SECTION 220500 - BASIC PLUMBING MATERIALS AND METHODS

PART 1 - GENERAL

1.1 APPLICABLE REQUIREMENTS

A. All work under this Section shall comply with the requirements of General Conditions, Supplemental Conditions, Special Conditions and Division 01 - General Requirements, and all Plumbing Sections specified herein.

1.2 SCOPE OF THIS SECTION

A. Work to be furnished and installed under this Section shall include, but not necessarily be limited to, the following:

1. Compliance with all codes and standards applicable to this jurisdiction.
2. Shop Drawings for Equipment
3. Coordination Documents
4. Record drawings
5. Start-up and commissioning service
6. Instruction, Training, and Operations & Maintenance Manuals
7. Work associated with delivery, storage, and handling of products
8. Work associated with provision of temporary facilities
9. Preparation of posted operating instructions
10. Meeting project safety and indemnity requirements
11. Proper cleaning and closing
12. Supplying proper Warranty information
13. Supply specified Guarantee documentation
14. Design and provision of supports and anchors
15. Design and provision of seismic restraints
16. Design and provision of vibration isolation
17. Design and provisions of thermal expansion.
18. Through-penetration and membrane penetration firestop assemblies
19. Hangers and supports
20. Pipe portals
21. Pipe stands
22. Equipment supports
23. Access panels and doors
24. Roof flashings
25. Water hammer arresters
26. Drains
27. Trap primers
28. Miscellaneous fixtures
29. Identification markers, equipment labels, pipe labels, valve tags, warning signs.
30. Coordination of electrical requirements for equipment provided

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1.3 DESCRIPTION OF WORK

A. The Contract Documents, including Specifications, Construction Drawings, Owner Design Requirements and referenced Codes and Standards, require the Contractor to provide all material and labor to install complete plumbing systems for the project, whether or not specifically shown in the documents, and where applicable, shall appropriately interface with all existing building systems affected by new construction.

B. The Contractor shall refer to the architectural interior details, floor plans, elevations, and the structural and other Contract Drawings and shall coordinate the work with that of the other trades to avoid interference.

C. The drawings are diagrammatic and show generally the locations of the fixtures, equipment, and pipe routing and are not to be scaled. All dimensions and existing conditions shall be inspected and verified by contractors at the building prior to start of any work.

D. The Contractor shall comply with the project closeout requirements as detailed in General Requirements of Division 01.

E. Where project involves interface with existing building and/or site systems, existing utilities and services have been indicated on the drawings to the extent possible based on available record drawings. The Contractor shall thoroughly familiarize themselves with existing conditions and be aware that in some cases information is not available as to concealed conditions, which exist in portions of the existing building affected by this work.

F. The contractor shall design and supply all miscellaneous metals and system support components that are necessary to support all plumbing system, whether indicated or not on the drawings. Such metals and support components and related connections shall be provided as necessary to directly and concentrically impost loads on the primary structure. Refer to structural design requirements for specific attachment requirements. The plumbing system supports shall accommodate lateral movements between floors as defined in the story drift requirements.

G. The contractor shall design and supply plumbing devices and system components that are necessary to accommodate structural movement as defined by structural design criteria associated with piping transitions through building expansion joints. Design of expansion joints to allow for dimensional changes in portions of a structure separated by such joints should take both reversible and irreversible movements into account.

H. The contractor shall design and supply plumbing devices and system components that are necessary to accommodate thermal expansion of piping systems based the temperature at the time of installation and the minimum/maximum anticipated temperature for the installed location. Design of thermal expansion provisions shall take into account all resilient restraints and anchors. Refer to 221000 Plumbing Piping Valves and Specialties for additional information and requirements.

I. Refer to Basis of Design on drawings. Systems as specified under this section shall include, but not necessarily be limited to, the following:

1. Connection to existing building utilities & systems.

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2. Connection of all waste, vent, and water piping to all plumbing fixtures, sinks, toilets, drinking fountains, sinks, water dispensers, drains and mechanical equipment.

1.4 SUBMITTALS

A. Prior to construction submit for approval all materials and equipment in accordance with Division 01. Submit manufacturer's data, installation instructions, and maintenance and operating instructions for all components of this section including, but not limited to, the following:

1. Supports and anchors
2. Access panels and doors
3. Identification markers, labels and tags
4. Electrical equipment
5. Pipe portals
6. Plumbing specialties
7. Trap primers
8. Cleanouts
9. Drains
10. Wall hydrants and hose bibbs

B. Contractor shall submit a letter that all products used in the plumbing system are certified for use in the State and Municipality of the project site.

1.5 DESCRIPTION OF BID DOCUMENTS

A. Specifications:

1. Specifications, in general, describe quality and character of materials and equipment.
2. Specifications are of simplified form and include incomplete sentences.

B. Drawings:

1. Drawings in general are diagrammatic and indicate sizes, locations, connections to equipment and details of installation. Coordinate with other trades before commencing any work.
2. Before proceeding with work check and verify all dimensions. Verify exact location and elevation of existing work prior to any construction.
3. Verify exact location and elevation of existing piping, ductwork, conduits and structure and coordinate to accommodate installation of new work as indicated on the drawings.
4. Contractor shall assume all responsibility for fitting of materials and equipment to other parts of equipment and structure, and to avoid other pipes, conduits and ducts. Contractor shall be responsible to relocate other work or modify new work as necessary.
5. Contractor shall make adjustments that may be necessary or requested, in order to resolve space problems, preserve headroom, and avoid architectural openings, structural members and work of other trades.

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6. If any part of Specifications or Drawings appears unclear or contradictory, apply to the Owner's Representative for interpretation and decision as early as possible, including during bidding period.

1.6 DEFINITIONS

A. Above Grade: Not buried in the ground and not embedded in concrete slab on ground.

B. Actuating or Control Devices: Automatic sensing and switching devices such as thermostats, pressure, float, electro-pneumatic switches and electrodes controlling operation of equipment.

C. Below Grade: Buried in the ground or embedded in concrete slab on ground.

D. Building Drain: That part of the lowest piping of a drainage system that receives the discharge from soil, waste, and other drainage pipes inside the walls of the building and conveys it to the building sewer beginning 2 feet (610 mm) to 5 feet (1,524 mm) outside the building wall.

E. Building Sewer: That part of the horizontal piping of a drainage system that extends from the end of the building drain and that receives the discharge of the building drain and conveys it to a public sewer, private sewer, private sewage disposal system, or other point of disposal.

F. Concealed: Embedded in masonry or other construction, installed in furred spaces, within double partitions or hung ceilings, in trenches, in crawl spaces, or in enclosures. In general, any item not visible or directly accessible.

G. Connect: Complete hook-up of item with required service.

H. Drift: The horizontal deflection at the top of the story relative to the bottom of the story. Refer to structural design for drift dimensional movements.

I. Embodied Carbon: The embodied carbon of a product is the total amount of Greenhouse Gas Emissions (GHG) associated with the whole life cycle of the product, including raw material extraction, manufacturing, transportation, installation, maintenance, and end-of-life disposal.

J. Environmental Product Declaration (EPDs): A standardized report quantifying the environmental impact of a product or system. Declarations include information on the environmental impact of raw material acquisition, energy use and efficiency, content of materials and chemical substances, and emissions related to air, soil, and water. Product and company information is also included. An acceptable EPD shall meet the environmental requirements of ISO 14021-1999, ISO 14025-2006 and EN 15804, or ISO 21930-2007.

1. Industry-Wide EPD: Based on multiple manufacturers of a common product type.
2. Product Specific EPD: Based on a product by single manufacturer but may include average of multiple facilities making the same product.
3. Product Specific, Facility Specific EPD: Based on product by single manufacturer from single facility.

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K. Expansion Joint: A mid-structure separation designed to relieve stress on building materials caused by building movement induced by any of the following: thermal expansion and contraction; wind sway; seismic events; static load deflection; or live load deflection. Expansion joint systems are used to bridge the gap and maintain building assembly functions while accommodating expected movements. Expansion joints also include transitions from an existing building to a new building addition. Refer to structural design for expansion joint dimensional movements.

L. Exposed: Not installed underground or concealed.

M. Furnish: To supply equipment and products as specified.

N. Indicated, Shown or Noted: As indicated, shown or noted on Drawings or Specifications.

O. Install: To erect, mount and connect complete with related accessories.

P. Lead Free: Materials containing not more than 0.2 percent lead when used with respect to solder and flux and not more than a weighted average of 0.25 percent when used with respect to the wetted surfaces of pipes and pipe fittings, plumbing fittings, and fixtures, providing a specified definition and formula for determining “weighted average”.

Q. Motor Controllers: Manual or magnetic starters (with or without switches), individual push buttons or hand-off-automatic (HOA) switches controlling the operation of motors.

R. Must: A desire to complete the specified task. Allows some flexibility in application as opposed to Shall.

S. Noncombustible Material: A noncombustible material is a substance that will not ignite, burn, support combustion, or release flammable vapors when subject to fire or heat in compliance with ASTM E136 Standard Test Method for Assessing Combustibility of Materials Using a Vertical Tube Furnace at 750°C. Examples of noncombustible materials include the following, but confirm compliance in manufacturer literature:

1. Portland cement concrete, concrete, gypsum concrete (normally used in drywall or poured gypsum floor toppings), Portland cement stucco, Portland cement plaster, and gypsum plaster, gypsum wall board (sheetrock), and Type X gypsum wall board.
2. Brick masonry, concrete block masonry, and ceramic tiles.
3. Steel, stainless steel, galvanized steel, and other metals, except aluminum (aluminum is classified as limited-combustible), magnesium and magnesium alloys.
4. Sheet glass, block glass, and uncoated glass fibers.
5. Mineral wool and rock wool.

T. NRTL: Nationally Recognized Testing Laboratory, including UL, CSA and/or ETL.

U. Piping: Pipe, tube, fittings, flanges, valves, controls, strainers, hangers, supports, unions, traps, drains, insulation, and related items.

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V. Provide: To supply, install and connect as specified for a complete, safe and operationally ready system.

W. Reviewed, Satisfactory or Directed: As reviewed, satisfactory, or directed by or to Architect/Engineer/Owner's Representative.

X. Rough-In: Provide all indicated services in the necessary arrangement suitable for making final connections to fixture or equipment.

Y. Shall: An exhortation or command to complete the specified task.

Z. Similar or Equal: Of base bid manufacture, equal in materials, weight, size, design, and efficiency of specified products.

AA. Supply: To purchase, procure, acquire and deliver complete with related accessories.

BB. Typical or Typ: Exhibiting the qualities, traits, or characteristics that identify a kind, class, number, group or category. Of or relating to a representative specimen. Application shall apply to all other similarly identified on plan or detail.

CC. Will: A desire to complete the specified task. Allows some flexibility in application as opposed to Shall.

DD. Wiring: Raceway, fittings, wire, boxes and related items.

EE. Work: Labor, materials, equipment, apparatus, controls, accessories, and other items required for proper and complete installation.

1.7 RELATED WORK SPECIFIED ELSEWHERE

A. All Division 22 Plumbing sections included herein.

B. Division 01: General Requirements

1. Including commissioning requirements.

C. Division 03: Concrete.

1. All concrete work required for plumbing work shall be provided by Division 03 installer. Division 22 installer shall coordinate with Division 03 installer for all locations, including, but not limited to, the following locations:

a. Concrete curbs and housekeeping pads for the plumbing equipment.
b. Thrust blocks, pads, and boxes for plumbing equipment.
c. Coordination of floor drain and floor sink installations in sloped floors.

D. Division 07: Thermal and Moisture Protection.

1. All caulking and sealing work required for plumbing work shall be provided by Division 07 installer. Division 22 installer shall coordinate with Division 07 installer for all locations, including, but not limited to, the following:

a. Flashing and sheet metal.
b. Sealants and caulking.
c. Firestopping at all rated penetrations.

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E. Division 09: Finishes.

1. All painting work required for plumbing work shall be provided by Division 09 installer. Division 22 installer shall coordinate with Division 09 installer for painting needs outlined in this specification.

F. Division 21: Fire Suppression.

1. Fire protection contractor to provide drain piping from fire suppression risers, inspector test locations and auxiliary drain locations to approved termination outside the building or other approved locations per NFPA-13.
2. Coordinate required indirect plumbing drain location(s), floor sinks and/or hub drains, with fire protection design. Provide minimum 3” sanitary sewer to serve riser drainage, or as shown on the drawings.

G. Division 23: HVAC.

1. Drain inlets and sanitary sewer piping to serve all condensate and equipment drainage from mechanical equipment.
2. Coordinate plumbing piping and drain locations with HVAC drawings.
3. Domestic water makeup water piping, valves and backflow prevention devices to serve mechanical equipment.

H. Division 26: Electrical.

1. Power connections to all plumbing equipment.
2. Life safety provisions.

1.8 CODES AND STANDARDS

A. The Contractor is cautioned that code requirements not explicitly detailed in these specifications or drawings, but which may be reasonably inferred or implied from the nature of the project, must be provided as part of the contract.

B. Perform all tests required by governing authorities and required under all Division 22 Sections. Provide written reports on all tests.

C. Electrical devices and wiring shall conform to the latest standards of NEC; all devices shall be UL listed and labeled.

D. All excavation work must comply with all provisions of state laws including notification to all owners of underground utilities at least 48 business day hours, but not more than 10 business days, before commencing an excavation.

