

SECTION 220000 - PLUMBING GENERAL REQUIREMENTS

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This section of the specifications shall be applicable to all phases of plumbing work covered by specifications and drawings issued for this project.
- B. The "General Conditions of the Contract," "Supplementary General Conditions," and all other similar general requirements issued for this project shall apply to all plumbing work and are hereby made a part of this section.
- C. The Contractor and/or his representatives shall be fully acquainted with the design and operation of the systems and equipment described in these specifications and on the drawings.
- D. Work included under this section shall include complete systems as shown on the plans and as specified. Provide supervision, labor, material, equipment, machinery, plant, and other items necessary to complete the plumbing systems. It is the intention of these specifications and drawings to call for finished work, tested, and ready for operation.
- E. Definitions:
 - 1. "Owner" and "Contractor" shall mean the respective parties to the prime contract governing the project. Only one contractor is recognized as a party to this contract. Where the terms "Plumbing Contractor" or "Subcontractor" are used, it is for convenience only.
 - 2. "Architect/Engineer" shall mean the firm and authorized representatives of the firm engaged by the Owner for architectural and engineering services related to this project.
 - 3. "Plumbing" shall mean all work related to plumbing systems including sanitary and storm drainage, domestic water, gas, compressed air, fuel oil, and similar systems, including all related components, accessories, controls, and miscellaneous work required for a complete system.
 - 4. "Contract Documents" shall mean and include the agreement, the drawings and specifications and all modifications thereto authorized by the Owner in writing prior to final completion of the project.
 - a. The term "Agreement" shall mean the completed and signed contract form.
 - b. The term "Drawings" shall mean the drawings prepared by the Architect/Engineer for specific use in bidding and execution of the work.
 - c. The term "Specifications" shall include the legal and procedural documents, the general conditions, special conditions, and the technical specifications.
 - d. The term "Technical Specifications" shall mean that part of the specifications which describes, outlines, and stipulates the kind and quality of the materials to be furnished, the quality of workmanship required, and the methods to be used in the construction under the contract. For convenience, the plumbing portions of the technical specifications are arranged into one general section and several detailed sections related to the various trades represented in the work. Such arrangement and references shall not operate to make the Architect/Engineer an arbiter in establishing the limits of any subcontract or trade.

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5. "Work" of the Contractor shall mean labor or materials or both.
6. "As shown," "as indicated," "as detailed," or words of similar import shall mean reference to the drawings included in the contract documents, unless stated otherwise.
7. "As directed," "as required," "as permitted," "approved," or words of similar import shall mean that the direction, requirement, permission, approval, or acceptance of the Architect/Engineer is intended unless stated otherwise.
8. "As necessary" shall mean that which is necessary to achieve satisfactory completion of the work in order to provide the intended function and form of the project in compliance with the contract documents.
9. "Provide" shall mean "provide complete and in place," that is "furnish and install," ready for beneficial occupancy by the Owner. Except where stated otherwise, description of any work in the contract documents shall mean that the work shall be provided by the Contractor, even though the words "provide" or "furnish and install" do not accompany the description.
10. "Similar" shall be interpreted in a general sense and not as meaning identical, and all related details shall be worked out in respect to their location and their connection with other parts of the work.
11. Exposed: Piping and equipment exposed to view in finished rooms.
12. Option or Optional: Contractor's choice of an alternate material or method.
13. "Sprinkler" shall mean all work related to fire suppression systems including sprinkler, standpipe, fire pump, and similar work, including all related components, accessories, controls, and miscellaneous work required for a complete system.

1.2 INTENT OF CONTRACT DOCUMENTS

- A. The contract documents are complementary, and what is called for in one place shall be as binding as if called for in all places. Where variances occur between drawings and specifications or within either document itself, include in the contract price the item or arrangement of better quality, greater quantity, or higher cost. Agreement shall take precedence over the specifications and drawings. Figured dimensions shall be used in preference to scaling the drawings. In case of conflict between large and small scale drawings, the large scale drawings shall govern.
- B. The plumbing drawings show the general arrangement of all piping, equipment, and appurtenances and shall be followed as closely as actual building construction and the work of other trades will permit. The plumbing work shall conform to the requirements shown on the plumbing drawings. Architectural and structural drawings shall take precedence over plumbing drawings. Because of the small scale of the plumbing drawings, it is not possible to indicate all offsets, fittings, and accessories which may be required. The Contractor shall investigate the structural and finish conditions affecting the work and shall arrange his work accordingly, providing such fittings, valves, boxes, offsets, transitions, and other accessories as may be required to meet such conditions.

1.3 CODES AND STANDARDS

- A. All materials and workmanship shall comply with all applicable codes, state and federal laws, local ordinances, industry standards, utility company regulations, and all other criteria which normally apply to work of this nature.
- B. In case of difference between building codes, state laws, federal laws, local ordinances, industry standards, utility company regulations, other criteria and the contract documents, the more

stringent regulations will apply. The Contractor shall promptly notify the Architect/Engineer in writing of any such difference.

- C. If the Contractor performs any work that does not comply with these contract documents or the requirements of the applicable building codes, state laws, local ordinances, industry standards, utility company regulations, and other applicable criteria, he shall bear all costs arising in correcting the deficiencies.
- D. The standards referred to, except as modified in the specifications, shall have full force and effect as though printed in these specifications. The manufacturer and trades involved shall be familiar with the application of these standards.
- E. Applicable codes and standards shall include, but are not necessarily restricted to, the most recently recognized issues of the following:
 - 1. Building Codes:
 - a. Virginia Uniform Statewide Building Code
 - b. International Plumbing Code and accumulative supplements.
 - 2. Industry Standards, Codes, and Specifications:
 - a. AASHO American Association of State Highway Officials
 - b. ABA Architectural Barriers Act
 - c. ADA Americans with Disabilities Act
 - d. AGA American Gas Association
 - e. ANSI American National Standards Institute
 - f. ASHRAE American Society of Heating, Refrigeration, and Air Conditioning Engineers
 - g. ASME American Society of Mechanical Engineers
 - h. ASPE American Society of Plumbing Engineers
 - i. ASSE American Society of Sanitary Engineering
 - j. ASTM American Society of Testing and Materials
 - k. AWS American Welding Society
 - l. CISPI Cast Iron Soil Pipe Institute
 - m. CSA Canadian Standards Association
 - n. AWWA American Water Works Association
 - o. FS Federal Specification
 - p. MSS Manufacturer's Standardization Society of the Valve and Fittings Industry, Inc.
 - q. NBS National Bureau of Standards
 - r. NEC National Electrical Code
 - s. NSF National Sanitation Foundation
 - t. PDI Plumbing & Drainage Institute
 - u. UL Underwriters' Laboratories, Inc.
 - v. UFAS Uniform Federal Accessibility Standards (2012)

1.4 GOVERNMENTAL FEES, PERMITS, AND INSPECTIONS

- A. Under each applicable section of the detailed plumbing specifications, the Contractor shall obtain and pay for all required licenses, permits, charges for connections to outside services, fees and inspections. Upon completion of the work under each section of the detailed plumbing specifications, the Contractor shall furnish a certificate of final inspection to the Architect/Engineer from the governmental inspection department having jurisdiction.

1.5 VISITING THE SITE

- A. Each Contractor shall be responsible for visiting the site before bidding the job to familiarize himself with all existing conditions to be met in the execution of the work under this contract. No additional compensation will be allowed for any changes which may be required to make because of site conditions.

1.6 QUALITY ASSURANCE

- A. Product Criteria:

1. All materials shall be new and shall bear the manufacturer's name, trade name, and the UL label in every case where a standard has been established for this particular material. The equipment to be furnished shall be essentially the standard product of a manufacturer regularly engaged in the production of the required type of equipment, and shall be the manufacturer's latest approved design. All equipment shall bear a permanent and legible factory-applied nameplate to permit identification of manufacturer, model number and type of unit.
2. Equipment Service: Products shall be supported by a service organization which maintains an adequate inventory of repair parts and is located, in the opinion of the Architect/Engineer, reasonably close to the site.
3. Multiple Units: When two or more units of materials or equipment of the same type or class are required, these units shall be products of one manufacturer to provide for uniform appearance, operation, and maintenance.
4. Assembled Units: Manufacturers of equipment assemblies, which use components made by others, assume complete responsibility for the final assembled product.

- B. Manufacturers' directions shall be followed in the delivery, storage, protection, and installation of all equipment and materials. The Contractor shall promptly notify the Architect/Engineer in writing of any conflict between any requirements of the contract documents and the written instructions before proceeding with the work. If the Contractor performs any work that does not comply with the manufacturers' directions or such written instructions from the Architect/Engineer, he shall bear all costs arising in correcting the deficiencies.

- C. Factory Start-up by the manufacturer's Factory Certified Representative shall be provided where required for equipment specified to have factory start-up. Letters signed by the Representative stating that their equipment has been started, tested, and is operating safely shall be submitted to the Owner as part of the bound Operations and Maintenance Instructions manual specified in section 2.10 CATALOG DATA FOR OWNER of this specification.

1.7 BIDDING INSTRUCTIONS

- A. Products are generally specified by a performance specification and/or by manufacturer's name and model number or trade name.
- B. When specified only by a performance specification, the Contractor may use any manufacturer who meets the performance specification and applicable codes. (The Contractor shall be subject to the requirements of 1.9 - SHOP DRAWINGS.)
- C. When several products/manufacturers are specified together, then the Contractor has the option of using any product/manufacturer listed. The Contractor shall be subject to the requirements of 1.9 - SHOP DRAWINGS. The Contractor's bid shall be compiled on the use of the listed products without exception. Substitutions will only be considered after the contract has been executed and shall be subject to the requirements of 1.8 - SUBSTITUTIONS.
- D. When several products/manufacturers are specified together and the system design is based on one of the listed products by specific model number(s) or catalog number(s), then the Contractor has the option of using the one specific product or any other product/manufacturer listed. In either case, the Contractor shall be subject to the requirements of 1.9 - SHOP DRAWINGS. However, when the other listed product/ manufacturer is used, the Contractor shall be responsible for determining that the product(s) will be compatible with building design, electrical design, plumbing design, and the product(s) will not necessitate design modifications by the Architect/Engineer. The Contractor's bid shall be compiled on the use of the listed products without exception. Substitutions will only be considered after the Contract has been executed and shall be subject to the requirements of 1.8 - SUBSTITUTIONS. If the products/manufacturer are listed to be "only," then substitutions will not be considered.
- E. When only one manufacturer's name is listed, this shall be the basis of the bid. The Contractor's bid shall be compiled on the use of the listed product. Substitutions will only be considered after the Contract has been executed and shall be subject to the requirements of 1.8 - SUBSTITUTIONS.

1.8 SUBSTITUTIONS

- A. Substitutions will not be considered during the bid.
- B. After the Contract has been executed, the Architect/Engineer will consider a formal request for a review of substituted products in place of those specified, under the following conditions:
 - 1. Not later than 30 days from the Contract Date, the Contractor shall provide a list of products proposed as substitutions, including the name, manufacturer, and section of the specifications governing the product.
 - 2. The request shall be accompanied by accurate cost data on the proposed substitutions indicating whether or not a modification of the Contract Sum is to be considered.
- C. Substitutions are understood to mean that the installing Contractor:
 - 1. Has personally investigated the proposed substitute and has determined that it is equal or superior in all respects to the item specified;
 - 2. Will provide the same guarantee for the substitution that he would for the item or equipment specified;
 - 3. Certifies that the cost data is complete and includes all related costs under this Contract, and waives all claims for additional cost related to the installation of the accepted substitute;

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4. Has coordinated the installation of the substitute, providing design modifications and changes as required for the work to be complete in all respects;
 5. Has coordinated the installation of the substitute with the General Contractor pertaining to changes required for the work to be complete with all trades and all changes shall be provided without additional cost to the Owner.
- D. The acceptance by the Architect/Engineer of any or all of those substitute items listed by the Contractor for review shall not constitute an approval of the substitute but shall mean that the Contractor may then submit detailed shop drawings for review.
- E. When a request for substitution is granted, shop drawings will be reviewed by the Architect/Engineer. Shop drawings not complete with proper review information will not be reviewed and will be returned unchecked. If after two submittals, the substitute equipment is not approved, the specified equipment shall be provided.

