plenum. Valves and unions shall not be located in such spaces used as a plenum.
3. In Floors: Install concealed gas piping in concrete floor slabs in an air-tight conduit constructed of Schedule 40 PVC with socket weld joints two pipe sizes larger than the gas pipe served. Extend conduit a minimum of 12" above finish floor and cap air tight at both ends. Vent conduit to the outside with a minimum 2" pipe and terminate with a screened vent cap.
4. Piping In Partitions: Install concealed gas piping in hollow partitions with welded joint (subject to the approval of the authority having jurisdiction) and protect gas piping against physical damage. Install gas piping passing through partitions with no joints or unions inside the partition.
5. Concrete or Masonry Walls: Do not install gas piping in masonry or concrete walls.
6. Prohibited Locations: Do not install gas piping in or through a circulating air duct, clothes chute, chimney or gas vent, ventilating duct, dumbwaiter or elevator shaft. This does not apply to accessible above-ceiling space specified above.

D. Fire Barrier Penetrations: Where pipes pass though fire-rated walls, partitions, ceilings, and floors, maintain the fire-rated integrity. Refer to Division 22 Section "Common Work Results for Plumbing" for special sealers and materials.

E. Elevated Floor Penetrations of Waterproof Membrane, Interior Penetrations of No-Fire Rated Walls and Concrete Slab on Grade Penetrations: Provide sleeves and seal pipes that pass through waterproof floors, non-fire rated walls, partitions and ceilings or concrete slab on grade. Refer to Division 22 Section "Basic Piping Materials and Methods" for special sealers and materials.

F. Exterior Wall Penetrations: Seal pipe penetrations through exterior wall constructions with sleeves, packing, and sealant. Refer to Division 22 Section "Common Work Results for Plumbing" for additional information.

G. Underground Exterior Wall Penetrations: Seal pipe penetrations through underground exterior walls with sleeves and mechanical sleeve seals. Refer to Division 22 Section "Basic Piping Material and Methods" for additional information.

H. Dirt legs and Sediment Traps: Install a dirt leg at points where condensate and impurities may collect, at the outlet of the gas meter, as close to the inlet of each gas appliance or equipment as possible, and in a location readily accessible to permit cleaning and emptying.

1. Construct dirt legs and sediment traps using a tee fitting with the bottom outlet plugged or capped. Provide a 3" length of pipe and screwed cap for the dirt leg. Use line size pipe for dirt leg, refer to the drawings for sizes. Enter the tee with flow from the top and exit the tee from the side outlet. Install the dirt leg a minimum of 3-1/2" above the roof or floor readily accessible to permit cleaning and emptying.
2. Install line size gas cock, union and dirt leg at each equipment connection; refer to the drawings for sizes. Provide reducers at the equipment connection as required. Unions are specified in Division 22 section "Basic Piping Materials and Methods".

I. Use fittings for all changes in direction and all branch connections.

J. Install exposed piping at right angles or parallel to building walls. Diagonal runs are not permitted, unless expressly indicated.

K. Install piping free of sags or bends and with ample space between piping to permit proper insulation applications.

L. Conceal all pipe installations in walls, pipe chases, utility spaces, above ceilings, below grade or floors, unless indicated to be exposed to view.

M. Install horizontal piping as high as possible allowing for specified slope and coordination with other components. Install vertical piping tight to columns or walls. Allow sufficient space above removable ceiling panels to allow for panel removal.

N. Locate groups of pipes parallel to each other, spaced to permit applying insulation and servicing of valves.

O. Install gas piping at a uniform grade of 1/4 inch in 15 feet, upward to risers, and from the risers to the meter, or service regulator when meter is not provided, or the equipment.

P. Make reductions in pipe sizes using eccentric reducer fittings installed with the level side down.

Q. Connect branch outlet pipes from the top or sides of horizontal lines, not from the bottom.

R. Install unions in pipes 2 inch and smaller, adjacent to each valve, and elsewhere as indicated. Unions are not required on flanged devices. Unions are specified in Section “Basic Piping Materials and Methods”.

S. Joints Containing Dissimilar Metals: Provide dielectric unions for 2” and smaller and dielectric flanges for piping 2-1/2” and larger. Dielectric unions and flanges are specified in Section “Basic Piping Materials and Methods”.

T. Install flanges on valves, apparatus, and equipment having 2-1/2 inch and larger connections.

U. Install strainers on the supply side of each control valve, pressure reducing valve, pressure regulating valve, solenoid valve, and elsewhere as indicated.

V. Anchor piping to ensure proper direction of expansion and contraction. Install expansion loops and joints as indicated on the Drawings and specified in Division 22 Section "Expansion Fittings and Loops for Plumbing Piping."