E. Provide in accordance with rules and regulations of the following:

1. Oregon Building Codes enforced by the Authority Having Jurisdiction (AHJ):

a. 2025 Oregon Structural Specialty Code (OSSC) based on 2024 International Building Code (IBC)
b. 2025 Oregon Energy Efficiency Code (OEESC) based on the 2022 ASHRAE 90.1

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c. 2025 Oregon Mechanical Specialty Code (OMSC) based on 2024 International Mechanical Code (IMC) and 2024 International Fuel Gas Code (IFGC) with State Amendments
d. 2023 Oregon Plumbing Specialty Code (OPSC) based on 2021 Uniform Plumbing Code (UPC) with State Amendments
e. 2025 Oregon Fire Code (Based on the 2024 International Fire Code)
f. 2023 Oregon Electric Specialty Code (Based on the 2023 National Electric Code (NEC) with State Amendments

2. Local jurisdiction codes and amendments
3. Local utility requirements for water, sewer and gas provisions as appropriate
4. State Fire Marshal Office
5. Health Department
6. State Administrative Codes

F. All accessible plumbing work shall comply with the Americans with Disabilities Act (ADA)and local amendments. Compliance requirements applicable to plumbing work includes, but is not limited to, the following ADA requirements:

1. Section 309: Operable parts shall be operable with one hand and shall not require tight grasping, pinching, or twisting of the wrist. The force required to activate operable parts shall be five (5) pounds maximum.
2. Section 609: No plumbing fixtures or valves may impede on grab bar clearances. Grab bars are installed in a horizontal position between 33” and 36” above the finish floor to the top of the grab bar. The clear space between the wall and the grab bar shall be 1-1/2” minimum with no obstructions created by valves, fittings or controls. The space between the grab bar and projecting objects above shall be 12” minimum. The space between the grab bar and projecting objects below shall be 1-1/2” minimum.
3. Section 604.4: The seat height of a water closet above the finish floor shall be 17” minimum and 19” maximum measured to the top of the seat. Seats shall not be sprung to return to a lifted position. A water closet in a toilet room for a single occupant accessed only through a private office and not for common use or public use shall not be required to comply. In residential dwelling units the height of water closets shall be permitted to be 15” minimum and 19” maximum above the finish floor measured to the top of the seat.
4. Section 605.2: Urinal shall be a stall-type or wall-hung type with the rim 17” maximum above the finish floor or ground. Urinals shall be 13-1/2” deep minimum.
5. Section 606.3: Lavatories and sinks shall be installed with the front of the higher of the rim or counter surface 34” maximum above the finish floor.
6. Section 606.4: Hand-operated metering faucets shall remain open for 10 seconds minimum.
7. Section 606.5: Water supply and drain pipes under lavatories and sinks shall be insulated or otherwise configured to protect against contact. There shall be no sharp or abrasive surfaces under lavatories and sinks.

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8. Section 602: Drinking fountain spout height shall be 36” maximum above the finish floor. The spout shall provide a flow of water 4” high minimum and shall be located 5” maximum from the front of the unit.
9. Section 608.6: A shower spray unit with a hose 59” minimum that can be used both as a fixed-position shower head and as hand-held shower. The shower spray unit shall have an on/off control with a non-positive shut-off. The shower unit shall not obstruct grad bar clearances. Shower spray units shall deliver water that does not exceed 120°F maximum.
10. Section 608.7: Thresholds in roll-in type shower compartments shall be 1/2” high maximum.

G. Provide in accordance with appropriate referenced standards of the following:

1. ADA - Americans with Disabilities Act.
2. ADC - Air Diffuser Council.
3. ANSI - American National Standards Institute.
4. ASHRAE - American Society of Heating, Refrigerating & Air Conditioning Engineers.
5. ASME - American Society of Mechanical Engineers.
6. ASSE - American Society of Sanitary Engineers.
7. ASTM - American Society for Testing Materials.
8. AWS - American Welding Society.
9. AWWA - American Water Works Association.
10. CIBSE TM65 _ 2021 – Chartered Institution of Building Services Engineers Technical Memorandum 65, Embodied Carbon in Building Services: A Calculation Methodology
11. CISPI - Cast Iron Soil Pipe Institute.
12. CSA - Canadian Standards Association.
13. ETL - Electrical Testing Laboratories.
14. FM - Factory Mutual.
15. IAPMO - International Association of Plumbing and Mechanical Officials.
16. MSS - Manufacturer's Standardization Society.
17. NEMA - National Electrical Manufacturer's Association.
18. NFPA - National Fire Protection Association.
19. PDI - Plumbing and Drainage Institute.
20. SMACNA - Sheet Metal and Air Conditioning Contractors National Association.
21. UL - Underwriter's Laboratories.

H. Provide compliance in accordance with the following referenced standard which applies to general system compliance in contrast to specific equipment standards referenced elsewhere:

1. UL-2043: Standard for Fire Test for Heat and Visible Smoke Release for Discrete Products and Their Accessories Installed in Air-Handling Spaces. This is applicable to spaces above suspended ceilings and below raised floors.

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1.9 CONFLICTING REQUIREMENTS

A. Referenced Standards: If compliance with two or more standards is specified and the standards establish different or conflicting requirements for minimum quantities or quality levels, comply with the most stringent requirement. Refer conflicting requirements that are different, but apparently equal, to the Owner's Representative for a decision before proceeding.

B. Minimum Quantity or Quality Levels: The quantity or quality level shown or specified shall be the minimum provided or performed. The actual installation may comply exactly with the minimum quantity or quality specified, or it may exceed the minimum within reasonable limits. To comply with these requirements, indicated numeric values are minimum or maximum, as appropriate, for the context of requirements. Refer uncertainties to the Owner's Representative for a decision before proceeding.

1.10 QUALITY ASSURANCE

A. Manufacturer's Nameplates: Nameplates on manufactured items shall be affixed to each piece of equipment and resistant to ambient conditions.

B. All work shall include the following:

1. Manufactured items and equipment shall be a current, cataloged product of the manufacturer.
2. Replacement parts shall be readily available and stocked in the USA.

C. Special Inspections: Provide structural design and Special Inspections as required in Chapter 17 of the local building code and the Authority Having Jurisdiction, and as defined in the manufacturer installation instructions for each anchorage system. All anchors post-installed in hardened concrete members shall have periodic Special Inspections. Special inspection agencies shall be independent of the design and construction companies and shall act as agents for the AHJ, but contracted directly with the Owner or Owner's Representative.

D. Welding Standards:

1. Welding Qualifications:

a. Certification: Each welder shall have a current AWS QC7 welding certification with successful completion of written test and welding samples in compliance with AWS D1.1. The Owner's Representative reserves the right to request sample coupon test welds of each welder to validate quality of welding work.

2. Welding Procedures:

a. Steel Support Welding: All work shall be performed in compliance with American Welding Society AWS D1.1/D1.1M-Structural Welding Code-Steel.
b. Pipe Welding: All work shall be performed to meet or exceed the requirements of the American Welding Society AWS B2.1 Specification for Welding Procedure and Performance Qualification and ASME Boiler &

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Pressure Vessel Code: Section IX “Qualification Standard for Welding and Brazing Procedures, Welders, Brazers, and Welding and Brazing Operators.”

E. Pressure Piping Standards

1. Comply with ASME B31.1 Power Piping, ASME B31.3-Process Piping and ASME B31.9-Building Services Piping standards for materials, products, and installation per pressure and temperature operating class.
2. Comply with ASME B31.9 Building Services Piping standard for the following services:

   a. Conveying fluid between 0°F (-18°C) to 250°F (121°C).
   b. Fluid pressure less than 350 psig.

3. Comply with ASME B31.3 Process Piping standard for the following services:

   a. Conveying fluid above 250°F (121°C).
   b. Toxic or flammable fluids.

F. Comply with minimum requirements in “Vents” chapter of local plumbing code including amendments from Authority Having Jurisdiction for termination height of vents above the roof due to localized frost and snow conditions.

1.11 GENERAL REQUIREMENTS

A. Examine all existing conditions at building site.

B. Review contract documents and technical specifications for extent of new work to be provided.

C. Provide and pay for all permits, licenses, fees and inspections.

D. Install equipment and materials to provide required access for servicing and maintenance. Coordinate the final location of concealed equipment and devices requiring access with final location of required access panels and doors. Allow ample space for removal of all parts that require replacement or servicing without impacting adjacent equipment or piping. This work shall include furnishing and installing all access doors required for mechanical access. Joints and fittings shall not be located in inaccessible locations such wall, floor and roof penetrations.

E. Verify final locations for rough-ins with field measurements and with the requirements of the actual equipment to be connected. Coordinate all work with other disciplines before proceeding with installation.

F. Coordinate plumbing equipment and materials installation with other building components.

G. Piping dimensions, as identified on drawings and in specifications, refer to the interior free dimensions. Adjust work as necessary to account for larger outside dimensions to account for material wall thickness.

H. Verify all dimensions by field measurements.

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I. Arrange for chases, slots, and openings in other building components to allow for plumbing installations.

J. Coordinate the installation of required supporting devices and sleeves to be set in poured-in-place concrete and other structural components, as they are constructed.

K. Coordinate the cutting and patching of building components to accommodate the installation of mechanical equipment and materials. Contractor to provide for all cutting and patching required for installation of his work unless otherwise noted.

L. Where mounting heights are not detailed or dimensioned, install plumbing services and overhead equipment to provide the maximum headroom possible.

M. Install plumbing equipment to facilitate maintenance and repair or replacement of equipment components. Connect equipment for ease of disconnecting, without interference with other installations.

N. Coordinate the installation of plumbing materials and equipment above ceilings with ductwork, piping, conduits, suspension system, light fixtures, cable trays, sprinkler piping and heads, and other installations.

O. Coordinate connection of plumbing systems with exterior underground and overhead utilities and services. Comply with requirements of governing regulations, franchised service companies, and controlling agencies. Provide required connection for each service.

P. Coordinate with Owner’s Representative in advance to schedule shutdown of existing systems to make new connections. Provide valves in new piping to allow existing system to be put back in service with minimum down time.

Q. All materials (such as insulation, piping, wiring, controls, etc.) located within air plenum spaces, air shafts, and occupied spaces shall have a flame-spread index of 25 or less, and smoke-developed index of 50 or less, as tested by ASTM E84 (NFPA 255) Method and UL-2043.

R. Coordinate installation of floor drains and floor sinks with work of other trades. Finished floors shall slope to floor drains as shown on Architectural drawings. Floor sinks will typically be installed flush with surrounding floor. Review plans and design intent for floor sinks that may require elevated rims.

S. Products made of or containing lead, asbestos, mercury or other known toxic or hazardous materials are not acceptable for installation under this Division. Any such products installed as part of the work of the Division shall be removed and replaced and all costs for removal and replacement shall be borne solely by the installing Contractor.

T. Pipes, pipe fittings, plumbing fittings and fixtures that come into contact with the wetted surface of a public water system or any plumbing in a facility providing water for human consumption shall be “Lead Free”.

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1.12 CYBERSECURITY PROTECTION

A. For all installed systems that have internet connectivity, including but not limited to controls, monitoring, metering, sensors, or other remote access capabilities, the General Contractor is responsible to request from its subcontractors a cybersecurity risk mitigation plan. All cybersecurity risk mitigation plans shall be coordinated with the owner to verify functionality and compatibility with the owner's network architecture and topology. Cybersecurity risks to be mitigated include intrusion, remote access, viruses, spy-ware, and malware. Put in-place and in-use effective protection and homogenous policies for infrastructure, servers, workstations, controllers, network connected equipment, internet connected systems/devices, WiFi devices, IOT devices and mobile devices. Where relevant and applicable, apply the requirements of ISO/IEC 27000 Series of Standards relating to "Information Technology - Security Techniques".

B. For any "highly secure environments" identified by the owner, implement relevant jurisdiction-specific standards to be performed by an accredited Information Security advisor.

C. Coordinate with Division 27 and 28 work as applicable.

1.13 MINOR DEVIATIONS

A. The Drawings are diagrammatic and show the general arrangements of all plumbing work and requirements to be performed. It is not intended to show or indicate all offsets, fittings, and accessories which will be required as a part of the work of this Section.

B. The Contractor shall review the structural and architectural conditions affecting the work. The contractor's scope of work shall include

1. Proper code complying support systems for all equipment whether or not scheduled or detailed on drawings or in these specifications
2. Minor deviations from the plumbing plans required by architectural and structural coordination.

C. The Contractor shall study the operational requirements of each system, and shall arrange the work accordingly, and shall furnish such fittings, offsets, supports, accessories, as are required for the complete, proper and efficient installation of all systems within the physical space available for use by this section. This requirement extends to the Contractor's coordination of this section's work with the "Electrical Work" , "Mechanical Work" and all work associated with deferred and delegated design and construction scopes. Should conflicts occur due to lack of coordination, the time delay, cost of rectification, demolition, labor and materials, shall be borne by the Contractor and shall not be at a cost to the Owner.

D. Minor deviations in order to avoid conflict shall be permitted where neither the design intent nor system performance is altered.

E. Advise the Owner's Representative, in writing, in the event a conflict occurs in the location or connection of equipment. Bear all costs for relocation of equipment,

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resulting from failure to properly coordinate the installation or failure to advise the Owner's Representative of conflict.

1.14 MAJOR DEVIATIONS

A. Major deviation is a deviation from the project design that is not a minor deviation. This includes but is not limited to changes to the design intent, system or equipment capacities and/or energy performance, system or equipment performance, utility routing, equipment room layouts, equipment orientations that may affect other trades, and weights that differ from the scheduled values.