1.9 SHOP DRAWINGS

- A. Shop Drawings are required for all material and equipment that is specified by a manufacturer's name or as indicated in the technical specifications. Furnish the number of copies required by the General and Special Conditions of the Contract, but in no case less than six (6) copies. Submittal data for related equipment shall be submitted at one time.
- B. Substitutions will not be considered if:
1. They are indicated or implied on shop drawing submissions without information specified in 1.8 - SUBSTITUTIONS.
 2. They require a substantial revision of the Contract Documents in order to accommodate their use.
- C. Identify submittals with PROJECT NAME and NUMBER, CONTRACTOR'S NAME, SECTION NUMBER & NAME, and PARAGRAPH NUMBER of SPECIFICATION GOVERNING, MANUFACTURER, MODEL or STYLE, and CONTRACTOR's REVIEW STAMP. Submittals shall be detailed, dimensioned drawings showing construction, size and arrangement, service clearances, performance characteristics, and capacity. Where submittals are provided that include multiple types or styles of the specified item and/or multiple options, the exact item and options being submitted shall be CLEARLY MARKED on the submittal sheet. Submittals not properly identified or containing information of a general nature will not be reviewed and will be returned unchecked.
- D. Acceptance of shop drawings shall not be considered as a guarantee of measurements or building conditions. Acceptance shall not relieve the Contractor from the responsibility or necessity of furnishing material or performing work required by the drawings and specifications. Submittal data on any one item shall not be reviewed more than three (3) times. If not accepted after the third review, the Contractor shall provide the equipment upon which the design was based.
- E. Failure to submit shop drawings in ample time for checking shall not entitle an extension of contract time, and no claim for extension by reason of such default will be allowed.
- F. No material or equipment, for which submittals are required, may be delivered to or installed at the job site until submittals have been accepted.

- G. Unless a specific finish is indicated in the contract documents, wherever a choice of finish is available for the specified item, submit accurate color chips or charts to the Architect for review and selection.

1.10 COMMISSIONING

- A. Requirements common to all plumbing specification sections are specified in Section 01 91 13. The Contractor is referred to Section 01 91 13 for details and Contractor responsibilities relative to the commissioning process. All requirements of the commissioning process relative to the construction contract are included in specification section 01 91 13. The commissioning will be performed by the Owner's representative and is not part of the Construction Contract except as it relates to the responsibilities and information required to coordinate with the Owner's representative that is performing the commissioning.

PART 2 – PRODUCTS

2.1 DRIVE GUARDS

- A. For machinery and equipment, provide guards as shown in AMCA 410 for belts, chains, couplings, pulleys, sheaves, shafts, gears and other moving parts regardless of height above the floor. Drive guards may be excluded where motors and drives are inside factory fabricated unit casings.
- B. Materials: Sheet steel, cast iron, expanded metal or wire mesh rigidly secured so as to be removable without disassembling pipe, duct, or electrical connections to equipment.
- C. Access for Speed Measurement: One inch diameter hole at each shaft center.
- D. Lubrication: Guards shall not interfere with lubrication of equipment.

2.2 PAINTING

- A. General - Paint plumbing equipment and material in Equipment Rooms and utility type areas and located outside of the building or on the roof. Painting of equipment and material in finished rooms or areas shall be accomplished as described in PAINTING Section of the Architectural Specifications. Painting in concealed spaces shall be limited to equipment and materials not otherwise protected from rusting such as hangers and supports. Paint shall be products of Sherwin-Williams, Pittsburgh, or Pratt-Lambert. All paints, finishes and coatings shall comply with Green Seal Standards GS-03, GS-11, and SCAQMD Rule #1113 VOC limits for paints and coatings.
- B. Workmanship - The work shall be accomplished by workmen skilled in the painting trade after testing is complete and systems are ready for operation. Surfaces to be painted shall be completely dry before applying paint. Surfaces shall not be painted when the temperature is below 50 Deg. F or above 120 Deg. F, or when they are exposed to hot sun. Materials shall be evenly spread and smoothly flowed on without runs or sags. Each coat shall be thoroughly dry before application of succeeding coat. The painters shall protect adjacent surfaces with drip covers during the process of painting. Upon completion, paint spots, if any, shall be removed from adjacent surfaces.

- C. Preparation of surface - Metal surfaces shall be cleaned with solvent before applying materials. Rust and scale shall be removed by wire brushing or sanding. Galvanized surfaces shall be pretreated with a phosphoric acid cleaning solution and primed with Sherwin-Williams "Galvanized Iron Primer."

- D. Painting - After preparation as described above, each item shall be painted as follows, except color of paint for equipment and material located outside of the building or on the roof shall be as selected by the Architect.
 - 1. Painting is not required of equipment, equipment supports, and hangers with a factory-finish coat. Patch painting is required of any damaged areas to match factory-finish coat. Painting is required where equipment or equipment supports do not have factory-finish paint. Equipment and associated hangers and supports shall be primed with one coat of alkyd, zinc potassium chromate metal primer, except insulated surfaces shall be primed with one coat Sherwin-Williams "Wall Primer and Sealer." Finish with two coats of Sherwin-Williams "Metalastic II-Steel Gray" Enamel. Exterior of belt guards and other protective guards shall be finished with two coats of machinery enamel in OSHA yellow color. Interior of items covered by belt guards and other protective guards shall be finished with two coats of machinery enamel in OSHA orange color. Nameplates on equipment shall not be painted.
 - 2. Exposed pipes, conduits, and associated hangers exposed in equipment rooms and other unfinished areas such as storage areas shall have two finish coats of paint of the same color as adjacent walls or ceilings. Bare copper pipe shall not be painted. Canvas or paper jacket insulation of pipes exposed in unfinished areas shall be primed with Sherwin-Williams "Wall Primer and Sealer" before final two coats of paint. Hangers and supports in concealed areas not protected by factory-finish paint shall have one coat of Sherwin-Williams "Kromik Metal Primer."
 - 3. All exposed gas piping and fittings, interior and exterior, shall be painted, coated or wrapped as described in Section 22 60 00 and this section as applicable.

- E. Identification of pipes and equipment:
 - 1. Equipment - Each piece of equipment shall be identified by stenciled marking that will read the same as the identification shown on plumbing drawings. Stencil letters shall be 2 inches high upper case painted with Sherwin-Williams "Metalastic II" white enamel.
 - 2. Pipes shall be identified using pre-printed markers sized appropriately for the pipes being identified (shop drawings required). Markers shall be Seton "Setmark" type or approved equal or equivalent stencil. Pipe identification shall meet the most current edition of ANSI Specification A13.1. Apply a minimum of two complete wraps of tape at each end of pre-printed pipe markers equal to Seton Style #AR or approved equal. Markers shall be located close to valves or flanges and adjacent to changes in direction, branches and where pipes pass through walls or floors, and at maximum intervals of 15 feet on straight runs. Provide a Color Code Chart, framed with glass front, indicating piping service and color code schedule. Post in Mechanical Room where directed by Engineer.
 - 3. Color code schedule

COLOR BANDING CODE

Number	Color	Catalog Number
1.	Orange	No. F65 E 36
2.	Blue	No. F65 L 3

3.	Brown	No. F65 N 11
4.	Red	No. F65 R 1
5.	Black	No. F65 B 1
6.	Yellow	No. F65 Y 48
7.	Green	No. F65 G 40

4. Pipe shall be identified with flow arrows as described below

- a. Arrows shall be stencil type.
- b. Arrows shall be readable from floor.
- c. Arrows shall be installed every 15'-0" maximum.
- d. Arrows shall be painted on pipes.

F. Identification of Valves: Properly mark service and control valves. Valve markers shall be metal tags with designations stamped thereon or laminated engraved plastic chained with jack chains (not beaded chains) to their respective valves. Identification symbols or designations shall be the same as shown on the Contract Documents.

G. Equipment locations above acoustic tile ceilings: Provide colored brass push-pins complete with a minimum 1/2" shank and 5/8" diameter head. Pin head color shall be blue or color as selected by Architect or Owner. Locate push-pins directly below all scheduled plumbing equipment.

2.3 MOTORS, CONTROL, AND ELECTRICAL WIRING

A. Provide motors in accordance with NEMA Standards and suitably designed to match the starting and running characteristics of the driven equipment. Unless indicated otherwise, motors less than 1/2 horsepower shall be wound for 120 volt, single phase, 60 hertz. Motors 1/2 horsepower and above, unless indicated otherwise, shall be wound for three phase, 60 hertz, 200 volt, 230 volt, or 460 volt as required by the system voltage. Select motors coordinated with the utilization voltage and phase. Motors for equipment with VFD shall be matched to the VFD.

B. All starters and safety switches, except for those specified to be furnished with the plumbing equipment, shall be furnished as part of the Electrical Work - Division 26.

C. Starters and safety switches furnished with the plumbing equipment shall comply with the specifications of Division 26. Starters furnished as an integral part of the plumbing equipment shall be complete with properly sized overload heaters. Integral 3-phase motor starters and VFD's shall be provided with phase loss relay as specified in Division 26.

D. Domestic water temperature control wiring, equipment control wiring, and interlock wiring necessary for the proper sequence of operation of plumbing equipment shall be furnished as part of the Plumbing Work. Control wiring is any wiring, regardless of voltage, related to plumbing equipment that is not the equipment power circuit from the circuit breaker in the panelboard to the motor starter or safety disconnect switch and to the motor or equipment junction box. Where control devices (On-Off switch, Aquastat, etc.) that are intended to interrupt the motor or equipment power circuit are provided by the Plumbing Contractor and are mounted other than on or directly adjacent to the controlled equipment, the Plumbing Contractor shall provide wiring through these devices regardless of voltage or phases. All wiring shall conform to applicable sections of Divisions 26, 27, and 28 of the specifications. All low voltage control wiring in inaccessible areas or in exposed areas shall be in metal conduit and shall comply with the specifications of Divisions 26, 27, and 28. All low voltage control wiring in unexposed, accessible areas shall be wire in conduit or U.L. approved plenum rated cable supported from

the structure with ties spaced 3'-0" on center. All 120 volt wiring shall be wire in conduit and shall comply with the specifications of Divisions 26, 27, and 28 of the specifications.

- E. All equipment that has electrical connections shall have wiring terminals/connectors rated for not less than 75 deg. C. If terminals/connectors are provided that are rated for less than 75 deg. C., the mechanical contractor shall incur all costs associated with upsizing wire and conduit as required by the National Electrical Code.

2.4 FIRE-STOPPING

- A. Pipe penetrations of rated walls, floors, and floor-ceiling assemblies shall be constructed in accordance with Underwriter's Laboratories, Inc., Fire Resistance Directory, Volume II, Hourly Ratings for Through Firestop Penetrations. The Contractor shall provide U.L. firestop penetrations according to the particular wall, floor, or floor-ceiling assembly rating, construction type, pipe material, pipe size, insulation requirements, sleeve requirements, and the contractor's choice of firestop products as listed by U.L. Refer to the architectural drawings for the wall, floor, or floor-ceiling assembly construction types and ratings.

2.5 PIPE AND EQUIPMENT SUPPORTS AND RESTRAINTS

- A. Under each applicable section of the detailed plumbing specifications, the Contractor shall furnish and install all accessories, connections, bases, guards, supports, and incidental items necessary to fully complete the work, ready for use, occupancy, and operation by the Owner.
- B. Type Numbers Specified: MSS SP-58; for selection and application, MSS SP-69. Refer to Division 05, METALS, for miscellaneous metal support materials and prime coat painting.
- C. For Attachment to Concrete Construction:
 - 1. Concrete Insert: MSS SP-69, Type 18
 - 2. Self-Drilling Expansion Shields and Machine Bolt Expansion Anchors: Fed. Spec. FF-S-325, permitted in concrete not less than four inches thick. Applied load shall not exceed one-fourth the proof test load listed in Fed. Spec. FF-S-235.
 - 3. Power-Driven Fasteners: Permitted in existing concrete or masonry not less than four inches thick when approved by the Architect/ Engineer for each job condition. Use fasteners capable of supporting a 1000 pound test load, with the actual load not exceeding 50 pounds.
- D. For Attachment to Steel Construction; MSS SP-69:
 - 1. Welded Attachment: Type 22.
 - 2. Beam Clamps: Types 20, 21, 28 or 29. Type 23 C-clamp may be used for individual copper tubing up to 7/8-inch outside diameter.
- E. Attachment to Metal Pan or Deck: As required for materials specified in Division 05 - METALS.
- F. For Attachment to Wood Construction: Wood screws or lag bolts.
- G. Hanger Rods: Hot-rolled steel, ASTM A 36 or A 575 for allowable load listed in MSS SP-58. For piping, provide adjustment means for controlling level or slope. Types 13 or 15 turnbuckles shall

provide 1-1/2 inches minimum of adjustment and incorporate locknuts. All-thread rods are acceptable.