W. Paint Exposed Outdoor Gas Piping: Cleaning and painting of exposed outdoor gas piping is specified in Division 9 Section "Painting".

1. Final color per the architect.

X. Install plastic pipe underground with socket weld plastic joints. Use transition fittings for joining steel to plastic pipe. Installation and pipe bedding shall be per the manufacturer’s published installation recommendations.

3.06 HANGERS AND SUPPORTS

A. General: Hanger, support, and anchor components and installation procedures conforming to MSS SP-58 and SP-69 are specified in Division 22 Section "Hangers and Supports for Plumbing Piping”. Conform to the table below for maximum spacing of supports.

B. Pipe Attachments: Install the following:

1. Adjustable clevis hangers, MSS SP-69 Type 1, for steel pipe 2-1/2” and larger for individual horizontal runs.
2. Riser clamps, MSS SP-69 Type 8, for individual vertical runs.
3. Extension split ring pipe clamp, MSS SP-69 Type 12, for individual exposed runs on walls.
4. Engineered strut support system may be provided, at the contractor’s option, in lieu of individual hangers for horizontal pipes as specified in Division 22

"Hangers and Supports for Plumbing Piping". Provide two piece straps for uninsulated pipe secured to the bare pipe and provide plastic galvanic isolators for bare copper tube.

5. Provide roll hangers for individual horizontal runs 100 feet or longer.
6. Provide roll hangers for individual horizontal runs 20 feet or longer for exposed piping installed on roofs.
7. Install hangers with maximum horizontal spacing and minimum rod diameters, to comply with MSS-58 and SP-69, locally enforced codes, this specification, and authorities having jurisdiction requirements, whichever are most stringent. Install hangers for horizontal piping with the following maximum spacing and minimum rod diameters:

Nom. Pipe Size in Inches	Max Span In Feet	Min. Rod Dia. - Inches
1/2	6	3/8
3/4 to 1	8	3/8
1-1/4 to 2	10	3/8
2-1/2 to 3	10	3/8
4	10	3/8

C. Support vertical piping at every floor.

D. Support gas piping within 12" of each elbow or tee and for gas piping 2-1/2" and larger at each valve or pressure regulator.

3.07 PIPE JOINT CONSTRUCTION

A. Welded Joints: Comply with the requirements in ASME Boiler and Pressure Vessel Code, Section IX.

B. Threaded Joints: Conform to ANSI B1.20.1, tapered pipe threads for field cut threads. Join pipe, fittings, and valves as follows:

1. Note the internal length of threads in fittings or valve ends, and proximity of internal seat or wall, to determine how far pipe should be threaded into joint. Refer to NFPA 54, for guide for number and length of threads for field threading steel pipe.
2. Align threads at point of assembly.
3. Apply thread compound for use with gas systems to the external pipe threads. Pipe thread tape is not accepted.
4. Assemble joint to appropriate thread depth. When using a wrench on valves place the wrench on the valve end into which the pipe is being threaded.
5. Damaged Threads: Do not use pipe with threads which are corroded, or damaged. If a weld opens during cutting or threading operations, that portion of pipe shall not be used.

C. Flanged Joints: Align flanges surfaces parallel. Assemble joints by sequencing bolt tightening to make initial contact of flanges and gaskets as flat and parallel as

possible. Use suitable lubricants on bolt threads. Tighten bolts gradually and uniformly to appropriate torque specified by the bolt manufacturer.

D. Fusion Welded: Joints shall be made by a qualified and approved operator in accordance with Title 49, CFR, Part 192.283 and be made in accordance with pipe manufacturer's recommendations.

3.08 VALVE APPLICATIONS

A. General: The Drawings indicate valve types, locations, and arrangements.

B. Shut-off duty: Use gas cocks specified in Part 2 above.

3.09 VALVE INSTALLATIONS

A. Install valves in accessible locations, protected from physical damage. Tag valves with a metal tag attached with a metal chain indicating the piping systems supplied.

B. Install the emergency natural gas shutoff valve furnished with exhaust hood fire extinguishing system in an accessible location.

C. Install line size gas cock at the outlet of the gas meter set or gas riser and install a line size union downstream of the gas cock outside of the building.