B. In addition to all Division 01 and Division 22 requirements associated with Substitution requests, Contractor shall give Engineer specific written notice of any major deviations that the Submittal may have from the requirements of the Contract Documents with each Submittal or Shop Drawing. This notice must be set forth in a written communication prepared on the contractor's letterhead separate from the Submittal; and, in addition, in the case of a Shop Drawing or Product Submittal, by a specific notation made on the Shop Drawing or Product Submittal itself. The Contractor shall clearly indicate proposed deviations from requirements in the Contract Documents, including variations, limitations, cost impacts and additional engineering design that may be required. Include relevant additional information and revisions, other than those requested by Engineer on previous submittals. Include the same identification information as related to the associated submittal.

1.15 SPECIFIED EQUIPMENT

A. Where specific manufacturers and/or model numbers are provided in the contract documents, it shall be understood that they constitute the design basis for the project. Where approved optional manufacturers are identified, the Contractor may submit based on these manufacturers, however, the submittals must be inclusive of all additional costs (or credits) and coordination requirements necessary to successfully and fully implement said manufacturer's product. See section on Substitutions below for procedures to use non-specified equipment.

B. **Where required by law**, specified equipment listed on the contract documents shall be interpreted to include the phrase "or equal" to allow products that are equal to those specified. The Engineer of Record has the sole authority to accept a product as equal to the specified product. For an "or equal" product to be accepted for use on the project, the following conditions must be met:

1. The proposed "or equal" substitution shall be submitted within seven days (7) of contract award.
2. Contractor shall notify the Engineer as to how the substituted product will impact the project completion.
3. Contractor shall notify Engineer as to the costs of both the substituted product and the listed product.
4. Contractor shall provide a detailed analysis of the difference between the listed product and proposed product.

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5. Contractor shall provide:
    a. Product identification, manufacturer literature, samples, names and addresses of similar projects where the substituted product has been used along with facility contact information, and
    b. The name and address of the manufacturer’s representative
6. Contractor shall pay the cost of the design team to review the proposed substitution and any redesign fees.

C. Engineer's approval of an “or equal” product does not relieve Contractor of the responsibility to submit required shop drawings and to comply with all other requirements of the Contract Documents. Contractor is solely at their risk and all costs associated with removal and replacement with specified components shall be borne by Contractor.

1.16 SHOP DRAWINGS AND EQUIPMENT SUBMITTALS

A. Prior to construction submit for review all materials and equipment in accordance with this section and Division 01 requirements.

B. The Work shall be in accordance with submittals that comply with the Contract Documents, except that the Contractor shall not be relieved of responsibility for deviations from the requirements of the Contract Documents by the Engineer’s review of Shop Drawings, Product Data, Samples, or similar submittals, unless the Contractor has specifically notified the Engineer of such deviation at the time of submittal and (1) the Engineer has given written approval to the specific deviation as a minor change in the Work, or (2) a Change Order or Construction Change Directive has been issued authorizing the deviation.

C. After approval of preliminary list of materials, the Contractor shall submit Shop Drawings and manufacturer's Certified Drawings to the Owner’s Representative for approval.

D. The Contractor shall submit Shop Drawings that comply with the Contract Documents and manufacturer's equipment cuts, of all equipment requiring connection by Division 26, to the Electrical Contractor for final coordination of electrical requirements. Contractor shall bear all additional costs for failure to coordinate with Division 26.

E. Delegated-Design Submittal: For structural pipe and equipment supports, vibration isolation and seismic-restraint details indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for preparation.

1. Design Calculations: Calculate static and dynamic loading due to equipment weight and operation, seismic, and where required wind forces required to select vibration isolators, seismic and wind restraints, support framing members, and for designing vibration isolation bases.
2. Vibration Isolation Base Details: Detail overall dimensions, including anchorages and attachments to structure and to supported equipment. Include auxiliary motor slides and rails, base weights, equipment static loads, power transmission,

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component misalignment and cantilever loads. Provide base with level top surfaces with integral sloping on bottom to match support structure.

F. Submittals and Shop Drawings:

1. Submit electronic copies of manufacturer's submittal sheets in one (1) coordinated package per specification section. Multiple submissions will not be accepted without prior approval of the Engineer or the Owner’s Representative. Organize submittal sheets in sequential order aligned with matching specification section numbers.
2. Provide electronic copies of shop drawings prepared to show details of the proposed installation. Copies of contract design drawings submitted to demonstrate shop drawing compliance will not be accepted.
3. Paper submittals will only be acceptable if specifically required by Division 01.
4. Submittals that comply with the Contract Documents shall be converted into Operations & Maintenance Manuals at the completion of the project. Refer to Division 01 for additional requirements.
5. Mark each copy of each submittal to show which specific products, options, accessories, appurtenances, etc. are applicable to this specific project.
6. Include the following information, as applicable:

    a. Manufacturer and country of origin.
    b. Manufacturer's catalog cuts.
    c. Manufacturer's product specifications.
    d. Standard color charts.
    e. Statement of compliance with specified referenced standards.
    f. Testing by recognized testing agency.
    g. Application of testing agency labels and seals.
    h. Notation of coordination requirements.
    i. Availability and delivery time information.
    j. Environmental Product Declaration Submittal: For each product and piece of equipment, an acceptable Environmental Product Declaration Submittal shall be provided in accordance with MEP 2040. The submittal shall include the highest-preference option available, following the order of preference listed below, from highest to lowest:

        1) Product Specific, Facility Specific EPD
        2) Product Specific EPD
        3) Industry Average EPD
        4) Requesting EPDs supports MEP 2040 participation and promotes the production of these documents by manufacturers while adding no cost to the project. If EPDs are not available for a particular product, the manufacturers shall provide a letter to be included in the submittal stating an EPD does not yet exist for their product on manufacturer letterhead.

7. For equipment, include the following in addition to the above, as applicable:

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a. Wiring diagrams that show factory-installed wiring.
b. All required electrical operational and connection requirements.
c. Connection requirements for all required systems, utilities and services to make equipment/product fully operational.
d. Printed performance data and curves.
e. Operational range diagrams.
f. Equipment/product dimensions and weights, point loads, center-or-gravity, etc.
g. Clearances required to other construction, if not indicated on accompanying Shop Drawings.

1.17 COORDINATION DOCUMENTS/SHOP DRAWINGS

A. The Contractor shall prepare coordinated Shop Drawings using the same electronic format as the contract documents.

1. The shop drawings shall serve to record the coordination of the installation and location of all piping, fixtures, HVAC equipment, ductwork, grilles, diffusers, fire sprinklers, lights, audio/video systems, electrical services and all system appurtenances.
2. The Drawings shall include all mechanical rooms and floor plans.
3. The Drawings shall be keyed to the structural column identification system, and shall be progressively numbered. Prior to completion of the Drawings, the Contractor shall coordinate the proposed installation with the Owner's Representative and the structural requirements, and all other trades (including HVAC, Plumbing, Fire Protection, Electrical, Ceiling Suspension, and Tile Systems), and provide maintenance access clearance as required by manufacturer installation instructions and as required to meet minimum code clearances. When conflicts are identified, modify system layout as necessary to resolve. Do not fabricate, order or install any equipment or materials until coordination documents are approved by the General Contractor and Owner's Representative.
4. Within thirty (30) days after award of Contract, submit proposed coordination document Shop Drawing schedule, allowing adequate time for review and approval by parties mentioned above. Drawings or electronic coordination should be prepared and submitted for approval on a floor-by-floor basis to phase with building construction.

B. The coordination work shall be prepared as follows:

1. Two dimensional AutoCAD / Revit based documents:

a. Contractor shall prepare AutoCAD/Revit coordination drawings to an accurate scale of 1/4" = 1'-0" or larger. Drawings are to be same size as Contract Drawings and shall indicate locations, sizes and elevations above finished floor, of all systems. Lettering shall be minimum 1/8" high.
b. Contractor shall obtain AutoCAD/Revit drawings from all other trades as required to fully coordinate the installation with architectural, structural,

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HVAC, plumbing, electrical, fire alarm devices, low voltage devices, and other systems that interface with and/or impact the fire protection work.

c. Plumbing drawings shall indicate locations of all fixtures and piping, including valves and fittings, dimensions from column lines, and bottom of pipe elevations above finished floor.
d. Provide maintenance access clearance as required by manufacturer installation instructions and as required to meet minimum code clearances.
e. Drawings shall incorporate all addenda items and change orders.
f. Distribute drawings to all other trades and provide additional coordination as needed to assure adequate space for piping, equipment and routing to avoid conflicts. When conflicts are identified, modify system layout as necessary to resolve.

2. Three dimensional Revit / BIM based documents (if required for project):

a. Provide three dimensional Revit model and BIM input information locating all equipment and piping, including valves and fittings, dimensions from column lines, and bottom of pipe elevations above finished floor.
b. Contractor shall obtain Revit model and BIM input from all other trades as required to fully coordinate the installation with architectural, structural, HVAC, plumbing, electrical, fire alarm devices, low voltage devices, and other systems that interface with and/or impact the fire protection work.
c. Model shall indicate locations of all equipment and piping, including valves and fittings, dimensions from column lines, and bottom of pipe elevations above finished floor.
d. Provide maintenance access clearance as required by manufacturer installation instructions and as required to meet minimum code clearances.
e. Model shall incorporate all addenda items and change orders.
f. Distribute Revit model and BIM input information to all other trades and provide additional coordination as needed to assure adequate space for equipment and piping and routing to avoid conflicts. When conflicts are identified, modify system layout as necessary to resolve.

C. Advise the Owner’s Representative in the event a conflict occurs in the location or connection of equipment. Bear all costs for relocation of equipment, resulting from failure to properly coordinate the installation or failure to advise the Owner’s Representative of conflict.

D. Verify in field exact size, location, invert, and clearances regarding all existing material, equipment and apparatus, and advise the Owner’s Representative of any discrepancies between those indicated on the Drawings and those existing in the field prior to any installation related thereto.

E. Final Coordination Drawings with all appropriate information added are to be submitted as Record Drawings at completion of project.

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1.18 PRODUCT SUBSTITUTIONS

A. General: In addition to all other requirements included in Division 01, by submitting a bid, the Contractor represents that its bid is based on materials, equipment and performance described in the Contract Documents, including Addenda. Contractors shall request approval for use of proposed substitute materials and equipment when the Contract Documents list materials and equipment by product or manufacturer name and/or model number.

B. Definitions

1. Substitutions: Changes in products, materials, equipment, and methods of construction from those specified in the Contract Documents.

C. Substitution Requests will be received and considered by Owner when the following conditions are satisfied, as determined by the Engineer; otherwise, requests will be returned without action:

1. Revisions to the Contract Documents are not required.
2. Revisions to the Contract Documents are required and Contractor’s substitution request includes provisions for both schedule affects, and all costs associated with required additional Design and Engineering fees to incorporate Contractor’s proposed substitution.
3. Proposed substitution is in keeping with the general intent and performance requirements of the Contract Documents, including the level of quality of the Work represented by the requirements therein.
4. The substitution request is fully documented and properly submitted in a timely fashion.
5. Substitution requests submitted for retroactive approval of already installed products and materials will be rejected.

D. Substitution Requests shall be made in writing by Contractor in accordance with the following requirements:

1. While requests for Substitution shall be submitted no later than 30 days after contract award, Contractor is encouraged to submit such requests for Substitution during the bid period. All bids that are based on unapproved Substitutions shall be at the Contractor’s sole risk.
2. Substitution Format: Unless otherwise specified in Division 01 requirements, submit written Substitution requests using CSI Substitution Request Form 1.5C.

a. Identify the proposed Substitution product, fabrication or installation to be replaced in each Substitution request. Include within each request the related contract document reference to include specification Section(s) and/or drawing sheet number(s).
b. Provide complete documentation on both the specified product and the proposed Substitution, including the following information as may be appropriate:

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1) Statement indicating why specified product or fabrication or installation method cannot be provided or why substitution is being proposed.
2) Coordination of information, including a list of changes or revisions needed to other parts of the Work and to construction performed by Owner and separate contractors that will be necessary to accommodate proposed substitution. Coordination information shall identify cost savings or increases associated with the proposed Substitution and shall include all additional design and engineering fees as well as additional construction costs necessary to incorporate.
3) Point-by-point comparison of specified and proposed substitute product data, fabrication drawings, and installation procedures. This shall include detailed comparison of significant qualities of proposed substitutions with those of the Work specified. Include annotated copy of applicable Specification Section. Significant qualities may include attributes, such as performance, utility consumption, energy efficiency, weight, size, durability, visual effect, sustainable design characteristics, maintenance and maintainability, warranties, and specific features and requirements indicated. Indicate deviations, if any, from the Work specified.
4) Samples, where applicable or when requested by Owner or Engineer.
5) Certificates and qualification data, where applicable or requested.
6) List of similar installations for completed projects, with project names and addresses as well as names and addresses of architects and owners.
7) Material test reports from a qualified testing agency, indicating and interpreting test results for compliance with requirements indicated.
8) Research reports evidencing compliance with building code in effect for Project as may be required.
9) Compatibility of Substitutions: Investigate and document compatibility of proposed substitution with related products and materials. Engage a qualified testing agency to perform compatibility tests recommended by manufacturers.
10) Detailed comparison of Contractor's construction schedule using proposed substitutions with products specified for the Work, including effect on the overall Contract Time. If specified product or method of construction cannot be provided within the Contract Time, include letter from manufacturer, on manufacturer's letterhead, stating date of receipt of purchase order, lack of availability, or delays in delivery.
11) Cost information, including a proposal of change, if any, in the Contract Sum.
12) Contractor's certification that proposed substitution complies with requirements in the Contract Documents, except as indicated in

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substitution request, is compatible with related materials and is appropriate for applications indicated.