- H. Multiple (Trapeze) Hangers: Galvanized, cold formed, lipped steel channel horizontal member, not less than 1-1/2 inches by 1-1/2 inches, No. 12 gage, designed to accept special spring held, hardened steel nuts. Not permitted for condensate piping, fire and sprinkler piping or chemical waste drain piping.
1. Allowable Hanger Load: Manufacturers rating less 200 pounds.
 2. Guide individual pipes on the horizontal member of every other trapeze hanger with 1/4-inch U-bolt fabricated from steel rod. Provide Type 40 insulation shield, secured by two 2-inch galvanized steel bands, for insulated piping at each hanger.
- I. Pipe Hangers and Supports: Use hangers sized to encircle insulation on insulated piping. Refer to Section 22 07 00 - PLUMBING INSULATION, for insulation thickness. To protect insulation, provide Type 39 saddles for roller type supports. Provide Type 40 insulation shields at all other types of supports and hangers including those for pre-insulated piping.
1. General Types (MSS SP-69):
 - a. Standard Clevis Hanger: Type 1; provide locknut
 - b. Riser Clamps: Type 8 or 42
 - c. Wall Brackets: Types 31, 32, or 33
 - d. Saddle Support: Type 36, 37, or 38
 - e. Roller Support: Type 41, 43, or 46
 - f. Turnbuckle: Types 13 or 15
 - g. U-Bolt Clamp: Type 24
 - h. For Uninsulated Copper Tube: Material compatible for use with copper to prevent electrolysis
 - i. Supports for Plastic Piping: As recommended by the pipe manufacturer
 2. Plumbing Piping:
 - a. Sprinkler System: NFPA or Factory Mutual approved types.
 - b. Horizontal Piping: Types 1, 5, 7, 9, and 10
 - c. Chrome Plated Piping: Chrome plated supports
 - d. Hangers and Supports in Pipe Chase: Prefabricated system ABS self-extinguishing material, not subject to electrolytic action, to hold piping, prevent vibration, and compensate for all static and operational conditions
 - e. Blocking, Stays and Bracing: Angle iron or preformed metal channel shapes, 18 gage minimum
- J. Support hubless cast iron pipe and fittings per CISPI 301-12. Brace hubless cast iron pipe and fittings 5 inches and larger using Holdrite 117 Series No-Hub Pipe and Fitting Restraints or approved equal.
- K. Concrete Equipment Bases: Unless otherwise noted on the drawings or in the specifications, concrete pads and bases not less than 4 inches high and which project not less than 3 inches beyond the equipment on all sides shall be provided for floor-mounted equipment which normally requires foundations. Concrete shall conform to requirements in the concrete section of these specifications. The trade responsible for the supported equipment shall establish sizes and locations of the various concrete bases required and shall provide all necessary anchor bolts, together with templates for holding these bolts in position. Anchor bolts shall be placed in

steel pipe sleeves to allow for adjustment, with a suitable plate at bottom end of sleeve to hold the bolt. When indicated in the drawings or detailed specifications, other floor-mounted items of equipment shall have a similar concrete base. Special vibration isolation foundations that are required are specified in the detailed specifications.

2.6 PIPE SLEEVES

- A. Locate sleeves during normal course of work. Provide sleeves for piping and conduit passing through concrete floor slabs and concrete, masonry, tile, and gypsum wall construction. Sleeves shall not be provided for piping and conduit running embedded in concrete or slab on grade, except that copper piping shall require sleeves through slabs on grade. Sleeves through structural members shall be only as directed by Architect. In interior wall, provide 1/4 inch space all around between sleeve and conduit, piping, or insulation of piping.
- B. Sleeves placed in exterior walls below grade shall be O.Z. Gedney Type 'FSK' or equal, Thunderline 'LINK SEAL', or equal sleeve assemblies sized for the pipe or conduit encountered, except for cast iron piping. Sleeve assembly shall provide watertight seal and electrical insulation to reduce cathodic reaction. When a sleeve passes through a wall below a concrete slab on grade, the sealing assembly shall be on the outside of the wall. When a sleeve passes through a wall into a crawl space or the building interior, the sealing assembly shall be in the crawl space or interior of the building. Provide sleeve assembly for copper piping through slab on grade, with sealing assembly located on interior side of floor slab. Where cast iron pipes pass through an exterior wall below grade, provide an iron-pipe sleeve two (2) pipe sizes greater than pipe passing through. Caulk between pipe and sleeve with a rubber-based compound.
- C. Where sleeves are located through fire-rated walls and floor/ceiling assemblies, provide sleeves and protect the penetration in accordance with Underwriter's Laboratories, Inc., Fire Resistance Directory, Volume II, Ratings for Through Firestop Penetrations.
- D. Sleeves in mechanical rooms with floor drains or hose bibbs shall extend 4 inches above floor. Provide flanges or flashing rings with sleeves in floors with waterproof membrane and clamp or flash into the membrane. Provide sleeves flush with floor in other rooms.
- E. Sleeves shall be constructed of 20 gage galvanized sheet steel with lock seam joints for all sleeves set in concrete floor slabs terminating flush with the floor. All other sleeves shall be constructed of galvanized steel pipe unless otherwise indicated.
- F. Fasten sleeves securely in floors or walls so that they will not become displaced when concrete is poured or when other construction is built around them. Take precautions to prevent concrete, plaster, or other materials from being forced into the space between pipe and sleeve during construction.

2.7 WALL, FLOOR AND CEILING PLATES (ESCUTCHEONS)

- A. Material and Type: Chrome plated brass or chrome plated steel, one piece or split type with concealed hinge, with setscrew for fastening to pipe, or sleeve. Use plates that fit tight around pipes, cover openings around pipes, and cover the entire pipe sleeve projection.
- B. Thickness: Not less than 3/32-inch for floor plates. For wall and ceiling plates, not less than 0.025 for up to 3-inch pipe, 0.035 for larger pipe.

- C. Locations: Use where pipe penetrates floors, walls and ceilings in exposed locations, except mechanical rooms.

2.8 ACCESS PANELS

- A. Under each applicable section of the detailed plumbing specifications, the Contractor shall provide access panels in all locations where required for access to concealed valves, traps, air cushions, controls, and any other equipment or materials requiring inspection or maintenance. Access panels shall be of adequate size and properly located so that concealed items will be readily accessible for servicing or for removing and replacing if necessary, except as indicated or specified otherwise. Access panels are not required in ceilings formed of removable acoustical panels.
- B. Access panels that are not fire-rated shall be Milcor or equal. Provide modular-sized access panels in inaccessible acoustic tile ceilings sized according to the tile size. Provide Milcor metal access panels with cam lock, continuous hinge and mounting trim to match finish encountered. Provide natural anodized aluminum finish for panels in kitchens and toilets. Provide prime finished steel for panels in other areas. Paint panels in finished areas to match finish surface.
- C. Where indicated and where access panels are installed in walls of shafts that are not sealed at each floor, access panels shall be Milcor or equal "Fire-Rated" and shall bear the Underwriters' Laboratories, Inc. Class B, 1-1/2 hour label. Openings shall be framed in accordance with the access panel manufacturer's recommendations. Frames shall be not lighter than 16-gage steel. Panels shall be not lighter than 20-gage steel and shall be insulated sandwich type. Panels shall have a continuous hinge, self-lubricating lock, a direct action-knurled knob, and an interior latch release mechanism.

2.9 CHARTS, DIAGRAMS, AND SCHEMES

- A. Charts, diagrams, and schemes listed below shall be provided under each applicable section of the detailed plumbing specifications by the Contractor, framed under glass, and installed where shown on the drawings or directed in the field. All charts, diagrams, and schemes shall be complete, neat, clear, legible, and permanent.
- B. Valve identification chart with typewritten schedule of all valves giving their tag number, description, system served, and normal operation position.
- C. Piping schemes where required by the detailed specifications.

2.10 CATALOG DATA FOR OWNER

- A. Furnish one (1) bound copy and one (1) electronic copy of Catalog Data on each manufactured item of equipment used in the plumbing work, complete with index listing the products alphabetically by name, together with the names and addresses of manufacturers, sales, and service representatives. Furnish two (2) bound copies and one (1) electronic copy of Operating and Maintenance Instructions of each item of equipment. Catalog Data and Operating and Maintenance Instructions shall be submitted to the Engineer for review prior to transmittal to the Owner.

2.11 RECORD OF AS-BUILTS AND CONDITIONS

- A. Provide a complete set of prints and one (1) electronic copy of plumbing plans marked to indicate as-built conditions which are different from those shown on the original construction documents. Site as-built conditions which are different from the construction documents shall be dimensioned from building or identifiable marker. Accurate locations of all concealed utility lines, both interior and exterior shall be recorded. These drawings shall be delivered to the Architect/Engineer before being turned over to the Owner.

PART 3 – EXECUTION

3.1 INSTALLATION

- A. Coordination of Work:
 - 1. The Contractor shall compare the plumbing drawings and specifications with the drawings and specifications of other trades, and shall report any discrepancies between them to the Architect/Engineer, and shall obtain from him written instructions for changes necessary in the plumbing work. The plumbing work shall be installed in cooperation with other trades installing interrelated work. Before installation, the Contractor shall make proper provision to avoid interferences in a manner approved by the Architect/Engineer. All changes required in the work of the Contractor caused by his neglect to do so shall be made by him at his own expense.
 - 2. Anchor bolts, sleeves, inserts, and supports that may be required for the work shall be fully coordinated and compatible with the related equipment or materials. Locations shall be determined by the trade installing the related equipment or materials.
 - 3. Slots, chases, openings, and recesses through floors, walls, ceilings, roofs, and partitions shall be located by the trades requiring them.
 - 4. Locations of pipes, equipment, fixtures, etc., shall be adjusted to accommodate the work to interferences anticipated and encountered. The installing Contractors shall coordinate their work to the building structure and to other trades as directed by the General Contractor. No additional compensation or extension of completion time will be granted for extra work caused by a lack of coordination. The installing Contractor shall provide dimensions and locations of all openings, shafts, and similar items to the General Contractor for his coordination and execution. Work shall be installed as required so as not to interfere with or delay the building construction. Pipes, etc., shall be concealed above ceilings, in walls, or in floors as applicable in all areas of the building except in equipment rooms, unfinished storage rooms, or other areas specifically noted to the contrary.
 - a. Right-of-Way: Lines which pitch shall have right-of-way over those which do not pitch. For example, plumbing drains shall normally have right-of-way. Lines whose elevations cannot be changed shall have the right-of-way over lines whose elevations can be changed.
 - b. Offsets, transitions, and changes in direction of pipes shall be made as required to maintain proper head room and pitch of sloping lines whether or not indicated on the drawings. The Contractor shall furnish and install all traps, drains, sanitary vents, etc., as required to affect these offsets, transitions, and changes in direction.
 - 5. Exact locations of items such as hose bibbs, wall hydrants and other similar items in finished areas of the building and on the exterior of the building shall be coordinated with

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each other, the building structure, and architectural features thereof so as to be aligned with or centered on other items as applicable. Locations indicated on the drawings are approximate. Trades shall coordinate their work with door swings, block coursing, tile arrangement, required clearances and other similar features before establishing the location of any components. Before any related work has begun, the Architect/Engineer may direct reasonable minor changes in equipment locations with no increase in contract price to the Owner. Before roughing in conduit or pipe, verify the location of equipment to be connected.

6. Installation and Arrangement: The Contractor shall install all plumbing work to permit removal of all parts requiring periodic replacement or maintenance. The Contractor shall arrange pipes and equipment to permit ready access to valves, cocks, traps, motors, control components, and to clear the openings of swinging and overhead doors and of access panels.
7. Drawings by Contractor: When directed by the Architect/Engineer, the Contractor shall submit for review by Architect/Engineer drawings clearly showing certain portions of the plumbing work and its relation to the work of other trades before beginning shop fabrication or erection in the field.
8. Dimensions: The Contractor shall ensure that items to be furnished fit the space available. He shall make necessary field measurements to ascertain space requirements, including those for connections, and shall furnish and install such sizes and shapes of equipment that the final installation shall suit the true intent and meaning of the drawings and specifications. If he concludes that there is insufficient space for installation or specified materials, he shall immediately notify the Architect/Engineer of the conflict and shall stop affected work until he receives instructions as to how to proceed from the Architect/Engineer.
9. Damage to Work: The Contractor is responsible for damage caused by his work or workmen. Repairing of damaged work shall be done by the Contractor as directed by the Engineer at no additional cost.
10. Connections to Existing Facilities, Piping Systems, Etc: All connections to existing facilities, piping systems, etc., shall be made as required or deemed necessary to insure the maintenance of continued operation of the above and provide the very minimum of interruption. This Contractor shall make such temporary connections as may be required to facilitate this work and to protect the existing building from damage. Any work which will in any way affect the continued operation of any existing facility shall be coordinated with the proper authorities as well as the Architect-Engineer before any service is interrupted.
11. The Contractor shall be responsible for any interruptions to existing services and shall repair any damages to existing systems caused by his operations.

