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SECTION 220000 – PLUMBING GENERAL CONDITIONS

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. All drawings and applicable provisions of Division 0 Bidding Requirements and Division 1 General Requirements apply to work of this Section.
- B. Should a conflict arise between Section 220000 General Conditions and other Sections, the General and Supplementary Conditions of Division 1 shall take precedence.
- C. The plumbing work shall comply with all provisions of the architectural, plumbing, fire protection, mechanical and electrical drawings and specifications.
- D. The word "Contractor" as used in these specifications shall be held to mean the person, firm or corporation contracting to do the herein described work.
- E. It shall be a part of this Contractor's bid that the submission of a proposal carries with it the agreement to all items and conditions referred to in the specifications and accompanying drawings.
- F. Rough-in for and connect, as shown on the drawings, facilities for equipment furnished by the Owner under a separate contract.

1.2 RULES AND REGULATIONS

- A. The rules, regulations, ordinances of all applicable governing bodies in force at the time of execution of the Contract shall become a part of these specifications. These shall include the requirements of state, county, city and also the local utility companies.
- B. All materials furnished and work performed shall be in compliance with the latest applicable version of the following codes:

- International Building Code - 2015
- International Plumbing Code - 2015
- International Mechanical Code - 2015
- International Fuel Gas Code - 2015
- International Energy Conservation Code - 2015
- National Electrical Code - 2014
- NFPA 13-2002
- ASHRAE STANDARD 90.1

1.3 PERMITS AND FEES

- A. Cost of all fees, permits or licenses that may be required for the performance of the Contract shall be included.

1.4 PLANS AND SPECIFICATIONS

- A. The specifications and the accompanying plans (architectural, structural, mechanical, electrical, fire protection and plumbing) are mutually explanatory and anything described or shown on one, but not on the other, shall be considered as if shown or described on both. The intention of the plans and specifications is to provide complete functioning systems in every respect. Contractor shall furnish all material and equipment and shall perform all labor to achieve this intent, whether or not such material or equipment is indicated herein. Whenever the term "provide" is used, it shall mean "furnish and install." If a conflict exists between the drawings and the specifications or between one specification and another specification or between one drawing and another drawing, the most demanding requirement shall apply unless otherwise authorized in writing by the Engineer.

- B. Data given herein and on the drawings is as exact as could be secured. Their absolute accuracy is not guaranteed and this Contractor shall obtain and verify exact locations, measurements, levels, space requirements, etc., at the site, and shall satisfactorily adapt the work to actual conditions at the building as constructed.
- C. The drawings shall be considered schematic and are not intended to indicate all changes in direction and necessary fittings to be installed by this Contractor. Piping, equipment, etc., shall be installed so all items clear the structure and other building elements and maintain appropriate clearances for access, service and maintenance.
- D. Some of the details on the plans are schematic or diagrammatic. These details are not intended to show all pipe, fittings, etc., required to achieve the arrangement shown on the plan view, but instead are intended to show those items, such as pipe arrangement, fittings, specialties, etc., which are not shown on the plan view. This Contractor shall appropriately adapt these details to the actual conditions of the job.
- E. Routing of piping, location of equipment, and location of other devices are shown on plans for general guidance. This Contractor shall coordinate his work with other Contractors and shall provide necessary deviations in routing as far as 10 feet from those shown to provide systems as specified or implied, without interference and pursuant to these requirements at no additional cost to the Owner, Architect or Engineer.
- F. Contractor shall not scale the drawings. Refer to architectural and structural drawings for building construction and dimensions and to room finish schedule on architectural drawings for material, finish and construction method of walls, floors and ceilings in order to insure proper rough-in and installation of contractor's work.
- G. Changes, modifications or variations to the plans and specifications will be issued by the Engineer in writing.

1.5 DISCREPANCIES OR OMISSIONS

- A. During the bidding period, should a bidder find discrepancies or omissions in any of the documents or should he be in doubt as to their meaning, he should at once notify the Engineer who will, time permitting, issue a written instruction in the form of an addendum to all bidders of record. The Engineer will not be responsible for any oral explanations or interpretations of the documents.
- B. During construction, should a discrepancy or omission be found, it shall be brought to the attention of the Engineer at once for resolution.
- C. No changes in contract price will be allowed for minor changes in layout or location required to avoid interferences, obstructions, etc. Contract price changes will be considered only for changes in the scope of the project requirements. All such scope changes and price revisions must be authorized in writing.
- D. If discrepancies are found within the contract documents, the most demanding requirement shall take precedence unless otherwise agreed by the engineer in writing.

1.6 HOISTING

- A. Contractor shall be responsible for hoisting of all materials and equipment furnished or installed under this Section of the Specifications, in accordance with all city, state and federal rules and regulations.

1.7 SHOP DRAWINGS

- A. Contractor shall submit shop drawings in compliance with the General and Special Conditions. Contractor shall field verify exact locations, measurements, and space availability at the site, etc. prior to fabricating materials and shall notify the Engineer of discrepancies in writing.

- B. The Contractor shall submit copies of all required Shop Drawings and material and equipment lists.
- C. Submittals shall be transmitted to SSC Engineering as paper documents, electronic documents via email attachments, or electronic documents via FTP file transfers.
 - 1. All submittals shall include a transmittal form identifying the project name, date, contents of submittal package, and names of subcontractor, manufacturer, and supplier.
 - 2. On an attached separate sheet clearly identify deviations from requirements in the Contract Documents, including minor variations and limitations.
 - 3. Paper submittals shall be sent to

SSC Engineering
Attention: Submittals
18207 Edison Ave.
Chesterfield, MO 63005
 - 4. Emails regarding submittals shall be sent to "submittals@sscengineering.com".
- D. Documents transmitted in paper format shall be sent to the Architect who will forward these to SSC. If approved by the Architect prior to submitting documents, these documents may be submitted simultaneously to the Architect and SSC. SSC will return all documents to the Architect only regardless of how they were transmitted to SSC. Submit four (4) paper copies of all required Shop Drawings and material and equipment lists for the Engineer's and Owner's sole use. The Contractor shall submit additional paper copies that will be required for his own use and the Operation and Maintenance Manuals. The additional copies will be reviewed by the Engineer and returned to the Contractor marked accordingly.
- E. If SSC is the prime consultant and there is no Architect, paper documents shall be transmitted directly to SSC.
- F. Documents transmitted as email attachments shall be sent simultaneously to the Architect and SSC. SSC will return one (1) electronic copy of these documents to the Architect only.
- G. Documents transmitted via FTP file transfers shall be retrieved from the FTP site after SSC has received an email notification that these documents have been posted to the site. SSC will return one (1) electronic copy of these documents to the Architect only unless another procedure is agreed to in writing by the Architect and the Engineer.
- H. Contractor shall review and correct all shop drawings before they are submitted. Shop drawings shall bear the signed and dated approval stamp of this Contractor.
- I. Shop drawings shall include the plan mark used on the plans.
- J. Valve and fitting shop drawings shall indicate the intended service.
- K. Equipment shop drawings shall give capacities at conditions specified and shall include manufacturer's catalog numbers and cuts. Shop drawings shall be clearly marked; shall indicate all accessories, items, conditions, etc., which are being furnished; and shall indicate that all conditions of the plans and specifications are being met. Wiring diagrams shall be submitted.
- L. Submittals which do not provide the required information will be returned unchecked.
- M. Contractor shall be responsible for deviations, errors and omissions, quantities, and coordination dimensions in submittals, and this responsibility shall not be relieved by Engineers' review of submittals.
- N. This Contractor shall coordinate each submittal with the contract documents, work of other contractors, and job site conditions.

- O. The Contractor shall not be relieved of responsibility for deviations from requirements of the Contract Documents by the Engineer's approval of Shop Drawings, Product Data, Samples or similar submittals unless the Contractor has specifically informed the Engineer in writing 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. The Contractor shall not be relieved of responsibility for errors or omissions in Shop Drawings, Product Data, Samples or similar submittals by the Engineer's approval thereof.

1.8 RELEASE OF CAD FILES

- A. See "Release of Cad Files" at the end of this section.

1.9 MAINTENANCE AND OPERATING INSTRUCTIONS AND MANUALS

- A. Upon completion of the job, the installing contractors and major suppliers shall instruct the Owner's representatives in the proper operation and maintenance of the systems installed. The installing Contractors shall submit documentation indicating the date of instruction; names and organization of persons providing and receiving the instructions; systems the instructions covered; and materials received.
- B. Binders: Heavy-duty, three-ring, vinyl-covered, loose-leaf binders, in thickness necessary to accommodate contents, sized to hold 8-1/2-by-11-inch paper; with clear plastic sleeve on spine to hold label describing contents and with pockets inside covers to hold folded oversize sheets.
 - 1. If two or more binders are necessary to accommodate data of a system, organize data in each binder into groupings by subsystem and related components. Cross-reference other binders if necessary to provide essential information for proper operation or maintenance of equipment or system.
 - 2. Identify each binder on front and spine, with printed title "OPERATION AND MAINTENANCE MANUAL," Project title or name, and subject matter of contents. Indicate volume number for multiple-volume sets.
- C. Dividers: Heavy-paper dividers with plastic-covered tabs for each section of the manual. Mark each tab to indicate contents. Include typed list of products and major components of equipment included in the section on each divider, cross-referenced to Specification Section number and title of Project Manual.
- D. Contractor shall also submit four (4) complete hard copy sets and one (1) electronic copy of properly bound operating manuals to the Engineer for review. These manuals shall include the following:
 - 1. Complete set of shop drawings.
 - 2. Copies of all submittals.
 - 3. Parts lists, wiring diagrams, piping diagrams, etc.
 - 4. Manufacturers' operating and maintenance instructions.
 - 5. As-built drawings.
 - 6. Written operating and maintenance instructions for the system. This is a written version of Paragraph "(J-1)" above.
 - 7. Copies of warranties.
 - 8. Parts list for each piece of equipment and name of local supplier.
- E. At a predetermined time, prior to building occupancy, an instructional session shall take place. The installing contractors and major suppliers shall instruct the Owner's operating personnel on operation and maintenance of the systems. The installing Contractor shall submit documentation indicating the date of instruction; names and organization of persons providing and receiving the instructions; systems the instructions covered; and materials received.

1.10 RECORD DRAWINGS

- A. During construction, a separate set of plans at the jobsite shall be maintained by the Contractor to keep a record of all changes of locations. See additional requirements in General Conditions and Supplementary Conditions.
- B. Locations of piping, specialties and other concealed facilities are to be shown by the Contractor if and when they differ from the drawings. Underground piping shall be dimensioned on those drawings.
- C. "As built" drawings are to be submitted to Architect/Engineer for review prior to the time of request for final payment. Submit as-built record drawings in accordance with the General Conditions.
- D. For drawings that SSC has furnished to the contractor in CAD format, contractor shall prepare "As Built" drawings in CAD format. "As built" drawings in CAD format are to be submitted to Architect/Engineer, in addition to marked up paper documents for review prior to the time of request for final payment. Submit as-built record drawings in accordance with the General Conditions.

1.11 WORKMANSHIP AND MATERIALS

- A. All work shall be performed in a manner acceptable to the Engineer, Architect, and the Owner, by properly trained, supervised and experienced personnel using new and clean materials, supplies, equipment, and hardware.

1.12 MATERIAL AND EQUIPMENT HANDLING AND STORAGE

- A. It is recognized that space at the project for storage of materials and products is limited. Coordinate the deliveries of materials and products with the scheduling and sequencing of the work so that storage requirements at the project are minimized. In general, do not deliver individual items of equipment to the project substantially ahead of the time of installation.

1.13 GUARANTEE AND WARRANTY

- A. This Contractor shall guarantee and warrant all equipment, materials, workmanship, installation, etc., for a period of one year from final acceptance in accordance with the General Conditions.
- B. During the guarantee period, this Contractor shall make all required repairs and replacements, and shall provide all necessary service, labor, tools, materials, parts, etc., required during this period at no additional cost to the Owner.

PART 2 - PRODUCTS

2.1 MATERIAL SUBSTITUTION

- A. Equipment selection has been based on one manufacturer to establish the desired type, style, quality, performance, etc. When other manufacturers are listed as equally acceptable, the product of those manufacturers will be accepted if their product complies with these specifications and drawings. The listing of a manufacturer does not relieve that manufacturer from complying with the specifications and drawings.
- B. All equipment and materials are subject to the review and approval of the Engineer and Architect.
- C. All differences in cost involved in using an equally acceptable manufacturer shall be included in this Contractor's bid. This contractor shall be responsible for any and all engineering and installation variations due to the substituted equipment. These include structural, electrical, architectural, plumbing, mechanical, fire protection, etc. changes.

- D. Deviations from these specifications are not solicited and are not encouraged. If a deviation between the specifications or drawings and items bid does exist, then that deviation must be clearly itemized and explained on the bid form.
- E. Solvent based adhesives or sealants shall not be substituted for water based adhesives or sealants.

PART 3 - EXECUTION

3.1 GENERAL

- A. Contractor shall furnish all material, equipment, labor, services, supplies, etc., required to execute to completion all work shown on the mechanical, electrical, fire protection and plumbing drawings, described in these specifications, or made necessary by the work shown on the drawings and/or described in these specifications.
- B. This Contractor shall schedule all work and furnish the required materials in such a manner that the work may progress from start to finish in an expeditious and efficient manner without undue interruption. This Contractor shall also schedule his work to coordinate with the construction staging for this project.
- C. Contractor shall hire the proper trades to accomplish the work described on the drawings or in the specifications.

3.2 COORDINATION OF TRADES

- A. Prior to the fabrication or installation of any materials, this Contractor shall review the drawings indicating work to be performed by each trade. If conflicts occur, they shall be brought to the attention of the Engineer for resolution.
- B. If this Contractor installs the work without coordinating with the other trades, then, if requested by the Owner, Architect, or Engineer, this Contractor shall remove and rework some installed work to resolve a conflict, and such change shall be done at no change in contract price.
- C. The Contractor supplying the equipment shall furnish all motors and components which are part of the equipment.
- D. Control wiring is defined as that wiring which conducts electrical energy at a voltage of less than 100 volts. Interlock wiring is defined as that wiring which performs a control function, but at a voltage of 100 volts or greater. All other wiring shall be considered power wiring.
- E. The Electrical Contractor shall furnish and install all power wiring to, and including connection to the equipment. Unless specifically noted otherwise, all interlock wiring shall be furnished and installed by the Electrical Contractor. Unless noted otherwise, the control wiring shall be furnished and installed by the Contractor furnishing the controlled equipment.
- F. Unless noted otherwise, the Electrical Contractor shall furnish and install all starters, disconnects, switches, push-button stations, etc., except those which are furnished with the equipment as a part of a factory-assembled package. Heater elements for overload relays on magnetic motor starters (except the starters factory pre-wired with equipment) shall be sized, furnished and installed by the Electrical Contractor. Magnetic motor starters for mechanical equipment (except starters factory pre-wired with equipment such as chillers and packaged air conditioners) shall be furnished by the Electrical Contractor. Magnetic motor starters will be provided with:
 - 1. Auxiliary contacts as required by the interlocks defined on the drawings or in the specifications.
 - 2. Control Power Transformer - 120 volt secondary, minimum 40 Volt Amps.