13) Contractor's waiver of rights to additional payment or time that may subsequently become necessary because of failure of proposed substitution to produce indicated results.

E. Contractor’s proposed Substitutions shall fully include the costs of the design team to review and to incorporate the proposed substitution into the Contract Documents including all redesign and re-engineering fees. Contractor shall also, as a part of the substitution request, identify the funding mechanism to compensate the design and engineering team for approved Substitutions that require additional design and engineering to successfully incorporate into the project. Substitutions that do not account for redesign and re-engineering costs will not be reviewed.

F. Engineer's approval of a substitute does not relieve Contractor of the responsibility to submit required shop drawings and coordination drawings and to comply with all other requirements of the Contract Documents.

1.19 REQUESTS FOR INFORMATION (RFIS)

A. General: An RFI is a document submitted by the Contractor requesting clarification of a portion of the Contract Documents or a field condition. Immediately on discovery of the need for additional information or interpretation of the Contract Documents, Contractor shall prepare and submit an RFI in the form specified (refer to Division 01).

1. Coordinate and submit RFIs in a prompt manner so as to avoid delays in Contractor's work or work of subcontractors.
2. RFIs shall address single questions and related issues only.
3. All RFIs shall be thoroughly reviewed and approved by the General Contractor and/or Construction Manager for accuracy and need for information required before submittal to the Owner’s Design Representative.

B. Content of the RFI: Include a detailed, legible description of item needing information or interpretation and the following:

1. Project name.
2. Project number.
3. Date.
4. Name of Contractor.
5. Name of Architect and Construction Manager.
6. RFI number, numbered sequentially and unique.
7. RFI subject.
8. Specification Section number and title and related paragraphs, as appropriate.
9. Drawing number and detail references, as appropriate.
10. Field dimensions and conditions, as appropriate.
11. Contractor's suggested resolution. If Contractor's suggested resolution impacts the Contract Time or the Contract Sum, Contractor shall state impact in the RFI.
12. Contractor's signature.

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13. Attachments: Include sketches, descriptions, measurements, photos, Product Data, Shop Drawings, coordination drawings, and other information necessary to fully describe items needing interpretation.
    a. Include dimensions, thicknesses, structural grid references, and details of affected materials, assemblies, and attachments on attached sketches.

C. Engineer’s Action: Engineer will review each RFI, determine action required, and respond. Allow a minimum three business days for Engineer's response for each RFI, plus additional time for Architect and General Contractor to review and forward. RFIs received by Engineer after 1:00 p.m. will be considered as received the following working day.
    1. The following Contractor-generated RFIs will be returned without action:
        a. Incomplete, frivolous, or inaccurately prepared RFIs.
        b. RFIs submitted without indication of review and approval for submission by General Contractor or Construction Manager.
        c. RFIs addressing multiple unrelated issues.
        d. Requests for approval of submittals.
        e. Requests for approval of substitutions.
        f. Requests for approval of Contractor's means and methods.
        g. Requests for information already indicated in the Contract Documents.
        h. Requests for adjustments in the Contract Time or the Contract Sum.
        i. Requests for interpretation of Engineer's actions on submittals.
    2. Frivolous RFI's are defined as:
        a. RFI's that request information that is clearly shown on the Contract Documents.
        b. RFI’s that do not meet the content requirements as indicated above.
        c. RFI's that do not comply with the definition of an RFI as indicated above.
    3. Delays caused by improper or frivolous RFI's are the sole responsibility of the Contractor who shall waive the Contractor's right to seek additional time or compensation.
    4. Engineer's action may include a request for additional information, in which case Engineer's time for response will date from time of receipt of additional information.

1.20 RECORD DOCUMENTS

A. Maintain set of Coordination Documents (drawings and specifications) marked “Record Set” at the job site at all times, and use it for no other purpose but to record on it all the changes and revisions during construction.

B. Record Drawings shall indicate revisions to piping, size and location both exterior and interior; including locations control devices, and equipment requiring periodic maintenance or repair; actual equipment locations, dimensioned from column lines; actual inverts and locations of underground piping; concealed equipment, dimensioned to column lines; mains and branches of piping systems, with valves and control devices

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located and numbered, concealed unions located, and with items requiring maintenance (i.e. – valves, traps, strainers, expansion compensators, tanks, etc.).

C. Record Specifications shall indicate approved substitutions; Change Orders; and actual equipment and materials provided.

D. At the completion of the construction transfer all “Record Set” notations to a clean set of drawings and specifications in a neat and orderly fashion that incorporates all site markups to clearly show all changes and revisions to the Contract Documents. Submit copies of Record Documents and CD/DVD disks labeled with all drawings and specifications and other supporting documentation.

E. Refer also to Division 01 for full scope of requirements.

1.21 INSTRUCTION, MAINTENANCE, AND O&M MANUALS

A. Operations and Maintenance (O&M) Manuals: Contractor shall submit to the Owner’s Representative complete set of operating instructions, maintenance instructions, part lists, and all other bulletins and brochures pertinent to the operation and maintenance for equipment furnished and installed as specified in this section.

B. The Contractor shall be responsible for proper instruction of Owner's personnel for operation and maintenance of equipment, and apparatus installed as specified in Division 22, to be no less than two (2) hours for each type of equipment.

C. Refer to Division 01 for additional requirements.

1.22 DELIVERY, STORAGE AND HANDLING

A. Deliver products to project properly identified with manufacturer’s names, model numbers, types, grades, compliance labels, and similar information needed for distinct identifications; adequately packaged and protected to prevent damage during shipment, storage, and handling.

B. Store equipment and materials in an environmentally controlled area at the site, unless off-site storage is authorized in writing. Protect stored equipment and materials from damage. Piping and equipment that is damaged or showing signs of rust shall be removed from site and replaced with new.

1.23 START-UP SERVICE

A. Prior to start-up, assure that systems are ready for start-up and commissioning, including checking the following: proper equipment rotation, proper wiring, auxiliary connections, lubrication, venting, controls, and installed and properly set relief and safety valves.

B. Provide services of factory-trained technicians for start-up of controls, pumps, water heaters, and other major pieces of equipment. Certify in writing, compliance with this paragraph, stating names of personnel involved and the date work was performed.

C. Refer to other Division 01 and Division 22 sections for additional requirements.

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1.24 UNIT PRICING SUBMITTALS

A. Prior to construction submit for review all materials and equipment and pricing in accordance with Division 01 requirements.

1.25 POSTED OPERATING INSTRUCTIONS

A. Print or engrave operating instructions and frame under glass or UV resistant plastic. Post instructions as directed by Owner's Representative. Attach or post operating instructions adjacent to each principal system and equipment including start-up, operating, shutdown, safety precautions and procedure in the event of equipment failure. Provide weather-resistant materials or weatherproof enclosures for operating instructions exposed to the weather. Operating instructions shall not fade when exposed to sunlight and shall be secured to prevent easy removal.

1.26 SAFETY AND INDEMNITY

A. The Contractor shall be solely and completely responsible for conditions of the job site including safety of all persons and property during performance of the work for the duration of the project.

B. No act, service, Drawing, review, or Construction Review by the Owner, Architect, the Engineers or their consultants, is intended to include the review of the adequacy of the Contractor's safety measures, in, on, or near the construction site.

C. The Contractor performing work under this Division of the Specifications shall hold harmless, indemnify and defend the Owner, the Architect, the Engineers and their consultants, and each of their officers, employees and agents from any and all liability claim, losses or damage arising, or alleged to arise from bodily injury, sickness, or death of a person or persons, and for all damages arising out of injury to or destruction of property arising directly or indirectly out of, or in connection with, the performance of the work under the Division of the Specifications, and from the Contractor's negligence in the performance of the work described in the Construction Contract Documents; but not including the sole negligence of the Owner, the Architect, the Engineers, and their consultants or their officers, employees and agents.

1.27 CLEANING AND CLOSING

A. All work shall be inspected, tested, and approved before being concealed or placed in operation.

B. Upon completion of the work, all equipment installed as specified in this section, and all areas where work was performed, shall be cleaned to provide operating conditions satisfactory to the Owner's Representative.

1.28 WARRANTIES

A. Refer to general terms and conditions, as well as warranties and obligations defined in Division 1 of the specifications that provide basic warranty requirements for the entire project.

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B. The warranties and corrective obligations provided under this section (i) are in addition to, and not in lieu of, any other warranty, representation, covenant, duty or other obligation (including any corrective obligation) of the Contractor or Manufacturer, (ii) have no relationship to the time when any warranty, representation, duty, covenant or other obligation of Contractor or Manufacturer may be enforced or any dispute resolution proceeding commenced and (iii) are made by the Manufacturer to both the Contractor and the Owner and by the Contractor to Owner.

C. All equipment and systems shall be provided with a minimum one-year warranty, or longer, as defined in each subsequent specification section. Warranty shall include all parts, material, labor and travel.

D. Warranty Start Date: The start date for all warranty periods shall be defined as starting from the date of Substantial Completion which shall include the Certificate of Occupancy from the Authority Having Jurisdiction.

E. Refer to individual Specification sections for additional extended warranty requirements.

F. Provide complete warranty information for each item, to include product or equipment, date of beginning of warranty or bond; duration of warranty or bond; and names, addresses, telephone numbers and procedures for filing a claim and obtaining warranty services.

G. Nothing in any separate warranty or other document provided by Contractor or Manufacturer, or both, will apply to limit their liability or responsibility for damages arising out of or related to a breach of any warranty or corrective obligation.

H. Service during warranty period: Contractor shall provide maintenance as specified elsewhere during the 12-month warranty period.

1.29 GUARANTEE

A. The Contractor shall guarantee and service all workmanship and materials to be as represented by him and shall repair or replace, at no additional cost to the Owner, any part thereof which may become defective within the period of one (1) year, minimum, after the Certificate of Occupancy, ordinary wear and tear excepted.

B. Contractor shall be responsible for and pay for any damages caused by or resulting from defects in this work.

PART 2 - PRODUCTS

2.1 GENERAL

A. Furnish and install all new material, equipment, and apparatus hereinafter specified unless specifically noted otherwise. All material, equipment, and apparatus shall be identified by the manufacturer's name, nameplate, and pertinent data.

B. All materials, equipment, and apparatus are mentioned as standards unless noted otherwise. The words "or approved equal" shall be considered to be subsequent to all

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manufacturers' names used herein, unless specifically noted that substitutes are not allowed.

C. All materials and equipment under this Division of the Specifications shall be new, of best grade and as listed in printed catalogs of the manufacturer.

D. All manufactured materials shall be delivered and stored in their original containers. Equipment shall be clearly marked or stamped with the manufacturer's name and rating.

E. For secure facilities, schools and public safety buildings exposed equipment and access shall be Vandal Proofed. One type of vandal proof screw is to be used throughout this facility. Coordinate with General Contractor for type.

F. The following products to be included as part of this work but specified under Section 220500 Basic Plumbing Materials and Methods and Section 221000 Plumbing Piping, Valves and Specialties:

1. Piping.
2. Valves.
3. Hangers and supports.
4. Escutcheon plates, flashings, and sleeves.
5. Identification markers and signs.
6. Anchors and alignment guides to comply with seismic requirements as indicated on structural plans.
7. Pressure and temperature gauges.
8. Access Panels.

G. Plumbing Fixtures: Refer to Section 224000.

H. Products made of, or containing, lead, asbestos, mercury, or other known toxic or hazardous materials are not acceptable for installation under this Section. Any such products installed as part of the work of this Section shall be removed and replaced and all costs for removal and replacement shall be borne solely by the Contractor(s).

I. All products requiring service, such as, but not limited to; valves, equipment, and fixtures shall be sourced from a single manufacturer unless otherwise noted on plans and schedules. Interconnected piping systems that require manufacturer warranty shall be from a single manufacturer.

2.2 SUPPORTS AND ANCHORS

A. General: Comply with applicable codes pertaining to product materials and installation of supports and anchors, including, but not limited to, the following:

1. UL: Provide products which are UL listed.
2. FM: Provide products which are FM approved.
3. ASCE 7-05: "American Society of Civil Engineers."
4. MSS Standard Compliance: Manufacturer's Standardization Society (MSS).
5. SMACNA: "Seismic Restraint Manual: Guidelines for Mechanical Systems."
6. NFPA: Pamphlet number 13 and 14 for fire protection systems.

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7. Provide copper plated or plastic coated supports and attachments for copper piping systems. Field applied coatings or tape is unacceptable.
8. Manufacturer: Hilti Inc, B-Line/Tolco (Eaton), Anvil International, Erico, Empire, Kin-Line, Simpson, or Superstrut.

B. Horizontal Piping Hangers and Supports: Except as otherwise indicated, provide factory-fabricated hangers and supports of one of the following MSS types listed.