B. Protection and Cleaning:

1. Equipment and materials shall be carefully handled, properly stored, and adequately protected to prevent damage before and during installation, in accordance with the manufacturer's recommendations. Damaged or defective items, in the opinion of the Architect/Engineer, shall be replaced.
2. All items subject to moisture damage (such as controls and electrical equipment) shall be stored in dry, heated spaces.
3. Protect all finished parts of equipment, such as shafts and bearings where accessible, from rust prior to operation by means of protective grease coating and wrapping. Close pipe openings with caps or plugs during installation. Tightly cover and protect fixtures and equipment against dirt, water, chemical or mechanical injury. Clean plumbing equipment to remove dust, oil, dirt, plaster, mortar, trash, or paint. Piping and conduit shall be blown

out or flushed of all foreign matter before wires are pulled in or before connections are made to equipment or systems.

- C. Protection of Electrical Equipment: Plumbing and sprinkler piping shall NOT be installed directly over electrical panelboards, switchboards or motor control centers, unless the pipe is a minimum of 6 feet above the electrical equipment or above a structural ceiling (concrete cap or similar). If compliance with this requirement is not possible, notify the engineer immediately. If the piping is directly above and at least 6 feet above the electrical equipment, provide a galvanized steel drain pan installed directly under the piping. Drain pan shall have minimum 2 inch high sides with a drain pipe connection at the lowest point and shall be full width of the electrical equipment being protected. Extend drain pipe to exterior or to nearest floor drain.
- D. Concrete and Grout: Use concrete and shrink compensating grout 3000 psi minimum.
- E. Install gages, thermometers, valves and other devices with due regard for ease in reading or operating and maintaining said devices. Locate and position thermometers and gages to be easily read by operator standing on floor or walkway provided. Servicing shall not require dismantling adjacent equipment or pipe work.
- F. Work in Existing Building:
 - 1. Cut required openings through existing masonry and reinforced concrete using diamond core drills. Use of pneumatic hammer type drills, impact type electric drills, and hand or manual hammer type drills will be permitted only with approval of the Architect/Engineer. Locate openings that will least effect structural slabs, columns, ribs or beams. Refer to the Architect/Engineer for determination of proper design for openings through structural sections and opening layouts approval, prior to cutting or drilling into structure. After Architect/Engineer's approval, carefully cut opening through construction not larger than is absolutely necessary for the required installation.
 - 2. Remove existing work as necessary to install new work. Except as otherwise shown or specified, do not cut, alter or remove any structural work or any ducts, plumbing, steam, gas or electric work without approval of Architect/Engineer. Existing work (walls, ceilings, partitions, floors, mechanical, and electrical work) disturbed or removed as a result of performing required new work shall be patched, repaired, reinstalled, replaced with new work, and refinished and left in as good condition as existed before commencing work. Existing work to be altered or extended that is found to be defective in any way shall be reported to the Architect/Engineer before it is disturbed. Materials and workmanship used in restoring work shall conform in type and quality to that of original existing construction, except as otherwise shown or specified.
 - 3. Continuity of service shall be maintained to all existing systems, except for designated short intervals during which connections are to be made. Interruptions shall be coordinated with the Owner as to the time and duration.
 - 4. Upon completion of contract, deliver work complete and undamaged. Damage that is caused by Contractor or Contractor's workmen to existing structures, grounds, or utilities or to work done by others shall be repaired by Contractor and left in as good condition as existed prior to damaging.
 - a. At Contractor's own expense, Contractor shall immediately restore to service and repair any damage caused by Contractor's workmen to existing piping and conduits, wires, cable, etc., of utility services or of fire protection system and communications systems (except telephone) which are not scheduled for discontinuance or abandonment.

- b. Restoration work required by damage to telephone systems shall be done by telephone company at Contractor's expense.

3.2 GENERAL PIPING INSTALLATION

- A. Under each applicable section of the detailed plumbing specifications, the Contractor shall furnish and install as shown on the drawings or as necessary to complete the working system in accordance with the intent of the drawings and specifications, a complete system of piping, valves, supports, anchors, sleeves, and all other appurtenances. The piping drawings are diagrammatic and indicate the general location and connections. The piping may have to be offset, lowered, or raised as required or as directed at the site. This does not relieve the Contractor of responsibility for the proper erection of systems of piping in every respect suitable for the work intended as described in the specifications and as approved by the Architect/Engineer. Wherever two dissimilar metals join in any piping system, install a dielectric fitting at their intersection.
- B. Erection: Piping shall be properly supported and adequate provisions shall be made for expansion, contraction, slope, and anchorage without damage to joints or hangers. All piping shall be cut accurately for fabrication to measurements established at the construction site. Pipe shall be worked into place without springing and/or forcing, properly clearing all windows, doors, and other openings and equipment. Cutting or other weakening of the building structure to facilitate piping installation will not be permitted without written approval. Pipe extending through the roof shall be properly flashed. All changes in direction shall be made with fittings. Wherever pipe hanger bears directly on the pipe being supported, the hanger shall be of the same material as the pipe.
- C. Arrangement: All piping shall be arranged so as not to interfere with removal of other equipment or devices nor to block access to doors, windows, manholes, or other access openings. Piping shall be arranged so as to facilitate removal of tube bundles. Flanges or unions, as applicable for the type of piping specified, shall be provided in the piping at connections to all items of equipment. Piping shall be placed and installed so that there will be no interference with the installation of the equipment, ducts, etc. All piping shall be installed to ensure noiseless circulation. All piping shall be erected and pitched to ensure proper drainage. Piping shall be installed so as to avoid liquid or air pockets throughout the work. Pipe in finished areas shall be concealed. Install piping generally parallel to walls and column centerlines, unless shown otherwise on the drawings. Space piping, including insulation, to provide one inch minimum clearance between adjacent piping or other surface. Pipe shall be installed to permit free expansion and contraction without damage to joints or hangers. Exposed piping shall be installed in practical alignment with the building. All valves and specialties shall be placed to permit easy operation and access, and all valves shall be regulated, packed, and glands adjusted at the completion of the work before final acceptance. Water pipes shall not be installed in attic spaces, crawl spaces, exterior walls or similar areas which are subject to freezing, unless indicated to be heat traced.
- D. Installation of Underground Pipe: Each pipe shall be laid true to line and grade and in such manner as to form a close concentric joint with adjoining pipe and to prevent sudden offsets to flow line. As work progresses, the interior of the pipe shall be cleared of dirt and superfluous materials of every description. Where cleaning after laying is difficult because of small pipe size, a suitable swag or drag shall be kept in the pipe and pulled forward past each joint immediately after jointing has been completed. Trenches shall be kept free from water until pipe jointing material has set. Pipe shall not be laid when the condition of the trench or weather is unsuitable

for such work. At all times when work is not in progress, all open ends of pipe and fittings shall be securely closed so that no water, earth, or other substance will enter the pipe or fittings.

3.3 PIPE AND EQUIPMENT SUPPORTS

- A. Supports: The Contractor shall support plumb, rigid, and true to line all work and equipment furnished under each section of these specifications. The Contractor shall study thoroughly all general, structural, and plumbing drawings, shop drawings, and catalog data to determine how equipment, fixtures, piping, ductwork, etc., are to be supported, mounted, or suspended, and shall provide extra steel bolts, inserts, pipe stands, brackets and accessories for proper support, whether or not shown on the drawings. When directed, the Contractor shall submit drawings showing supports for review by the Architect/Engineer.
- B. Where hanger spacing does not correspond with joist or rib spacing, use structural steel channels secured directly to joist and rib structure that will correspond to the required hanger spacing, and then suspend the equipment and piping from the channels. Drill or burn holes in structural steel only with the prior approval of the Architect/Engineer.
- C. Use of chain, wire or strap hangers; wood for blocking stays or bracing; or hangers suspended from piping above will not be permitted. If products are rusty, replace or thoroughly clean and coat with prime paint.
- D. Use hanger rods that are straight and vertical. Turnbuckles for vertical adjustments may be omitted where limited space prevents use. Provide a minimum of 2-inch clearance between pipe or pipe covering and adjacent work. Pipe hanger rods shall be attached to the top chord only on steel joists and beams by joist or beam clamps, without welding. Where clamps cannot be attached to the top chord of joists or beams, trapeze hangers shall be provided.
- E. Horizontal Pipe Support Spacing:
 - 1. Cast Iron: Five feet on centers maximum spacing. At least one hanger on each full length of pipe, close to hub where possible and at least one within 24 inches of each fitting, and wherever else required to prevent tendency toward deflection due to load. Provide a hanger at upper angle at each drop. Locate hangers adjacent to hubs on multiple fittings not more than four feet on centers.
 - 2. Plastic and Glass Pipe: Support in accordance with manufacturer's recommendations.
 - 3. For support spacing of all other horizontal piping, refer to MSS SP-69 and provide additional supports at valves, strainers, inline pumps and other heavy components. Provide a support within one foot of each elbow.
- F. Vertical Pipe Supports--Cast Iron Stacks: Base of stacks shall be supported on concrete, brick in cement mortar, or metal brackets permanently attached to building structure. Support stacks on each building floor structure, but not to exceed 15 feet spacing.
- G. Connections: All piping connecting to equipment shall be installed without strain at the piping connection. The Contractor shall be required as directed to remove the bolts in flanged connections or to disconnect piping to demonstrate that piping has been so connected.

3.4 MOTOR AND DRIVE ALIGNMENT

- A. Belt Drive: Set driving and driven shafts parallel and align so that the corresponding grooves are in the same plane.
- B. Direct-Connect Drive: Securely mount motor in accurate alignment so that shafts are free from both angular and parallel misalignment when both motor and driven machine are operating at normal temperatures.

3.5 EXCAVATION AND TRENCHING

- A. Under each applicable section of the detailed plumbing specifications, the Contractor shall perform all excavation of every description and of whatever substances encountered, to the depths indicated on the drawings or as otherwise specified. No extras will be allowed for rock unless indicated otherwise. During excavation, material suitable for backfilling shall be piled in an orderly manner a sufficient distance from the banks of the trench to avoid overloading and to prevent slides or cave-ins. All excavated materials not required or suitable for backfill shall be removed and wasted as indicated on the drawings or as directed by the Architect/Engineer. Such grading shall be done as may be necessary to prevent surface water from flowing into trenches or other excavations, and any water accumulating therein shall be removed by pumping or by other approved method. Such sheeting and shoring shall be done as may be necessary for the protection of the work and for the safety of personnel. Unless otherwise indicated, excavation shall be by open cut except that short sections of a trench may be tunneled if, in the opinion of the Architect/Engineer, the pipe can be safely and properly installed and backfill can be properly tamped in such tunnel sections.
- B. Trench Excavations (Includes under building and 5 feet outside of building): Trenches shall be of necessary width for the proper laying of the pipe or duct, and the banks shall be as nearly vertical as practicable. The bottom of the trenches shall be accurately graded to provide uniform bearing and support for each section of the pipe on undisturbed soil at every point along its entire length. Except where rock is encountered, care shall be taken not to excavate below the depths indicated. Where rock excavations are required, the rock shall be excavated to a minimum over depth of 4 inches below the trench depths indicated on the drawings or specified. Over-depths in the rock excavation and authorized over depths shall be backfilled with loose, granular, moist earth, thoroughly tamped. When corrosive material or unstable soil or material that is incapable of supporting the pipe is encountered in the bottom of the trench, the Contractor shall promptly notify the Architect/Engineer. Such unsuitable soil or material shall be removed to a depth as directed by Architect/Engineer and the trench backfilled to the proper grade with coarse sand, fine gravel, or other suitable backfill material, as directed by the Architect/Engineer.
- C. Sanitary Sewers, Storm Sewers, and Water Mains: The width of the trench at and below the top of the pipe shall be such that the clear space between the barrel of the pipe and the trench shall be between 6 and 12 inches on either side of the pipe. The width of the trench above that level may be as wide as necessary for sheeting and bracing and the proper performance of the work. The bottom of the trench shall be rounded so that at least the bottom quadrant of the pipe shall rest firmly on undisturbed soil for as much of the full length of the barrel as proper jointing operations will permit. This part of the excavation shall be done manually only a few feet in advance of the pipe laying by men skilled in this type of work.
- D. Protection of Existing Utilities: Existing utility lines to be retained that are shown on the drawings or the locations of which are made known to the Contractor prior to excavation, as well as all utility lines uncovered during excavation operations, shall be protected from damage during excavation and backfilling, and if damaged, shall be repaired by the Contractor, at his expense.