D. Installation of Gas Pressure Regulators:

1. Install a gas cock 10 pipe diameters upstream of each gas pressure regulator. Where two gas pressure regulators are installed in series in a single gas line, a manual valve is not required at the second regulator.
2. Install line pressure regulators a minimum of 10 pipe diameters upstream of each atmospheric or power burner equipment connection.
3. Install line pressure regulators a minimum of 10'-0" upstream of each condensing boiler or water heater connection.
4. Install gas pressure regulator relief devices so they can be readily operated to determine if the valve is free; so they can be tested to determine the pressure at which they will operate; and examined for leakage when in the closed position.
5. Install gas pressure regulators with listed vent limiters indoors where allowed by the AHJ. Install with regulator dome vertically upright and level.
6. Install gas pressure regulators located outside the building with the relief port facing down to prevent the entry of moisture with the relief port a minimum of 18" above the roof or finish grade. Remove vent limiter and provide with line size (same size as gas vent relief port) insect screen or gas relief vent and 1" long schedule 40 black steel nipple.

    a) Where manufacturer does not allow the gas pressure regulator to be installed upside down, install gas pressure regulator with regulator

dome in the horizontal or vertically upright with factory breather plug.

7. Gas Pressure Regulator Relief Vents: Provide for gas pressure regulators that require them or for vent less regulators where the AHJ requires them. Install steel pipe with threaded joints and fittings for 2 inch and smaller, and with welded joints for 2-1/2 inch and larger. Route vent to the outdoors thru building side wall and turn down or thru the roof and turn down minimum 18" above the roof or grade. Provide with line size (same size as gas relief) insect screen or gas relief vent. Provide vent sizes per the following developed length and include 3 feet of length for each elbow:

   a) 10 feet developed length = size vent one pipe size larger than relief vent outlet size
   b) 20 feet developed length = size vent two pipe size larger than relief vent outlet size
   c) 30 feet developed length = size vent three pipe size larger than relief vent outlet size
   d) 40 feet developed length = size vent four pipe size larger than relief vent outlet size

3.010 TERMINAL EQUIPMENT CONNECTIONS

A. Install line size gas cock upstream and within 6 feet of gas appliance. Install a line size union or flanged connection downstream from the gas cock to permit removal of controls. Install reducer at the gas appliance connection, if required.

B. Install stainless steel flexible gas pipe connector, of size and length as required to complete equipment hook-up of foodservice equipment. Verify appropriate length of flexible gas pipe connector for movement of the foodservice equipment for cleaning.

3.011 ELECTRICAL BONDING AND GROUNDING

A. Install above ground portions of gas piping systems, upstream from equipment shutoff valves electrically continuous and bonded to a grounding electrode in accordance with NFPA 70 - "National Electrical Code."

B. Do not use gas piping as a grounding electrode.

C. Conform to NFPA 70 - "National Electrical Code," for electrical connections between wiring and electrically operated control devices.

3.012 FIELD QUALITY CONTROL

A. Piping Tests: Inspect, test, and purge natural gas systems in accordance with NFPA 54, and local utility requirements.

END OF SECTION

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PART 1 - GENERAL REQUIREMENTS

1.01 SUMMARY

A. This Section includes mechanically joined fittings and valves for distribution piping systems for natural gas, liquid petroleum-gas and manufactured gas within the building and extending from the point of delivery to the connections with gas utilization devices. Piping materials and equipment specified in this Section include:

1. Fittings.

B. This Section does not apply to liquid petroleum piping; industrial gas applications using such gases as acetylene and acetylenic compounds, hydrogen, ammonia, carbon monoxide, oxygen and nitrogen; gas piping, meters, gas pressure regulators and other appurtenances used by the serving gas supplier in distribution of gas.

C. Related Sections: The following sections contain requirements that relate to this Section:

1. Division 22 Section "Natural Gas Systems," for valves, hangers, natural gas systems and installation requirements.

D. Gas pressures for systems specified in this Section are limited to 2 psig.

1.02 SUBMITTALS

A. Product data for each mechanically joined gas pipe fitting. Include rated capacities of selected models, furnished specialties and accessories, and installation instructions.

B. Maintenance data for mechanically joined gas pipe fittings, for inclusion in operating and maintenance manual specified in Division 1 and Division 22 Section "General Plumbing Requirements."

C. Installer qualification certificates, certifying that installers comply with the quality requirements specified under "Quality Assurance" below.

D. Test reports specified in Part 3 below.

1.03 QUALITY ASSURANCE

A. Installer Qualifications: Installation of mechanically joined fittings shall be performed only by a qualified installer. The term qualified is defined as experienced in such work (experienced shall mean having a minimum of 5 previous projects similar in size and scope to this project), familiar with precautions required,

and has complied with the requirements of the authority having jurisdiction. Upon request, submit evidence of such qualifications to the Architect.

B. Local Gas Utility Requirements: Installation of mechanically joined fittings shall comply with local gas utility installation rules and regulations.

C. Mechanically joined fittings shall be manufactured in plants located in the United States or certified to meet the specified ASTM and ANSI standards.

D. Obtain training from the mechanically joined fittings manufacturer for all workers that will be installing or handling the mechanically joined fittings.