C. (Note to Editor: refer to MSS-58 images for styles allowed and not allowed:

1. Adjustable Steel Clevis Hangers: MSS Type 1.
2. Adjustable Steel Swivel Band Hangers: MSS Type 10.
3. U-Bolts: MSS Type 24.
4. Pipe Slides and Slide Plates: MSS Type 35, including one of the following plate types:
    a. Plate: Unguided type.
    b. Plate: Guided type.
    c. Plate: Hold-down clamp type.
5. Pipe Saddle Supports: MSS Type 36, including steel pipe base support and cast iron floor flange.
6. Pipe Saddle Supports with U-Bolt: MSS Type 37, including steel pipe base support and cast iron floor flange.
7. Adjustable Pipe Saddle Supports: MSS Type 38, including steel pipe base support and cast iron floor flange.
8. Upper Attachment Side Beam Bracket: MSS Type 34
9. Upper Attachment Side Beam Angle Bracket: MSS Type 34, UL listed and FM Approved.
10. Single Pipe Roller with Malleable Sockets: MSS Type 41.
11. Adjustable Roller Hangers: MSS Type 43.
12. Pipe Roll Stands: MSS Type 44.
13. Pipe Guides: Provide factory-fabricated guides of cast semi-steel or heavy fabricated steel, consisting of a bolted two-section outer cylinder and base with a two-section guiding spider bolted tight to pipe. Size guide and spiders to clear pipe and insulation (if any), and cylinder. Provide guides of length recommended by manufacturer to allow indicated travel.

D. Horizontal Cushioned Pipe Clamp: Where pipe hangers are called out to absorb vibration or shock install a piping clamp with thermoplastic elastomer insert. Cush-A-Clamp type by many manufacturers.

E. Vertical Piping Clamps: Provide factory-fabricated two-bolt vertical piping riser clamps, MSS Type 8 and or four-bolt riser clamps for heavy loads, MSS Type 42. Provide with 1” thick (minimum) neoprene pad on floor with 1/4" thick steel plate to distribute riser clamp weight to pad.

1. Pre-insulated two-bolt riser clamps up to 4” diameter. Manufacturer: Hydra-Zorb #Klo-Shure Titan Riser Clamp.

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F. Hanger-Rod Attachments: Except as otherwise indicated, provide factory-fabricated hanger-rod attachments of one of the following MSS types listed.

1. Steel Turnbuckles: MSS Type 13.
2. Steel Clevises: MSS Type 14.
3. Swivel Turnbuckles: MSS Type 15.
4. Malleable Iron Eye Sockets: MSS Type 16.
5. Steel Weldless Eye Nuts: MSS Type 17.

G. Building Attachments: Except as otherwise indicated by the Structural Engineering design, provide factory-fabricated building attachments of one of the following types listed.

1. Concrete Inserts:
    a. MSS Type 18.
    b. Manufacturers: Hilti #KCS-MD (for metal deck) or HCI-WF (for wood forms), Simpson Strong Tie #Blue Banger Hanger, Powers Fasteners #Bang-It (for metal deck) or #Wood-Knocker (for wood forms).
2. Steel Brackets: One of the following for indicated loading:
    a. Light Duty: MSS Type 31.
    b. Medium Duty: MSS Type 32.
    c. Heavy Duty: MSS Type 33.
3. Horizontal Travelers: MSS Type 58.
4. Concrete Screw Anchors: For floor mounted attachments with maximum allowable pullout and shear force of 250 lbs. (1.1 kN) per anchor regardless of size.
    a. Manufacturers: Hilti #Kwik Hus EZ-I, Simpson Strong-Tie #Titen HD (or Rod Hanger version), Powers Fasteners #Wedge-Bolt+ (Screw Anchor), Powers Fasteners #Vertigo+ (Rod Hanger), or Powers Fasteners #Snake+ (Internally Threaded Screw Anchor).
5. Wood Screw Anchors:
    a. Simpson RWV (vertical rod hanger) or Simpson RWH (horizontal rod hanger) or approved equal.
6. Torque-Controlled Expansion Anchor:
    a. Manufacturers: Hilti #Kwik Bolt TZ, Simpson Strong Tie #Strong-Bolt 2, or Powers Fasteners #Power-Stud+ SD1 or Power-Stud+ SD2.
7. Screws and Bolts:
    a. Manufacturers: Bolt Depot, Fastenal, or National Bolt & Nut.
8. Eye Bolts:
    a. Manufacturers: Lawson Products, Sierra Pacific, or US Cargo Control.
9. Powder-Driven Concrete Anchors:

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a. Only for existing concrete structures with minimum 4000 psi concrete compressive strength.
b. Minimum embedment of 1” (25 mm).
c. Maximum allowable load of 50 lbs. (0.2 kN) per anchor.
d. Manufacturer: Hilti #X or D Series, or Powers Fasteners #CSI Series.

H. Saddles and Shields: Except as otherwise indicated, provide saddles or shields under piping hangers and supports, factory-fabricated, for all insulated piping. Size saddles and shields for exact fit to mate with pipe insulation.

1. Pipe Covering Protection Saddles: MSS Type 39; fill interior voids with segments of insulation matching adjoining insulation.
2. Insulation Protection Shields: MSS Type 40, 18” minimum, or of the length recommended by manufacturer to prevent crushing of insulation. High-density insulation insert lengths shall match or exceed shield length.
3. Thermal Hanger Shields: Constructed of 360° insert of waterproofed calcium silicate (60 psi flexural strength minimum) encased in 360° sheet metal shield. Provide assembly of same thickness as adjoining insulation. Shield length shall match or exceed length of calcium silicate insert. Alternately Polyisocyanurate Urethane with a minimum flexural strength of 60psi, fully encased in 360 PVC (1.524 mm thick) SNAPPITZ. Provide assembly of same thickness as adjoining insulation.
4. Thermal Hanger Couplings: Constructed of high strength plastic coupling to retain tubing and join insulation at clevis hangers and strut-mounted clamps. Manufacturer: Klo-Shure Insulation Coupling.

I. Miscellaneous Materials:

1. Metal Framing: Provide products complying with AISC 360 and AISI S240.
2. Steel Plates, Shapes, and Bars: Provide products complying with ASTM A36.
3. Cement Grout: Portland Cement (ASTM C150, Type I or Type III) and clean uniformly graded, natural sand (ASTM C404, Size No. 2). Mix at a ratio of 1.0 part cement to 3.0 parts sand by volume, with minimum amount of water required for placement and hydration.
4. Heavy-Duty Steel Trapezes: Fabricate from steel shapes selected for loads required. Weld steel in accordance with AWS standards. Manufacturer: B-Line.
5. Copper Pipe Brackets: Copper plated brackets. Insulate brackets attached to metal studs with felt. Manufacturer: Holdrite, or Sioux Chief.

2.3 SEISMIC RESTRAINT/VIBRATION ISOLATION REQUIREMENTS

A. Equipment, piping, and all system appurtenances (including weight of normal operating contents) shall be adequately restrained to resist seismic forces. Restraint devices shall be designed and selected to meet seismic requirements as defined in the latest code editions with State Amendments, applicable local codes, and applicable Importance Factors and Soil Factors. Refer to Section 220548 Vibration Isolation for Plumbing Equipment or Section 220549 Seismic Restraint for Plumbing Piping and Equipment, as applicable.

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2.4 PIPE STANDS

A. General Requirements for Pipe Stands: Shop- or field-fabricated assemblies made of manufactured corrosion-resistant components to support roof-mounted piping. Coordinate all pipe stands with structural design. Select stands for rated support weight and spacing. Refer to details on drawings for permanent fixed roof support and curbs.

B. Compact Pipe Stand:

1. Adjustable strut-based support stands shall only be used as intermediate support points between permanent fixed stands/supports as required to prevent pipe from sagging.
2. Description: Single base unit with integral-rod roller, pipe clamps, or V-shaped cradle to support pipe, for roof installation without membrane penetration.
3. Base: Single piece, vulcanized rubber, molded polypropylene or polycarbonate.
4. Hardware: Galvanized or stainless steel.
5. Pipe Stand Manufacturers: Dura-Blok, Roof Top Blox, Roof Products Systems, nVent CADDY Pyramid, Portable Pipe Hangers, or equal.
6. Accessories: Mount on protective roof pad with a minimum of 6” material extending beyond all edges to allow for future pipe movement. Nonwoven pad shall be constructed spaghetti-like strands of flexible plastic with UV inhibitor and rated for -40°F to 180°F (-40°C to +82°C). Manufacturer: Yellow Spaghetti or equal.

C. Single-Pipe Stand:

1. Adjustable strut-based support stands shall only be used as intermediate support points between permanent fixed stands/supports as required to prevent pipe from sagging.
2. Description: Single base with vertical and horizontal members, and pipe support, for roof installation without membrane protection.
3. Base: Single piece, vulcanized rubber, molded polypropylene, or polycarbonate.
4. Vertical Members: Two, galvanized or stainless steel, continuous-thread 1/2-inch (12-mm) rods.
5. Horizontal Member: Adjustable horizontal, galvanized or stainless-steel pipe support channels.
6. Pipe Supports: Roller, strut clamps, clevis hanger or swivel hanger.
7. Hardware: Galvanized or stainless steel.
8. Pipe Stand Manufacturers: Dura-Blok, Roof Products Systems, nVent CADDY Pyramid, Portable Pipe Hangers, or equal.
9. Accessories: Mount on protective roof pad with a minimum of 6” material extending beyond all edges to allow for future pipe movement. Nonwoven pad shall be constructed of spaghetti-like strands of flexible plastic with UV inhibitor and rated for -40°F to 180°F (-40°C to +82°C). Manufacturer: Yellow Spaghetti or equal.

D. Multiple-Pipe Stand:

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1. Adjustable strut-based support stands shall only be used as intermediate support points between permanent fixed stands/supports as required to prevent pipe from sagging.
2. Description: Single base with vertical and horizontal members, and pipe support, for roof installation without membrane protection.
3. Base: Two or more, vulcanized rubber, molded polypropylene, or polycarbonate.
4. Vertical Members: Two or more, galvanized or stainless steel, channels.
5. Horizontal Member: Two or more, adjustable height, galvanized or stainless-steel pipe support slotted channels or plates.
6. Pipe Supports: Roller, strut clamps, clevis hanger or swivel hanger.
7. Hardware: Galvanized or stainless steel.
8. Pipe Stand Manufacturers: Dura-Blok, Roof Products Systems, nVent CADDY Pyramid, Portable Pipe Hangers, or equal.
9. Accessories: Mount on protective roof pad with a minimum of 6” material extending beyond all edges to allow for future pipe movement. Nonwoven pad shall be constructed of spaghetti-like strands of flexible plastic with UV inhibitor and rated for -40°F to 180°F (-40°C to +82°C). Manufacturer: Yellow Spaghetti or equal.

E. Curb and Rail-Mounted Type Pipe Stands:

1. Shop- or field-fabricated pipe supports made from structural-steel shapes, channels, continuous-thread rods, with rollers, strut clamps, clevis hangers or swivel hangers for mounting on permanent stationary roof curbs.
2. Coordinate with structural design and mechanical details for attachment through membrane.
3. Manufacturer: Pate, Thybar, ThyCurb, Roof Products Systems, Protech, FastCurbs, or equal.

2.5 THROUGH-PENETRATION FIRESTOP ASSEMBLIES

A. Through-penetration and membrane penetration of fire-resistance-rated assemblies shall be caulked, sealed and/or insulated as required to maintain the fire (F) rating and temperature rise (T) rating of the penetrated assembly. Install per manufacturer’s installation instructions and conform with ASTM E814 or UL 1479 and comply with Chapter 7 of the Building Code. Refer to drawings for additional requirements.

B. Through-penetrations of rated floor assemblies by floor sinks, trench drains, and similar deep plumbing fixtures, shall be protected by a firestop system with an F rating and T rating of not less than one hour but not less than the required rating of the floor penetrated. Manufacturer: 3M #System F-A-1131 or F-A-1160, Hilti #System F-A-1135 or F-A-1137.

C. Through-penetrations of rated floor assemblies by floor drains, tub drains or shower drains contained and located within the concealed space of a horizontal assemblies do not require compliance to a T rating.

D. Manufacturers: 3M, Hilti, Metacaulk, STI Firestop, Holdrite, or ProSet.

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2.6 ACCESS PANELS AND ACCESS DOORS

A. Provide all access doors and panels to serve equipment under this work, including those which must be installed, in finished architectural surfaces. Frame of 16-gauge steel, door of 20-gauge steel. 1” flange width, continuous piano hinge, key operated, prime coated. Refer to Architectural Specifications for the required product Specification for each surface. Contractor is to submit schedule of access panels for approval. Exact size, number and location of access panels is not shown on Plans. Access doors shall be of a size to permit removal of equipment for servicing. Access door shall have same rating as the wall or ceiling in which it is mounted. Provide access panel for each trap primer or concealed valve. Use no panel smaller than 12” x 12” for simple manual access, or smaller than 24" x 24" where personnel must pass through. Provide cylinder lock for access door serving mixing or critical valves in public areas.

B. Included under this work is the responsibility for verifying the exact location and type of each access panel or door required to serve equipment under this work and in the proper sequence to keep in tune with construction and with prior approval of the Owner’s Representative. Access doors in fire rated partitions and ceilings shall carry all label ratings as required to maintain the rating of the rated assembly.

C. Acceptable Manufacturers: Milcor, Karp, Nystrom, or Elmdor/Stoneman.

D. Submit markup of architectural plans showing size and location of access panels required for equipment access for approval by Owner’s Representative.

2.7 PIPING

A. Refer to Section 221000 Plumbing Piping, Valves and Specialties

2.8 VALVES

A. Refer to Section 221000 Plumbing Piping, Valves and Specialties.

2.9 PLUMBING FIXTURES

A. Refer to Section 224000 Plumbing Fixtures.

2.10 CLEANOUTS

A. Acceptable Manufacturers: J.R.Smith, Zurn, Wade, Mifab, Watts, Sioux Chief and Josam.

B. Cleanout Plugs: Bronze, taper thread countersunk head.

C. Floor Cleanouts: Service weight cast-iron body and frame, flange with flashing clamp, adjustable cast-iron collar, caulk inside, Ty-seal or No-hub joints, neoprene plug gasket seal.