3.6 BACKFILLING OF TRENCHES

- A. Trenches shall not be backfilled until all required pressure and other tests and inspections have been performed and until the utilities systems as installed conform to the requirements of the drawings and specifications. Trenches for piping shall be carefully backfilled with materials consisting of earth, loam, sandy clay, sand and gravel, soft shale, or other approved materials saved from the excavation or borrowed as required. The backfill materials shall be granular in nature and shall not contain coal, dust, cinders, ashes, roots, sod, rubbish, corrosive materials, large clods of earth, or stones over 2-inch maximum dimension. The Architect/Engineer may reject any on-site or borrowed materials which he considers unsuitable for the intended use of the fill.
- B. Controlled compacted backfill shall be used under slabs-on-grade, building structure, concrete paving, asphaltic concrete paving, driveway, parking areas, and other areas so specified or indicated on the drawings. All backfill required to raise the surface to the desired subgrade shall be continuously controlled and placed in maximum of 8-inch loosely placed lifts and compacted to 100 percent maximum dry density beneath the building and 95 percent under all paved drives and parking areas in accordance with ASTM D 698 (Standard Proctor). The soils engineer shall check each lift and submit reports to the Architect/Engineer in accordance with Division 31 - Earthwork.
- C. Normal Backfill: Where controlled compacted backfill is not required, such as grassed areas, the trenches shall be carefully backfilled with material in eight-inch layers and thoroughly and carefully rammed until cover is not less than one foot. The remainder of the backfill material shall then be carefully placed in the trench in one-foot layers and tamped. The surface shall be graded to a reasonable uniformity and the mounding over trenches left in a uniform and neat condition as approved by the Architect/Engineer.
- D. Test for Displacement of Sewers: Storm and sanitary sewer mains shall be checked by the Contractor to determine whether any displacement of the pipe has occurred after the trench has been backfilled to two feet or more above the pipe. A light shall be flashed between manhole locations and through each straight section of pipe. If the illuminated interior of the pipeline shows poor alignment, displaced pipe, or any other defects, in the opinion of the Architect/Engineer, such defects shall be remedied by the Contractor at his expense.
- E. Plants, turf, and surfacing that are to remain in the area of the excavation shall be carefully removed and placed where they will not be damaged. After the excavations are filled, the plants, turf, and surfacing shall be replaced as directed. Provide repairs for sidewalks, driveways, and other cement and asphalt surfaces which are damaged during excavating to match the adjacent work in material and finish.

3.7 CUTTING AND PATCHING

- A. The Contractor shall be responsible for all required digging, cutting, etc., incident to the work, and shall thereafter make all required repairs necessary to restore the cut structure or material to the condition existing prior to the cutting. In no case shall the Contractor cut into any major structural element, beam, or column without the written approval of the Architect/Engineer. All cutting, patching, repairing, or replacing of work required because of fault, error, tardiness, or damage by any trade shall be performed with no increase in the contract price to the Owner.

- B. Patch and repair roof in accordance with requirements of existing roof warranties and manufacturer's standard approved details.

3.8 LUBRICATION

- A. Under each applicable section of the detailed plumbing specifications, the Contractor shall provide all oil and grease required for the operation of all equipment until acceptance by the Owner. The type and application of all lubricants shall conform to the recommendations of the manufacturer of the equipment involved. The Contractor shall be held responsible for all damage to bearings while the equipment is being operated by him up to the date of acceptance of the project. This Contractor shall be required to protect all bearings during installation and shall thoroughly grease or otherwise protect steel shafts and other bare ferrous parts to prevent corrosion. All equipment shall be provided with covers as necessary for proper protection against damage or deterioration during construction.

3.9 OPERATING AND PERFORMANCE TESTS

- A. Prior to the final inspection, perform required tests as specified under each applicable section of the detailed plumbing specifications, and submit the test reports and records to the Architect/Engineer.
- B. Should evidence of malfunction in any tested system, or piece of equipment or component part thereof, occur during or as a result of tests, make proper corrections, repairs or replacements, and repeat tests at no additional cost to the Owner.

3.10 QUIET OPERATION AND VIBRATION

- A. Systems shall operate under conditions of load without unusual or excessive noise or vibration. Unusual or excessive noise or vibration shall be corrected.

3.11 INSTRUCTIONS TO OWNER'S PERSONNEL

- A. Under each applicable section of the detailed plumbing specifications, the Contractor shall instruct the representative of the Owner in the proper operation and maintenance of all elements of the plumbing systems. A competent representative of the Contractor shall spend not less than two days in such formal instruction and shall spend such additional time as directed by the Architect/Engineer to fully prepare the Owner to operate and maintain the plumbing systems. The Contractor shall provide letter of instruction upon completion to the Architect/Engineer stating the date of instruction and the names of those in attendance.

3.12 GUARANTEE

- A. All plumbing equipment, materials, and labor required by the contract documents for this project shall be guaranteed to be free of defective materials or workmanship for a period of one year after final acceptance of the project. Defects in equipment, materials, or workmanship occurring during this period shall be corrected with new equipment and materials or additional labor at no cost to the Owner.

3.13 SITE VISIT REPORT

- A. Answer in writing each item of discrepancy noted on all site visit reports.

3.14 DEMOLITION

- A. Contractor shall visit the site before bidding to determine the extent and location of demolition to be performed.
- B. Contractor to remove all pipes, equipment, etc. not required, reused or needed for reconnecting to the new systems. All items not required for the new system shall be removed.
- C. The Owner shall select and retain such existing items indicated or required to be removed as he desires. Items selected by the Owner to be retained shall be removed and relocated to an Owner designated location by the Contractor.
- D. All equipment, piping, conduit, etc. to remain and be reused shall be protected from damage. Any damage to existing material shall be repaired to original condition.
- E. Coordinate all demolition activities with the phasing of construction. Demolition shall not affect operations of the building.

3.15 PHASING OF WORK

- A. The mechanical contractor is required to fully understand the phasing of work and to coordinate his work according to phasing plan drawings and related sections of the specifications.
- B. Sections of the existing building will continue to be occupied during renovation. The contractor shall be responsible for retaining existing plumbing systems to serve the occupied sections of the building. Otherwise, the contractor shall provide interim plumbing systems for the occupied sections of the building.
- C. The contractor is cautioned to fully understand the need to operate plumbing systems during construction.
- D. Provide temporary plumbing to protect the owner's property from freeze damage and from high humidity. For new construction, provide plumbing for proper drying and application of finishes.
- E. Portions of the renovated building will be reoccupied as sections of renovation become complete. The contractor shall be responsible for providing plumbing for the reoccupied sections of building.

END OF SECTION 220000

SECTION 220700 - PLUMBING INSULATION

PART 1 – GENERAL

1.1 CONDITIONS

- A. The applicable provisions of Section 22 00 00, PLUMBING GENERAL REQUIREMENTS, are hereby made a part of this section, and the Contractor is cautioned to read Section 22 00 00 carefully as items of work applicable to this section are included in Section 22 00 00.

1.2 DESCRIPTION OF WORK

- A. The work to be performed under this section of the specifications comprises the furnishing of all labor and materials and the completion of all work of this section as shown on the drawings and/or herein specified.
- B. Insulation materials and accessories shall be installed in a workmanlike manner by skilled and experienced workers who are regularly engaged in commercial insulation work.
- C. In general, the work included under this section consists of, but is not limited to, the following:
 - 1. Field applied insulation for thermal efficiency and condensation control for plumbing piping and equipment.

1.3 RELATED WORK

- A. Section 22 00 00, PLUMBING GENERAL REQUIREMENTS.
- B. Section 22 11 00, FACILITY WATER DISTRIBUTION.
- C. Section 22 13 00, DRAINAGE SYSTEMS.

1.4 SUBMITTALS

- A. In accordance with Section 22 00 00, PLUMBING GENERAL REQUIREMENTS, furnish the following:
 - 1. Manufacturer's Literature and Dimension Cuts:
 - a. Insulation Materials: Each type used. State surface burning characteristics and thermal properties.
 - b. Insulation Facings and Jackets: Each type used. State vapor barrier properties. State that white finish will be furnished for exposed pipe and equipment.
 - c. Insulation Accessory Materials: Each type used.
 - d. Manufacturer's installation and fitting fabrication instructions for elastomeric unicellular insulation.
 - e. Make reference to applicable specification paragraph numbers for coordination.

1.5 DEFINITIONS

- A. Cold: Equipment or piping handling media at design temperature of 60 Deg. F. or below.
- B. Hot: Equipment or piping handling media above 105 Deg. F.
- C. PCF: Density, pounds per cubic foot.
- D. Runout: Branch pipe connection up to one inch nominal size and not over 12 feet in length.
- E. Thermal Conductance: Heat flow rate through materials.
 - 1. Flat Surface: BTU per hour per square foot.
 - 2. Pipe or Cylinder: BTU per hour per linear foot.
- F. Thermal Conductivity (k): $(\text{BTU} \times \text{inch thickness}) / (\text{hour} \times \text{square foot} \times \text{degree Fahrenheit temperature difference})$.
- G. Finished Spaces: Spaces used for habitation or occupancy where rough surfaces are plastered, paneled, or otherwise treated to provide a pleasing appearance.
- H. Unfinished Spaces: Spaces used for storage or work areas where appearance is not a factor, unexcavated spaces, crawl spaces, etc.
- I. Concealed Spaces: Spaces between a ceiling and floor construction above or between double walls or furred-in areas, pipe shafts, etc.
- J. Exposed: Open to view inside the building. For example, pipe run through a room, and not covered by other construction, is exposed.

PART 2 – PRODUCTS

2.1 GENERAL

- A. Building characteristics of insulation materials shall comply with NFPA 90A, pertinent parts of which are noted as follows:
 - 1. Pipe insulation and coverings shall meet the requirements of NFPA 90A Sections 4-3.3.1 and 4-3.3.2 when installed in plenums or concealed spaces used as part of the air distribution system.
 - 2. In addition to NFPA, the insulation material shall not transform into a molten flaming liquid during combustion as characterized by some polyethylenes.
- B. Test Methods: ASTM E 84, UL 723, or NFPA 255.
- C. Insulation shall be Johns Manville, Owens Corning, Pittsburg Corning, or Armstrong. Trade names are used herein, unless indicated otherwise, to establish a standard of quality.

- D. Specified k factors are at 75 Deg. F. mean temperature unless stated otherwise. Where optional insulation material is used, select thickness to provide thermal conductance no greater than that for the specified material. For pipe, use insulation manufacturer's published heat flow tables. For a flat surface, thermal conductance equal thermal conductivity (k) divided by the thickness of the insulation. For runout insulation and condensation control insulation, no thickness adjustment need be made.
- E. All materials shall be compatible and suitable for service temperature and shall not contribute to corrosion or otherwise attack surfaces to which applied in either the wet or dry state.
- F. Underwriters' Laboratories, Inc. label or listing, or satisfactory certified test report from an approved testing laboratory will be required to show that surface burning characteristics for materials to be used do not exceed specified ratings.

2.2 INSULATION FACINGS AND JACKETS

- A. Fed. Spec. HH-B-100 for Vapor Barrier Types I and II:
 - 1. Puncture Test Method: ASTM D 781.
 - 2. Type I, Low Vapor Transmission (0.02 Perm Rating), Beach Puncture 50 Units: For insulating facing on exposed equipment, and for all pipe insulation jackets. Facings and jackets shall be white all service type (ASJ) suitable for painting without priming.
 - 3. Type II, Medium Vapor Transmission, Beach Puncture 25 Units: Foil-Scrim-Kraft (FSK) type for concealed equipment.
 - 4. Factory composite materials may be used provided they have been tested and certified by the manufacturer to meet Beach puncture units specified above.
 - 5. Fire and smoke treatment of jackets and facings shall be permanent. The use of water soluble treatments is not acceptable.
 - 6. Pipe insulation jackets shall have 1-1/2 inch minimum lap at longitudinal joints and not less than 3-inch butt strips at end joints. Facing on board, blanket and block insulation shall have 2-inch laps or 3-inch minimum butt strips. Butt strip material shall be the same as the jacket or facing. Laps and butt strips may be self-sealing type with factory applied pressure sensitive adhesive.

2.3 MINERAL FIBER INSULATION

- A. Owens-Corning Fiberglass SSL II ASJ Heavy Density Sectional Pipe Insulation, Fed. Spec. HH-I-558, Form D, Type III (Molded), Class 12, k = 0.24.
- B. Molded pipe fitting covering: Fed. Spec. HH-I-558, Form E. Class 16, k = 0.26, for temperatures up to 370 Deg. F.
- C. Insulation thickness and type for various piping systems shall be as indicated in the following table (Pipe Size/Insulation Thickness).

