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 SUMMARY

A. Related Requirements:
1. Section 018113 “Sustainable Design Requirements.”

1.3 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. Through-penetration firestop assemblies
18. Pipe portals
19. Pipe stands
20. Equipment supports
21. Access panels and doors
22. Roof flashings
23. Water hammer arrestors
24. Drains
25. Trap primers
26. Water meters
27. Miscellaneous fixtures
28. Identification markers
29. Coordination of electrical requirements for equipment provided

B. LEED Submittals: Credits EQc4.1 and EQc4.2. Refer to Section 018113 "Sustainable Design Requirements" for additional submittal requirements.

1.4 DESCRIPTION OF WORK

A. The Contract Documents, including Specifications and Construction Drawings, are intended to include all material and labor to install complete plumbing systems for the building and shall interface with all existing building systems affected by new construction. Refer to project narrative and basis of design for scope of work to be included in all systems.

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. The plans are diagrammatic and show generally the locations of the fixtures, equipment, and pipe lines and are not to be scaled; all dimensions and existing conditions shall be checked at the building.

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

D. 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.

E. 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 utilities at five (5) feet from the building. Coordinate with the Civil Engineering Plans and/or Division 02 work.
   2. Connection of all waste, vent, and water piping to all plumbing fixtures, drinking fountains, sinks, water coolers, drains and mechanical equipment.

1.5 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 and tags
   4. Electrical equipment
   5. Pipe portals
   6. Emergency showers and eye washes
   7. Plumbing specialties
   8. Trap primers
   9. Cleanouts
   10. Drains
   11. Roof flashing
   12. Wall hydrants and hose bibbs
   13. Backwater valves

1.6 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.
   2. Before proceeding with work check and verify all dimensions.
   3. Assume all responsibility for fitting of materials and equipment to other parts of equipment and structure.
   4. 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.
   5. 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.
   6. If any part of Specifications or Drawings appears unclear or contradictory, apply to Architect or Engineer for interpretation and decision as early as possible, including during bidding period.

1.7 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. "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.

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

F. "Exposed": Not installed underground or "concealed."

G. "Furnish": To supply equipment and products as specified.

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

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

J. “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".

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

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

M. "NRTL": Nationally Recognized Testing Laboratory, including UL and/or ETL.

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

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

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

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

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

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

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

U. "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.

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

W. "Wiring": Raceway, fittings, wire, boxes and related items.

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

1.8 RELATED WORK SPECIFIED ELSEWHERE

A. All Division 22 Plumbing sections included herein.

B. Division 01: General Requirements
   1. Including commissioning requirements.

C. Division 02: Existing Conditions

1. Coordination of excavation of trenches and the installation of mechanical systems and piping on site.

D. Division 03: Concrete.
1. All concrete work required for plumbing work shall be coordinated by Division 22 with Division 03 including:
   a. Concrete curbs and housekeeping pads for the mechanical equipment.
   b. Thrust blocks, pads, and boxes for mechanical equipment.
   c. Coordination of floor drain and floor sink installations in sloped floors.

E. Division 07: Thermal and Moisture Protection.
1. Flashing and sheet metal
2. Sealants and caulking
3. Firestopping

F. Division 09: Finishes:
1. Division 22 installers shall perform all painting, except where specifically stated otherwise in Division 09.
2. Painting of all exposed steel, piping, insulation, equipment, and materials.
3. All exposed gas piping located exterior to the building and as required by Authority Having Jurisdiction.

G. Division 26: Electrical is related to work of:
1. Power connections to all plumbing equipment
2. Life safety provisions

1.9 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 2013 standards of CEC; all devices shall be UL listed and labeled.

D. 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:
1. 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.
2. 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.

3. 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.
4. 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 120ºF maximum.
5. Section 608.7: Thresholds in roll-in type shower compartments shall be 1/2" high maximum.
6. Section 604.9: Water closets in buildings serving children ages 3 through 12 shall comply with reduced dimensions.
7. 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.
8. Section 606.4: Hand-operated metering faucets shall remain open for 10 seconds minimum.
9. Section 606.5: Water supply and drain pipes under lavatories and sinks shall be insulated or otherwise configures to protect against contact. There shall be no sharp or abrasive surfaces under lavatories and sinks.
10. 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.
11. 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 5 pounds maximum.