1. Carpeted Areas:

a. Medium duty, polished bronze or nickel bronze top, bronze plug, carpet clamping flange, vandal-proof screws.

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b. Manufacturers: Zurn #Z1400 Series, J.R. Smith #4020 Series, or Josam #55000-1 Series.

2. Tiled Areas:

a. Medium duty, polished nickel bronze top, bronze plug, flange with flashing clamp, vandal-proof screws.
b. Manufacturers: Zurn #Z1400 Series, J.R. Smith #4140, or #55000-1 Series.

3. Unfinished Areas:

a. Heavy duty, rough bronze top, bronze plug, flange with flashing clamp, vandal-proof screws.
b. Manufacturers: Zurn #Z1400 Series, J.R. Smith #4100 Series, or Josam #55000 Series.

4. Outdoor Areas:

a. Heavy duty, rough bronze top, bronze plug, flange with flashing clamp, vandal-proof screws.
b. Manufacturers: Zurn #Z1474 Series, J.R. Smith #4250 Series, or Josam #58680 Series.

D. Cleanout Tee: Cast iron cleanout tee with countersunk bronze plug, neoprene plug gasket seal and smooth stainless steel cover.

1. Manufacturer: Zurn #Z1446, or J.R. Smith #4530 Series.

2.11 WATER HAMMER ARRESTERS

A. Provide a water hammer arrester before each quick closing valve, including but not limited to, flush valves, solenoid valves, electronic trap primers, pre-rinse faucets, dishwashers, washer box and water outlet box (where arrester is not integral with box assembly). For flush valve fixtures it is acceptable to install a single arrester to serve banks of fixtures where sized and installed in accordance with PDI WH-201. Each water hammer arrester shall be mounted in an accessible location with access panel to facilitate installation and future replacement.

B. Piston or Bellows Type: Hard drawn copper construction or stainless steel, mirror finished internal surfaces; machine finished brass piston or stainless steel bellows, lead free, air pre-charged, 150 psi rated, threaded connection, tested and certified per PDI WH-201 and ASSE/ANSI 1010.

C. Water hammer arresters shall be sized based on the PDI WH-201 Standard method.

D. Manufacturers: Watts #LF15 Series, Precision Plumbing Products #SC Series, Sioux Chief #Hydra-Rester 650 Series, Mifab #WHB Series, or J.R. Smith #5000 Series.

2.12 TRAP SEAL PRIMER

A. Single Fixture Trap Seal Primer Device:

1. Device shall conform to ASSE Standard 1018 or 1044. Provide ball valve upstream of trap primer to allow for future maintenance and replacement.

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2. Pressure Operating Range: 20-80 psi.
3. Pressure Activation: Minimum 3 psi differential and mounted with ten (10) feet of fixture source of pressure drop. Or, minimum 10 psi differential and mounted within three (3) feet of fixture source of pressure drop. Maximum pipe distance is 20 feet to floor drain.
4. Brass body with lead free construction and removable filter screens. Chrome plated in exposed areas.
5. Inlet and outlet connections may be threaded, unions or soldered.
6. Manufacturer: Mifab #M-500 Series (3 psi activation), PPP #PR-500 (10 psi activation), or Sioux Chief #695-01 (10 psi activation),.

B. Multiple Fixture Trap Seal Primer Device:

1. Device shall conform to ASSE Standard 1018 or 1044. Provide ball valve upstream of trap primer to allow for future maintenance and replacement.
2. Manifold or distribution unit to serve 2 to 10 floor drains.
3. Pressure Operating Range: 20-80 psi.
4. Pressure Activation: Minimum 3 psi differential and mounted with ten (10) feet of fixture source of pressure drop. Or, minimum 10 psi differential and mounted within three (3) feet of fixture source of pressure drop. Maximum pipe distance is 20 feet to floor drain.
5. Brass body with lead free construction and removable filter screens. Chrome plated in exposed areas.
6. Inlet and outlet connections may be threaded, unions or soldered.
7. Manufacturer: Mifab #M-500 Series (3 psi activation), PPP #P1-500 (10 psi activation), or Sioux Chief #695-01 (10 psi activation).

C. Electronic Trap Seal Primer Device:

1. Device shall conform to ASSE Standard 1018 or 1044. Provide ball valve upstream of trap primer to allow for future maintenance and replacement.
2. Manifold or distribution unit to serve 1 to 10 floor drains.
3. Recessed steel cabinet with stainless steel cover or galvanized steel painted to match wall.
4. Electric Controls: 24-hour timer, solenoid valve, and manual switch for 120-volt AC power. Coordinate power requirements with electrical design. Listed and labeled as defined in NFPA-70.
5. Vacuum breaker compliant with ASSE 1001.
6. Water hammer arrester shall be integral or externally mounted upstream.
7. Pressure Operating Range: 20-80 psi.
8. Brass body with lead free construction.
9. Inlet and outlet connections may be threaded or soldered.
10. Manufacturer: Mifab #MI-100 Series, PPP #MP-500 Series, or Sioux Chief #695-E Series.

2.13 DRAINS

A. Manufacturers: J.R. Smith, Zurn, Wade, Sioux Chief, Josam, or Watts.

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B. Provide drains of type and size as indicated in plumbing schedule on Drawings, including features, as specified herein. Provide with TP supplies for all floor drains and floor sinks, refer to plans for trap primer locations.

C. Floor drains and shower drains installed above food preparation, food handling and patient healthcare areas shall be provided with integral seepage holes that drain into the drain body/pan.

2.14 ANTI-CONTAMINATION WALL HYDRANTS AND HOSE BIBBS

A. Provide fixtures of type and size as indicated in plumbing schedule on drawings, including features, as specified herein.

2.15 IDENTIFICATION MARKERS

A. Mechanical Identification Materials: Provide 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. Stencils, hand printed, painted, and felt pen markers are not acceptable.

1. Labels shall be printed to match the abbreviations or spelled out names used in the construction drawings. Custom printed labels are acceptable for specialty piping services and equipment.

B. Plastic Pipe Markers:

1. Pre-Tensioned Pipe Labels: Precoiled, semi-rigid plastic formed to partially or fully cover the circumference of pipe, or insulated pipe, and to attach to pipe without fasteners or adhesive complying with ANSI A13.1. Minimum letter size shall be 1/2” high.
2. Pressure Sensitive Type: Provide pre-printed, permanent adhesive, color coded, pressure sensitive vinyl pipe markers, complying with ANSI A13.1. Secure both ends of markers with color coded adhesive vinyl tape. Minimum letter size shall be 1/2” high.
3. 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°F (52°C) or greater. Cut length to extend 2” beyond each end of plastic pipe marker.
4. Arrows: Point each pipe marker with arrows indicating direction of flow, either integrally with piping system service lettering (to accommodate both directions), or as separate unit of plastic.
5. Pipe Label Color Schedule:

a. Domestic Cold Water piping:

1) Background Color: Green.
2) Letter Color: White.

b. Domestic Hot Water Supply and Domestic Hot Water Recirculation piping:

1) Background Color: Green.

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2) Letter Color: White.

c. Sanitary Sewer, Storm Drainage and Vent piping:

1) Background Color: Green.
2) Letter Color: White.

d. Other piping services:

1) Background Color: Comply with ANSI and ASME A13.1standards.
2) Letter Color: Comply with ANSI and ASME A13.1standards.

C. Valve Tags:

1. Brass Valve Tags: Provide 1-1/2" diameter 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. Fill tag engraving with black enamel.
2. Plastic Laminate Valve Tags (indoors only): Provide 3/32” thick engraved plastic laminate valve tags, with piping system abbreviations in 1/4" high letters and sequenced valve number 1/2" high, and with 5/32” hole for fasteners.
3. Valve Tag Fasteners: Provide 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.

D. Access Panel Markers: Provide 1/16” thick engraved plastic laminate access panel markers, with abbreviations and numbers corresponding to concealed valve.

E. Plastic Equipment Signs:

1. Provide 3” x 5” (minimum) plastic laminate sign, ANSI A.13 color coded with engraved white core lettering. Minimum letter size shall be 1/2” high.
2. Fasteners: Self-tapping stainless steel screws, except contact-type permanent adhesive where screws cannot or should not penetrate the substrate.
3. Nomenclature: Include the following, matching terminology on schedules as closely as possible:

a. Name and plan number.
b. Equipment service.
c. Design capacity.
d. Other design parameters, such as pressure drop, entering and leaving conditions, rpm, etc.

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

F. Acceptable Manufacturers: Craftmark, Seton, Brady, Marking Services, Inc., or Brimar.

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2.16 ELECTRICAL

A. General:

1. Plumbing Contractor shall be responsible for coordinating all electrical requirements of plumbing equipment with Electrical Contractor prior to procurement or installation.
2. All electrical material, equipment, and apparatus specified herein shall conform to the requirements of Division 26.
3. Provide all motors for equipment specified herein. Provide motor starters, controllers, and other electrical apparatus and wiring which are required for the operation of the equipment specified herein.
4. Set and align all motors and drives in equipment specified herein.
5. Provide expanded metal or solid sheet metal guards on all V-belt drives to totally enclose the drive on all sides. Provide holes for tachometer readings. Support guards separately from rotating equipment.
6. Provide for all rotating shafts, couplings, etc., a solid sheet metal, inverted "U" cover over the entire length of the exposed shaft and support separately from rotating equipment. Cover shall extend to below the bottom of the shaft and coupling, and shall meet the requirements of the State Industrial Safety Regulations.
7. Specific electrical requirements (i.e., horsepower and electrical characteristics) for plumbing equipment are scheduled on the Drawings.

B. Quality Assurance:

1. Electrical components and materials shall be UL or ETL listed/labeled as suitable for location and use - no exceptions.

C. Motors:

1. The following are basic requirements for simple or common motors. For special motors, more detailed and specific requirements are specified in the individual equipment Specifications.
2. Torque characteristics shall be sufficient to satisfactorily accelerate the driven loads.
3. Motor sizes shall be large enough so that the driven load will not require the motor to operate in the service factor range. Unless otherwise noted on plans, all motors 1/2 HP or larger shall be rated for 208 or 460-volt, 3-phase, operation. Unless otherwise noted on plans, all motors less than 1/2 HP shall be rated for 120-volt, single phase operation.
4. Temperature Rating: Motor meets class B rise with class F insulation.
5. Service Factor: 1.15 for poly-phase motors and 1.35 for single phase motors.
6. Motor Construction: NEMA Standard MG 1, general purpose, continuous duty, Design "B", except "C" where required for high starting torque.
    a. Frames: NEMA Standard No. 48 or 56; use driven equipment manufacturer's standards to suit specific application.
    b. VFD driven motors. To be provided rated for inverter duty (NEMA Standard MG-1, Part 31) and equipped with a shaft grounding device.

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c. Bearings:

1) Ball or roller bearings with inner and outer shaft seals.
2) Regreasable, except permanently sealed where motor is normally inaccessible for regular maintenance.
3) Designed to resist thrust loading where belt drives or other drives product lateral or axial thrust in motor.
4) For fractional horsepower, light duty motors, sleeve type bearings are permitted.
5) Enclosure Type:

a) Open drip-proof (ODP) motors for indoor use in clean air environments.
b) Totally enclosed fan cooled (TEFC) motors for outdoor use and indoor application in dirty environments and mechanical rooms.
c) Totally enclosed air over (TEAO) motors for motors in the airstream of cooling towers and fluid coolers.
d) Guarded drip-proof motors where exposed to contact by employees or building occupants.
e) Weather protected Type I for outdoor use, Type II where not housed.

d. Overload Protection: Built-in thermal overload protection where external overload protection is not provided and, where indicated, internal sensing device suitable for signaling and stopping motor at starter.
e. Noise Rating: "Quiet."
f. Efficiency:

1) Motors shall have a minimum efficiency per governing State or Federal codes, whichever is higher.
2) And, motors shall meet the NEMA premium efficiency standard.

g. Nameplate: Indicate the full identification of manufacturer, ratings, characteristics, construction, special features and similar information.

D. Starters and Electrical Devices:

1. Motor Starter Characteristics:

a. Enclosures: NEMA 1, general purpose enclosures with padlock ears, except in wet locations shall be NEMA 3R with conduit hubs.
b. Type and size of starter shall be as recommended by motor manufacturer and the driven equipment manufacturer for applicable protection and start-up condition.

2. Manual switches shall have pilot lights and all required switch positions for multi-speed motors. Overload Protection: Melting alloy or bi-metallic type thermal overload relays, sized according to actual operating current (field measured).
3. Magnetic Starters:

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a. Heavy duty, oil resistant, hand-off-auto (HOA), or as indicated, and pilot lights, properly arranged for single speed or multi-speed operation as indicated.
b. Trip-free thermal overload relays, each phase, sized according to actual operating current (field measured).
c. Interlocks, pneumatic switches and similar devices as required for coordination with control requirements of Division 23 Controls sections.
d. Built-in primary and secondary fused control circuit transformer, supplied from load side of equipment disconnect.
e. Externally operated manual reset.
f. Under-voltage release or protection for all motors over 20 hp.

4. Motor Connections: Liquid tight, flexible conduit, except where plug-in electrical cords are specifically indicated.

E. Low Voltage Control Wiring:

1. General: 14-gauge, Type THHN, color coded, installed in conduit.
2. Manufacturer: General Cable Corp., Alcan Cable, American Insulated Wire Corp., Senator Wire and Cable Co., or Southwire Co.