- G. The Contractor furnishing motor-operated equipment shall furnish a list of motor characteristics to the Electrical Contractor so that properly sized elements may be provided. The list shall include equipment identification by name and by number, the full load current, locked rotor current, voltage rating, and suggested service factor to compensate for operating duty cycle and ambient temperatures.
- H. Unless specifically noted otherwise, pilot controllers (aquastats, flow switches, pressure switches, etc.) shall be furnished and mounted by the Contractor furnishing the controlled equipment.
- I. Unless specifically noted otherwise, thermal wells for temperature control system sensors shall be provided by the Temperature Control Contractor and installed by the Plumbing Contractor or other contractor as indicated.
- J. Unless specifically noted otherwise, control valves shall be furnished and installed by the Plumbing Contractor or other contractor as indicated.
- K. Electrical Work For Plumbing Equipment: Electrical Contractor to wire all plumbing equipment furnished by this contractors in accordance with the following general provisions:
 - 1. Power wiring from panel to motor controllers, relays, etc., and from controller to motor terminals per equipment manufacturer's wiring diagram.
 - 2. Receive, unload, set and align all separately shipped motors. Adjust and align drive and adjust belt tension.
 - 3. Field lubricate all motors prior to initial operation of same.
 - 4. Install individual motor starters specifically called for to be furnished by other Contractors when not a factory pre-wired component.
- L. Plumbing Contractor shall provide the following:
 - 1. All equipment, motors, disconnect switches or control devices specifically called for.
 - 2. Automatic control and interlock wiring diagrams as called for in the specifications.
 - 3. Complete and accurate wiring diagrams to Electrical Contractor for all equipment requiring electrical power wiring including motor terminal connection diagrams.
 - 4. Adjustable motor bases and all bolts and nuts required for installation of base and motor.
 - 5. Supervision of Electrical Contractor in lubrication of motors to eliminate possibility of motor starting or operating without proper lubrication and control systems.

3.3 PROTECTION OF EQUIPMENT AND WORK

- A. This Contractor shall, at all times, protect and preserve all materials, supplies, equipment, piping, etc., from damage due to weather, corrosion, dirt, vandalism, theft, etc., and shall further provide all enclosures or special protection as indicated by circumstances.
- B. Should any of the materials, equipment, etc., be damaged as a result of his negligence, then this Contractor shall be held responsible for all such damage and costs incurred for repair or replacement.

3.4 CONSTRUCTION STAGING

- A. See schedule in Division 0 and Division 1. This Contractor shall cooperate with and coordinate with the Owner's Representative to plan and schedule the work to satisfy the schedule.

3.5 MAINTENANCE OF WORK AREAS

- A. During the project this Contractor shall maintain his work area in an organized manner, shall not allow debris to accumulate, and shall store equipment, tools and supplies in a manner which shall not cause interference with the activities of others engaged on the project.

- B. Open ends of pipe, equipment and specialties shall be kept properly closed during construction and installation so as to avoid contamination.

3.6 CLEANING AND CLEANUP

- A. Upon completion of this work, the Contractor shall clean all pipe, fixtures, and equipment. Contractor shall leave all work in a finished, clean, and satisfactory working condition.
- B. Each contractor shall be responsible for his own cleanup to a central location designated by the Owner and General Contractor. Contractor shall periodically remove all rubbish, crating, unused material, outfall, and any other debris created by him during the course of the work.

END OF SECTION 220000

RELEASE OF CADD FILES

The drawings prepared by SSC Engineering have been prepared using AUTOCAD 2013. Files for plan drawings prepared by SSC Engineering will be made available to the successful HVAC, plumbing, electrical and fire protection contractor by email; no other drawings will be released. The files will have background files bound in, borders and title blocks removed, and all notes, details, diagrams, and schedules removed. A release form must be signed. Utilization of these documents for the development of shop drawings and submittals does not relieve the contractor from any of his responsibilities herein.

Release form that must be signed:

As requested, SSC Engineering will provide _____ (name of contractor) with electronic CADD files of the requested (M, E, P, FP) floor or ceiling plans on the terms set forth below. While SSC is not required under its contract to provide or update these electronic files for this purpose, they are being made available as a convenience to the contractor and as a substantial time saver in the preparation of submittals for this project.

The files contain information through the date when the drawings were issued for bidding and may or may not contain information from the addenda. The company using these files shall be responsible for the coordination of the information contained therein with the Plans, Specifications and other Contract Documents. In the event of any ambiguity, discrepancy or conflict between the information within the electronic files and the Contract Documents, the Contract Documents shall be used.

SSC will not be responsible for any error or malfunction in the translation, interpretation or use of this electronic information once it has been provided to the contractor. SSC does not assume any responsibility arising out of the use or adaptation of the information contained in these files or the sufficiency of any drawings prepared based upon the information included within. By accepting these drawing files, the contractor agrees to hold the Engineer harmless with regard to any errors or omissions in the drawing files. Nothing included in this release shall modify any requirements or responsibilities of either party under their respective contracts.

Signing below indicates understanding and acceptance of these terms. Upon receipt of a signed letter or fax, SSC will release the electronic CAD files.

Project Name and Number: _____

Specific Drawings Request: _____

Acknowledged and Agreed:

Company Version of AutoCAD used

Name (Must be an officer of the Company) E-mail address

Title Maximum e-mail attachment size

Date

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SECTION 220010 - BASIC PLUMBING MATERIALS AND METHODS

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. All drawings and applicable provisions of Division 0 Bidding Requirements and Division 1 General Requirements apply to work of this Section.
- B. Section 220000 - Plumbing General Conditions.
- C. This section covers basic plumbing materials and methods for Plumbing work and applies to work of those sections.

1.2 SUBMITTALS

- A. This Contractor shall submit shop drawings on all material or equipment furnished by him or his Subcontractors. Manufacturer's technical product data and installation instructions shall be submitted on:
 - 1. All Supports
 - 2. Pipe Seals and Pipe Stands
 - 3. Sealants
 - 4. Pipe Markers

PART 2 - PRODUCTS

2.1 PRODUCT CRITERIA

- A. Material and equipment shall be the standard product of a manufacturer regularly engaged in the manufacture of the product for at least 5 years.
- B. Products shall be supported by a service organization which maintains an inventory of repair parts and is located within 100 miles of the jobsite.

2.2 MATERIALS AND STANDARDS

- A. All equipment and materials furnished by this Contractor shall be new, and where two or more items of the same kind are required, they shall be the product of the same manufacturer.
- B. All materials, equipment, operations, procedures and installation of all materials and equipment shall conform to:

ADA	Americans with Disabilities Act
ASME	American Society of Mechanical Engineers
UL	Underwriters' Laboratories, Inc.
NFPA	Applicable sections of the National Fire Protection Association
NEMA	National Electrical Manufacturers Association
OSHA	Occupational Safety and Health Administration
NEC	National Electrical Code
AMCA	Air Moving and Conditioning Association
ASHRAE	American Society of Heating, Refrigeration and Air Conditioning Engineers
ARI	Air Conditioning and Refrigeration Institute
ANSI	American National Standards Institute, Inc.
ASTM	American Society for Testing Materials
SMACNA	Sheet Metal and Air Conditioning Contractors' National Association
IPCEA	Insulated Power Cable Engineers Association
HEW	U.S. Department of Health, Education and Welfare
PDI	Plumbing and Drainage Institute
NSF	National Sanitation Foundation

IEEE Institute of Electrical and Electronic Engineers
AWWA American Water Works Association

- C. All materials used shall be applied in compliance with the manufacturer's recommendations. If a discrepancy occurs between the application of materials as called for on the drawings or in the specifications and the manufacturer's recommendations, this discrepancy shall be called to the Engineer's attention before materials are purchased or applied.

2.3 PREFABRICATED PIPE SEALS

A. Seals for Roof Penetrations:

1. Prefabricated pipe seals shall have a one piece spun aluminum base with a 5" high roof surface flange sloped for runoff. Unit shall have a PVC boot with graduated widths and adjustable stainless steel clamps. Unit shall withstand expansion, and vibration and shall fit pipe sizes from ½" through 10" be heavy-gage, galvanized steel curb with mitered and welded corners; 1-1/2-inch-thick
2. Equal products, complying with these specifications by the following manufacturers are acceptable:
 - a. Pate
 - b. Roof Products & Systems
 - c. Thycurb
 - d. Approved Equal

B. Seals for Floor or Foundation Wall Penetrations:

1. Mechanical Seal: Link-Seal or approved equal. A modular mechanical sealing assembly consisting of interlocking rubber links shaped to fill the annular space between the pipe and sleeve; corrosion-protected carbon steel bolts, nuts, and pressure plates. After the assembly is positioned in the sleeve, tightening the bolts shall cause the rubber links to provide a watertight seal between the pipe and the sleeve. Seal assembly shall be sized as recommended by the manufacturer. Provide sleeves of proper diameters.

2.4 FLASHING

- A. Metal Flashing: 26 gage galvanized steel.
- B. Lead Flashing: 5 lb/sq ft sheet lead for waterproofing; one lb/sq ft sheet lead for soundproofing.
- C. Flexible Flashing: 47 mil thick sheet butyl; compatible with roofing.
- D. Caps: Steel, 22 gage minimum; 16 gage at fire resistant elements.

2.5 MISCELLANEOUS MATERIALS

- A. Steel Plates, Shapes, and Bars: ASTM A 36. Interior applications shall be galvanized steel or black steel. Exterior applications shall be galvanized steel.
- B. Strut systems shall be painted steel equal to B-Line Systems or Unistrut. Where used in exterior applications, the materials shall be galvanized steel.

2.6 SLEEVES

- A. Exterior and Foundation Walls: All piping through exterior or foundation walls shall pass through schedule 40 galvanized steel sleeves which shall be large enough to allow for caulking material. No sleeves are permitted through concrete structural members unless indicated on the structural drawings or approved by the Engineer.

- B. Interior Walls and Partitions: All piping through interior walls and partitions that are fire rated shall pass through either schedule 40 black steel or 20 gauge galvanized steel sheet metal sleeves. Schedule 40 steel pipe sleeves must be used when required for structural purposes. Sleeves are not required for automatic control tubing.
- C. Floors: All piping through elevated floor slabs shall be provided with schedule 40 carbon steel pipe sleeves, extending 2 inches above floor except in finished areas. Sleeves in finished areas shall terminate flush with floor, and shall be schedule 40 carbon steel pipe.

2.7 BACKING & SEALANTS

- A. Backing and sealant for piping passing through floors, plaster ceilings, partition, and walls shall be as follows:
 - 1. Backing Material:
 - a. A pure ceramic fiber made of alumina-silica; "Cerafiber- FS" by Manville or equal.
 - b. Insulation: Glass fiber type, non- combustible.
 - 2. Sealant: Gun Grade. An 1-part modified polyurethane, gun applied, elastic sealant, "Dymonic" by Tremco, or Chem-Calk 900 by Bostik.
 - 3. Mechanical Seal: Link-Seal or approved equal. A modular mechanical sealing assembly consisting of interlocking rubber links shaped to fill the annular space between the pipe and sleeve; corrosion-protected carbon steel bolts, nuts, and pressure plates. After the assembly is positioned in the sleeve, tightening the bolts shall cause the rubber links to provide a watertight seal between the pipe and the sleeve. Seal assembly shall be sized as recommended by the manufacturer. Provide sleeves of proper diameters.
 - 4. Fire Retardant Sealants: Products used shall be U.L. Classified and approved for the application. Products shall produce non-toxic fumes and shall be PCB and asbestos free. Subject to compliance with requirements, provide fire retardant sealant products from one of the following:
 - a. "SpecSeal" by Specified Technologies Inc.
 - b. 3M
 - c. Chase Technology Corporation
 - d. Link-Seal
 - e. Pyro-Pac by Thunderline Corporation
 - f. "Fyre Seal" by Tremco
 - g. Pensil 100 by General Electric
 - h. Pensil by STI
 - i. "Flameseal" by G. S. Nelson Electric.

2.8 FIRE PROOFING ON STRUCTURE

- A. Where fire proofing is existing or has been applied to the structure by others and the work of this contractor damages or removes this fire proofing while making attachments to the structure, this contractor shall include cost to repair the fire proofing to its original condition.

2.9 LINTELS

- A. Unless otherwise indicated on plans, all lintels required for the support of building construction above pipes, equipment, etc., shall be furnished and installed by this Contractor.
- B. Lintels furnished shall be structural steel angles, channels, or tees of proper size and sections for the load being supported.

2.10 CUTTING

- A. All openings for pipes etc., shall be provided by this Contractor by means of sleeves or framed openings.
- B. Cutting shall be limited to the size necessary for working conditions. When cutting surfaces are difficult or costly to replace, such as marble, glazed tile, wood paneling, etc., this contractor shall obtain the Owner's approval in advance of the cutting and patching.
- C. Contractor shall be responsible for any cutting required for pipes, etc., if sleeves or openings are not properly provided. Under no circumstances shall any structural members, load bearing walls, or footings be cut without first obtaining written permission from the Structural Engineer. All cutting and patching shall be done at the expense of the contractor requiring the cutting.
- D. Prior to cutting or core drilling of structural concrete slabs, contractor shall locate steel reinforcing bars using x-ray or other approved methods. Location of holes shall be adjusted to locations that will not damage reinforcing bars; coordinate locations with the Structural Engineer.
- E. Where trenches are cut in the floor slab that contains structural reinforcing, reinforcing bars in the floor shall NOT be saw cut flush with the edge of the trench. See details on the structural drawings for retaining stubs of reinforcing bars (in both directions where this occurs) so they may be repaired and reinstalled as detailed by the structural engineer OR if not detailed on the structural drawings, contact the Structural Engineer before cutting begins to determine the course of action.
- F. Concrete for patching trenches in the floor slab shall be in accordance with Section 033000 (do not use the concrete specification in this section for patching structural concrete floor trenches.)

2.11 PATCHING

- A. Concrete or concrete block surfaces - Patch the opening with concrete, finished smooth with adjacent surface. Painting is the responsibility of the contractor doing the cutting and patching.
- B. Drywall or plastered surfaces - Patch with filler compound. Painting is the responsibility of the contractor doing the cutting and patching.
- C. Surfaces with finishing materials such as tiled, paneled, stone or marble surfaces - Patch the opening with cement or plaster to the underside of final finishing material. Final patching is the responsibility of the contractor doing the cutting and patching.

2.12 PIPING AND EQUIPMENT SYSTEMS MARKERS

- A. Markers shall be Allen Systems, Inc., W.H. Brady Co.- Signmark Div., or Industrial Safety Supply Co., Inc.
- B. Pipe banding shall consist of 1" wide single tape wrapped completely around the circumference of the pipe or insulation.
- C. All color coding shall comply with ANSI A13.1 1975.
- D. Pipe markers shall be manufacturer's standard pre-printed, semi-rigid plastic, snap-on type or vinyl, pressure-sensitive type with permanent adhesive.
- E. Valve tags shall be brass, plastic laminate, or plastic valve tags that are 1½" diameter or square. Indicate piping system abbreviation in ¼" high letters and sequenced valve numbers ½" high letters. Provide 5/32" hole for fastener. Provide manufacturer's standard solid brass or plated steel chain, or plated steel S-hooks of the sizes required for proper attachment of tags to valves.
- F. Equipment markers shall be manufacturer's standard laminated plastic type. Include the following, matching terminology on schedules as closely as possible: 1) Name and plan

number, 2) Equipment service. Provide approximate 2½" x 4" markers for control devices, dampers, and valves; and 4½" x 6" for equipment.

2.13 UNDERGROUND PIPING MARKERS

- A. Tape: Triple-laminate, consisting of aluminum foil, polyester film, and polyethylene, 6" wide.
- B. Colored background, black lettering, two lines wide, and 2" tall letters. Provide different color tape for each piping service.
- C. Acceptable Manufacturer, subject to compliance with requirements: Panduit Corporation.

2.14 CEMENT GROUT

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

2.15 CONCRETE

A. Reinforcing Materials

- 1. Reinforcing and Joint Dowel Bars: Deformed steel bars, ASTM A 615, Grade 40, unless otherwise indicated. Furnish metal expansion caps for one end of each dowel bar. Design caps with one end closed and a minimum length of 3" to allow bar movement of not less than 1" unless otherwise indicated.
- 2. Welded Wire Mesh: Welded plain cold-drawn, ASTM A 185. Furnish in flat sheets, not rolls.