PART 2 - PRODUCTS AND MATERIALS

2.01 MANUFACTURERS

A. Manufacturer: Subject to compliance with requirements, provide gas piping system products from one of the following:

1. Mechanically Joined Fittings:

a) Viega “Mega-Press G Fittings”
b) Apollo “PowerPress”

2.02 FITTINGS

A. Mechanically Joined Fittings: ½ inch through 4 inch meeting ANSI LC4-2012 /CSA 6.32-2012 2nd Edition with zinc/nickel coating, HNBR sealing element, 420 stainless steel grip ring, 304 stainless steel separator ring, and Smart Connect (SC) Feature that allows the joint to leak if not properly sealed. Fittings shall be for use with IPS schedule 10 thru schedule 40 carbon steel, or galvanized pipe meeting ASTM A53. Fittings shall have temperature and pressure rating of -40F to 180F at a maximum operating pressure of 125 psi.

2.03 VALVES

A. Mechanically Joined Gas Ball Valves: ½ inch through 2 inch carbon steel body meeting ASTM A216 with full port 316 stainless steel ball meeting ASTM A276, blowout-proof stem, with replaceable "Teflon" or "PTFE" seats and seals, solder ends and vinyl-covered steel handle. Provide with mechanically joined ends meeting ASTM LC4 with HNBR O-ring.

1. Apollo “PowerPress” # 89FHV4 series

PART 3 - EXECUTION

3.01 PIPING INSTALLATION

A. Install fittings and valves in accordance with manufacturer's installation instructions.

3.02 PREPARATION

A. Precautions: Before turning off the gas to the premises, or section of piping, turn off all equipment valves. Perform a leakage test as specified in "FIELD QUALITY CONTROL" below, to determine that all equipment is turned off in the piping section to be affected.

B. Conform with the requirements in NFPA 54, for the prevention of accidental ignition.

3.03 PIPE APPLICATIONS

A. Install above floor steel pipe with mechanically joined fittings for pipe 1/2 inch and larger up to 4".

3.04 PIPING INSTALLATION

A. Piping Installation requirements are specified in Division 22 Section "Natural Gas Systems".

3.05 PIPE JOINT CONSTRUCTION

A. Joint materials and installation requirements are specified in Division 22 Section "Natural Gas Systems".

B. Joints for Mechanically Joined Fittings: Comply with the manufacturer's installation instructions and Requirements:

1. Cut pipe ends at right angle (square) to the pipe.
2. Ream pipe ends with chamfer.
3. Remove paint, lacquer, grease, oil or dirt from the pipe end with an abrasive cloth, or with the "Ridgid MegaPress" pipe end prep tool.
4. Visually examine the fitting sealing element to ensure there is no damage.
5. Utilize a "Viega MegaPress Insertion Depth Inspection Gauge" to mark the pipe wall, with a felt tip pen, at the appropriate location, or insert the pipe fully into the fitting and mark the pipe wall at the face of the fitting.
6. Verify the pipe is fully inserted into the fitting prior to pressing the joint.
7. Install mechanically joined fittings using "Ridgid" MegaPress Tools.

3.06 VALVE APPLICATIONS

A. Valves are specified in Division 22 Section "Natural Gas Systems".

B. Valves can be installed with screwed joints for 2" and smaller and flanged joints for 2-1/2" and larger. Or, valves can be provided with mechanically joined fitting adapters and the joints installed as specified herein.

3.07 VALVE INSTALLATIONS

A. Valve installation requirements are specified in Division 22 Section "Natural Gas Systems".

3.08 FIELD QUALITY CONTROL

A. Field quality control requirements are specified in Division 22 Section "Natural Gas Systems".

B. Installing contractor shall schedule training session with the mechanically joined fittings manufacturer at project site for all workers that will be installing or handling mechanically joined fittings. Submit certification letter along with list of certified attendees to Architect within 30-days of mobilization. Include copy of certification letter with closeout documents. Mechanically joined fittings manufacturer shall provide certification training to the contractor without cost and without additional cost to the Owner.

C. Piping Tests: Inspect, test, and purge natural gas systems in accordance with NFPA 54, and local utility requirements.

D. Manufacturer's Piping Test: Provide two-step test process as follows:

1. Pressurize the system between 0.5 psi and 45 psi with air or dry nitrogen.
2. If the system does not hold pressure, walk the system and check for un-pressed fittings.
3. If un-pressed fittings are found, ensure the pipe is fully inserted into the fitting and properly marked prior to pressing the joint.
4. If failed joints are fond, cut out the failed fitting and replace with new as specified herein.
5. After appropriate repairs have been made, test the system per local code, not to exceed 200 psig.

END OF SECTION