F. Disconnect Switches:

1. Fusible Switches: For equipment 1/2 HP or larger, provide fused, each phase; heavy duty; horsepower rated; spring loaded quick-make, quick-break mechanism; dead front line side shield; solderless lugs suitable for copper or aluminum conductors; spring reinforced fuse clips; electro silver plated current carrying parts; hinged doors; operating lever arranged for locking in the "OPEN" position; arc quenchers; capacity and characteristics as indicated.
2. Non-Fusible Switches: For equipment less than 1/2 horsepower, switch shall be horsepower rated; toggle switch type with thermal overload quantity of poles and voltage rating as required.

PART 3 - EXECUTION

3.1 GENERAL

A. Workmanship shall be performed by licensed journeymen or master mechanics and shall result in an installation consistent with the best practices of trades.

B. Install work uniform, level and plumb, in relationship to lines of building. Do not install any diagonal or otherwise irregular work, unless so indicated on Drawings or approved by Owner’s Representative.

C. Install all items specified in this section of the Specification under the full purview of local and state governing agencies.

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3.2 PERFORMANCE OF WORK

A. Examine areas, physical conditions and phasing requirements under which materials are to be installed. Layout the system to suit the different types of construction and equipment as indicated on the drawings.

B. Work shall start immediately after authorization has been given to proceed so that the overall progress of the construction is not delayed. No foundry items to be installed until submittals have been approved.

C. Coordinate with other trades as necessary to properly interface components of the plumbing system.

D. Follow manufacturer's directions and recommendations in all cases where the manufacturers of articles used on this Contract furnish directions covering points not shown on the drawings or covered in these Specifications.

E. The omission from the drawings or Specifications of any details of construction, installation, materials, or essential specialties shall not relieve the Contractor from furnishing the same in place for a complete system.

3.3 MANUFACTURER'S DIRECTIONS

A. Follow manufacturers' directions and recommendations in all cases where the manufacturers of articles provided on this Contract furnish directions covering points not shown on the Drawings or covered in these Specifications.

3.4 INSTALLATION

A. Coordinate the work between the various Plumbing Sections and with the work specified under other Divisions. If any cooperative work must be altered due to lack of proper supervision, coordination or failure to make proper and timely provisions, the alterations shall be made to the satisfaction of the Owner’s Representative and at the Contractor’s cost.

B. Inspect all material, equipment, and apparatus upon delivery and do not install any damaged or defective materials.

3.5 SUPPORTS AND HANGERS

A. Prior to installation of hangers, supports, anchors, and associated work, installer shall meet at project site with all trades and testing agency representatives to coordinate work associated with placement of such work.

B. Installation of Building Attachments: Install building attachments at required locations within concrete or on structural steel for proper piping support. Install additional building attachments where support is required for additional concentrated loads, including valves, flanges, guides, strainers, expansion joints, and at changes in direction of piping. Install concrete inserts before concrete is placed. Fasten insert securely to forms. Where gypcrete is indicated, install reinforcing bars through opening at top of inserts.

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C. Proceed with installation of hangers, supports, and anchors only after required building structural work has been completed in areas where the work is to be installed. Correct inadequacies including, but not limited to, proper placement of inserts, anchors, and other building structural attachments.

D. Install hangers, supports, clamps, and attachments to support piping properly from building structure. Arrange for grouping of parallel runs of horizontal piping to be supported together on trapeze type hangers where possible. Where piping of various sizes is to be supported together by trapeze hangers, space hangers for smallest pipe size or install intermediate supports for smaller diameter pipe. Do not use wire, stranded wire, or perforated metal to support piping, and do not support piping from other piping.

E. Install a minimum of one hanger within 12” of each change of direction (only one required on either side of elbow), at the end of a pipe run or concentrated load, and within 36” of every piece of equipment. Hangers shall be installed on both sides of flexible connections. Where flexible connection connects directly to a piece of equipment only one hanger is required.

F. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories. Except as otherwise indicated for exposed continuous pipe runs, install hangers and supports of same type and style as installed for adjacent similar piping.

G. Prevent electrolysis in support of copper tubing by use of hangers and supports which are copper plated, or by other recognized industry methods.

H. Horizontal Hanger Spacing in accordance with following minimum schedules (other spacings and rod sizes may be used in accordance with MSS SP-58 and the SMACNA Seismic Restraint Manual using a safety factor). Comply with more restrictive requirements of local codes where those exceed the following minimum criteria.

1. Cast Iron:

CAST IRON PIPE SIZE	HANGER/SUPPORT SPACING (MAXIMUM)	ROD SIZE (MINIMUM)
Up to 4”	Each joint and 10 feet max	3/8”
Up to 8”	Each joint and 10 feet max	1/2”
Up to 12”	Each joint and 10 feet max	5/8”

2. Copper Pipe (Water Filled):

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COPPER PIPE SIZE	3. HANGER/SUPPORT SPACING 4. (MAXIMUM)	5. ROD SIZE 6. (MINIMUM)
1/2"	6 feet	3/8”
3/4” to 2”	6 feet	3/8”
2-1/2” to 4”	8 feet	3/8”
5” to 8”	10 feet	1/2"

7. Provide a minimum of one hanger for each section of pipe. Where an excessive number of fittings are installed between hangers, provide additional reinforcing.

I. Vertical Support Spacing in accordance with following minimum schedules:

1. Cast Iron:

Pipe Size	Vertical Support Spacing (Maximum)
All sizes	Base and each floor, not to exceed 15 feet

2. Copper Pipe:

Pipe Size	Vertical Support Spacing (Maximum)
All sizes	Base and each floor, not to exceed 10 feet

J. Sloping, Air Venting, and Draining:

1. Slope all piping as specified and as indicated, true to line and grade, and free of traps and air pockets. Unless indicated otherwise, slope piping in the direction of flow as follows:

Service	Inclination	Slope
Soil and Waste	Down	1/4" per foot
Sanitary Vent	Up (towards roof terminal)	1/4" per foot

2. Provide hose bibb valve, with threaded brass cap, at all low points in piping for maintenance draining.
3. Slope all compressed air branch piping down toward main risers at 1” per 100’.

K. Provisions for Movement:

1. Install hangers and supports to allow controlled movement of piping systems and to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units. Where hot water pipes are installed inside walls and ceilings do not firmly attach pipes to framing as necessary to avoid noise generation during expansion and contraction.
2. Load Distribution: Install hangers and supports so that piping live and dead loading and stresses from movement will not be transmitted to connecting equipment.
3. Insulated Piping: Comply with the following installation requirements:
   a. Clamps: Attach clamps, including spacers (if any), to piping with clamps projecting through insulation.

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b. Shields: Where low compressive strength insulation or vapor barriers are indicated on cold water piping, install shields or inserts.
c. Saddles: Where insulation without vapor barrier is indicated install protection saddles.

L. Installation of Anchors:

1. Install anchors at proper locations to prevent excessive stresses and to prevent transfer of loading and stresses to connected equipment.
2. Fabricate and install anchor by welding steel shapes, plates and bars to piping and to structure.
3. Where expansion compensators are indicated, install anchors in accordance with expansion unit manufacturer's written instructions, to limit movement of piping and forces to maximums recommended by manufacturer for each unit.
4. Anchor Spacing: Where not otherwise indicated, install anchors at ends of principal pipe runs, at intermediate points in pipe runs between expansion loops and bends.

M. Equipment Supports:

1. Provide all concrete bases, unless otherwise furnished as work of Division 03. Furnish to Division 03 Contractor scaled layouts of all required bases, with dimensions of bases, and location to column centerlines. Furnish templates, anchor bolts, and accessories necessary for base construction. Coordinate size of concrete pads and placement of anchors bolts with structural design. Anchor bolts shall be placed to maintain 6”, minimum, or greater distance from concrete pad edges.
2. Provide structural steel stands to support equipment that are not floor mounted or hung from structure. Construct of structural steel members or steel pipe and fittings. Provide factory-fabricated tank saddles for tanks.

N. Adjusting:

1. Hanger Adjustment: Adjust hangers to distribute loads equally on attachments.
2. Support Adjustment: Provide grout under supports to align piping and equipment to proper level and elevations.
3. Clean factory-finished surfaces. Repair any marred or scratched surfaces with manufacturer's touch-up paint.

O. Sanitary Roof Vents:

1. Coordinate with Architect and Roofing Installer for required height of termination and support structure as required by local environmental requirements, such as local snow, ice and wind loads. Confirm that Architect and Roof Installer have provided deflectors or splitters on the roof to protect vents where required.

3.6 WALL, FLOOR, AND ROOF PENETRATIONS

A. All pipe penetrations through rated and non-rated assemblies shall be sized to allow for compliance with structural integrity and fire ratings, as applicable. Penetrations of fire-resistance-rated assemblies shall be protected by an approved firestop system

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installed and tested in accordance with ASTM E119, ASTM E814, UL 263 or UL 1479. The system shall have an F rating/T rating of not less than the required rating of the floor or wall penetrated. Where sleeves are required, the sleeve size shall be installed with the inside clear diameter providing clearances as required below. Systems shall have an F rating of not less than 1 hour but not less than the required fire resistance rating of the assembly being penetrated. Systems protecting floor penetrations shall have a T rating of not less than I hour but not less than the required fire resistance rating of the floor being penetrated. Floor penetrations contained within the cavity of a wall at the location of the floor penetration do not require a T rating. No T rating shall be required for floor penetrations by piping that is not in direct contact with combustible material.

1. Uninsulated pipe penetrations through non-rated walls and floors: pipe penetration sizes shall be a 1” (minimum) to 2” (maximum) larger than the outside diameter of each uninsulated pipe.
2. Insulated pipes penetrations through non-rated walls and floors: pipe penetration sizes shall be a 1” (minimum) to 2” (maximum) larger than the outside diameter of each insulated pipe.
3. Uninsulated pipe penetrations through fire rated walls and floors, and through roof: penetration sizes shall be a 1/2” (minimum) to 1-1/2” (maximum) larger than the outside diameter of each uninsulated pipe to provide minimum 1/4” annular space between the outside of the pipe surface and assembly. Coordinate with specific manufacturer requirements and UL listing.
4. Insulated pipe penetrations through fire rated walls and floors, and through roof: pipe penetration sizes shall be a 1/2” (minimum) to 1-1/2” (maximum) larger than the outside diameter of each insulated pipe to provide minimum 1/4” annular space between the outside of the insulation surface and assembly. Coordinate with specific manufacturer requirements and UL listing.
5. Uninsulated pipe penetrations through foundation and basement walls: penetration sizes shall be larger than the outside diameter of each uninsulated pipe to allow adequate space for installation of mechanical link seals. Coordinate with specific manufacturer requirements.

3.7 PLUMBING FIXTURE THROUGH-PENETRATION AND MEMBRANE PROTECTION

A. Fire-resistance-rated assemblies shall be protected at membranes and/or through-penetrations where plumbing fixtures are installed in accordance with ASTM E119, ASTM E814, UL 263 or UL 1479.

B. Floor penetrations by floor drains, tub drains or shower drains contained and located within the concealed space of a horizontal assembly do not require a T rating as allowed by Chapter 7 of the Building Code.

C. Floor penetrations by floor sinks, trench drains and other fixtures that penetrate through the assembly must be enclosed within a rated enclosure with a comparable F/T rating of the assembly. Coordinate construction of fixture enclosures with Architectural design and General Contractor as required to comply with Chapter 7 of the Building Code.

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D. Plumbing fixtures that penetrate into rated membranes, without penetrating through the membrane, shall be protected to maintain the fire-resistance rating of the assembly as required by Chapter 7 of the Building Code. Coordinate installation of fixtures with Architectural design and General Contractor. Manufacturer: 3M #Interam Endothermic Mat.

3.8 WALL AND PIPE SIZING COORDINATION

A. Pipes routed horizontally or vertically in framed wall enclosures shall be limited to sizes that fit within the available free area without impacting the construction of the wall or intent of architectural floor plans. Maximum piping diameters shall be adjusted as necessary to accommodate insulation, fittings and pipe crossings inside the wall enclosure. Sizing is based on the following criteria:

1. 4” Stud Wall: Maximum 2” outside diameter of pipe and/or fittings.
2. 6” Stud Wall: Maximum 4” outside diameter of pipe and/or fittings.
3. 8” Stud Wall: Maximum 6” outside diameter of pipe and/or fittings.
4. 10” Stud Wall: Maximum 8” outside diameter of pipe and/or fittings.
5. 12” Stud Wall: Maximum 10” outside diameter of pipe and/or fittings.

3.9 WATER HAMMER ARRESTERS

A. Install as per PDI WH-201 Standard and equipment manufacturer’s recommendation and as shown on working drawings. Install at each plumbing fixture, bank of fixtures, equipment as required by code and where indicated on the drawings.

B. Provide upstream of quick closing valves, including but not limited to, flush valves, solenoid valves, electronic trap primers, pre-rinse faucets, dishwashers and banks of fixtures.

C. Water hammer arresters shall only be installed in the upright position above the piping and connected as close to pipe as possible to maximize effectiveness. Provide a manual ball valve (to remain in open position) at the inlet of the water hammer arrester to allow for future replacement without shutting water supply to fixtures.

D. Where water hammer arresters are installed in walls or above ceilings provide access panels as required for future maintenance and replacement. Coordinate locations with Architect or Owner’s Representative prior to installation or water hammer arrester and access doors.