B. Concrete Materials

- 1. Portland Cement: ASTM C 150, Type II with tricalcium aluminate content of less than 5%.
- 2. Coarse aggregate shall be clean, hard, durable, uncoated limestone conforming to ASTM C-33. Use size "67" throughout with no more than one percent flint and chert by weight (i.e., when the amount of flint and chert are added together, this quantity shall be less than 1% of the coarse aggregate weight).
- 3. Water: Potable.
- 4. Air-Entraining Admixture: ASTM C 260.
- 5. Water-Reducing Admixture: ASTM C 494, Type A.
- 6. Membrane-Forming Curing Compound: ASTM C 309, Type I unless other type acceptable to Engineer.

C. Proportioning and Design of Mixes

- 1. Prepare design mixes for concrete in accordance with applicable provisions of ASTM C 94. Use an independent testing facility for preparing and reporting proposed mix designs. The testing facility may be the same as used for field quality control testing.
- 2. Submit written reports to Engineer of the proposed mix at least 15 days prior to start of work. Do not begin concrete production until mixes have been reviewed by Engineer.
- 3. Design mixes to provide normal weight concrete with the following properties: 3500 psi 28-day compressive strength.
- 4. Adjustment to Concrete Mixes: Mix design adjustments may be requested by Contractor when characteristics of materials, job conditions, weather, test results, or other circumstances warrant, at no additional cost to Owner and as accepted by Engineer. Laboratory test data for revised mix design and strength results must be submitted to and accepted by Engineer before using in work.

D. Admixtures

1. Use air-entraining admixture. Add air-entraining admixture at manufacturer's prescribed rate to result in concrete at point of placement having air content within following limits: 2% to 4% air.
2. Use admixtures for water-reducing and set-control in strict compliance with manufacturer's directions.

E. Slump Limits

1. Proportion and design mixes to result in concrete slump at point of placement at not less than 1" and not more than 4".

2.16 MISCELLANEOUS MATERIALS

- A. Powder-Actuated Drive-Pin Fasteners: Powder-actuated-type, drive-pin attachments with pull-out and shear capacities appropriate for supported loads and building materials where used. Acceptable manufacturers: Gunnebo Fastening Corp., Hilti, Inc., ITW Ramset/Red Head., or Masterset Fastening Systems, Inc.
- B. Mechanical-Anchor Fasteners: Insert-type attachments with pull-out and shear capacities appropriate for supported loads and building materials where used.
- C. Drilled Inserts: Self-drilling expansion shields and machine bolt expansion anchors: permitted in concrete not less than four inches thick. Applied load shall not exceed one-fourth the proof test load listed by the manufacturer. Phillips Red-head, wedge anchors or equal.
- D. Structural Steel: ASTM A 36/A 36M, steel plates, shapes, and bars, black and galvanized.
- E. Bolts and nuts, except as required for piping applications, shall be carbon steel in accordance with ASTM A 307 and shall be cadmium-plated, zinc-coated steel, or Type 304 stainless steel. Each bolt shall be provided with neoprene and cadmium-plated steel washers under the heads.

PART 3 - EXECUTION

3.1 EQUIPMENT SUPPORTS

- A. This Contractor shall furnish and install all bases, concrete inserts, anchor bolts, and structural steel to support the equipment, piping, etc., furnished and installed by him. Any equipment legs, guy wire, anchors, etc., or any pipe that passes through the roof shall be sealed by a method approved by the Architect.
- B. Provide concrete housekeeping pads a minimum of 3-1/2" high, unless detailed otherwise, under all equipment, heaters, tanks, etc., in the equipment rooms where piping containing water is located. The horizontal distance from the equipment support to the edge of the pad shall be at least 2", but not more than 4". All exposed edges of each pad shall be 1/2" chamfer and all surfaces shall be smooth. The housekeeping pads shall be reinforced with wire mesh and shall be doweled to the floor.
- C. Plywood backboards shall be provided for all wall mounted equipment and controls (with the exception of surface mounted cabinets). Backboards shall be constructed of 3/4" plywood grade B-C. The "B" face shall be exposed. All boards shall be painted before attachment of any surface equipment.

3.2 PIPE PROTECTION DURING CONSTRUCTION

- A. Protect pipe interiors with plastic plugs or plastic sheeting during construction to protect from moisture, construction debris and dust, and other foreign materials.

3.3 BUILDING OPENINGS FOR ADMISSION OF EQUIPMENT

- A. This Contractor shall ascertain from his examination of the architectural and structural drawings whether any special temporary openings or supports in the building for the admission of apparatus furnished under the Contract will be necessary.
- B. The Contractor shall pay all cost of making such openings or providing such supports.

3.4 CUTTING AND PATCHING

- A. All cutting that may be necessary for the installation of the work and any required patching that results therefrom shall be done by the proper trade involved and shall be included in the work of this Contractor. Columns, beams, girders or other structural members shall not be cut.
- B. No openings shall be cut without written approval of the Owner's Representative.

3.5 ROOF PENETRATIONS

- A. Any penetration of the roof shall be provided with an appropriate roof penetration apparatus as herein described.
- B. Cutting of the metal decking for all unframed openings is the responsibility of the Contractor requiring the opening. Cutting, patching and flashing of roof shall be the responsibility of the Contractor needing the opening. Roof cutting and patching shall be coordinated with the roof installer. The original roof warranty shall be maintained.
- C. When penetrations occur in new roofs, the installation of the roofing materials to the connection and the waterproofing of the roofing at the roof penetration apparatus shall be by the General Contractor.
- D. When penetrations occur in an existing roof, the penetrations shall be made in the presence of the Owner, roof installer or General Contractor. If the penetration reveals any indication of wet or damaged roof, insulation, subroof or structure, all roof work by this contractor shall stop and the Owner shall be notified in writing as to the conditions found.
- E. At all times during construction, this Contractor shall provide temporary covers, enclosures, etc., required at roof openings to prevent injury to personnel and to prevent outdoor elements (water, wind, etc.) from entering the opening.

3.6 FLASHING

- A. Provide flexible flashing and metal counter flashing where piping penetrates weather or waterproofed walls, floors, and roofs.
- B. Provide acoustical lead flashing around pipes penetrating equipment rooms, installed in accordance with manufacturer's instructions for sound control where indicated on the drawings.

3.7 ACCESS

- A. All control devices, equipment, specialties, valves, plumbing traps, etc., shall be so located as to provide for easy access and proper clearance for operation, maintenance, and repair.
- B. Where items are located above non-accessible ceilings, in or behind walls, or in other similar concealed areas, contractor requiring access shall provide access panels.
- C. Contractor shall not provide access panel to equipment above drywall ceilings without written permission of Architect/Engineer.

3.8 PAINTING

- A. All pieces of plumbing equipment shall be factory finished machinery-grey, or standard color as furnished by the manufacturer, or as called for in the technical section. Scratches shall be touched up in the field after equipment is installed with a paint which matches the original color.
- B. This Contractor shall paint the following items:
 - 1. Items specified under "Demolition and Restoration of Facilities", Section 220000 shall be painted.
 - 2. No other painting is required unless specifically called for on the plans.

3.9 SLEEVES AND ESCUTCHEONS

- A. This Contractor shall be responsible for locating, placing and maintaining in proper position all sleeves required for the work. In the event that failure to do so requires cutting and patching of finished work, it shall be done at this Contractor's expense.
- B. Sleeves in foundation walls or footings shall be as detailed on the plans.
- C. Sleeves through floors shall extend 2" above finished floors.
- D. Sleeves in foundation walls or footings shall be as detailed on the plans. No sleeves, other than those shown on the drawings, shall be installed through footings or foundations without obtaining approval from the Structural Engineer.
- E. Where pipes pass through existing concrete floors or walls, the hole shall be core drilled. Sleeves shall be grouted in place.
- F. Where pipes pass through existing foundation walls or concrete walls below grade, the hole shall be core drilled.
- G. Where pipes pass through fire walls, plaster or drywall shall be applied around the outside of the sleeve to seal between sleeve and wall.
- H. The internal diameter of sleeves shall be 1" to 2" larger in diameter than the outside diameter of the pipe or pipe insulation. Insulation shall be continuous through sleeve.
- I. The space between the pipes and sleeves shall be sealed as follows:
 - 1. Exterior walls above grade: Caulking shall be applied to a minimum 3" total depth. Sealant shall then be applied on both sides of the wall opening to a minimum ½" in depth, finishing flush with the wall.
 - 2. Exterior walls below grade: The space between the pipe and the core drilled hole or sleeve shall be completely filled. Provide mechanical seal and install in accordance with manufacturer's instructions.
 - 3. Openings in floors or roofs: Caulking shall be applied from the upper side to a minimum depth of 3" recessed ½" below the finished floor or roof. This ½" recess shall then be filled with sealant to flush with finished floor or roof.
 - 4. Interior Non-Rated Walls/Partitions:
 - a. Concealed locations: Limit the size of the space between the wall and the outside of the pipe to 1" maximum. The space between the duct or pipe and the wall may be left open.
 - b. Visible Locations: Openings between pipe and wall shall be covered with a chrome plated escutcheon.
 - 5. Interior Fire-Rated Walls/Partitions/Floors/Ceilings:
 - a. Where pipes pass through rated assemblies (walls, floors, ceilings, etc), the pipes shall be sealed per approved methods to meet U.L. Classifications, see the details on the drawings.

J. Shop drawings shall be submitted on all fire resistant materials and methods.

3.10 PIPING AND EQUIPMENT SYSTEMS MARKERS

A. All piping shall be identified with color coded banding. This color banding shall be applied at the following locations:

1. Adjacent to each valve.
2. At each branch or riser take-off.
3. Where piping goes through floors, walls or ceilings.
4. On horizontal pipe runs at 80 foot intervals, but not less than one per room.

B. All color coding shall comply with ANSI A13.1 1975.

C. Pipe marking shall also include printed markers indicating the service and flow arrows indicating direction of flow.

D. Provide valve tag on every valve, cock and control device in each piping system; exclude check valves, valves within factory-fabricated equipment units, plumbing fixture faucets, convenience and lawn-watering hose bibs, and shut-off valves at plumbing fixtures. List each tagged valve in valve schedule for each piping system and include valve schedule in O & M Manual.

E. Provide equipment markers on all scheduled equipment. Provide manufacturer's standard laminated plastic markers. Provide approximate 2½" x 4" markers for control devices, dampers, and control valves; and 4½" x 6" for equipment. Include the A) Name and plan number and B) Equipment service, matching terminology on schedules as closely as possible.

3.11 LINES AND GRADES

A. This Contractor shall set all construction stakes required for establishing the lines and grades for underground piping and equipment. He shall assume full responsibility for dimensions and elevations measured from such stakes and reset all stakes displaced or moved while the work is in progress.

B. This Contractor shall coordinate all elevations and dimensions shown on the drawings with the General Contractor and other subcontractors and report any discrepancies to the Engineer. No work shall be installed until all discrepancies have been resolved.

3.12 EXCAVATION

A. Excavate, as necessary, for all underground piping as indicated on drawings and/or necessary.

B. Material to be excavated shall be non-classified and shall include all earth or other materials encountered. The contract price shall cover the removal of all such material to the depth and extent indicated on the drawings and/or herein specified.

C. Unless otherwise shown, provide separate trenches for each utility. Lay all piping in open trench except when the Engineer gives written permission for tunneling.

D. Excavation of trenches from surface to top of pipe shall be kept to a minimum but shall be of sufficient width for proper installation of the work. The excavation from bottom of trench to top of pipe shall be not more than twenty (20) inches wider than the outside diameter of the pipe to be laid therein, or where depth of backfill over pipe exceeds ten (10) feet, width of trench at top of pipe shall not exceed 4/3 of nominal diameter of pipe, plus eight inches. For larger pipe, the bottom of trench shall be shaped to conform to the lower half of pipe, and recesses four (4) inches in length shall be cut for pipe bells as required, to give uniform bearing making certain that the pipe is properly supported throughout. Provide ample excavation under and around all pipe joints to permit proper caulking, sealing, welding or thread tightening.

- E. Trench Bottoms: Excavate and shape trench bottoms to provide uniform bearing and support of pipes. Shape subgrade to provide continuous support for bells, joints, and barrels of pipes and for joints, and fittings. Remove projecting stones and sharp objects along trench subgrade.
- F. All excavations shall be properly protected by the necessary bracing and timbers to prevent any cave-ins or injury to adjacent improvements and workmen. The sides of all trenches shall be securely held by bracing or sheeting, which bracing and sheeting shall not be removed until the level of the backfill has reached the point where such removal can be safely carried out. The thickness of the sheeting and the dimensions of the cross-braces, shoes, etc., to be used by this Contractor shall be satisfactory to protect properly the sides of the trench and to prevent injurious cave-ins or erosions.
- G. Grading in the area of the excavation shall be such that it shall prevent surface water from flowing into the excavated trench. Under no circumstances lay, pipe or install appurtenances in water. Keep trench free from water until pipe joint materials have hardened. The presence of ground water in the soil or the necessity of sheeting or bracing trenches shall not constitute a condition for which an increase may be made in the contract price.
- H. Where underground pipes cross, the trench of the lower pipe shall be backfilled with sharp sand, well tamped, to provide bed for higher pipe. Pipes which run parallel and at different levels shall be adequately separated to provide firm bedding for the pipes. Sewer, water and gas pipes shall be run in completely separate trenches, and at least three (3) feet apart at center lines, except as approved by the Engineer. Whenever possible, water pipes shall be installed above sewer pipes and gas piping above water and sewer pipes.

3.13 BEDDING AND BACKFILLING

- A. All excavations by this Contractor shall be promptly backfilled.
- B. Trenches for sewers, piping, etc., shall be backfilled for a depth of at least six (6) inches over the top of pipe with sand. Bedding shall be provided in the form of six (6) inches of sand under the pipes. It shall be carefully deposited in uniform layers not exceeding six (6) inches in depth. Each layer shall be carefully and solidly tamped with appropriate tools in such a manner as to avoid injuring or disturbing the completed work. Backfill shall be placed beneath haunches of piping and thoroughly compacted to prevent lateral displacement.
- C. Backfill from 0'-6" above the top of the pipe to the surface shall be with clean on-site materials. Large rocks (over 3/4") or other materials shall be removed. Backfill shall be compacted. Compaction shall be at least 90% measured by the Proctor Test (ASTM D 698). Backfill shall be constructed in uniform layers of approximately 6 to 8 inches in loose dimension. Each layer shall be compacted.
- D. Backfill from 0'-6" above the top of the pipe, sewer, conduit, etc., to the bottom side of sidewalks, parking areas, streets, floor slabs or other paved areas shall be with crushed stone or gravel with maximum size of 1/2".
- E. Do not place fill during rainy or freezing weather or on subgrade softened by rain or thawing action. When filling is interrupted by weather, top surface of fill shall be scarified, recompact, and tested before placing new fill. Each day's fill shall be constructed with a slope that will ensure free and rapid drainage.
- F. If the soils are too wet during construction of the fill, dry by discing or other similar methods. If the soils are too dry during construction of the fill, add water in such a way as to permit uniform dispersion of the moisture through the layer to be compacted.
- G. The Owner shall have the option of requiring compaction tests. If the material tested does not meet these tests, this Contractor shall bear the cost of retesting and remedial work.