E. 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.

F. Provide in accordance with rules and regulations of the following:
1. Building Codes enforced by the Authority Having Jurisdiction in California:
   a. 2013 Building Standards Administrative Code, Part 1, Title 24 CCR
   b. 2013 California Building Code (CBC), Part 2, Title 24 CCR (2012 International Building Code with California Amendments)
   c. 2013 California Electrical Code (CEC), Part 3, Title 24 CCR (2011 National Electrical Code with California Amendments)
   d. 2013 California Mechanical Code (CMC) Part 4, Title 24 CCR 2011 Uniform Mechanical Code with California Amendments)
   e. 2013 California Plumbing Code (CPC), Part 5, Title 24 CCR (2011 Uniform Plumbing Code with California Amendments)
   f. 2013 California Building Energy Efficiency Standards for Residential and Nonresidential Buildings (T24), Part 6, Title 24 CCR
   g. 2013 California Fire Code, Part 9, Title 24 CCR (2012 International Fire Code with California Amendments
   h. 2013 California Green building Standards Code (CALGreen), Part 11, Title 24 CCR
   i. 2013 California Referenced Standards, Part 12, Title 24 CCR
   j. Title 19 CCR Public Safety, State Fire Marshal Regulations.

G. 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 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.
   2. 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.
   3. 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.
   4. 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 120ºF maximum.
   5. Section 608.7: Thresholds in roll-in type shower compartments shall be 1/2” high maximum.
   6. Section 604.9: Water closets in buildings serving children ages 3 through 12 shall comply with reduced dimensions.
   7. 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.
   8. Section 606.4: Hand-operated metering faucets shall remain open for 10 seconds minimum.
   9. Section 606.5: Water supply and drain pipes under lavatories and sinks shall be insulated or otherwise configures to protect against contact. There shall be no sharp or abrasive surfaces under lavatories and sinks.
   10. 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.
   11. 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 5 pounds maximum.

H. Provide in accordance with appropriate referenced standards of the following:
   1. NFPA - National Fire Protection Association
   2. CSA - Canadian Standards Association
   3. ADC - Air Diffuser Council
   4. ANSI - American National Standards Institute
   5. ASHRAE - American Society of Heating, Refrigerating & Air Conditioning Engineers
   6. ASME - American Society of Mechanical Engineers
   7. ASTM - American Society for Testing Materials
   8. AWS - American Welding Society

9. AWWA - American Water Works Association
10. FM - Factory Mutual
11. MSS - Manufacturer's Standardization Society
12. NEMA - National Electrical Manufacturer's Association
13. SMACNA - Sheet Metal and Air Conditioning Contractors National Association
14. UL - Underwriter's Laboratories
15. ADA - Americans with Disabilities Act
16. ETL - Electrical Testing Laboratories
17. ASSE - American Society of Sanitary Engineers
18. PDI - Plumbing and Drainage Institute
19. IAPMO - International Association of Plumbing and Mechanical Officials
20. CISPI - Cast Iron Soil Pipe Institute

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. Current Models. All work shall be as follows:
1. Manufactured items furnished shall be the current, cataloged product of the manufacturer.
2. Replacement parts shall be readily available and stocked in the USA.

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. This work shall include furnishing all access doors required for mechanical access.

E. Verify final locations for rough-ins with field measurements and with the requirements of the actual equipment to be connected. Refer to Equipment Specifications in Divisions 02 through 48 for rough-in requirements.

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

G. Verify all dimensions by field measurements.

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

I. 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.

J. 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.

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

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

M. 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.

N. 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 within 5 feet of building.

O. 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.

P. 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. In addition, the products, when tested, shall not drip flame particles, and flame shall not be progressive. Provide Underwriters Laboratories, Inc., label or listing, or satisfactory certified test report from an approved testing laboratory to prove the fire hazard ratings for materials proposed for use do not exceed those specified.