E. On multiple fixture branch lines up to 20 feet in length, the water hammer arrester should be installed on the branch line between the last two fixtures being served. The water hammer arrester should have a fixture unit rating equal to, or greater than, the total fixture units connected to the branch line.

F. On multiple fixture branch lines over 20 feet in length, two water hammer arresters should be used on each line with the second unit placed at the approximate midpoint of the line. The sum of the fixture unit ratings of the water hammer arresters on each branch should be equal to, or greater than, the total fixture units connected to the branch line.

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G. Water hammer arresters shall be sized based on the PDI WH-201 Standard method as follows for water pressures up to 65 psi. For water pressures in excess of 65 psi provide the next larger size.

WATER HAMMER ARRESTER SIZING	
PDI SIZE RATING	FIXTURE UNITS SERVED
A	1-11
B	12-32
C	33-60
D	61-113
E	114-154
F	155-330

3.10 PIPING INSTALLATION

A. The word “piping” shall mean all pipes, fittings, nipples, valves and all accessories connected thereto.

B. Run piping generally parallel to the axis of the building, arranged to conform to the building requirements and to suit the necessities of clearance for other mechanical ducts flues, conduits and work of other trades and close to ceiling or other construction as practical, free of unnecessary traps or bends.

C. Run horizontal sanitary drainage piping at uniform pitch of not less than 1/4" per foot (2%), unless otherwise indicated on the drawings. Pipe sizes 4” (100 mm) and larger may be sloped at 1/8” per foot (1%) as allowed by local plumbing code to serve required invert elevations. Pitch horizontal vent piping downward from stack to fixtures.

D. Each plumbing fixture shall be properly vented as required by local plumbing code. Sanitary sewer and vent pipe sizes shall be meet or exceed minimum requirements of the local plumbing code.

E. Ream or file each pipe to remove burrs. Inspect each length of pipe and each fitting for workmanship and clear passageway.

F. All piping shall be inspected for defects and flaws prior to installation. Remove any damaged piping from job site. Piping shall be thoroughly cleaned of dirt, debris or rust.

G. Cleanouts to be provided at each change in direction greater than 135° or 100' maximum intervals on underground piping.

H. Cleanout elevations shall be mounted flush with finished floor elevation.

I. Cleanouts to be same size as pipe except cleanout plugs larger than 4" shall not be required.

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J. Cleanouts on concealed piping to be extended through and terminate flush with the finished wall or floor. Cover plates to be provided on all cleanout plugs in finished areas.

K. The bodies of cleanout ferrules to conform in thickness to that required for pipe and fittings of the same metal.

L. Provide cleanout on waste/vent riser serving each urinal. Locate cleanout above urinal where required by local code.

M. Attached piping on roof to manufactured polypropylene pipe supports, curbs or rails. Manufacturers: Caddy Pyramid, or Roof Top Blox.

3.11 ELECTRICAL COORDINATION

A. Division 22 installers shall coordinate with Division 26 work to provide complete systems as required to operate all mechanical devices installed under this Division of work.

B. Installation of Electrical Connections: Furnish, install, and wire (except as may be otherwise indicated) all heating, ventilating, air conditioning, etc., motors and controls in accordance with the drawings and in accordance with equipment manufacturer's written instructions and with recognized industry practices, and complying with applicable requirements of UL, NEC, and NECA's "Standard of Installation" to ensure that products fulfill requirements.

C. Division 22 has responsibilities for electrically powered plumbing equipment which is specified in Division 22 Specifications or scheduled on Division 22 Drawings as follows:

1. Motors: Furnish and install all motors necessary for mechanical equipment.
2. Magnetic Starters: Furnish all magnetic starters whether manually or automatically controlled which are necessary for mechanical equipment. Furnish these starters with all control relays or transformers necessary to interface with mechanical controls. If the starter is factory installed on a piece of Division 22 equipment, also furnish and install the power wiring between starter and motor.
3. Variable Frequency Drives: Provide all VFD's associated with fire protection equipment. If the drive is installed on a piece of factory assembled equipment the wiring between motor and drive is to be provided as part of the factory equipment.
4. Disconnects: Provide the disconnects which are part of factory wired Division 22 equipment. Factory wiring to include wiring between motor and disconnect or combination starter/disconnect.
5. Controls: Division 22 Contractor (including the Building Automation System (BAS) Controls subcontractor) is responsible for furnishing the following equipment in its entirety. This equipment includes but is not limited to the following:

a. Control relays necessary for controlling Division 22 equipment.
b. Control transformers necessary for providing power to controls for Division 22 equipment.

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c. Additional control panels beyond what is identified on drawings shall be provided by BAS contractor in order to provide a complete control system at no additional cost to Owner. 120v wiring to these control panels shall be provided by BAS Contractor from nearest source panel.
d. Low or non-load voltage control components.
e. Non-life safety related valve or damper actuators.
f. Float switches.
g. Solenoid valves, EP and PE switches.
h. Communications wiring and conduit between control devices and plumbing equipment.
i. Raceway to support control cabling.

D. Division 26 Electrical Responsibilities:

1. Motors: Provide the power wiring for the motors from servicing panel to motor controller.
2. Magnetic Starters: Except where magnetic starters are factory installed on Division 22 factory assembled equipment, Division 26 is to install magnetic starters furnished by Division 22 and install the necessary power wiring to the starter and from the starter to the motor. In the case of factory installed starters, Division 26 is to install the necessary power wiring from source panel/disconnect to the starter.
3. Variable Frequency Drives: Provide the necessary power wiring to the VFD and from the VFD to the motor except in the case of factory installed VFD's where wiring between the motor and VFD is to be by Division 22.
4. Disconnects: Provide all disconnects necessary for Division 22 equipment which are not provided as part of factory wired Division 22 equipment. Provide power wiring to all disconnects. In addition, provide power wiring between motor and disconnect when the disconnect is not factory installed.
5. Controls: Division 26 is responsible for providing power to control panels and provide final power connection to Division 22 provided control transformers.
6. Fire Sprinkler System: Division 26 is responsible for providing power wiring to fire protection controls including flow switches and alarm bells.
7. Specialized fire suppression systems: Division 26 is responsible for providing power wiring to suppression system and its controls.

E. Motors and Motor Control Equipment: Conform to the standards of the NEMA. Equip motors with magnetic or manual line starters with overload protection. Motor starters and line voltage controls shall be installed under Electrical Section but located and coordinated as required under this Section of the work. Starters shall be combination type with non-fusible disconnect switches. All single phase fractional horsepower motors shall have built-in overload protection.

3.12 PAINTING

A. All painting shall be provided under this Division work, unless otherwise specified under Division 9: Painting. Division 22 installer shall coordinate with Division 09

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installer, except where specifically stated otherwise in Division 09 the installer shall paint the systems noted below. Painting schemes shall comply with ANSI A13.1.

1. Painting of all exposed steel, piping, insulation, equipment, and materials.
2. Paint all exposed gas piping, interior and exterior to the building, and as required by Authority Having Jurisdiction, yellow color if not stated elsewhere in Architectural design.

B. All exposed work under Division 22 shall receive either a factory finish or a field prime coat finish, except:

1. Exposed copper piping.
2. Aluminum jacketed outdoor insulated piping.

3.13 IDENTIFICATION MARKERS

A. General: Where identification is to be applied to surfaces which require insulation, painting, or other covering or finish, including valve tags in finished mechanical spaces, install identification after completion of covering and painting. Install identification prior to installation of acoustical ceilings and similar removable concealment. Identification is not required inside wall assemblies or under concrete slabs.

B. Piping System Identification:

1. Install pipe markers on each system indicated to receive identification and include arrows to show normal direction of flow.
2. Locate pipe markers as follows:
    a. Near each valve and control device.
    b. Near each branch, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
    c. Near locations where pipes pass through walls, floors, ceilings, or inaccessible enclosures.
    d. At access doors, manholes, and similar access points which permit view of concealed piping.
    e. Near major equipment items and other points of origination and termination.
    f. Spaced horizontally at maximum spacing of 50' along each piping run, with minimum of one in each room. Vertically spaced at each story traversed.
    g. For natural gas piping labels shall be spaced at intervals not exceeding five feet. Labels may be spaced horizontally at maximum spacing of 50' along each piping run where pipe is located in the same room or area as the appliance served, with minimum of one in each room or space. Vertically spaced at each story traversed.
3. Directional Flow Arrows: Arrows shall be used to indicate direction of flow in pipes, including pipe where flow is allowed in both directions.
4. Provide pipe identification on:
    a. Domestic cold water.
    b. Domestic hot water (supply and recirculation).

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c. Sanitary sewer and vent piping.
d. Other piping systems.

C. Valve Tag Identification: Install tags on valves and control devices in piping systems, except at check valves, valves within factory-fabricated equipment units, shutoff valves, faucets, convenience and lawn-watering hose connections, and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule.

1. Provide valve tags for:

a. Domestic cold water.
b. Domestic hot water (supply and recirculation).
c. Other piping systems.

D. Plumbing Equipment Identification: Locate engraved plastic laminate signs on or near each major item of plumbing equipment and each operational device. Additional labels are not required if systems are properly labeled by equipment manufacturers.

1. Text of Signs: In addition to name of identified unit, provide lettering to distinguish between multiple units. Equipment signs shall include an identification of the area or other equipment served by the equipment being labeled.
2. Provide signs for the following equipment:

a. Main control and operating valves, including safety devices.
b. Pumps, compressors and similar motor-driven units.
c. Hot water system mixing valves and similar equipment.
d. Water heaters, heat exchangers and similar equipment.
e. Tanks and pressure vessels.
f. Strainers, filters, treatment systems and similar equipment.

3.14 CLEANING EQUIPMENT AND MATERIALS

A. In addition to the requirements of Section 220500, provide for the safety and good condition of all materials and equipment until final acceptance by the Owner's Representative. Protect all materials and equipment from damage. Provide adequate and proper storage facilities during the progress of the work. Special care to be taken to provide protection for bearings, open connections, pipe coils, pumps, compressors, and similar equipment.

B. All piping, finished surfaces, and equipment to have all grease, adhesive labels, and foreign materials removed.

C. All piping to be drained and flushed to remove grease and foreign matter. Pressure regulating assemblies, traps, flush valves, and similar items shall be thoroughly cleaned. Remove and thoroughly clean and reinstall all liquid strainer screens after the system has been in operation for ten days.

D. When connections are to be made to existing systems, the Contractor is to do all cleaning and purging of the existing systems required to restore them to the condition existing prior to the start of work.

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3.15 TESTING

A. Provide all tests specified herein, in other Division 22 Sections, and as otherwise required. Provide all test equipment, including test pumps, gauges, instruments, and other equipment required. Test all rotational equipment for proper direction of rotation. Upon completion of testing, certify to the Owner's Representative, in writing, that the specified tests have been performed and that the installation complies with the specified requirements and provide a report of the test observations signed by qualified inspector.

B. Owner's Representative to witness all field tests and conduct all field inspections. The Contractor to give the Owner's Representative ample notice of the dates and times scheduled for tests. Any deficiencies to be completely retested at no additional cost.

C. Inspection to continue during installation and testing. Perform a final inspection of the equipment prior to installation to determine conformity to the type, class, grade, size, capacity, and other characteristics specified herein or indicated. Correct or replace all rejected equipment prior to installation.

3.16 DISINFECTING - PLUMBING SYSTEMS

A. Disinfection of potable water distribution system shall be as prescribed by the local health authority or the following minimum requirement. After pressure tests have been made thoroughly flush the entire domestic water distribution system with water until all entrained dirt and mud have been removed and sterilize by chlorinating material. The chlorinating material shall be liquid chlorine. The chlorinating material shall provide a dosage of not less than 50 parts per million and shall be introduced into the system or part thereof in an approved manner. Retain the treated water in the pipe for 24 hours, or, fill the system or part thereof with a water-chlorine solution containing at least 200 parts per million of chlorine and allow to stand for three (3) hours. Open and close all valves in the system being disinfected three times during the contact period. Then flush the system with clean potable water until the residual chlorine is reduced to less than 1.0 ppm. During the flushing period open and close all valves and faucets three times. From at least three divergent points in the system, take samples of water in properly sterilized containers for bacterial examination. Repeat the disinfecting until tests indicate that satisfactory bacteriological results have been obtained.

B. Taking of samples shall be witnessed by Owner's Representative. Samples are to be taken and tested by an independent analytical testing laboratory. Written reports shall be supplied to Owner's Representative for approval.

3.17 OPERATING TESTING AND CERTIFICATION - PLUMBING SYSTEMS

A. Upon completion and disinfection, and prior to acceptance of the installation, the Contractor shall subject the plumbing system to operating tests to demonstrate satisfactory, functional, and operating efficiency. Such operating tests to include the following information in a report with conclusions as to the adequacy of the system.

1. Time, date, and duration of tests.
2. Water pressures at most remote location.

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3. Operation of all valves and hydrants.
4. Operation of all floor drains by flooding with water.
5. Quality of domestic water.
6. Read all indicating instruments at half-hour intervals unless otherwise directed. Supply four copies of the test report to the Owner's Representative.

3.18 VIBRATION AND DYNAMIC BALANCING

A. All equipment submitted and installed by Division 22 shall not exceed maximum tolerances as specified by the equipment manufacturer and the Hydraulic Institute for pumps.

B. Where installed equipment noise or vibration is objectionable to the Owner's Representative, it shall be responsibility of the contractor to conduct testing to confirm that the equipment does not exceed the standard.

C. Correction shall be made to all equipment, which exceeds vibration tolerances.

END OF SECTION 220500

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