END OF SECTION 220010

SECTION 220020 – PLUMBING SEISMIC RESTRAINTS

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Provide seismic restraints as indicated for each type of equipment and for piping systems. This section applies to:
 - 1. Plumbing Systems
- B. Scope of Work
 - 1. The following items of equipment shall have flexible pipe connectors installed at the piping connection to the items:
 - a. Water pumps where indicated on the plans.
 - 2. Flexible pipe connectors are specified in the appropriate piping section of these specifications.
 - 3. Where noted on the equipment schedule, Plumbing equipment shall be mounted on vibration isolators to prevent the transmission of vibration and mechanically transmitted sound to the building structure. Vibration isolators shall be selected in accordance with the weight distribution to produce reasonably uniform deflections.
 - 4. All isolators and isolation materials shall be of the same manufacturer and shall be selected and certified using published or factory certified data. Any variance or non-compliance with these specification requirements shall be corrected by the contractor in an approved manner.
 - 5. Seismic control manufacturer shall have the following responsibilities:
 - a. Determine seismic restraint sizes and locations.
 - b. Provide piping and equipment seismic restraints as scheduled or specified.
 - c. Provide installation instructions and drawings.
 - d. Provide calculations to determine restraint loads resulting from seismic forces in accordance with the Local Building Code (see below), governing codes, project seismic requirements. Seismic calculations shall be certified by a licensed engineer, experienced in the design of restraints for flexibly mounted equipment.
 - 6. Friction from gravity loads shall not be considered resistance to seismic forces.
 - 7. All piping shall to be restrained per the latest revision of SMACNA "Seismic Restraint Manual Guidelines for Mechanical Systems", Second Edition, 1998. At a minimum, the seismic restraint manufacturer shall provide documentation on maximum restraint spacing for various cable sizes and anchors, as well as 'worst case' reaction loads at restraint locations.

1.2 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- B. Section 220000 - Plumbing General Conditions.
- C. Section 220010 - Basic Plumbing Material and Methods.

1.3 REFERENCES

- A. NFPA Standard 13
- B. SMACNA (Sheet Metal and Air Conditioning Contractors National Association, Inc.) "Seismic Restraint Manual Guidelines for Mechanical Systems", Second Edition, 2008.

1.4 DEFINITIONS

- A. IBC: International Building Code.
- B. OSHPD: Office of Statewide Health Planning and Development for the State of California.

1.5 PERFORMANCE REQUIREMENTS

- A. Seismic-Restraint Loading:
 - 1. Site Class as Defined in the IBC: C.
 - 2. Assigned Occupancy Category or Building Category as Defined in the IBC: IV.
 - a. Component Importance Factor: See Schedule on drawings.
 - b. Component Response Modification Factor: See Schedule on drawings.
 - c. Component Amplification Factor: See Schedule on drawings.
 - 3. Design Spectral Response Acceleration at Short Periods (0.2 Second): 0.164.
 - 4. Design Spectral Response Acceleration at 1-Second Period: 0.121.
 - 5. Seismic Design Category: C.

1.6 SUBMITTALS

- A. Product Data: For the following:
 - 1. Include rated load, rated deflection, and overload capacity for each vibration isolation device.
 - 2. Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of seismic-restraint component used.
 - a. Tabulate types and sizes of seismic restraints, complete with report numbers and rated strength in tension and shear as evaluated by OSHPD or an agency acceptable to authorities having jurisdiction.
 - b. Annotate to indicate application of each product submitted and compliance with requirements.
 - 3. Interlocking Snubbers: Include ratings for horizontal, vertical, and combined loads.
- B. Delegated-Design Submittal: For 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 their preparation.
 - 1. Riser Supports: Include riser diagrams and calculations showing anticipated expansion and contraction at each support point, initial and final loads on building structure, spring deflection changes, and seismic loads. Include certification that riser system has been examined for excessive stress and that none will exist.
 - 2. Seismic Restraint Details:
 - a. Design Analysis: To support selection and arrangement of seismic restraints. Include calculations of combined tensile and shear loads.
 - b. Details: Indicate fabrication and arrangement. Detail attachments of restraints to the restrained items and to the structure. Show attachment locations, methods, and spacings. Identify components, list their strengths, and indicate directions and values of forces transmitted to the structure during seismic events. Indicate association with vibration isolation devices.

- c. Preapproval and Evaluation Documentation: By OSHPD or an agency acceptable to authorities having jurisdiction, showing maximum ratings of restraint items and the basis for approval (tests or calculations).
 - C. Coordination Drawings: Show coordination of seismic bracing for HVAC piping and equipment with other systems and equipment in the vicinity, including other supports and seismic restraints.
 - D. Welding certificates.
- 1.7 QUALITY ASSURANCE
- A. Comply with seismic-restraint requirements in the IBC unless requirements in this Section are more stringent.
 - B. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
 - C. Seismic-restraint devices shall have horizontal and vertical load testing and analysis and shall bear anchorage preapproval OPA number from OSHPD or preapproval by another agency acceptable to authorities having jurisdiction, showing maximum seismic-restraint ratings. Ratings shall be based on independent testing. If preapproved ratings are not available, submittals shall be based on independent testing. Calculations (including combining shear and tensile loads) to support seismic-restraint designs must be signed and sealed by a qualified professional engineer.

PART 2 - PRODUCTS

2.1 SEISMIC-RESTRAINT DEVICES

- A. Manufacturer and model number given are intended to establish desired type, quality and performance. Equivalent products of the following manufacturers are equally acceptable:
 - 1. Amber/Booth Company, Inc.
 - 2. California Dynamics Corporation.
 - 3. Cooper B-Line, Inc.; a division of Cooper Industries.
 - 4. Hilti, Inc.
 - 5. Kinetics Noise Control.
 - 6. Loos & Co.; Cableware Division.
 - 7. Mason Industries.
 - 8. TOLCO Incorporated; a brand of NIBCO INC.
 - 9. Unistrut; Tyco International, Ltd.
- B. General Requirements for Restraint Components: Rated strengths, features, and applications shall be as defined in reports by OSHPD or an agency acceptable to authorities having jurisdiction.
 - 1. Structural Safety Factor: Allowable strength in tension, shear, and pullout force of components shall be at least 4 times the maximum seismic forces to which they will be subjected.
- C. Snubbers: Factory fabricated using welded structural-steel shapes and plates, anchor bolts, and replaceable resilient isolation washers and bushings.
 - 1. Anchor bolts for attaching to concrete shall be seismic-rated, drill-in, and stud-wedge or female-wedge type.
 - 2. Resilient Isolation Washers and Bushings:
 - 3. Oil- and water-resistant neoprene.
 - 4. Maximum 1/4 inch air gap and minimum 1/4-inch thick resilient cushion.

- D. Specification SB: Spring type isolators shall be free standing and laterally stable and complete with 1/4 inch neoprene acoustical friction pads or neoprene cup between the spring and the base plate. All mountings shall have leveling bolts. Spring diameters shall be no less than 0.8 of the compressed height of the spring at rated load. Springs shall have a minimum additional travel to solid equal to 50% of the rated deflection. Submittals shall include spring diameters, deflections compressed spring height and solid spring height. A steel housing shall be included to resist motion due to earthquake loads. A minimum clearance of 1/4 inch shall be maintained around restraining bolts and between the housing and the spring so as not to interfere with the spring action. The housing shall be out of contact during normal operations. Mountings used out of doors shall be hot dipped galvanized. Mounting shall be SSLFH or SLR as manufactured by Mason Industries, Inc.
- E. Specification SC: Restraint Cables:
1. ASTM A 603 galvanized for interior locations and ASTM A 492 stainless for outdoor locations -steel cables with end connections made of galvanized/stainless steel assemblies with thimbles, brackets, swivel, and bolts designed for restraining cable service; and with a minimum of two clamping bolts for cable engagement. Accessories shall be the same material as the cable. Mason Industries, Type SCB Seismic Slack Cables and Type SRC Seismic Rod Clamps.
 2. Strut System: MFMA-3, shop or field-fabricated support assembly made of slotted steel channels (struts), 1-5/8 wide, in varying lengths and combinations to meet load capacities, with accessories for attachment to braced component at one end and to building structure at the other end and other matching components; and rated in tension, compression, and torsion forces. 12 gage channels unless otherwise indicated in the approved submittals. Cooper B-Line model B22 strut systems, pipe hangers, and accessories.
- F. Hanger Rod Stiffener: Steel tube or steel slotted-support-system sleeve with internally bolted connections or reinforcing steel angle clamped to hanger rod. Mason Industries Seismic Rod Clamps or B Line SC-228 or SC-UB Hanger Rod Stiffener.
- G. Specification SG: Seismic Grommets. Resilient Isolation Washers and Bushings. One-piece, molded, oil- and water-resistant neoprene, with a flat washer face. The grommets shall be used with a steel washer between the bolt head (or nut if studs are used) and the grommet face. All anchor bolts shall be tightened until there is obvious grommet distortion and the bolt is torqued to 80% of allowable. In no case, shall the anchor bolt torque be less than 50% of the allowable. Mason Industries, Inc. Type HG.
- H. Specification SAB: Seismic Anchor Bolts.
1. Mechanical Anchor Bolts: Drilled-in and stud-wedge or female-wedge type in zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488. Minimum length of eight times diameter. Mason Industries, Inc. Type SAB.
 2. Adhesive Anchor Bolts: Drilled-in and capsule anchor system containing polyvinyl or urethane methacrylate-based resin and accelerator, or injected polymer or hybrid mortar adhesive. Provide anchor bolts and hardware with zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488. Mason Industries, Inc. Type SAA.

2.2 FACTORY FINISHES

- A. Finish: Manufacturer's standard paint applied to factory-assembled and -tested equipment before shipping.
1. Powder coating on springs and housings.

2. All hardware shall be galvanized. Hot-dip galvanize metal components for exterior use except as otherwise indicated.
3. Baked enamel or powder coat for metal components on isolators for interior use.
4. Color-code or otherwise mark vibration isolation and seismic/wind control devices to indicate capacity range.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and equipment to receive seismic control devices for compliance with requirements for installation tolerances and other conditions affecting performance.
- B. Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations before installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLICATIONS

- A. Multiple Pipe Supports: Secure pipes to trapeze member with clamps approved for application.
- B. Hanger Rod Stiffeners: Install hanger rod stiffeners where required to prevent buckling of hanger rods due to seismic forces.
- C. Strength of Support and Seismic-Restraint Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static and seismic loads within specified loading limits.

3.3 SEISMIC-RESTRAINT DEVICE INSTALLATION

- A. Comply with requirements in Section 220010 for installation of roof curbs, equipment supports, and roof penetrations.
- B. Equipment Restraints:
 1. Install resilient bolt isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inch.
 2. Install seismic-restraint devices using methods approved by the manufacturer, the Engineer and the approved submittals for the component.
 3. Install bushing assemblies for anchor bolts for floor-mounted equipment, arranged to provide resilient media between anchor bolt and mounting hole in concrete base.
 4. Install bushing assemblies for mounting bolts for wall-mounted equipment, arranged to provide resilient media where equipment or equipment-mounting channels are attached to wall.
- C. Piping Restraints:
 1. Comply with requirements in MSS SP-127 and NFPA 13.
 2. Space lateral supports and longitudinal supports at no more than the maximum of spacing indicated on the drawings or the local building code.
 3. Brace a change of direction as indicated on the drawings or the local building code.
 4. Install cables so they do not bend across edges of adjacent equipment or building structure.
 5. Cables shall be installed with sufficient slack to avoid short circuiting the vibration isolators. Attachment brackets at each end of the cable shall permit free cable movement in all directions up to a 45-degree misalignment. Protective thimbles shall be used at sharp connection points. Attachment bolts and anchors shall exceed the design load of the wire cable by a minimum of 50 per cent. Single sided "C" beam clamps shall

not be allowed. Wire rope connectors shall be approved by the wire rope manufacturer. Vertical suspension rods shall be braced to avoid buckling due to up forces.

D. Attachment to Structure:

1. Attachments shall be as indicated on the drawings and the approved submittals. If specific attachment is not indicated, anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or at concrete members.
2. Provide restraint attachment plates cast into housekeeping pads, concrete inserts, double sided beam clamps, etc. in accordance with the requirements of the seismic restraint vendor's calculations.
3. Capacity for concrete inserts used for support attachment shall not exceed the combination of gravity and seismic loads on the support.

E. Drilled-in Anchors:

1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or drilling. Notify the Architect, Engineer, and Structural Engineer if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.
2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
4. Adhesive Anchors: Clean holes to remove loose material and drilling dust prior to installation of adhesive. Place adhesive in holes proceeding from the bottom of the hole and progressing toward the surface in such a manner as to avoid introduction of air pockets in the adhesive.
5. Set anchors to manufacturer's recommended torque, using a torque wrench.
6. Install zinc-coated steel anchors for interior and stainless-steel anchors for exterior applications.

3.4 ACCOMMODATION OF DIFFERENTIAL SEISMIC MOTION

- A. Install flexible connections in piping where they cross seismic joints, where adjacent sections or branches are supported by different structural elements, and where the connections terminate with connection to equipment that is anchored to a different structural element from the one supporting the connections as they approach equipment. Comply with requirements in Section 220400 Plumbing Piping Systems for piping flexible connections.

3.5 ADJUSTING

- A. Adjust isolators on piping after piping system is at operating weight.
- B. Adjust limit stops on restrained spring isolators to mount equipment at normal operating height. After equipment installation is complete, adjust limit stops so they are out of contact during normal operation.
- C. Adjust active height of spring isolators.
- D. Adjust restraints to permit free movement of equipment within normal mode of operation.

END OF SECTION 220020

SECTION 220400 – PLUMBING SYSTEMS

PART 1 - GENERAL

1.1 SCOPE

- A. Work under the Plumbing Contract shall include, but is not limited to, all labor, materials, equipment, tools, controls, fees, etc., required to install, test, and start-up the systems described below and/or shown on the contract drawings.
 - 1. New Plumbing Fixtures.
 - 2. New Plumbing Specialties.
 - 3. New Water Heaters.
 - 4. New Plumbing Piping Insulation.
 - 5. New Domestic Hot and Cold Water Piping.
 - 6. New Sanitary Waste Piping and Vent Piping.
 - 7. Insulation for Plumbing piping and equipment requiring insulation.
 - 8. Any miscellaneous items required by applicable plumbing or building codes to meet improvements noted in plans or in these specifications herein.
 - 9. Any miscellaneous or customary items required to provide acceptable performance of the fixtures and systems specified in the plans and in these specifications.
 - 10. Installation or final connections of Owner furnished equipment as indicated on the drawings.
- B. The drawings are generally diagrammatic. Unless specifically shown, the drawings shall not be scaled for positioning of piping, fixtures, or equipment. This Contractor shall coordinate his work with the Architectural drawings and with all other trades in regard to placement of facilities. Contractor shall refer to architectural and structural plans for building construction and dimensions. Refer to architectural "Room Finish Schedules" for material and finish of walls, floors and ceiling so proper roughing-in may be provided.
- C. All plumbing work shall be in accordance with the local plumbing code, the requirements of the Building Code and the Seismic requirements defined in Section 220020 and with seismic details on drawings. If any of these documents are in conflict with the local code authority, the discrepancy shall be noted by the Contractor to the Engineer prior to initiating any work.
- D. All permits and inspection fees required to do this work shall be paid for by Plumbing Contractor. At the completion of the work, the Contractor shall furnish a certificate of approval showing that his work has been approved and accepted by the proper inspection authorities.
- E. Contractor shall be responsible for utility connections.
- F. Excavate for all underground work that requires excavation. See Section 220010 of this specification for excavation and backfill requirements.

1.2 RELATED DOCUMENTS

- A. All drawings and applicable provisions of Division 0 Bidding Requirements and Division 1 General Requirements apply to work of this Section.
- B. Section 220000 - Plumbing General Conditions.
- C. Section 220010 - Basic Plumbing Materials and Methods.
- D. Section 220020 - Seismic Restraints.
- E. Section 220410 - Plumbing Equipment.
- F. Section 220420 - Plumbing Fixtures and Trim.

1.3 EQUIPMENT FURNISHED BY OTHERS

- A. Where specifically indicated, some items of equipment will be furnished by the Owner or under other Divisions of these specifications.