Q. Coordinate installation of floor drains and floor sinks with work of other trades. Finished floors shall slopes 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.

R. 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.

S. 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".

1.12 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. Minor deviations in order to avoid conflict shall be permitted where the design intent is not altered.

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

1.13 PRODUCT SUBSTITUTIONS

A. The Contractor shall certify the following items are correct when using substituted products other than those scheduled or shown on the drawings as a basis of design:
1. The proposed substitution does not affect dimensions shown on drawings.
2. The Contractor shall pay for changes to building design, including engineering design, detailing, structural supports, and construction costs caused by proposed substitution.
3. The proposed substitution has no adverse effect on other trades, construction schedule, or specified warranty requirements.
4. Maintenance and service parts are available locally and readily obtainable for the proposed substitute.

B. The Contractor further certifies function, appearance, and quality of proposed substitution are equivalent or superior to specified item.

C. The Contractor agrees that the terms and conditions for the substituted product that are found in the contract documents apply to the proposed substitution.

1.14 SHOP DRAWINGS AND EQUIPMENT SUBMITTALS

A. Provide submittals for all materials and equipment in accordance with Division 01 requirements.

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

C. The Contractor shall submit <u>approved</u> Shop Drawings 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.

D. Submittals and Shop Drawings:
1. Submit electronic copies of manufacturer's submittal sheets in one (1) coordinated package per Division. Multiple submissions will not be accepted without prior approval of Engineer. 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. The approved submittals shall be converted into Operations & Maintenance Manuals at the completion of the project. Refer to Division 01 for additional requirements.

1.15 COORDINATION DOCUMENTS/SHOP DRAWINGS

A. The Contractor shall prepare coordinated Shop Drawings.
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, Wall Framing 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, 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.

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.

1.16 REQUESTS FOR INFORMATION (RFIS)

A. General: 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 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.
   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 2 days 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 RFIs 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.

1.17 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 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.

1.18 INSTRUCTION, MAINTENANCE, AND O&M MANUALS

A. 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.

1.19 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.

1.20 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.

1.21 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 (areas by General Contractor) to provide operating conditions satisfactory to the Owner's Representative.

1.22 WARRANTIES

A. All equipment shall be provided with a minimum one-year (12 months) warranty from the date of Certificate of Occupancy. The warranty shall include parts, labor, travel costs, and living expenses incurred by the manufacturer to provide factory authorized service. Refer to individual Equipment Specifications for extended or longer-term warranty requirements.

B. 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.

C. Contractor shall provide maintenance service as specified elsewhere during the 12-month warranty period.

1.23 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 after the Date of Final Acceptance, ordinary wear and tear excepted.

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

1.24 COMMISSIONING

A. Commissioning requires the participation of Division 22 plumbing contractor to work to ensure that all systems are operating in a manner consistent with the construction documents and the design intent. The general commissioning requirements and coordination are detailed in Division 1 and in Division 23. This Division shall be familiar with all parts of Division 1 and Division 23 and the commissioning plan issued by the Commissioning Authority and shall execute all commissioning responsibilities assigned to them in the Contract Documents.

B. The plumbing contractor is responsible for assisting the commissioning agent throughout the entire commissioning process on the work under their section. The work is not complete until the commissioning agent and the University has signed off on the commissioned systems.

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

2.2 GENERAL

A. 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.

B. 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.

C. 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.

D. The following products to be included as part of this work but specified under Section 220500 Basic Plumbing Materials and Methods and Section 221123 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. Excavation and backfill.
   8. Pressure and temperature gauges.
   9. Access Panels.

E. Plumbing Fixtures: Refer to Section 224000.

F. Plumbing Equipment: Refer to Section 223000.

G. 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).

2.3 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.
   7. Provide copper plated, field lined, or plastic coated supports and attachment for copper piping systems. Field applied coatings or tape is unacceptable.
   8. Manufacturer: Hilti Inc, B-Line, Anvil International, Erico, Tolco, 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.
   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. 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.