PIPE SIZE/INSULATION THICKNESS(1)

System	Temp. Range (°F)	Runouts < 1"	1" to < 1-1/2"	1-1/2" to < 8"	8" & above	Ins. Type (4,5,6)
Domestic Hot Water & HWR (Copper)	90-140	1.0	1.0	1.5	1.5	A
Tempered Water	85-109	1.0	1.0	1.0	1.0	A
Domestic Cold Water (Copper)	56-79	1.0	1.0	1.0	1.0	A
Horizontal Soil and Storm (2,3)	Any	---	---	1.0	1.5	A

NOTES:

- (1) Minimum thickness for insulation listed in preceding table is based on Thermal Conductivity, 'k' not exceeding 0.27 Btu per inch/hr. x sq. ft. x Deg. F. based on Mean Temperature of 75 Deg. F. Insulation with greater Thermal Conductivity shall have increased thickness to provide same performance characteristics as specified.
- (2) All horizontal sanitary piping above Kitchen or Dining Areas only.
- (3) All horizontal storm piping above lowest floor including roof drains from underside of deck to just below fitting at top of vertical portion of stack. Fittings at top and bottom of vertical sections of horizontal offsets shall be insulated. Lap joints, tape and seal.
- (4) A Fiberglass type insulation.

2.4 ELASTOMERIC INSULATION (COPPER) (PVC)

- A. Armstrong Armaflex II pipe insulation, fed. Spec. HH-I-573 and HH-I-1751/2, K = 0.27, flame spread not over 25, smoke developed not over 50, (1/2 inch thick test material), for temperatures from -40 Deg. F to 211 Deg. F. No jacket required.

2.5 INSULATION ACCESSORY MATERIALS

- A. Insulation inserts at pipe supports:
 1. Material: Cellular glass or calcium silicate 1/2 section of insulation, same thickness as adjacent insulation.
 2. Provide inserts for all insulated piping greater than 1-1/2 inch diameter. Install with metal insulation shields furnished with pipe supports, Section 22 00 00, PLUMBING GENERAL REQUIREMENTS. Minimum insert length: 10 inches for up to 3 inch pipe, 12 inches for 3 to 6 inch pipe, and 16 inches for 8 to 10 inch pipe.

- B. Adhesives, Mastics, Cement:
1. Mil. Spec. MIL-A-3316B, Class 1: Jacket and lap adhesive and protective finish coating for insulation.
 2. Mil. Spec. MIL-A-3316B, Class 2: Adhesive for laps for adhering insulation to metal surfaces.
 3. Mil. Spec. MIL-A-24179A, Type II, Class 1: Adhesive for installing flexible unicellular insulation and for laps and general use.
 4. Mil. Spec. MIL-B-19565B, Type 1 or Type II: Vapor barrier compound for indoor use.
 5. Fed. Spec. SS-C-160A, Type IIIB, (ASTM C 449): Mineral fiber hydraulic-setting thermal insulating and finishing cement.
 6. Other: Insulation manufacturer's published recommendations.
- C. Mechanical Fasteners:
1. Pins, Anchors: Welded pins, or metal or nylon anchors with tin-coated or fiber washer, or clips. Pin diameter shall be as recommended by the insulation manufacturer.
 2. Staples: Outward clinching monel or stainless steel.
 3. Wire: 18 gage soft annealed galvanized, or 14 gage copper clad steel or nickel copper alloy.
 4. Bands: 3/4-inch nominal width, brass, aluminum or stainless steel.
- D. Reinforcement and Finishes:
1. Glass Fabric, Open Weave: ASTM D 1668, Type III (resin treated) and Type 1 (asphalt treated).
 2. Glass Fiber Fitting Tape: Mil. Spec. MIL-C-20070, Type II, Class 1.
 3. Tape for Flexible Unicellular Insulation: Scotch No. 472, Nashua PE-12, or approved equal recommended by the insulation manufacturer.
 4. PVC Fitting Cover: Fed. Spec. L-P-535D, Composition A, Type II, Grade GU, with Form B mineral fiber insert, for media temperature 45 Deg. F. to 250 Deg. F. Below 45 Deg. F. and above 250 Deg. F., provide double layer insert. Provide color matching, vapor barrier, pressure sensitive tape.
- E. Firestopping Material: Refer to Section 22 00 00, PLUMBING GENERAL REQUIREMENTS.

PART 3 – EXECUTION

3.1 GENERAL INSULATION REQUIREMENTS

- A. Required pressure tests of joints and connections shall be completed before application of insulation. Surface shall be clean and dry with all foreign materials, such as dirt, oil, loose scale, and rust removed.
- B. Insulation materials and accessories shall be installed in a workmanlike manner by skilled and experienced workers who are regularly engaged in commercial insulation work. If any insulation material has become wet because of transit or job site exposure to moisture or water, the Contractor shall not install such material, and shall remove it from the job site. No insulation material shall be installed that has become damaged in any way. The Contractor shall also use necessary means to protect his work and materials.

- C. Except for specific exceptions, insulate entire specified equipment and piping systems. Insulate each pipe individually. Do not use scrap pieces of insulation where a full length section will fit.
- D. Insulation materials shall be installed in a first class manner with smooth and even surfaces, with jackets and facings drawn tight and smoothly cemented down at all laps. Insulation shall be continuous through all sleeves and openings. Vapor barriers shall be continuous and uninterrupted throughout systems with operating temperature 60 Deg. F. and below. Lap and seal vapor barrier over ends and exposed edges of insulation. Anchors, supports, and other metal projections through insulation on cold surfaces shall be insulated and vapor sealed for a minimum length of six inches.
- E. Insulation on hot piping and equipment shall be terminated square or beveled with insulating cement, covered with jacket, at items not to be insulated, access openings and nameplates.
- F. On cold systems, vapor barrier performance is extremely important. Particular care must be given to vapor sealing the fitting cover or finish to the insulation vapor barrier. All penetrations of the jacket and exposed ends of insulation must be sealed with vapor barrier mastic. All valve stems must be sealed with caulking which allows free movement of the stem but provides a seal against moisture incursion.
- G. Plumbing Work Not To Be Insulated:
 - 1. Chromium plated brass piping.
 - 2. Domestic Hot Water: Unions, flexible connectors, control valves, expansion tank, pump.
- H. Apply insulation materials subject to the manufacturer's recommended temperature limits. Apply adhesives, mastics and coatings at the manufacturer's recommended minimum coverage.
- I. New insulation (as specified herein) shall be provided and installed for existing piping at all locations where insulation has been removed during asbestos abatement and/or demolition of adjoining equipment. Contractor shall obtain and examine the asbestos abatement documents to determine the extent of the work.
- J. Where hot, cold and/or tempered water piping are bundled together, each pipe shall be insulated individually to prevent transfer of heat to other piping systems.

3.2 INSULATION INSTALLATION

- A. Molded Mineral Fiber Pipe and Tubing Covering:
 - 1. Fit insulation to pipe aligning longitudinal joints. Seal longitudinal joint laps and circumferential butt strips by rubbing hard with a nylon sealing tool to assure a positive seal. Staples may be used to assist in securing insulation. Seal all vapor barrier penetrations with vapor barrier mastic. Provide inserts and install with metal insulation shields at outside pipe supports.
 - 2. Fittings, Flange and Valve Insulation:
 - a. Fiberglass Pipe insulation shall be installed with joints butted firmly together. Valves and devices requiring access shall be insulated with mitered sections of insulation equal in thermal resistance and thickness to the adjoining insulation. Fittings shall be covered with Schuller "Zeston" type, pre-molded PVC fitting covers. Jackets on pipe insulation shall be stapled using outward clinching type

staples spaced 3" apart at least 1/4" from the lap edge on systems operating at 80 Deg. F. and above; below 80 Deg. F. the laps are to be vapor sealed using self-sealing lap, lap seal gun, or adhesive. All insulation joints, laps, voids, punctures, and end tapers shall be sealed with 1/32" thickness of Foster Vapor-Safe or Vapor-Fas adhesive regardless of service.

- b. Fitting tape shall extend over the adjacent pipe insulation and overlap on itself at least two inches.

B. Elastomeric Insulation:

1. Apply insulation and fabricate fittings in accordance with the manufacturer's installation instructions.
2. Pipe and Tubing Insulation:
 - a. Use proper size material. Do not stretch or strain insulation.
 - b. To avoid undue compression of insulation, provide inserts at supports as recommended by the insulation manufacturer. Insulation shields are provided under Section 22 00 00, PLUMBING GENERAL REQUIREMENTS.
 - c. Elastomeric insulation shall be slipped on the pipe prior to connection wherever possible. Pipe leak tests shall be performed prior to the insulation of fittings. Where the slip-on technique is not possible longitudinal slit insulation shall be snapped on the pipe. All seams, voids, and butt joints shall be sealed with a vapor barrier adhesive or taped with 1-1/2 inch wide 3M #471 tape.
 - d. Fittings and valves shall be insulated with mitered sections of insulation. All joints shall be secured and sealed with vapor barrier adhesive. Approved factory-made fittings such as F & D Mfgr. and Supply Co. may be used.

END OF SECTION 220700

SECTION 221100 - FACILITY WATER DISTRIBUTION

PART 1 – GENERAL

1.1 CONDITIONS

- A. The applicable provisions of Section 22 00 00, PLUMBING GENERAL REQUIREMENTS, are hereby made a part of this section and the Contractor is cautioned to read Section 22 00 00 carefully as items of work applicable to this section are included in Section 22 00 00.

1.2 DESCRIPTION OF WORK

- A. The work includes providing a complete plumbing system including, but not necessarily restricted to, the following:
 - 1. Domestic water system to a point five feet away from exterior building walls.
 - 2. Installation and connections to miscellaneous equipment furnished by Owner.
 - 3. Connections to fixtures and equipment provided under other sections of these specification.
 - 4. Miscellaneous work as described herein, as shown on drawings, and as required for a complete system.

1.3 RELATED WORK

- A. Section 22 00 00, PLUMBING GENERAL REQUIREMENTS.
- B. Pipe Insulation: Section 22 07 00, INSULATION
- C. Plumbing Fixtures: Section 22 40 00, PLUMBING FIXTURES

1.4 SUBMITTALS

- A. Manufacturer's shop drawings shall indicate that piping and equipment meet specified codes. All piping, equipment, and fittings that are connected to potable water systems, shall meet the 1996 Safe Water Drinking Act and the 2011 Reduction of Lead in Drinking Water Act, and where applicable, meeting NSF Standard 61, and be so labeled and be so certified. In accordance with Section 22 00 00, PLUMBING GENERAL REQUIREMENTS, furnish the following:
 - 1. Manufacturer's Literature and Data:
 - a. Piping
 - b. Valves
 - c. Backflow Preventers
 - d. Strainers
 - e. Shock Absorbers
 - f. Circuit Setters
 - g. Thermometers
 - h. Pressure Gages

- i. Access Panels
- j. Hose Bibbs
- k. Hydrants
- l. Tempering Valves
- m. Pipe Supports (except hangers)

PART 2 – PRODUCTS

2.1 PIPE AND EQUIPMENT SUPPORTS, PIPE SLEEVES, AND WALL CEILING PLATES

- A. Provide in accordance with specifications in Section 220000, PLUMBING GENERAL REQUIREMENTS.

2.2 WATER SERVICE CONNECTIONS TO BUILDING

- A. From inside face of exterior wall to a distance of approximately five feet outside of building and underground inside building, material shall be as follows:
 - 1. Less Than 3 Inch Size: Certified Copper tubing (Not Standard Tube), ASTM B 88, type K, seamless, annealed. Fittings as specified for Interior Domestic Water Piping using brazed joints with brazing alloys (AWS A5.8).

2.3 INTERIOR DOMESTIC WATER PIPING (DISTRIBUTION)

- A. Copper Tube and Fittings:
 - 1. Tube: ASTM B 88, Certified Copper Tubing (Not Standard Tube):
 - a. Above ground: Type L, hard drawn.
 - b. Below ground: Type K, hard drawn.
 - 2. Fittings: Wrought copper, ASME B16.22 or cast copper alloy ASME B16.18. Victaulic or accepted equal full flow copper fittings with grooved ends. Grooved copper fittings shall be copper per ASTM B75 alloy C12200; bronze sand cast per ASTM B-584 copper alloy CDA 844 (81-3-7-9) per ANSI B16.18.
 - 3. Joints:
 - a. Above ground: Soldered in accordance with ASTM B828, ASTM B32 lead free solder, ASTM B813 lead free flux. Lead free shall mean less than 0.2 percent lead. Grooved end copper piping systems as manufactured by Victaulic Company of America or accepted equal may be installed 2" – 8". For grooved end systems, couplings shall be copper tubing sized manufactured to ASTM A536 ductile iron Grade 65-45-12 painted copper color alkyd enamel. Gaskets for grooved system shall be of flush seal pressure responsive design having properties as designated in ASTM D2000. Installation-Ready, for direct slab installation without field disassembly. Victaulic Style 607H or equal.
 - b. Gaskets shall be UL classified in accordance with ANSI/NSF-61 for Potable water service.
 - c. Below ground: Brazed with AWS A5.8 filler metal (lead free).

- B. Brass, Copper, Chromium-plated nipples - ASTM B687.
- C. Press Fittings: Copper press fittings by Viega, Ridgid Tool Company or accepted equal, requirements of ASME B16.18 or ASME B16.22. O-rings for copper press fittings shall be EPDM.
- D. All valves on domestic water piping shall be installed BELOW ductwork and other piping for ease of access.