- B. Unless specifically noted otherwise for the items furnished by others, this Contractor shall receive, locate, set in place, rough-in and make final connections to all items requiring plumbing connections.
- C. Unless specifically noted otherwise, for the items furnished by others, this Contractor shall furnish and install all piping, stops, traps and accessories required to make final connection.

1.4 FIXTURES FURNISHED BY OTHERS

- A. Where specifically indicated on the plans, sinks, disposals, etc., will be furnished and set in place by others. This Contractor shall furnish:
 - 1. P-trap
 - 2. Angle Stop Valves.
- B. This Contractor shall receive and install these items and make final connections.

1.5 SUBMITTALS

- A. This Contractor shall submit shop drawings on all material or equipment furnished by him or his Subcontractors. Manufacturer's technical product data and installation instructions shall be submitted on:
 - 1. All Plumbing Fixtures
 - 2. Floor Drain
 - 3. All Plumbing Equipment
 - 4. Domestic Water Heaters
 - 5. Valves and Piping Specialties
 - 6. List of all proposed piping material and its intended use.
 - 7. Insulation: Submit schedule showing manufacturer's product number, k-value, thickness, and furnished accessories for each system requiring insulation.
 - 8. Hangers and Supports: Submit schedule showing Manufacturer's figure number, size, location, and features for each hanger and support.
 - 9. Water system pre and post testing per ASHRAE 188-2015.

1.6 QUALITY

- A. Comply with the provisions of the following:
 - 1. Manufacturers Standardization Society of the Valve and Fittings Industry (MSS)
Compliance: Comply with the various MSS Standard Practices referenced.
- B. References

<ul style="list-style-type: none"> 1. ASHRAE 188-2015 2. ASME B16.18 3. ASME B16.22 4. ASME B16.29 5. ASTM A 74 6. ASTM A 518 7. ASTM A 888 8. ASTM B 32 9. ASTM B 88 10. ASTM B 306 11. ASTM B 813-2010 12. ASTM B 828 	<ul style="list-style-type: none"> Legionellosis: Risk Management for Building Water System Cast Copper and Copper Alloy Solder Joint Pressure Fittings Wrought Copper and Copper Alloy Solder Joint Pressure Fittings Wrought Copper and Wrought Copper Alloy Solder Joint Drainage Fittings - DWV Cast Iron Soil Pipe and Fittings Corrosion-Resistant High-Silicon Iron Castings Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications Solder Metal Seamless Copper Water Tube Copper Drainage Tube (DWV) Liquid and Paste Fluxes for Soldering of Copper and Copper Alloy Tube.) Making Capillary Joints by Soldering of Copper and Copper Alloy
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		Tube and Fittings
13.	ASTM C 76	Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe
14.	ASTM C 443	Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets
15.	ASTM C 564	Rubber Gaskets for Cast Iron Soil Pipe and Fittings
16.	ASTM A 518	High Silicon Content Cast Iron Pipe and Fittings
17.	ASTM D 1784	Rigid Poly Vinyl Chloride Compounds and Chlorinated Poly Vinyl Chloride Compounds
18.	ASTM D 1785	Poly Vinyl Chloride Plastic Pipe, Schedules 40, 80, and 120
19.	ASTM D 2241	Poly Vinyl Chloride Pressure-Rated Pipe (SDR Series)
20.	ASTM D2447	Polyethylene (PE) Plastic Pipe, Schedule 40 and 80
21.	ASTM D 2464	Threaded Poly Vinyl Chloride Plastic Pipe Fittings, Schedule 80
22.	ASTM D 2466	Poly Vinyl Chloride Plastic Pipe Fittings, Schedule 40
23.	ASTM D 2467	Socket-Type Poly Vinyl Chloride plastic Pipe Fittings, Schedule 80
24.	ASTM D 2564	Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems
25.	ASTM D 2657	Heat-Joining Polyolefin Pipe and Fittings
26.	ASTM D 2661	Acrylonitrile-Butadiene-Styrene (ABS) Schedule 40 Plastic Drain, Waste, and Vent Pipe and Fittings
27.	ASTM D 2665	Poly(Vinyl Chloride) (PVC) Plastic Drain, Waste, and Vent Pipe and Fittings
28.	ASTM D 2774	Underground Installation of Thermoplastic Pressure Piping
29.	ASTM D 2855	Making Solvent-Cemented Joints with Poly Vinyl Chloride Pipe and Fittings
30.	ASTM D 3139	Joints for Plastic Pressure Pipes Using Flexible Elastomeric
	Seals	
31.	ASTM D 4101	Propylene Plastic Injection and Extrusion Materials
32.	ASTM E 84	Standard Test Method for Surface Burning Characteristics of Building Materials.
33.	ASTM F 477	Elastomeric Seals (Gaskets) for Joining Plastic Pipe
34.	ASTM F 1290	Electrofusion Joining Polyolefin Pipe and Fittings
35.	AWS A5.8	Filler Metals for Brazing and Braze Welding
36.	AWWA C104	Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water
37.	AWWA C105	Polyethylene Encasement for Ductile-Iron Piping for Water and Other Liquids
38.	AWWA C110	Ductile-Iron and Gray-Iron Fittings, 3 In. Through 48 In., for Water
39.	AWWA C111	Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
40.	AWWA C115	Flanged Ductile-Iron Pipe with Threaded Flanges
41.	AWWA C151	Ductile-Iron Pipe, Centrifugally Cast, for Water or Other Liquids
42.	AWWA C153	Ductile-Iron Compact Fittings, 3 In. Through 16 In., for Water
43.	AWWA C600	Installation of Ductile-Iron Water Mains and Their Appurtenances
44.	AWWA C900	Polyvinyl Chloride (PVC) Pressure Pipe, 4 In. Through 12 In., for Water Distribution
45.	AWWA C901	Polyethylene (PE) Pressure Pipe and Tubing, ½ In. Through 3 In.,
		for Water Service
46.	AWWA M23	Manual: PVC Pipe - Design and Installation
47.	CISPI HSN	Neoprene Rubber Gaskets for Hub and Spigot Cast Iron Soil
		Pipe
		and Fittings
48.	CISPI 301	Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications
49.	CISPI 310	Mechanical Compression Coupling
50.	NSF/ANSI 61	Drinking Water System Components

51. NSF/ANSI 372 Drinking Water System Components - Lead Content

C. NSF Compliance

1. Comply with NSF 61 for materials for water-service piping and specialties for domestic water.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

A. Interior Domestic Water Piping (Copper)

1. Interior Pipe 4" and Smaller:
 - a. Pipe below grade shall be copper, ASTM B88, Type K, soft copper tube annealed temper. No joints shall be allowed below slab.
 - b. Pipe above grade shall be copper, ASTM B88, Type "L" hard copper tube, drawn temper.
2. Fittings and Solder for Copper Tubing:
 - a. All solder fittings shall be wrought copper or cast bronze solder fittings and shall bear manufacturer's trade mark. ASME B16.18 or B16.22 pressure fittings.
 - b. Solder shall be 95-5 complying with ASTM B32; flux shall be ASTM B 813, water flushable type, for 4" and smaller.
 - c. Copper Pressure-Seal-Joint Fittings: Fittings for NPS 2 and Smaller: Wrought-copper fitting with EPDM-rubber, O-ring seal in each end. Manufactured by NIBCO, Elkhart or Viega conforming to the material and sizing requirements of ASME B16.18 or ASME B16.22. O-rings for copper press fittings shall be EPDM. Copper press fittings shall be rated at 200 psi working pressure and 250 degree working temperature. All copper press fittings, couplings and specialties shall be the products of a single manufacturer. Installation tools shall be as recommended by the fittings manufacturer.
 - d. Bronze Fittings for Roll Grooved-End, Copper Tubing: ASTM B 75 copper tube or ASTM B 584 bronze castings. For NPS 2-1/2" thru 4". Wrought copper or cast copper alloy roll groove fittings utilizing no-sweat coupling and flange adapter assemblies as manufactured by Victaulic, Shurjoint Piping Products, or Anvil.
3. Piping exposed to view shall be chrome plated unless otherwise indicated on the plans.

B. Sanitary Waste, and Vent Sewer Piping

1. See application criteria in Part 3 below.
2. Bell and Spigot Cast Iron Soil Pipe and Fittings:
 - a. Service weight pipe and fittings: ASTM A74.
 - b. One piece elastomeric compression type gaskets: ASTM C564.
 - c. Pipe and fittings shall be encased with 8 mil thick polyethylene: AWWA C105.
3. No Hub Cast Iron Soil Pipe and Fittings:
 - a. Service weight pipe and fittings: CISPI 301.
 - b. Mechanical compression coupling with neoprene gasket and stainless steel band and accessories: CISPI 310.
4. Copper Tubing and Fittings:

- a. Copper drainage tubing (DWV): ASTM B 306.
 - b. Wrought copper solder type fittings: ASME B16.29.
 - c. Joints: 95/5 type solder. ASTM B 32.
5. Poly-vinyl Chloride Pipe and Fittings:
- a. PVC schedule 40 pipe with plain ends: ASTM D-2665.
 - b. Socket fittings, schedule 40: ASTM D-2665.
 - c. Solvent cement joints: ASTM D-2665.
- C. Valves
1. Water Valves:
- a. All valves of the same type shall be of the same manufacturer.
 - b. All valves shall be lead free complying with NSF-61-G and ANSI 372.
 - c. Valves shall be as indicated using the Nibco figure numbers or the approved equal as manufactured by Crane, Jenkins Bros., Hammond, Powell, Stockham or Walworth.
 - d. For CW piping systems with 2" or less insulation, provide extended handles on stop valves with a vapor seal, adjustable memory stop and convenient valve packing maintenance - all without disturbing the insulation. Extended valve handles shall be Nibco NIB-SEAL or equal.
2. Stop valve sized through 2" shall be:
- a. Nibco Fig. No. T-585-66-LF (threaded), full port 400 psi WOG non-shock at 100°F, 2-piece construction, stainless steel ball and trim and bronze body with Teflon O-ring seals and seats.
 - b. Nibco Fig. No. PC-585-66-LF (press system), full port 250 psi WOG non-shock at 100°F, 2-piece construction, stainless steel ball and trim and bronze body with Teflon O-ring seals and seats.
3. Stop valve sized 2-1/2" and larger shall be:
- a. Nibco Fig. No. LC-2000-3 200 psi non-shock cold water, butterfly valves. Standard: MSS SP-67, Type I. CWP Rating: 2"-6" = 200 psig; 8"-10" = 150 psig. Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange. ASTM A 126, cast iron or ASTM A 536, ductile iron. Seat: EDPM. One- or two-piece stainless steel stem. Aluminum bronze disc.
4. Check valves in sizes through 3" shall be Nibco Fig. No. T-433, threaded swing check valves.
5. Check valves sizes over 3" shall be Nibco Fig. No. W-960, wafer style check valves.
6. Balance Valves
- a. Valves shall be calibrated bronze balance valves with provisions for connecting a portable differential pressure meter.
 - b. Meter connections to have built-in check valves. An integral pointer shall register degree of valve opening. Each balance valve shall be constructed with internal seals to prevent leakage around rotating element, suitable for 100% shut-off.
 - c. Each balance valve shall be constructed for 150 pounds working pressure at 250°F and supplied with preformed polyurethane insulation.

2.2 Y-PATTERN STRAINERS

- A. Manufacturer: Subject to compliance with requirements, provide hydronic piping system products from one of the following:
 - 1. Armstrong Machine Works

2. Keckley
3. Illinois
4. Mueller Steam Specialty
5. Metraflex Co.
6. Spirax Sarco.

- B. Pressure Rating: 125 psig minimum, unless otherwise indicated.
- C. Body: Bronze for NPS 3 and smaller; cast iron with interior lining complying with AWWA C550 or FDA-approved, epoxy coating and for NPS 4 and larger.
- D. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
- E. Screen: Stainless steel with round perforations, unless otherwise indicated.
- F. Perforation Size:
 1. Strainers thru NPS 2-1/2 inch: #20 mesh.
 2. Strainers NPS 3: 3/64 inch.
 3. Strainers NPS 4 and Larger: 1/8 inch.
- G. Drain: Pipe plug.

2.3 UNIONS

- A. All unions shall be streamline ground joints, Mueller Streamline or approved equal. Dielectric unions may be solder joint, screwed or flanged.

2.4 VACUUM BREAKERS

- A. This Contractor shall furnish and install vacuum breakers in the following locations where a vacuum breaker is not an integral part of the fixture:
 1. All water closet flush valves.
 2. All urinal flush valves.
 3. All wall hydrants and all hose bibbs.
 4. Janitor's sinks and mop basins.
 5. Shelf mounted water heaters.
- B. In addition to the above locations, vacuum breakers shall be installed where required by governing local authorities, on all connections to domestic water system to which hoses could be attached and all connections to the domestic water system where back siphonage could occur.

2.5 PIPE INSULATION

- A. The piping insulation material is specified to establish the desired quality and performance. Equal products, complying with the requirements of these specifications, by the following manufacturers are acceptable:
 1. Owens-Corning
 2. Certain-Teed
 3. Manville
 4. Knauf
 5. Armstrong
 6. Rubbatex
 7. Imcoa
- B. Insulation material:

1. Type (1) - Owens-Corning Fiberglass, Fiberglass 25 with ASJ all service jacket, seal down lap joints, vapor barrier in jacket. Thermal conductivity of 0.26 BTU/HR/SF°F/IN @ 100°F mean temperature, 0.3 @ 200°F, 0.35 @ 300°F.
 2. Type (2) - Armstrong AP (plenum rated) Armaflex foamed plastic flexible tubing insulation. Thermal conductivity of 0.28 BTU/HR/SF°F /IN @ 90°F mean temperature.
- C. The installed insulating system shall comply with the requirements of the National Fire Protection Association. Insulation, including finishes and adhesives, on the exterior surfaces of pipes and equipment shall have a flame spread of 25 or less and a smoke developed rating of 50 or less as determined by an independent laboratory in accordance with ASTM E84.
- D. Piping insulation material shall have a plenum rated jacket that allows for painting.
- E. All insulation shall be rat, vermin, germ, fungus and rot resistant.
- F. See Part 3 - Execution for items to be insulated.

2.6 HANGERS

A. Manufactured Units

1. Hangers and support components shall be factory fabricated of materials, design, and manufacturer complying with MSS SP-58 and MSS SP-69 except as modified herein.
 - a. Hangers: Types 5 and 12 shall not be used.
 - b. Hangers: Type 3 shall not be used on insulated piping.
 - c. C-Clamps: Type 19 and 23 C-clamps shall be torqued per MSS SP-69 and have both locknuts and retaining devices, furnished by the manufacturer. Field-fabricated C-clamp bodies or retaining devices are not acceptable.
 - d. Angle Attachments: Type 20 attachments used on angles and channels shall be furnished with an added malleable-iron heel plate or adapter.
 - e. Hangers: Type 24 shall be used only on trapeze hanger systems or on fabricated frames.
2. Pipe supports shall be equal to B-Line model numbers hereinafter listed. Equal products by Grinnell also acceptable.

a. Clevis Hanger	Fig. B 3100
b. Adjustable Swivel Ring	Fig. B 3170
c. Adjustable Swivel Roller	Fig. B 3111
d. Adjustable Roller Support	Fig. B 3121 or Fig. B 3122
e. Riser Clamp (Standard Duty)	Fig. B 3373
f. Riser Clamp (Heavy Duty)	Fig. B 3131
g. Offset Clamp	Fig. B 3148
h. Wall Bracket (Light Duty)	Fig. B 3068
i. Wall Bracket (Medium Duty)	Fig. B 3065
j. U-Bolts	Fig. B 3188
k. Structural Attachments:	
Beams clamps:	Fig. B 3031, B 3033, B 3034, B 3050, B 3045
Angle Iron Beam Clamp:	Fig. B 3046
Bar Joist:	Fig. B 3059
Concrete Inserts:	Fig. B 3500, B 2505 thru 2508, or B 3014
Drilled Inserts:	Phillips Red-head, wedge anchors or equal.