C. 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 or equal.

D. Vertical Piping Clamps: Provide factory-fabricated two-bolt vertical piping riser clamps, MSS Type 8.

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

F. Building Attachments: Except as otherwise indicated, provide factory-fabricated building attachments of one of the following types listed.
1. Concrete Inserts: HCI-MD (for metal deck) or HCI-WF (for wood forms) cast-in anchors by Hilti Inc. or MSS Type 18 or Blue Banger Hanger by Simpson
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: KWIK HUS EZ-I by Hilti Inc., Titen HD by Simpson or approved equal.
5. Torque-Controlled Expansion Anchor: KWIK BOLT-TZ by Hilti Inc., Strong-Bolt 2 by Simpson Strong-Tie Co. Inc or approved equal.

G. Insulate around hanger/hanger tight to piping.
1. clamps. Klo-Shure Insulation Coupling or equal.

H. Miscellaneous Materials:
1. Metal Framing: Provide products complying with NEMA STD ML1.
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.
5. Hyco strap.

2.4 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.

2.5 THROUGH-PENETRATION FIRESTOP ASSEMBLIES

A. Through-penetration firestop assemblies and caulking systems as required to maintain the fire/smoke integrity of the penetrated surface and install per manufacturer's installation instructions. Refer to drawings for additional requirements.

B. Manufacturers: 3M, Hilti, ProSet or equal.

2.6 PIPE PORTALS

A. Where pipe portals are not provided by other sections of Specification, provide prefabricated insulated pipe portals as required for piping penetrating through the roof where shown on plans. Field built pipe portals are acceptable alternatives - provide detail of construction for review.

B. Standard pipe portals, unless otherwise noted, shall be constructed as follows:
1. Curb shall be constructed of heavy gauge galvanized steel with continuous welds on shell seams.
2. Insulation to be 1-1/2" thick, 3 lb density rigid fiberglass.
3. Curb to have a raised 3" (minimum), 45° cant.
4. Curb to have 1-1/2" x 1-1/2" wood nailer (minimum).
5. Curb height to be 8" (minimum) above roof deck.
6. Cant shall be raised to match roof insulation thickness.
7. Cover or flashing to be constructed of galvanized steel or other suitable material to provide sturdy weather tight closure. Provide collars and rubber nipples with draw bands of sizes required by piping. Size curb, cover and nipples per manufacturer's recommendations.
8. Manufacturer: Roof Products Systems or Pate.

2.7 PIPE STANDS

A. General Requirements for Pipe Stands: Shop- or field-fabricated assemblies made of manufactured corrosion-resistant components to support roof-mounted piping.

B. Compact Pipe Stand: One-piece plastic unit with integral-rod roller, pipe clamps, or V-shaped cradle to support pipe, for roof installation without membrane penetration.

C. Low-Type, Single-Pipe Stand: One-piece plastic or stainless steel base unit with plastic roller, for roof installation without membrane penetration.

D. High-Type, Single-Pipe Stand:
1. Description: Assembly of base, vertical and horizontal members, and pipe support, for roof installation without membrane penetration.
2. Base: Plastic or stainless steel.
3. Vertical Members: Two or more cadmium-plated-steel or stainless-steel, continuous-thread rods.

4. Horizontal Member: Cadmium-plated-steel or stainless-steel rod with plastic or stainless-steel, roller-type pipe support.

E. High-Type, Multiple-Pipe Stand:
1. Description: Assembly of bases, vertical and horizontal members, and pipe supports, for roof installation without membrane penetration.
2. Bases: One or more; plastic.
3. Vertical Members: Two or more protective-coated-steel channels.
4. Horizontal Member: Protective-coated-steel channel.
5. Pipe Supports: Galvanized-steel, clevis-type pipe hangers.

F. Curb-Mounted-Type Pipe Stands: Shop- or field-fabricated pipe supports made from structural-steel shapes, continuous-thread rods, and rollers, for mounting on permanent stationary roof curb.

G. Manufacturer: Pate, Roof Products Systems, Portable Pipe Hangers, Roof Top Blox, or Erico Caddy Pyramid.

2.8 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.