2.4 EXPOSED WATER PIPING

- A. Finished Room: Use full iron pipe size chrome plated brass piping for exposed water piping connecting fixtures, including those furnished by the Owner or specified in other sections.
 - 1. Pipe: Red brass, standard weight, chrome plated.
 - 2. Fittings: Screwed brass or bronze, Class A, 125 pound, drainage pattern for waste.
 - 3. Nipples: Brass, standard weight.
 - 4. Unions: Brass or bronze. Unions 2-1/2 inches and larger shall be flange type with approved gaskets.
- B. *Unfinished and Mechanical Rooms: Chrome-plated brass piping is not required. Paint as specified in Section 22 00 00 PLUMBING GENERAL REQUIREMENTS.

2.5 VALVES

- A. General: All valves and specialties shall be suitable for 125 psi working pressure except as otherwise indicated. Each item shall have threaded, flanged, or sweat connections as applicable to match joints specified for its respective service.
- B. Valves--Hot and Cold Domestic Water Service: Acceptable manufacturers subject to compliance with requirements are Nibco, Jenkins, Hammond, Milwaukee, Lunkenheimer, Watts and Victaulic.
 - 1. Gate valves (Rising Stem): Valves 2 1/2 inch and smaller shall be Class 125 rising stem, union bonnet, solid wedge and manufactured in accordance with MSS-SP 80. Body, bonnet and wedge shall be of bronze ASTM B-62. Stems shall be of dezincification-resistant silicon bronze ASTM B-371 or low-zinc alloy B-99, non-asbestos packing and malleable or ductile iron handwheel. Where higher operating pressures approach 150 psi, Class 150 union bonnet valves of like construction shall be used. Valve ends shall be threaded or solder-type. [Class 125 NIBCO T124 (threaded); Class 150 NIBCO T134 (threaded), S134 (solder)]
 - 2. Ball valves: Valves 2 1/2 inch and smaller shall be rated 150 psi SWP and 600 psi non-shock WOG and shall have 2 piece cast bronze bodies, TFE seats, full port, separate packnut with adjustable stem packing, anti-blowout stems and chrome-plated brass/bronze ball. Valve ends shall have full depth ANSI threads or extended solder connections and be manufactured to comply with MSS-SP110. [NIBCO T585-70-LF (threaded); S585-70-LF (solder)] [Victaulic Company Series 722 (threaded); PL300 (push-to-connect, 200 psi)].
Note: Where piping is insulated, ball valves shall be equipped with 2" extended handles of non-thermal conductive material. Also, provide a protective sleeve that allows

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- operation of the valve without breaking the vapor seal or disturbing the insulation. Memory stops, which are fully adjustable after insulation is applied, shall be included. [NIBCO T585/70NS (threaded); S585-0NS (solder)]
3. Globe valves: Valves 2 1/2 inch and smaller shall be Class 125 and manufactured in accordance with MSS-SP80, body and bonnet shall to be of bronze ASTM B-62. Stems shall be of dezincification-resistant silicon bronze ASTM B-371 or low-zinc alloy B-99, non-asbestos packing, TFE seat disc and malleable or ductile iron handwheel. Where higher operating pressures approach 150 psi, Class 150 union bonnet valves of the like construction shall be used. Valve ends shall be threaded or solder-type. [Class 125 NIBCO globe T211-Y (threaded); S211-Y (solder); Class 150 NIBCO globe T235-Y (threaded); S235-Y (solder)]
 4. Check valves: Valves 2 inch and smaller shall be type inline lift, Class 125, threaded or solder ends; ASTM A582 stainless steel stem, 316 stainless steel spring, and ASTM A276 stainless steel seat screws; TFE disc and seat ring; bodies and end conforming to ASTM B-584 bronze, spring actuated type disc. (Nibco T-480, S-480) (Victaulic PL510).
 5. Butterfly valves: Valves 2-1/2" and larger: May be of butterfly design with grooved ends. Cast bronze body to CDA-836 (85-5-5-5). Ductile iron disc, ASTM A536, Grade 65-45-12, rubber encapsulated suited for intended service. Seat test to MSS-SP-67. Bubble tight, dead-end to 300 PSI or bi-directional service. Victaulic Series 608N or equal.
- C. Hose bibbs: (Toilets) Chicago 293-CP or equal, loose key, chrome plated, 1/2 inch size, with wall flange.
- D. Hose bibbs and hose-end drain valves: (Equipment rooms and similar spaces). Watts LFSC-5 (1/2 inch), Matco-Norca 646 RLF or equal rough brass, lead-free.
- E. Shock Absorbers: Josam "Absorbotron" 75000 Series, Smith 5000 Series "Hydrotrols", Zurn Z1700 "Shoktrols", Wade "Shokstop" or equal, lead-free, stainless steel. SA-A Max. 11 SFU; SA-B Max. 32 SFU. Provide on both hot and cold water branches. Job fabricated air chambers will not be permitted. O-ring type shock absorbers will not be accepted. (ASME/ANSI A112.26.1 OR ASSE 1010)
- F. Individual Fixture Tempering Valves: Provide Watts Model Series LFUSG-B-M2, or equal, under-sink Guardian ASSE 1070 thermostatic tempering valve for single lavatory and hand sink applications. Provide at all lavatory and hand sink locations including kitchen hand sinks applications. Set valve for minimum 105 Deg. F, maximum 109 Deg. F.
- G. Balancing valves shall be circuit setters as manufactured by (Bell and Gossett) (Watts) (Tour Andersson) (Victaulic) or equal and shall be a balancing valve of lead free all bronze construction, suitable for use in potable water systems. Valve shall have pressure taps with built-in check valves to determine pressure drop across valve. The pressure drop and the setting of the valve shall determine the actual system flow rate requirement. Valve shall be furnished with adjustable memory stop or locking device so the valve can be closed without disturbing the setting and be returned to the balanced position without further adjustment, and preformed polyurethane insulation suitable for use on domestic hot water and cold water systems. Unit to be suitable for minimum 175 psi working pressure at minimum 230 Deg. F. operating temperature. Tour Andersson Circuit Balancing valves containing digital readout handwheel for balancing hidden memory feature with locking tamper-proof setting and EPDM o-ring seals may be used. 1/2" – 2" shall be 300 PSI. Ametal brass copper alloy body. 2-1/2" and larger shall be 300 psi grooved end.

2.6 BACKFLOW PREVENTERS

- A. Provide a backflow prevention device at any point in the plumbing system where the potable water supply comes in contact with a potential source of contamination. Device shall be same size as line in which installed. Device shall be certified by recognized testing laboratory listed. Provide air gaps with drains pipe the same size as vent discharge on all backflow preventers with atmospheric vent. Extend drain to nearest floor drain. Listed below is a list of connection to the potable water system which shall be protected against backflow or back siphonage:
1. Hose Vacuum Breaker Type (ASSE 1011; CSA CAN/CSA-B64.2):
 - a. Watts No. NF8C or equal, with non-removable and manual drain feature for freezing conditions. (New and) Existing wall hydrant (if not provided as an integral part of the Hydrant)
 - b. Watts No. LF8A, LF8AC (chrome finished) or equal, lead free, with non-removable feature. Hose bibbs and sinks with threaded outlets
 2. Atmospheric Vacuum Breaker (ASSE 1001; CSA CAN/CSA-B64.1): Watts No. LF288A-C (1/2 inch thru 1 inch), LF288A (1-1/4 inch thru 3 inch) or equal. Unit shall not be subject to back-pressure and shall be installed on discharge side of the last control valve.
 - a. Kitchen equipment
 - b. Commercial dishwashers
 - c. Domestic dishwashers (if washer unit is labeled as conforming to ASSE 1006, atmospheric vacuum breaker is not required)
 - d. Commercial food waste grinder
 3. Intermediate Atmospheric Vent Continuous Pressure Type (ASSE 1024; CSA CAN/CSA-B64.6): Watts No. LF7R lead-free or equal.
 - a. Ice machine
 - b. Water filtration
 4. Continuous or Intermittent Pressure Dual Check Valve (ASSE 1022): Watts No. SD-3 or equal.
 - a. Carbonated beverage dispenser
 - b. Coffee and tea dispensers

2.7 STRAINERS

- A. Install on inlet of double check backflow preventers, on inlet side of indicating and control instruments and equipment subject to sediment damage, and where shown on drawings. Strainer element shall be removable without disconnecting piping. Suitable for 125 psi working pressure. Watts, Mueller Steam Specialty, or equal with bronze or stainless steel screen with valved and capped blow-off outlet.
1. Water: 2-1/2 inch and smaller, 20 mesh (1/32 inch) screen.
 2. Body: 3 inch or smaller, brass or bronze.

2.8 PRESSURE GAGES FOR WATER

- A. Gages for water pressure shall be Weksler Type BA14, 4-1/2 inch diameter dial, all metal case, bottom connected. Dials shall be black on white background throughout, 2 psi graduation, 20 psi figure graduation. Range shall be 0 to 160 psig. Provide tee handle cock and brass pressure snubber for water service.

2.9 THERMOMETERS

- A. Thermometers for water temperature shall be Weksler Type AS5H-9-AL or equal, adjustable angle form, blue spirit mercury-free column approximately 9 inches long, 30 to 240 Deg. F. range, 2 degree increments and complete with brass well.

PART 3 – EXECUTION

3.1 INSTALLATION

A. General:

1. Suspended horizontal piping shall be supported by adjustable wrought steel clevis hangers. Where supports bear on copper pipe, they shall be copper plated. Chain, strap, wire or other make-shift devices will not be permitted as hangers or supports. Hangers on all insulated pipes shall go around the insulation, with galvanized sheet steel saddle of sufficient size and thickness to prevent crushing of the insulation. Risers shall be securely supported and braced in an approved manner. Hangers for metal piping shall be spaced not over 6 feet apart for pipe 1/2 inch or smaller, 8 feet apart for 3/4 inch pipes and not over 10 feet apart for pipes 1 inch or larger. Hangers shall be located at all changes in direction. Maximum pipe support spacing shall be in accordance with Table 1 – MAXIMUM PIPING SUPPORT SPACING, except where grooved couplings are used, no pipe length shall be left unsupported between any two grooved couplings:

Table 1 - Maximum Piping Support Spacing

PIPING MATERIAL	MAXIMUM HORIZONTAL SPACING (feet)	MAXIMUM VERTICAL SPACING (feet)
Cast-Iron Pipe ^b	5	15
Copper or Copper-Alloy Pipe	12	10
Copper or Copper-Alloy Tubing, 1/4-inch Diameter and Smaller	6	10
Copper or Copper-Alloy Tubing, 1/2-inch Diameter & Larger	10	10
CPVC Pipe or Tubing, 1-inch & Smaller	3	10 ^c
CPVC Pipe or Tubing, 1/4-inch & Larger	4	10 ^c
Polypropylene (PP) Pipe or Tubing, 1-inch or Smaller	2-2/3 (32 inches)	10 ^c
Polypropylene (PP) Pipe or Tubing, 1/4-inch or Larger	4	10 ^c
For SI: 1 inch = 25.4 mm, 1 foot = 304.8 mm a. See Section 301.18. b. The maximum horizontal spacing of cast-iron pipe hangers shall be increased to 10 feet where 10-foot lengths of pipe are installed. c. Mid-story guide.		

2. Install branch piping for water from the respective piping systems and connect to all fixtures, valves, outlets, and equipment, including those furnished by the Owner or specified in other sections of these specifications. Approximate locations for roughing-in are shown on the contract drawings. No piping or roughing-in shall be started until data showing exact locations for equipment and connections required are provided by the Architect. This data shall then be used for roughing-in equipment. Individual stops and other connection components not furnished with the equipment, but required for a complete installation, shall be provided under this section of these specifications. All exposed trim and fixture supply pipe, except in laundry, shall be chrome-plated.
3. Install trim and fittings provided with casework, cabinets, and laboratories, but not installed at point of fabrication.
4. Pipe shall be round and straight. Cutting shall be done with proper tools. Pipe shall be reamed to full size after cutting.
5. All pipe runs shall be laid out and scheduled to avoid interferences with other work.
6. Press connections: Copper press fittings shall be made in accordance with the manufacturers installation instructions. The tubing shall be fully inserted into the fitting and the tubing marked at the shoulder of the fitting. The fitting alignment shall be checked against the mark on the tubing to assure the tubing is fully engaged (inserted) in the fitting. The joints shall be pressed using the tool approved by the manufacturer.
7. Install valves with stem in horizontal position whenever possible. All valves shall be easily accessible. Isolation gate valves shall be installed on each side of each major piece of equipment and at other points indicated or required for draining, isolation, or sectionalizing purposes. Discharge of relief valves and backflow preventers shall be piped full size of valve connection to 6 inches above nearest floor drain or to exterior concrete pad as marked on drawings. Pipe shall be supported so that weight of pipe is not on valve body. Trap primers shall be piped full size to the floor drain indicated.
8. Exterior cold water main shall have a minimum of 36-inch cover unless indicated otherwise on drawings.
9. Unions or flanged joints shall be provided on each side of each valve 2-1/2 inch or larger and in each line immediately preceding the connection of each major piece of equipment. Unions shall be 125 psi bronze seat type. Flanges shall be ANSI standard 125 psi service

with 1/16 inch thick composition or red rubber gaskets. Where grooved end piping and butterfly valves are used, Victaulic Style 608 valves with 607H couplings will be considered unions.