- B. Components shall have galvanized or cadmium plated coatings where installed for piping and equipment that will not have field-applied finish.
- C. Pipe supports shall be compatible with the pipe being supported to prevent galvanic corrosion. All supports for copper piping shall be copper coated hangers conforming in general to the

above specifications. Where copper pipes are separated from hangers by pipe insulation, hangers do not need to be copper coated.

D. Saddles and hangers for insulated piping:

1. Type 39 saddles shall be used on all insulated pipe 12 inches and larger. Type 39 saddles shall be welded to the pipe.
2. Type 40 shields shall:
 - a. be used on all insulated pipes less than 12 inches.
 - b. be used on insulated pipes larger than 12 inches when the temperature of the medium is 60 degrees F or less.
 - c. have rigid insulation saddle, equal to Fee and Mason Fig. 71, consisting of rigid urethane foam insulation with vapor barrier jacket and thermal conductivity of 0.13 BTU/HR/FT²/°F/IN @ 75°F. Insulation saddle length shall be 6" for pipes 6" and smaller. Thickness shall be the same as pipe insulation.
 - d. distribute the loading on the bearing area of the insulation in accordance with the following minimum dimensions covering 180° of arc:

Pipe Size (Inches)	Galvanized Steel Saddle Length (Inches)	Gauge Thickness
½ to 4	12	16
6	18	16
8	24	14
10 and larger	24	14

2.7 ROOF FLASHING ASSEMBLIES

A. Roof Flashing Assemblies:

1. Basis-of-Design Product: Subject to compliance with requirements, provide a comparable product by one of the following:
 - a. Acorn Engineering Company; Elmdor/Stoneman Div.
 - b. Thaler Metal Industries Ltd.
 - c. or equivalent
2. Description: Manufactured assembly made of 5.0-lb/sq. ft., 0.0782-inch thick, lead flashing collar and skirt extending at least 8 inches from pipe, with galvanized-steel boot reinforcement and counterflashing fitting.

PART 3 - EXECUTION

3.1 PIPING APPLICATION

A. Domestic Water Piping Above Ground

1. Piping 4" and smaller
 - a. Above Ground Domestic Water Piping shall be copper.
 - b. Above Ground Copper Domestic Water Piping above grade shall be soldered, roll groove fittings or Pressure-Seal-Joint fittings as indicated below:
 - 1) Thru 2": Soldered or Pressure-Seal-Joint fittings.
 - a) Pressure-Seal-Joint fittings not allowable in concealed locations. (Above drywall ceilings, in chases and in walls.)
 - 2) 2" thru 4": Soldered or roll groove fittings.

B. Sanitary Sewer

1. Below Building Slab on Grade Install:
 - a. cast iron hub and spigot
 - b. PVC
 - c. PVC piping shall only be provided if permitted by the local code.
2. Above Grade Install:
 - a. hubless cast iron
 - b. PVC (except not allowed in return air plenums)
 - c. Copper sanitary piping.
 - d. PVC piping shall only be provided if permitted by the local code.

3.2 PLUMBING SYSTEMS INSTALLATION

A. Interior Water Piping System

1. The Plumbing Contractor shall furnish all materials and labor to install the cold water, hot water and hot water circulating piping systems. Unless specifically stated otherwise, piping shall be extended and connected to all fixtures or equipment requiring domestic hot or cold water.
2. All piping shall be installed level and plumb. All pipes shall be properly cleaned inside and outside.
3. Provide strainers where indicated on the plans and details. Provide ball valve on the blow down connection unless otherwise indicated and route to a drain as indicated.

B. Installation of Piping

1. All pipe shall be run parallel to or at right angles to walls, beams, or columns. Pipe shall be run as direct as possible, but no short cut diagonal methods will be allowed, avoiding unnecessary offsets and maintaining maximum headroom.
2. Piping shall be concealed in finished rooms unless noted otherwise.
3. Piping drawings are to be considered schematic and are not intended to indicate all changes in direction and necessary fittings to be furnished and installed by this Contractor. Pipe and fittings must be installed so that all pipe and/or insulation completely clears all nearby structures, piping and items by other contractors.
4. Piping shall be arranged to allow for expansion and contraction. Expansion loops, expansion joints, and pipe anchors and guides shall be provided on piping mains where shown on the drawings or where required to avoid additional stresses in the piping and supports. Branch take-offs shall be made with swing connections as required to avoid stress at these points.
5. Pipes shall not be hung from other piping or from equipment of other trades. No hanger rods or piping shall pierce ductwork.
6. Bull head tee arrangements shall not be allowed.
7. The entire water system shall be free of water hammer. Air chambers shall not be used in place of water hammer arresters. Install water hammer arresters where indicated on the plans and as required for all quick closing valve devices. Plumbing fixtures that require water hammer arresters shall include but not be limited to the following:
 - a. Dishwashers.
 - b. Mop Service Basins.
 - c. Wall Hydrants.
 - d. Lavatories.
 - e. Water closets.
 - f. Urinals.
 - g. Kitchen sinks.
 - h. Drinking Fountains and electric water coolers.
 - i. Ice makers.
 - j. Kitchen equipment such as coffee machines, etc.

8. Valves shall be installed on each main and each piece of equipment, fixture or fixtures group, and all other items requiring water supply shall be separately valved to allow equipment or fixture removal without shutdown of the entire system. All valves shall be located as to be easily accessible. Install valves in horizontal piping with stem at or above the center of the pipe.
9. Use ball and butterfly valves for shut-off duty; ball, and butterfly for throttling duty. Refer to drawings for specific valve applications and arrangements. Use ball valves for isolation on pipe sizes 2" and smaller. Use butterfly valves for isolation on pipe sizes 2½" and larger. Use gate valves only where indicated or required by local code.
10. Unions shall be installed:
 - a. At piping connections to equipment.
 - b. Connections between ferrous and non-ferrous copper pipe shall be made with dielectric unions or flanges.
11. All valves and specialties must be placed to permit easy operation and shall be made accessible to use, or provided with access panels. Special care must be taken to provide room for removing the inner parts of all specialties. Access panels must be sized properly for maintenance purposes and repairs.
12. If dope, lead or cement is used in making up joints, it shall be based on male threads only.
13. Routing of piping shall be coordinated with other trades to assure adequate space for electrical and mechanical installations above ceilings and in chases. Piping shall not be routed through electrical rooms/closets or elevator equipment rooms.

C. Installation of Hangers and Supports

1. All piping shall be supported from the building structure by means of approved hangers and supports. Piping shall be supported to maintain required grading and pitching of pipes, to prevent vibration and excessive deflections, and secure piping in place.
2. Contractor shall verify loading on hangers, hanger rods and structural attachments. Loading on the assembly shall not exceed 75% of the manufacturer's rating for any component of the assembly. If loading does exceed the 75%, then hanger spacing shall be reduced.
3. Hangers and supports shall be provided as required to eliminate vibration and excessive deflection, but in no case over the following centers, unless specifically indicated otherwise on the drawing. Rod sizes for individual pipe shall not be less than the following schedule: (DI= ductile iron, CI= cast iron, STL= steel, CU= copper)

Pipe Size (Inches)	Maximum Hanger Spacing (Feet) DI/CI/STL	Minimum Rod Size (Inches) DI/CI/STL	Maximum Hanger Spacing (Feet) CU	Minimum Rod Size (Inches) CU
1/2	7	3/8	5	3/8
3/4	7	3/8	5	3/8
1	7	3/8	5	3/8
1-1/4	7	3/8	8	3/8
1-1/2	9	3/8	8	3/8
2	10	3/8	8	3/8
2-1/2	11	1/2	8	1/2
3	12	1/2	10	1/2
3-1/2	13	1/2	10	1/2
4	14	5/8	10	1/2
5	16	5/8		

- a. An additional hanger shall be installed at every change in direction of piping.
 - b. Cast-iron and ductile iron pipe shall have minimum one hanger per section close to each joint and at branch connections.
 - c. Plastic pipe shall have hangers spaced in accordance with manufacturer's recommendations.
4. When trapeze hangers are used to support two or more pipes, rods shall be used for vertical hanger members and angles, channels or Unistrut for horizontal hanger members. The material used shall be sized to support the load without excessive deflection. Spacing of trapeze hangers shall be based on the smallest pipe supported on the trapeze hanger. Rod sizes shall be based on the supported weight and load carrying capacity of attachment device.
 5. Horizontal pipe supports shall be spaced as specified in MSS SP-69 and a support shall be installed not over 1 foot from the pipe fitting joint at each change in direction of the piping. Pipe supports shall be spaced not over 5 feet apart at valves. Pipe hanger loads in excess of 50 pounds, suspended from steel joists, shall have the hanger loads suspended from panel points. Pipe supports for PVC piping shall be maximum 4 feet on centers. Where local codes require closer spacing than indicated on the plans or specifications, the supports shall conform to the local code requirements. For buildings built with steel joists before 1985, pipe supports shall be attached to the top leg of the joist.
 6. Vertical pipe shall be supported at each floor with riser clamps, except at slab-on-grade, and at intervals of not more than 15 feet, not more than 8 feet from end of risers, and at vent terminations.
 7. Piping shall not be supported from joist bridging or a roof metal deck.
 8. Pipe supports shall be structurally capable of carrying the pipe or pipes supported by them and shall be capable of vertical adjustment after installation of piping.
 9. Piping at all equipment shall be supported to prevent strains or distortions in the connected equipment. Piping shall be installed and supported to allow for removal of equipment, valves and accessories with minimum dismantling and without requiring additional supports after these items are removed. Unions shall be installed at the connection to all equipment and at valves, strainers, traps, etc.
 10. Domestic water pipes which are subject to rapid changes in flow rate shall be anchored to prevent excessive movement or vibration.

D. Interior Waste, Soil and Vent Piping

1. The arrangement of the system shall be as shown on the drawings, and as direct as possible avoiding all unnecessary offsets.
2. Supporting of horizontal and vertical pipe shall be as hereinbefore described under "Installation of Piping".
3. Horizontal soil and waste pipes 4" and larger shall be given a minimum slope of 1/8" per foot, and pipes 3" and smaller shall be given a pitch of 1/4" per foot. All main vertical soil and waste stacks shall be installed with provision for expansion and shall be extended full size to and above the roof line as vents, except where otherwise specifically indicated.
4. Where practical, two or more vent pipes shall be connected together and extended as one pipe through the roof. Where the Contractor makes changes of vent connections other than that indicated, he shall keep a record of the change. Vent pipes shall be run

with horizontal piping pitched down to stacks without forming traps in pipes using fittings as required. Where an end of circuit vent pipe from any fixtures or line of fixtures are connected to a vent pipe serving other fixtures, the connection shall be at least 6" above the flood rim of the highest fixture above the floor on which the fixture is located.

5. All pipe shall be carefully handled and protected from damage. Damaged pipe shall not be installed.
6. Bedding for underground pipes shall be as specified in Section 220010.
7. All changes in pipe size on soil, waste and drain pipes shall be made with reducing fittings or recessed reducers. All changes in direction shall be made by the appropriate use of 45o Y's, half Y's, long sweep 1/4 bends, 1/6, 1/8 or 1/16 bends, except that sanitary tees may be used on vertical stacks, and short 1/4 bends or elbows may be used in soil and waste pipes where the change in direction of flow is from the horizontal to the vertical and on the discharge from water closets.
8. Slip joints will be permitted only in trap seals or on the inlet side of the traps. Tucker or hub drainage fittings shall be used for making union connections wherever practicable in connection with dry vents.
9. Vent pipes shall be flashed. This Contractor shall furnish and install all flashing and counter-flashing. Flashing shall be 5 pound lead. Flashings in connection with cast-iron pipe vents will be extended up to top of vent and turned down into pipes or hubs minimum 1". For pipes through outside walls, turn flanges back into wall, flash, metal counterflash and seal.
10. Flash floor drains in floors with topping over finished areas with lead, 10 inches clear on sides with minimum 36 x 36 inch sheet size. Fasten flashing to drain clamp device.
11. Seal drains watertight to adjacent materials.
12. Each fixture and piece of equipment requiring connection to the drainage system, except fixtures with continuous waste, shall be equipped with a trap. Each trap shall be placed as near to the fixture as possible and no fixture shall be double-trapped. Traps installed on hub and spigot pipe shall be cast-iron. Traps installed on threaded pipe shall be recessed drainage pattern.
13. The vent stack shall be connected to the soil stack below the lowest fixture and carried up, all individual vents being connected thereto, extending through the roof.
14. Vents extending through the roof shall be a minimum of 25' from any supply fan or fresh air intake. If necessary, the vent shall be offset to meet this requirement. Check location of air intakes on equipment on roof prior to installation of vents.
15. Double "Y" soil, waste and storm pipe fittings are not allowed to be installed horizontally.

E. Service Entrance

1. Extend water distribution piping to connect to utility water service piping, of size and in location indicated for service entrance to building.
2. Install sleeve and mechanical sleeve seal at penetrations through foundation wall and valve pits for watertight installation.
3. Install backflow preventer at service entrance inside building; complete with strainer, pressure gauge, test tee with valve and drain valve.
4. Minimum depth of water pipe, exterior to building, shall be below the locally established frost line, but not less than 3'-6".

F. Sewer Pipe and Water Main Separation

1. Sanitary sewers parallel to water mains shall be located at least 10 feet horizontally from water mains. Distance shall be measured from edge to edge.
2. When local conditions prevent a horizontal separation of 10 feet, a sanitary sewer may be laid closer to a water main provided:
 - a. that the bottom of the water main is at least 18 inches above the top of the sewer.
 - b. that the joints be centered at the point of crossing and as far as possible from the water main.

G. Cleanouts and Test Tees

1. Cleanouts shall be provided at the following locations:
 - a. Bottom of each exposed fixture trap not integral with the fixture.
 - b. At the foot of each soil and storm water stack.
 - c. At intervals not exceeding 50' for 4" sewer pipes and smaller, and not exceeding 100' for 5" sewer pipe and larger.
 - d. Miscellaneous locations as shown on the plans.
 - e. Where required by code.
2. Cleanouts shall be the same size as the pipe except cleanout plugs larger than 4" will not be required. Cleanouts installed in connection with cast-iron hub and spigot pipe shall consist of a long sweep 1/4 bend or one or two 1/8 bends extended to an easily accessible place, or where indicated on the drawings. An extra heavy cast-iron ferrule with screw cap plug shall be caulked into the hub of the fitting. Where cleanouts in connection with threaded pipe are indicated and are accessible, they shall be cast-iron drainage T-pattern 90o branch fittings or Y-branch fittings with screw plugs of the same size as the pipe up to and including 4". Test tees with cleanout plugs shall be installed at the foot of all soil, waste, and drain and roof drainage stacks and on each building drain outside the building.
3. Wall Access Cover Plate: Round, flat, chrome-plated brass or stainless-steel cover plate with screw. Deep, chrome-plated bronze type may be used where a flat type does not fit.

H. Joints

1. Installation of pipe and fittings shall be made in accordance with the manufacturer's recommendations. Mitering of joints for elbows and notching of straight runs of pipe for tees shall not be permitted. Joints shall be made up with fittings of compatible material and made for the specific purpose intended.
2. Threaded joints shall have American Standard taper pipe threads conforming to ASME B1.20.1. Only male pipe threads shall be coated with graphite or with an approved graphite compound, or with an inert filler and oil, or shall have a polytetrafluoroethylene tape applied.
3. Flanged Joints: Align flanges surfaces parallel. Assemble joints by sequencing bolt tightening to make initial contact of flanges and gaskets as flat and parallel as possible. Use suitable lubricants on bolt threads. Tighten bolts gradually and uniformly using torque wrench.
4. Brazed joints shall be made in conformance with AWS B2.2 with flux and are acceptable for line sizes. Brazing of dissimilar metals (copper to bronze or brass) shall include the use of flux with either a copper-phosphorus, copper-phosphorus-silver or a silver brazing filler metal.
 - a. CAUTION: Remove stems, seats, and packing of valves and accessible internal parts at piping specialties before brazing.