2.9 PIPING

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

2.10 VALVES

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

2.11 PLUMBING EQUIPMENT

A. Refer to Section 223000 Plumbing Equipment.

2.12 PLUMBING FIXTURES

A. Refer to Section 224000 Plumbing Fixtures.

2.13 CLEANOUTS

A. Acceptable Manufacturers: J. R. Smith, Zurn, Wade, 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. Z1400-BZ for all.

D. Cleanout Tee: Cast iron cleanout tee with countersunk brass plug, neoprene plug gasket seal and smooth stainless steel cover.
   1. Manufacturer: Zurn Z-1446-BP or J. R. Smith 4532 S (Y)

2.14 ROOF FLASHING

A. Flashing: Unless indicated otherwise on the drawings flashings for pipes through the roof shall be galvanized sheet metal, 24 gauge minimum << or sheet copper, 8 oz. per sq. ft. minimum >> with seams and joints lapped and soldered watertight. Coordinate with Architectural Sections for flashings and roofing.

B. Vent Pipes: Provide caulk type, vandalproof hood with Allen head vandal proof screws for all vent pipes through roof or preformed vinyl/galvanized steel assembly.

2.15 WATER HAMMER ARRESTORS

A. Piston Type: Hard drawn copper construction, mirror finished internal surfaces; machine finished brass piston, air charged, 250 psi rated, tested and certified per PDI WH-201 and ASSE 1015.

B. Manufacturers: Watts Series 15, Precision Plumbing Series SC, or Sioux Chief.

2.16 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.

2.17 DRAINS

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

B. Manufacturers: J.R. Smith, Zurn, Wade, Sioux Chief, Josam and Watts.

2.18 TRAP PRIMER

A. Alternate for single trap application adjacent to a flush valve toilet: One piece, chrome plated flush valve connection with vacuum breaker, 3/8” elbow, flex-bend tube connection, diverter. Sloan VBF-72A or equal.

2.19 BACKWATER VALVE (FOUNDATION DRAINAGE)

A. Drain Tile Sump: Enamel coated body with extension frame and solid cover. Zurn # Z-753 or J.R. Smith #7098.

B. Backwater Valve. Enamel coated body and cover with removable wheel handle, bronze gates and flapper valve and cast iron extension. Provide 30" diameter fiberglass or cast iron basin with access top, minimum. Zurn #Z-1088 or J.R. Smith series 7150-Y.

2.20 WATER METERS

A. Water meter shall have a mechanical drive with hermetically sealed registers; meter shall be equal to or exceed AWWA Standards and shall have an all bronze case. Meter shall also include “dual-output” capability using a programmable frequency pulse output compatible with BAS (Building Automation System) integration. Coordinate BAS integration requirements with BAS Controls Installer for monitoring and trend logging of water use (gallons). Provide water meter with shutoff valves on each side of meter. Provide flanges on valves and support stands or wall brackets for meter support. Meter shall be approved for use by local water district.

B. Manufacturer: Hersey Products, Niagara, Rockwell, Neptune or equal.

2.21 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.

B. Plastic Pipe Markers:
   1. Pretensioned Pipe Labels: Precoiled, semirigid 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.
   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.
   3. Arrows: Print 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.
   4. Pipe Label Color Schedule:
      a. Domestic Water and Nonpotable Water Piping:
         1) Background Color: Green.
         2) Letter Color: White.
      b. Sanitary Sewer, Storm Drainage and Vent Piping:
         1) Background Color: Green.

2) Letter Color: White.

c. Compressed-Air Piping:
   1) Background Color: Blue.
   2) Letter Color: White.

C. Underground-Type Plastic Line Markers: Provide 6” wide x 4 mils thick multi-ply tape, consisting of solid metallic foil core between 2 layers of plastic tape. Markers to be permanent, bright colored, continuous printed, intended for direct burial service.

D. 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: 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.
   4. Non-potable Water Tags: 1/16” thick, engraved, plastic tags as indicated on Drawings.

E. Plastic Equipment Signs:
   1. Provide 4-1/2” x 6” plastic laminate sign, ANSI A.13 color coded with engraved white core lettering.
   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.

F. Acceptable Manufacturers: Craftmark, Seton, Brady, Marking Services, Inc., Brimar or R&R I.D. Co.

2.22 ELECTRICAL

A. General:
   1. All electrical material, equipment, and apparatus specified herein shall conform to the requirements of Division 26.
   2. 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.
   3. Set and align all motors and drives in equipment specified herein.
   4. 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.
   5. 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.

6. 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 ½ 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 or as an insulated bearing motor.
   c. Bearings:
      1) Ball or roller bearings with inner and outer shaft seals.
      2) Re-greasable, 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.
         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:

g. Motors shall have a minimum efficiency per governing State or Federal codes, whichever is higher.

h. And, motors shall meet the NEMA premium efficiency standard.

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

D. 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.

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.

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 Engineer 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 concrete with compressive strength less than 2,500 psi is indicated, install reinforcing bars through opening at top of inserts.

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 or perforated metal to support piping, and do not support piping from other piping.

E. 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.

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

G. Horizontal Hanger Spacing in accordance with following minimum schedules (other spacings and rod sizes may be used in accordance with the SMACNA Seismic Restraint Manual using a safety factor of five):

1. Cast Iron:

Pipe Size	Max. Hanger Spacing	Rod Size
Up to 4”	Each joint, 10 feet max	3/8"
6” and larger	Each joint, 10 feet max	1/2"

2. Steel Pipe (Water Filled):

Pipe Size	Max. Hanger Spacing	Rod Size
1/2" to 1-1/4"	5 feet	3/8"
1-1/2" to 2"	7 feet	3/8"
2-1/2" to 3"	10 feet	1/2"
4" and larger	10 feet	5/8"

3. Steel Pipe (Gas/Air Filled):

Pipe Size	Max. Hanger Spacing
1/2" to 1"	6 feet
1-1/4" and larger	10 feet

4. Copper Pipe:

Pipe Size	Max. Hanger Spacing
1/2" to 1-1/2"	6 feet
2" and larger	8 feet

5. CPVC Pipe (Schedule 80):

Pipe Size	Max. Hanger Spacing
1"	5 ½ feet
1 ¼” & 2”	6 feet

6. Caulked Bell and Spigot: Provide hanger for each section of pipe, located at shoulder of bell. Where an excessive number of fittings are installed between hangers, provide additional reinforcing.

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

1. Cast Iron:

Pipe Size	Max. Vertical Support Spacing
All sizes	Base and each floor, not to exceed 15 feet

2. Steel Pipe (Water and Air Filled):

Pipe Size	Max. Vertical Support Spacing
All sizes	Base and every other floor, not to exceed 25 feet

3. Steel Pipe (Gas Filled):

Pipe Size	Max. Vertical Support Spacing
1/2"	6 feet
3/4” to 1”	8 feet
1-1/4” and larger	Every floor level

4. Copper Pipe:

Pipe Size	Max. Vertical Support Spacing
All sizes	Base and each floor, not to exceed 10 feet

I. Sloping, 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 / 1/8” per foot 4” & up
Storm Water	Down	1/4" per foot / 1/8” per foot 4” & up
Steam~~Sanitary~~	**Down**~~Up (towards roof~~	**1" per 40'**~~1/4" per foot~~

~~Vent~~	~~terminal)~~	
~~Steam~~	~~Down~~	~~1" per 40'~~

2. In steam piping, provide eccentric reducers in horizontal piping for all sizing changes. Where horizontal piping must be reduced in size, use eccentric reducers that allow continuing a uniform pitch along the bottom of the piping (in downward pitched systems). Avoid concentric reducers in horizontal piping to avoid potential water hammer.
3. Provide drain valves and hose adapters at low points in piping as shown on drawings.

J. 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.
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.
   b. Shields: Where low compressive strength insulation or vapor barriers are indicated on cold water piping, install shields or inserts.

K. 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 Spacings: Where not otherwise indicated, install anchors at ends of principal pipe runs, at intermediate points in pipe runs between expansion loops and bends.