- b. Fill the pipe and fittings during brazing, with an inert gas (ie., nitrogen or carbon dioxide) to prevent formation of scale.
 - c. Heat joints using oxy-acetylene torch. Heat to proper and uniform temperature.
 - 5. Soldered joints shall be made with flux and are only acceptable for pipes 2 inches and smaller. Soldered joints shall conform to ASME B31.5.
 - 6. Copper Tube Extracted Tee Joints shall not be allowed.
 - 7. Unions, flanges and mechanical couplings shall not be concealed in walls, ceilings, or partitions. Unions shall be used on pipe sizes 2-1/2 inches and smaller; flanges shall be used on pipe sizes 3 inches and larger.
 - 8. Bell and spigot compression and hubless gasketed clamp joints for soil, waste and vent piping shall be installed per the manufacturer's recommendations.
 - 9. The tube or fittings for copper piping shall not be annealed when making connections.
 - 10. PVC pipe shall have joints made with solvent cement, elastomeric gaskets, or mated flanges.
 - 11. Joints connecting pipe of differing materials shall be made with transition fittings approved by the pipe manufacturer and in accordance with the manufacturer's recommendation as approved by the Engineer.
- I. Backup Plates
- 1. Where hot, cold and waste piping penetrates chase walls for connections to fixtures, this Contractor shall furnish and install backup plates. Backup plates shall span between and shall be firmly attached to the studs on either side of the fixture. Backup plate shall not be less than 3/4" plywood and shall be attached to the metal stud flange with at least three screws on each end. Holes through the backup plates for pipe penetrations shall be accurately drilled to pipe size to provide a close fit with the pipe. Piping shall be secured to the backup plate.
- J. Escutcheons
- 1. Chrome plated escutcheons shall be provided at all locations where pipes penetrate walls in exposed locations.
- K. Piping Insulation
- 1. Installation of the material shall comply with the manufacturer's recommendations.
 - 2. Unions, flanges, valves and other similar fittings shall be insulated except insulation may be omitted on unions for hot water piping.
 - 3. Prior to application of insulation, piping and equipment shall have been tested. All surfaces to be insulated shall be clean and dry. Special solvents are not required for use in cleaning, but any oil, grease, dirt or foreign material shall be wiped or scraped from the pipe or equipment surface. Insulation shall not be applied on damp or frosty surfaces.
 - 4. All pipes with hangers, saddles, etc., shall be set in their permanent location before insulation is applied. Should it be necessary to block or shore up pipe to install insulation, or should it be necessary to displace or remove hangers, the pipe and hangers shall be restored to their original location and alignment when the insulation is complete.
 - 5. Where insulated piping is supported by hangers clamped directly to the pipe, the insulation shall be carefully fitted around hanger clamp and sealed at openings in jacket.

6. All fittings, flanges, valves, instruments, hanger rods and clamps shall be insulated with molded or mitered insulation or built-up insulation to a thickness equal to that of the insulation of the adjoining pipe, securely adhered and wired in place. For cold services (fluid temperatures less than 75°F) paint insulation with a vapor-barrier mastic. Fittings shall be covered with Zeston or Snap Form preformed fitting covers. Aluminum fitting covers by GASCO are equally acceptable. For cold services, wrap the end joint with pressure sensitive joint tape furnished by the insulation manufacturer.
7. At pipe hangers, install "rigid insulation saddle" the same thickness as the insulation to prevent crushing the insulation.
8. Insulate Piping as follows:

a. Application	Insulation Type	Thickness
CW & NP up to 1-1/2"	1	1/2"
	2	1/2"
CW & NP over 1-1/2"	1	1"
HW, TW & HWR up to 1-1/2"	1	1"
	2	1"
HW, TW & HWR over 1-1/2" ST (horizontal piping only) to 5" 6" to 24"	1	1-1/2"
	1	1/2"
	2	1/2"
	1	1"
Indirect waste pipes from Kitchen equipment (ice bins, refrigerator drains, etc.) or as noted on plans.		
	1	1"
	2	1"
Indirect waste pipes from air handling equipment.		
	1	1"
	2	1"
Drinking fountain chilled water pipes.		
	1	1-1/2"
	2	1-1/2"

- b. The following equipment shall be insulated with 1" thick Type 1 insulation:

- 1) All roof drain bodies.
- 2) Hot water storage tanks.

3.3 PLUMBING SYSTEMS TESTING

- A. It shall be the responsibility of this Contractor to test, and to place all equipment, piping, materials, etc., installed by him into proper and unattended operation.
- B. Piping systems shall be tested as hereinafter described. Piping or equipment not installed by this Contractor shall not be subject to tests. Existing piping or piping which is the property of utility companies shall not be subject to tests.
- C. All plumbing tests shall be made in the presence of the local Plumbing Inspector and Owner's representative unless approved otherwise by the engineer. Testing procedure shall conform to the regulations and codes of the local agency. All pipework shall be tested for leaks, cracked

pipes, cracked fittings. All openings shall be capped or plugged, the pipework filled with water, and the installation proven tight before insulation and furrings are applied.

D. Piping systems shall be tested in ambient temperatures of 40°F or higher.

E. Testing of Soil, Waste and Vent Piping

1. All underground soil, waste and vent piping shall be tested with water. The water shall maintain a constant level at the highest point or at least 10' above the mean elevation of the piping under test for at least one (1) hour. If leaks appear, lines shall be drained, leaks repaired and test repeated. No piping shall be concealed in any manner before being tested and approved.
2. If local code is more stringent than the above test, then all soil, waste and vent piping shall be tested in accordance with local code.

F. Water System Testing

1. All water piping shall be tested with water at 100 psi or 1-1/2 times the maximum working pressure, whichever is greater. Pressure shall be maintained for a period of one hour. If leaks appear, pipes shall be drained, leaks repaired, and test repeated. No piping shall be concealed in any manner before tests are approved.
2. All domestic systems shall be chlorinated in accordance with procedures described in AWWA Standard for Disinfecting Water Mains, AWWA C601-68, and in accordance with applicable local codes. The system shall be flushed prior to chlorination as thoroughly as possible. Clean all faucets strainers and shower heads. A velocity in the system of at least 2.5 fps should be developed. Chlorine shall be added to the system at the meter at a rate sufficient to produce a chlorine concentration of 50 mg/l available chlorine and held in the system for a 24-hour retention period. After chlorination, the system shall be flushed until the chlorine residual is 1.0 ppm at all faucets and shower heads. Testing for domestic systems shall be in accordance with ASHRAE 188-2015.

END OF SECTION 220400

SECTION 220410 – PLUMBING EQUIPMENT

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

- A. Furnish all labor, services, material and related items to completely furnish and install the plumbing equipment indicated on the plans and/or specified herein.

1.2 SUBMITTALS

- A. Submit shop drawings and product data under provisions of Section 220000.
- B. Include dimension drawings of water heaters indicating components and connections to other equipment and piping.
- C. Include dimensions of tanks, tank lining methods, anchors, attachments, lifting points, tappings, and drains.
- D. Indicate pump type, capacity, power requirements and affected adjacent construction.
- E. Submit certified pump curves showing pump performance characteristics with pump and system operating point plotted. Include NPSH curve when applicable.
- F. Data for inclusion in Operating and Maintenance Manual specified in Section 220000.

1.3 RELATED DOCUMENTS

- A. All drawings and applicable provisions of Division 0 Bidding Requirements and Division 1 General Requirements apply to work of this Section.
- B. Section 220000 - Plumbing General Conditions.
- C. Section 220010 - Basic Plumbing Materials and Methods.
- D. Section 220020 - Seismic Restraints.
- E. Section 220400 - Plumbing Systems.

1.4 QUALITY ASSURANCE

- A. Hydraulic Institute Compliance: Design, manufacture, and install pumps in accordance with "Hydraulic Institute Standards."
- B. National Electrical Code Compliance: Provide components complying with NFPA 70 "National Electrical Code."
- C. UL Compliance: Provide pumps which are listed and labeled by UL, and comply with UL Standard 778 "Motor Operated Water Pumps."
- D. Design Criteria: The Drawings indicate sizes, profiles, connections, and dimensional requirements, and are based on the specific manufacturer types and models indicated. Equipment having equal performance characteristics by other manufacturers may be considered, provided deviations in dimensions and profiles and efficiencies do not change the design concept or intended performance as judged by the Engineer.
- E. Motor Selection: Select pump motors which cannot overload over the full operating range of the pump.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Deliver products to job site.
- B. Store products in a dry location.
- C. Retain shipping flange protective covers and protective coatings during storage.

- D. Protect bearings and couplings against damage from sand, grit, and other foreign matter.
- E. Comply with manufacturer's rigging instructions for handling.

1.6 NSF COMPLIANCE

- A. Comply with NSF 61 for materials for water-service piping and specialties for domestic water.

PART 2 - PRODUCTS

2.1 HOT WATER CIRCULATING PUMP (RP-1)

- A. Hot water circulating pump shall be Bell and Gossett, Armstrong or Taco Series.
- B. Pumps shall comply with the following:
 - 1. All bronze construction.
 - 2. Suitable for continuous duty while pumping water up to 200°F and controlled by hot water aquastat.
 - 3. Working pressures of 150 psi.
 - 4. Bronze sleeve bearings with replaceable sleeves.
 - 5. Oil fittings for lubrication.

2.2 OIL WATER HEATER

- A. Heater shall be A.O. Smith, State, Bock, Rheem-Ruud, Lochinvar, or approved equal.
- B. Glass-lined, non-condensing, commercial oil fired water heater. Input rating and recovery capacity as shown on drawings. Multi-flue tank shall be constructed in accordance with ASME Code Section IV and stamped for 160 psi working pressure. Tubes shall be covered with pure dead soft copper and expanded and beaded into the tube sheets to permit field replacement.
- C. The water heater shall be insulated with heavy density fiberglass insulation and trimmed with heavy gauge enameled steel jacket. Lower operating thermostat, upper operating thermostat, temperature limiting device and a drain valve shall be factory installed. An ASME pressure and temperature relief valve shall be furnished and installed.
- D. The water heater shall include all standard equipment as shown on manufacturer's specification sheet, shall fit properly into the space provided for it and shall conform to the drawing requirements.

2.3 EXPANSION TANK (DOMESTIC WATER)

- A. Pre-pressurized steel tank with a Butyl diaphragm expansion membrane that prevents contact of water with the air. 150 psig maximum working pressure. 40 psig air precharge. Thermally fused epoxy liner. Field adjustable pre-charge. Inline mounting model.
- B. See schedule on plans for size.

2.4 BACKFLOW PREVENTERS

- A. Reduced Pressure Backflow Preventer
 - 1. Watts model 909 or 009 or approved equal by Ames, Cla-Valve or Febco.
 - 2. Reduced pressure principle backflow preventer shall be ASSE type 1013 consisting of gate or ball valves on the inlet and outlet, an inlet strainer and a pressure differential relief valve having an ASME A 112.1.2 air gap fitting located between two positive seating check valves; suitable for 125 psi normal working pressure at temperatures up to 140°F. Size indicated on drawings.
 - 3. Valve bodies shall be either bronze or galvanized cast iron. Valve internals shall be constructed of bronze and stainless steel.

B. Double Check Backflow Preventer

1. Watts model 709 or 007 or approved equal by Ames, Cla-Valve or Febco.
2. Double check valve type backflow preventer shall be UL listed, ASSE type 1015 with gate or ball valves on inlet and outlet and strainer on inlet. Provide two positive seating check valves; suitable for 125 psi normal working pressure at temperatures up to 140°F. Provide test cocks. Size indicated on drawings.
3. Valve bodies shall be either bronze or galvanized cast iron. Valve internals shall be constructed of bronze and stainless steel.

2.5 WATER METERS

A. Manufacturer: Subject to compliance with requirements, provide meter(s) of one of the following:

1. Badger Meter, Inc.
2. Hays Div., Romac Industries
3. Hersey Products, Inc.
4. Neptune Water Meter Co.; Subs. Neptune International Corp.
5. Rockwell International; Measurement & Flow Control Div.

B. Magnetic Driver Turbine Meter

1. Magnetic driver turbine meter type suitable for fluid with hermetically sealed register.
2. Provide water meter with bronze outer case and bronze bottom cap. The register lid shall be made of high impact resistant plastic.
3. The register shall be completely separated from the product to be measured and shall be available with center sweep hand, straight reading totaling in cubic feet.
4. Water meter shall be Hersey Model MVR or equal.

C. Compound Water Meter

1. Provide Neptune Model "Tru/Flo Compound" with dual suspension rotating disc and turbine meter type.
2. Provide water meter with bronze outer case and bronze bottom cap. The register lid shall be made of high impact resistance plastic.
3. Water meter shall be provided with A.R.B. cubic feet automatic reading and billing system.

2.6 EXPANSION LOOPS

A. Expansion Loops shall comply with the following:

1. U bend design expansion loop equal to Metraloop as manufactured by the MetraFlex Company. Loops shall be designed to impart no thrust loads on the anchors and shall consist of two flexible sections of hose and braid, two 90 degree elbows and a 180 degree return bend. Or equal by Flexonics or Anaconda.
2. For copper pipe applications, pipe fittings shall be type L copper wrought copper or bronze metal with a bronze hose and braid with fittings for solder connections, 150 psi working pressure at up to 250°F.
3. For storm drain applications, pipe fittings shall be schedule 40 steel with a series 300 stainless steel hose and braid with 150# flanged connections, 150 psi working pressure at up to 150°F.

2.7 PIPE ALIGNMENT GUIDES

A. Alignment guides shall be factory fabricated with split steel guiding cylinder with anchor case and split steel spider. Guiding cylinders shall be split on 45° and shall be designed to accommodate specified insulation thickness. Allow 1/8" minimum clearance between I.D. of

guiding cylinder and O.D. of insulation. For cold services, guides shall include a thermal barrier between the pipe and spider.

- B. Guides shall be equal to ADSCO Model E for steel piping and Model FRC for copper. For cold services, guides shall include ITB feature. Equal guides by MetraFlex are acceptable.

2.8 THERMOMETERS

- A. Thermometers shall be equal to Weiss #A9VU35. Equivalent products complying with these specifications by the following manufacturers are acceptable:

1. Marsh
2. Miljoco
3. Trerice
4. Weiss
5. U.S. Gauge
6. Weksler

- B. Weiss #A9VU35 adjustable angle. Red Reading Mercury Industrial Thermometers cast of extruded brass or aluminum closed cases, stainless steel or brass tapered bulbs with bulbs in direct contact with metal, individually calibrated tubes and engraved scales. Each 9" thermometer shall have adjustable angle and shall be installed in a matching brass separable socket with a 3/4" NPT. Stem length of socket shall be 3-1/2" except on lines where the insulation thickness exceeds 3" the stem length shall be 6" with an extension neck socket.

- C. Thermal wells in liquid lines shall be brass construction of same manufacturer as thermometers with 3/4" NPT, cap and chain, and shall have Government Standard tapered walls. Socket length shall be 3-1/2" under hex, except on lines where the insulation thickness exceeds 3" the length shall be 6" including 2-1/2" extension neck.

- D. All thermometers and thermal wells shall be by one manufacturer and shall be interchangeable.

- E. Graduation of thermometers shall be as follows:

	RANGE(°F)	DIVISIONS	FIG. INTERVAL
Hot Water	30 to 240	2°F	20°

- F. Submit shop drawings on thermometers and thermal wells.