L. Equipment Supports (Exclude Formed Concrete):
1. . 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.
2. Provide structural steel stands to support equipment not floor mounted or hung from structure. Construct of structural steel members or steel pipe and fittings. Provide factory-fabricated tank saddles for tanks.

M. Adjusting:
1. Hanger Adjustment: Adjust hangers so as to distribute loads equally on attachments.
2. Support Adjustment: Provide grout under supports so as to bring 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.

3.6 WALL, FLOOR, AND ROOF PENETRATION SIZING

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. Where sleeves are required to create blockout in block or concrete walls (sleeves not required for drywall penetrations), the sleeve size shall be installed with the inside clear diameter providing clearances as required below.

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 WATER HAMMER ARRESTERS

A. Install as per PDI Standard WH-20 and equipment manufacturer’s recommendation and as shown on working drawings. Provide before each quick closing valve (flush valve, solenoid valve, etc.) or bank of fixtures.

B. Install at each plumbing fixture, bank of fixtures, equipment and as indicated.

3.8 ROOF CURBS, EQUIPMENT RAILS, PIPE PORTALS

A. Install per manufacturer's instructions.

B. Coordinate with other trades so units are installed when roofing is being installed.

C. Verify roof insulation thickness and adjust cant to match.

3.9 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 at uniform pitch of not less than 1/8" per foot, unless otherwise indicated. Pitch horizontal vent piping downward from stack to fixtures or flat as permissible per current code requirements.

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

E. 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.

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

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

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

I. 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.

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

K. Mount piping on roof to manufactured polypropylene pipe supports: Caddy Pyramid, Roof Top Blox or equal.

3.10 VIBRATION CONTROL ISOLATORS

A. Comply with manufacturer's recommendations for selection and application of vibration isolation materials and units except as otherwise indicated. Comply with minimum static deflections recommended by ASHRAE, of vibration isolation materials and units where not otherwise indicated.

B. Comply with manufacturer's instructions for installation and load application to vibration control materials and units except as otherwise indicated. Adjust to ensure that units have equal deflection, do not bottom out under loading, and are not short-circuited by other contacts or bearing points. Remove space blocks and similar devices intended for temporary support during installation.

C. Install units between substrate and equipment as required for secure operation and to prevent displacement by normal forces, and as indicated.

D. Adjust leveling devices as required to distribute loading uniformly onto isolators. Shim units as required where substrate is not level.

E. Flexible Pipe Connectors: Install on equipment side of shutoff valves.

F. Upon completion of vibration control work, prepare report showing measured equipment deflections for each major item of equipment as indicated. Clean each vibration control unit, and verify that each is working freely, and that there is no dirt or debris in immediate vicinity of unit that could possibly short-circuit unit isolation.

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, CEC, 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: 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.
      c. Low or non-load voltage control components.
      d. Non-life safety related valve or damper actuators.
      e. Float switches.
      f. Solenoid valves, EP and PE switches.
      g. Communications wiring and conduit between control devices and plumbing equipment.
      h. 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 provide and install magnetic starters and install the necessary power wiring to 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.

3.12 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.

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 transversed.

C. Underground Piping Identification: During backfilling/topsoiling of each exterior underground piping system, install continuous underground-type plastic line marker, located directly over buried line at 6" to 8" below finished grade. Where multiple small lines are buried in common trench and do not exceed overall width of 16", install single line marker.

D. Plumbing Equipment Identification: Locate engraved plastic laminate signs on or near each major item of plumbing equipment and each operational device. Provide signs for the following:
1. Pumps, compressors and similar motor-driven units.
2. Hot water system mixing valves and similar equipment.
3. Water heaters, heat exchangers and similar equipment.

4. Tanks and pressure vessels.

E. 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.

F. Gas pressure regulators shall have metal tags attached statingupstream natural gas pressure. Do not remove."

3.13 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.

3.14 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.

3.15 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.

3.16 OPERATING TESTING AND CERTIFICATION - PLUMBING SYSTEMS

A. Upon completion and disinfection, and prior to acceptance of the installation, the Contractor to 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.
   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.

END OF SECTION