2.9 PRESSURE GAUGES

- A. Gauges shall be equal to Trerice #600. Equivalent products complying with these specifications by the following manufacturers are acceptable:

1. Marsh
2. Miljoco
3. Weiss
4. U.S. Gauge
5. Weksler.

- B. Gauges shall include the following:

1. 4-1/2" diameter
2. Closed type ring with clear glass
3. Bronze tube, Bourdon Type
4. Brass movement
5. 1/4" NPT bottom connections with brass tee handle cock
6. Use pressure "snubbers" at locations where gauge needle pulsation might occur

- C. Graduation of pressure gauges shall be:

	RANGE	DIVISIONS	FIG. INTERVAL
City Water	0-150 psi	1.0 psi	10 psi
Domestic Hot Water	0-100 psi	1.0 psi	10 psi

- D. Gauge cocks shall be brass, equal to Trerice No. 865 or 880, and shall be provided at all gauges.

2.10 PRESSURE BOOSTER PUMP SYSTEM

- A. Booster pump selections have been based on the manufacturer scheduled. Equivalent products complying with these specifications by the following manufacturers are acceptable:
1. Bell & Gossett
 2. Peerless
 3. Taco
 4. Paco
 5. Federal
 6. Weinman
- B. Provide a factory pre-piped and pre-wired assembly constant speed pumping system with pressure regulating valves. Components shall be mounted on a steel frame complete with pumps, motors and automatic controls. Assembly shall employ one lead pump for low flows and a lag pump for higher flows. The system capacity and capacity of individual pumps shall be as scheduled on the drawings.
- C. System shall be provided with a single point power connection and suction & discharge piping connections. Isolation valves shall be provided for each pump and PRV set.
- D. System shall be rated for 175 psig working pressure.
- E. Cast iron body pressure regulating valves with non-slam check valves and bronze discs shall be provided for each pump. Each PRV shall be sized for a maximum pressure drop of 5 PSIG at the scheduled flow rate for its respective pump.
- F. A flow sensor shall be provided to stage the pumps with two steps of control (50%-100%).
- G. The pumps shall be protected from thermal buildup, when running at no-flow, by a common thermal relief valve. Pressure gauges shall be mounted on the suction and discharge headers which shall be copper or stainless steel, flanged, and properly supported.
- H. The control panel shall be UL listed with a NEMA 1 enclosure and shall include the following:
1. Fusible disconnect switches for each pump motor
 2. Magnetic motor controllers for each pump motor
 3. "HAND-OFF-AUTOMATIC" switches for each pump
 4. External resets
 5. Automatic alternation of equally sized pumps
 6. Time delays
 7. Control power transformer
 8. Minimum run timers
 9. Indicating lights for power on, individual motor overload, and low suction pressure.
 10. The control circuit shall be interlocked so that failure of any controller shall energize the succeeding controller.
 11. Wiring terminal strip.
- I. The pump controller shall provide the following features:

1. Low Suction Pressure Alarm and Cut Out
 2. High Suction Pressure Alarm and Cut Out
 3. Low System Pressure Alarm
 4. High System Pressure Alarm and Cut Out
 5. High Temperature Alarm and Cut Out
 6. Low Level Alarm and Cut Out
 7. No-Flow Shut Down
 8. Audio-Visual alarm with push to silence feature
 9. Overload Failure Alarm
 10. Pump Failure Alarm
 11. Dry contacts for system alarm output and pump status indication shall be provided for connection to a future Energy Management System.
- J. If the pump controls are microcomputer based, all software and on-line field modified data entries, such as stage point, or method of staging, shall be stored in EEPROM to prevent accidental loss of data due to voltage surge or spike. In the event of a complete power outage, all factory preset data values remain stored and available for recall by the operator.
- K. The pump controls shall be capable of operation in ambient conditions of 0° C to 60° C and a humidity range of 5% to 95%, non-condensing.
- L. Any external sensors/transmitters and switches shall be powered by the pump control panel through its integral power supply. Overvoltage and short circuit protection shall be on-board.
- M. Booster pumps shall be single stage, end suction, horizontal or vertical close-coupled centrifugal-type pumps. The speed shall not exceed 3600 rpm. Pump casings shall be cast iron or ductile iron or steel and shall be rated for the pressure in the system with bronze bearing or sealing rings. Impellers shall be bronze, balanced to eliminate vibration, and shall be keyed to bronze shaft sleeves. Pumps shall be provided with mechanical seals. Pump bases shall be cast iron or steel with ribs and lugs and shall have a drip lip with drain hole. Casings shall have gauge ports and vent & drain ports at top and bottom of casing.
- N. Pump motors shall be high efficiency and shall be in accordance with Section 220050.
- O. Each pump shall be tested at the manufacturer's plant for operating characteristics at the rated capacity and under specified operating conditions. Test curves shall be furnished showing capacity, head, efficiency, brake horsepower, and operation in parallel. Multiple pump installations shall have pump characteristics compatible for operation in parallel.
- P. Sequence of Operation
1. The lead pump shall operate at the point on its curve where system demand is satisfied. If the lead pump is unable to satisfy demand, the lag pumps shall be started as required.
 2. As demand decreases, the lag pumps shall be destaged to minimize energy consumption.
 3. In the event of a failure due to motor overload, the next pump in sequence shall be started.

PART 3 - EXECUTION

3.1 INSTALLATION OF PUMPS

- A. Install pumps, where indicated, in accordance with manufacturer's published installation instructions, with recommended clearances provided for service and maintenance.
- B. Install in-line pumps per manufacturer's instructions, supported from piping system, located for access to oil cups, service, and maintenance.

- C. Ensure that pump units are wired properly, with rotation in correct direction, and that pump and motor grounding have been provided.

3.2 INSTALLATION OF OIL HEATERS

- A. Location: Clean and dry location with a minimum of 18-inches clearance at sides and back and 48-inches in front of heater should be maintained for inspecting and servicing. Consult local codes for proper clearance. Central location is indicated in drawings.
- B. Installation: Inspect the water heater and burner for possible damage that may have occurred in shipping or during storage. Check the rating plate on the hot water heater and the burner.
- C. Venting: See HVAC section of specification.
- D. Electrical: Wiring to the unit should conform to the National Electrical Code and/or other locally authorized code.
- E. Securely anchor to floor and provide seismic restraints indicated in Section 220020.
- F. Provide a PVC drain line from the boiler flue with a neutralization kit in accordance with the manufacturers installation instructions and route to a floor drain.

3.3 SERVICE ENTRANCE

- A. Install shutoff valve at service entrance inside building; complete with strainer with blowdown valve, pressure gauge, and test tee with valve and pressure gauge.
- B. Install pressure regulating valve with inlet and outlet shutoff valves and balance cock bypass. Install strainer with blowdown valve, pressure gauge with gauge cock on reduced pressure side.
- C. Install backflow preventer at service entrance to building.

3.4 EQUIPMENT CONNECTIONS

- A. Piping Runouts to Fixtures: Provide hot and cold water piping runouts to fixtures of sizes indicated, but in no case smaller than required by plumbing code.
- B. Mechanical Equipment Connections: Connect hot and cold water piping system to mechanical equipment as indicated. Provide shutoff valve and union for each connection; provide drain valve on drain connection. Provide valved bypass for operation of system during service. For connections 2-1/2 inch and larger, use flanges instead of unions.

3.5 INSTALLATION OF BACKFLOW PREVENTERS

- A. Install backflow preventers of type and capacity indicated, at each water supply connection to mechanical equipment and systems; to other equipment and systems indicated; and in compliance with the plumbing code and authority having jurisdiction.
- B. Valves shall be installed at not less than 12" above the floor with the maximum of 60" above floor.
- C. Provide strainer and stop valve upstream and stop valve downstream. Provide union to allow removal of backflow preventer.
- D. Provide a drain line with air gap fitting to nearest floor drain or other suitable termination point. Waste connection shall be a fixed air gap fitting with a threaded connection.
- E. Backflow preventers shall be full line size.

3.6 INSTALLATION OF PRESSURE REDUCING VALVES

- A. Install pressure-regulating valves with inlet and outlet shutoff valves and balance cock bypass. Install pressure gauge on valve outlet.

3.7 EXPANSION TANK INSTALLATION

- A. Install expansion tanks as indicated on the drawings and in accordance with the manufacturer's instructions. Support tank from the structure. Adjust precharge to 60 psig unless otherwise indicated on the plans.

END OF SECTION 220410

SECTION 220420 - PLUMBING FIXTURES AND TRIM

PART 1 - GENERAL

1.1 SCOPE

- A. This section provides requirements for furnishing and installing water closets, mop sinks, lavatories, fixture carriers, floor drains and cleanouts.

1.2 RELATED WORK

- A. All drawings and applicable provisions of Division 0 Bidding Requirements and Division 1 General Requirements apply to work of this Section.
- B. For electrical connections to electric water coolers and other plumbing fixtures, not work of this section.

1.3 QUALITY ASSURANCE

- A. Plumbing Fixture Standards: Comply with applicable portions of National and Local Plumbing Codes pertaining to materials and installation of plumbing fixtures or equipment.
- B. ASSE 1016 (2005) - Automatic Compensating Valves for Individual Showers, Tub/Shower Combinations.
- C. ASSE 1017 (2009) - Temperature Actuated Mixing Valves for Hot Water Distribution Systems.
- D. ASSE 1069 (2005) - Automatic Temperature Control Mixing Valves.
- E. ASSE 1070 (2004) - Water Temperature Limiting Devices.
- F. ASSE 1071 (2008) - Temperature Actuated Mixing Valves for Plumbed Emergency Equipment.
- G. ANSI Z358.1 - Temperature Actuated Mixing Valves for Plumbed Emergency Equipment.
- H. NSF/ANSI 61 - Drinking Water System Components
- I. NSF/ANSI 372 - Drinking Water System Components - Lead Content

1.4 SUBMITTALS:

- A. Submit product data under provisions of Section 220000.
- B. Describe supports, components, accessories, and sizes.
- C. Data for inclusion in Operating and Maintenance Manual specified in Section 220000.

1.5 NSF COMPLIANCE:

- A. Comply with NSF 61 for materials for water-service piping and specialties for domestic water.

1.6 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Deliver plumbing fixtures individually wrapped in factory fabricated containers.
- B. Handle plumbing fixtures carefully to prevent breakage, chipping and scoring the fixture finish. Do not install damaged plumbing fixtures; replace and return damaged units to equipment manufacturer.

PART 2 - PRODUCTS

2.1 PLUMBING FIXTURES

- A. General: Provide factory fabricated fixtures of type, style and material indicated. For each type fixture, provide fixture manufacturer's standard trim, carrier, seats, and valves as indicated by their published product information; either as designed and constructed, or as recommended by the manufacturer, and as required for a complete installation. Where more than one type is indicated, selection is Installer's option; but, all fixtures of same type must be furnished by single manufacturer. Where type is not otherwise indicated, provide fixtures complying with governing regulations. Furnish faucets and supply stops with renewable monel seats. Lavatories and

sinks shall have the correct number of holes to coordinate with the faucets and accessories indicated even if model number listed does not indicate the correct number of holes; contractor shall be responsible to properly coordinate the sink/lavatory with the faucet and accessories.

- B. The named manufacturer and model number establishes a reference for quality and design. The omission of other manufacturers' names and model numbers does not limit or exclude the use of their products.
- C. The following are acceptable substitute component manufacturers:
 - 1. Vitreous China fixtures: American Standard, Sloan, Zurn, Toto and Kohler
 - 2. Faucets: Symmons, Chicago, Delta, American Std., Grohe
 - 3. Drinking Fountains Halsey-Taylor, Elkay, Haws, Oasis
 - 4. Carriers, Drains, Cleanouts, Hose bibbs, Wall Hydrants Woodford, Josam, JR Smith, Wade, Zurn, Watts, Prier, Mifab
 - 5. Flush Valves Sloan, Zurn
 - 6. Sinks American Standard, Just, Elkay
 - 7. Mop Basin Fiat, Swan, Willoughby
 - 8. Shower Receptors General Partitions Mfg. Corp., Florestone
- D. Where battery operated fixtures are specified, contractor shall furnish and install batteries with the fixtures.

2.2 FIXTURES

- A. See Drawings for Schedule

PART 3 - EXECUTION

3.1 INSTALLATION OF FIXTURES

- A. Examine rough-in work of domestic water and waste piping systems to verify actual locations of piping connections prior to installing fixtures. Also examine floors and substrates, and conditions under which fixture work is to be accomplished. Correct any incorrect locations of piping, and other unsatisfactory conditions for installation of plumbing fixtures. Do not proceed with work until unsatisfactory conditions have been corrected.
- B. Fasten plumbing fixtures securely to indicated supports or building structure; and ensure that fixtures are level and plumb. Secure plumbing supplies behind or within wall construction so as to be rigid, and not subject to pull or push movement.
- C. Caulk between fixtures and walls with white silicone caulking.

3.2 CLEAN AND PROTECT

- A. Clean plumbing fixtures of dirt and debris upon completion of installation.
- B. Protect installed fixtures from damage during the remainder of the construction period.

3.3 FIELD QUALITY CONTROL

- A. Upon completion of installation of plumbing fixtures and after units are water pressurized, test fixtures to demonstrate capability and compliance with requirements. When possible, correct malfunctioning units at site, then retest to demonstrate compliance; otherwise, remove and replace with new units and proceed with retesting.

3.4 INSTALLATION OF FLOOR DRAINS AND FLOOR SINKS

- A. General: Install floor drains and sinks in accordance with manufacturer's written instructions and in locations indicated.
- B. Install floor drains and sinks at low points of surface areas to be drained, or as indicated. Set tops of drains and sinks flush with finished floor.
- C. Install drain and sink flashing collar or flange so that no leakage occurs between drain and adjoining flooring. Maintain integrity of waterproof membranes, where penetrated.

3.5 INSTALLATION OF CLEANOUTS

- A. General: Install in waste piping and storm piping as indicated and as required by National Standard Plumbing Code; at each change in direction of piping greater than 45 degrees; at minimum intervals of 50 feet for piping 4 inch and smaller and 100 feet for larger piping; and at base of each stack or conductor. Install floor and wall cleanout covers for concealed piping; select type to match adjacent building finish.
- B. Flashing Flanges: Install flashing flange and clamping device with each cleanout passing thru waterproof membrane.
- C. Cleanout Size: Install cleanouts the same size as the soil waste lines in which the cleanouts are placed; however, no cleanout should be larger than 4 inches in diameter.

3.6 HYDRANT INSTALLATION

- A. Install all hydrants in accordance with manufacturer's instructions and approved product data submittals and in accordance with details on the plans. Where manufacturer's instructions and plan details conflict, follow the more stringent requirement.
- B. Install non-freeze wall hydrants in walls of sufficient stem length to prevent freezing when the hydrant is turn off. Locate wall hydrants so valve
- C. Install ground hydrants with 1 cu. yd. of crushed gravel around drain hole. Set ground hydrants with box flush with grade.
- D. Install draining-type post hydrants with 1 cu. yd. of crushed gravel around drain hole. Set post hydrants in concrete paving or in 1 cu. ft. of concrete block at grade.
- E. Install non-freeze, non-draining type post hydrants set in concrete or pavement.
- F. Install freeze-resistant yard hydrants with riser pipe set in concrete or pavement. Do not encase canister in concrete.

3.7 TRAP PRIMER INSTALLATION

- A. Install trap seal primer valves with valve outlet piping pitched down toward drain trap a minimum of 1/8 inch per foot and connect to floor drain body, trap, or inlet fitting. Adjust valve for proper flow.

3.8 EXPANSION TANK INSTALLATION

- A. Install expansion tanks as indicated on the drawings and in accordance with the manufacturer's instructions. Support tank from the structure. Adjust precharge to 60 psig unless otherwise indicated on the plans.

END OF SECTION 220420

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