10. Joints between pipes of dissimilar metals shall have dielectric fittings such as unions, flanges or Clearflow dielectric nipples to isolate metals. Isolation shall be accomplished by non-metallic sleeves or couplings of materials suitable to withstand temperatures and pressures encountered.
11. Grooved joints shall be installed in accordance with the manufacturer's latest published installation instructions. Grooved ends shall be clean and free from indentations, projections, and roll marks in the area from pipe end to groove. Gaskets shall be of an elastomer grade suitable for the intended service, and shall be molded and produced by the coupling manufacturer. The grooved coupling manufacturer's factory trained representative shall provide on-site training for contractor's field personnel in the use of grooving tools and installation of grooved joint products. The representative shall periodically visit the jobsite and review contractor is following best recommended practices in grooved product installation. A distributor's representative is not considered qualified to conduct the training or jobsite visits.
12. Anchors for pipe shall be provided at all flush valves and fixtures or where required to localize pipe movement. Anchors shall consist of brass collars bolted to the pipe and rigidly connected to the building structure in an approved manner and so as not to damage the building structure.
13. Provide manufacturer's certification of all Pro-Press piping installations for full manufacturer's warranty.

B. Piping shall conform to the Domestic Water:

1. Grade all lines to facilitate drainage. Provide hosed-end drain valves at bottom of risers. All unnecessary traps in circulating lines shall be avoided.
2. Connect branch lines at bottom of main serving fixtures below and pitch down so that main may be drained through fixture. Connect branch lines to top of main serving only fixtures located on floor above.

3.2 PROTECTION OF ELECTRICAL EQUIPMENT

- A. Refer to Specification Section 220000, Paragraph 3.01.C.1 for requirements for piping above electrical equipment.

3.3 TESTS

- A. General: Contractor shall provide all instruments, materials, and labor required. Tests shall be made in the presence of the Owner or Authority having jurisdiction or as otherwise directed by the Architect, who shall be given five (5) days notice by this Contractor of his readiness to perform such tests. Any leaks that develop during the tests shall be repaired by remaking the joint or replacing pipe and fittings. Temporary caulking will not be permitted. No piping shall be insulated or concealed until it has been tested, with results acceptable to the Architect. Air testing will be acceptable where permitted by the Virginia Uniform Statewide Building Code. Do NOT perform air testing on systems where plastic piping is installed. Test systems either in its entirety or in sections.

- B. Potable Water System: Test after installation of piping and domestic water heaters, but before piping is concealed, before covering is applied, and before plumbing fixtures are connected. Fill systems with water and maintain hydrostatic pressure of 125 psig or at 50 percent higher than actual operating pressure which ever is greater for one hour during inspection and prove tight without any loss of pressure.
- C. Optional tests for connections to existing systems: After installation of piping and connecting to existing systems, and where herein before specified tests are impractical, test all new piping under actual operating conditions and prove tight to the satisfaction of the Architect.
- D. Double check-valve, assemblies, and pressure vacuum breaker assemblies shall be tested to determine whether they are operable. The testing procedure shall be in accordance with one of the following:
 - 1. Double Check-Valve: ASSE 5010-1015-1-91 with August 1992 Revisions; ASSE 5010-1015-2-91 with August 1992 Revisions; ASSE 5010-1015-3-91 with August 1992 Revisions; ASSE 5010-1015-4-91 with August 1992 Revisions.
 - 2. Pressure Vacuum Breaker: ASSE 5010-1020-1-91.

3.4 DISINFECTION--COPPER PIPING SYSTEMS

- A. After tests have been successfully completed, thoroughly flush and disinfect the interior domestic water distribution system in accordance with the local Health Department. In the absence of a prescribed procedure, systems shall be disinfected in accordance with AWWA C651 or AWWA C652.
- B. Optimal Disinfection: After all tests have been satisfactorily completed, the entire water distribution system shall be thoroughly flushed and disinfected. Disinfect by tapping the main and introducing a solution of chlorine and water in such quantity as to provide a concentration of not less than 50 PPM with all water lines filled with water from the water main connection to all supply outlets. Care shall be taken not to flush the lines at this time. Air only shall be allowed to escape. This solution shall be allowed to stand in the lines for not less than twenty-four hours, after which the lines shall be flushed out until a residual reading of 0.5 PPM is obtained.

3.5 CLEANING

- A. Remove trash, plaster, dust, paint spots and all foreign matter from outside of all piping and equipment.
- B. The Contractor shall check each length of pipe before it is put in place to make certain there is not foreign material (stones, sand, etc.) in the systems. Provide temporary bypass around equipment if or as required. All plumbing pipes shall be thoroughly flushed with water to remove construction debris before final connections are made to equipment and fixtures.

3.6 REPORTS

- A. Reports of cleaning, disinfection and testing: Contractor shall verify *in writing before completion of the job* that all specified cleaning procedures, tests, and disinfection have been performed, with results as specified or as required by codes.

END OF SECTION

SECTION 221300 - DRAINAGE SYSTEMS

PART 1 – GENERAL

1.1 CONDITIONS

- A. The applicable provisions of Section 22 00 00, PLUMBING GENERAL REQUIREMENTS, are hereby made a part of this section and the Contractor is cautioned to read Section 22 00 00 carefully as items of work applicable to this section are included in Section 22 00 00.

1.2 DESCRIPTION OF WORK

- A. The work includes providing a complete plumbing system including, but not necessarily restricted to, the following:
 - 1. Sanitary sewer system to a point five feet away from exterior building walls.
 - 2. Installation and connections to miscellaneous equipment furnished by Owner.
 - 3. Connections to fixtures and equipment provided under other sections of these specification.
 - 4. Miscellaneous work as described herein, as shown on drawings, and as required for a complete system.

1.3 RELATED WORK

- A. Supports: Division 05, METAL FABRICATIONS.
- B. Section 22 00 00, PLUMBING GENERAL REQUIREMENTS.
- C. Pipe Insulation: Section 22 07 00, INSULATION.
- D. Plumbing Fixtures: Section 22 40 00, PLUMBING FIXTURES.

1.4 SUBMITTALS

- A. Manufacturer's shop drawings shall indicate that piping and equipment meet specified codes. In accordance with Section 22 00 00, PLUMBING GENERAL REQUIREMENTS, furnish the following:
 - 1. Manufacturer's Literature and Data:
 - a. Piping
 - b. Valves
 - c. Floor Drains
 - d. Cleanouts
 - e. Access Panels
 - f. Grease Interceptors
 - g. Pipe supports

- h. IGCC Submittals: Submit product documentation indicating VOC content in g/L for all insulation material, field-applied interior adhesives, sealants and mastics.

PART 2 – PRODUCTS

2.1 PIPE AND EQUIPMENT SUPPORTS, PIPE SLEEVES, AND WALL CEILING PLATES

- A. Provide in accordance with specifications in Section 22 00 00, PLUMBING GENERAL REQUIREMENTS.

2.2 SOIL, WASTE, VENT AND CONDENSATE DRAIN PIPING

- A. Cast Iron Soil Pipe and Fittings: Used for pipe buried in or in contact with earth and for extension of pipe to a distance of approximately five feet outside of building walls. May be used for piping above ground, where space within partitions involved can accommodate greatest diameter of cast iron soil pipe without any dimension deviation from the requirements of contract drawings. Pipe shall be bell and spigot, modified hub, or plain end (no-hub) as required by selected jointing method. Pipe and fittings shall be listed by NSF International, IAPMO, ICC or other third party organization that is accredited as an ANSI-Guide 65 organization as listed on www.ansi.org. Drains from urinals shall be cast iron or PVC piping.
 1. Soil, Waste, and Vent Piping Material (Pipe and Fittings): ASTM A74, ASTM A888 or CISPI 301, service weight.
 2. Joints: Provide any one of the following types to suit pipe furnished.
 - a. Lead and oakum and caulked by hand.
 - b. Mechanical: Compression-type (ASTM C564) molded neoprene gasket. Gaskets shall suit class of pipe being jointed. Dual-service gaskets will not be accepted.
 - c. Mechanical: Mechanical joint coupling (ASTM C564) (CSA CAN/CSA-B602) shall consist of a stainless steel coupling and neoprene gaskets. Do not install below grade.
 - d. Adapters: Where service weight pipe is connected to extra heavy pipe and extra heavy fittings of chair carriers, provide adapters or similar system to make tight, leakproof joints.
 3. Coating: Provide a heavy coat of asphalt or bitumastic paint on pipe buried in earth or installed in cinders or concrete construction.
 4. Cast Iron Soil Pipe Markings: All cast iron soil pipe shall be clearly marked with the manufacturer's name, country of origin, eight-digit date code, pipe diameter and length, relevant ASTM standard and registered trademark of the third party certifier.
 5. Material Test Reports: Supplier of cast iron soil pipe shall be able to supply material test reports in accordance with the relevant ASTM standard and shall include testing and analysis on radioactivity, dimensional characteristics, tensile strength and chemical/metallurgical content. Suppliers shall also supply MSDS sheets on all coatings.

- B. Plastic Pipe: May not be used under concrete or in accessible floor slab. May be used for piping above ground and below ground, sanitary forced main above and below ground. Foam core piping is NOT acceptable. All plastic pipe, fittings and components shall be third party certified as conforming to NSF 14. PVC shall not be used where waste temperatures exceed 140 Deg. F., such as Kitchens and Mechanical Rooms. PVC shall not be used in return air plenums.
1. Pipe: PVC Schedule 40 DWV, ASTM D 2665.
 2. Soil, Waste, & Vent Fittings: PVC ASTM D3311 fittings for solvent joints.
 3. Joints: ASTM F656 purple primer, solvent ASTM D2564 (Not Purple in color) complying with SCAQMD Rule #1168, joints made in accordance with ASTM D2855.

2.3 EXPOSED WASTE PIPING

- A. Finished Room: Use full size chrome plated brass piping for exposed waste piping connecting fixtures, including those furnished by the Owner or specified in other sections.
1. Pipe: Red brass, standard weight, chrome plated.
 2. Fittings: Screwed brass or bronze, drainage pattern for waste.
 3. Nipples: Brass, standard weight.
- B. Unfinished and Mechanical Rooms: Chrome-plated brass piping is not required. Paint as specified in Section 22 00 00, PLUMBING GENERAL REQUIREMENTS.

2.4 CLEANOUTS

- A. Same size as pipe served up to 4 inches. Five and six inch mains shall have four-inch cleanouts. Cleanouts shall be easily accessible. Provide a minimum of 18-inch clearance for 6 inch and smaller pipes for rodding. Cleanouts shall be provided at the base of each soil stack, waste stack, at all points in sanitary drainage systems where direction change is more than 45 degrees, where required by code, and where indicated on the drawings. All cleanout plugs shall be bronze, set in graphite grease. All cleanout covers shall be secured with vandal resistant screws unless noted otherwise. (ASTM A74, ASME A112.3.1, ASME A112.36.2M) Covers shall be set flush with finished floor or wall unless otherwise indicated. Provide carpet markers in all carpeted areas.
1. Cleanouts at base of vertical stacks: Josam 58600-COT with stainless steel wall cover and tapped for center screw threaded bronze plug. Josam 58540-19 with 58600 wall cover for 8 inch size. Cleanout plug located approximately 30 inches above floor. Cleanout plugs under lavatories and sinks located approximately 10 inches above floor.
 2. In horizontal runs above grade: Cleanouts shall be iron body ferrule with bronze screw plug in fitting or tapped cast iron ferrule with bronze plug.
 3. In Floors: Floor cleanouts shall have cast iron body, bronze plug, and ABS or cast iron frame with round or square adjustable heavy-duty scoriated vandal resistant nickel bronze top. Unit shall be vertically adjustable for a minimum of two inches. When waterproof membrane is used in floor, provide clamping collars on cleanouts. Cleanouts shall consist of a "Y" fitting and a 1/8 bend. In carpeted areas, provide carpet cleanout markers.

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- a. For light traffic floors: Josam Series 55000-VP cast iron floor cleanout with secured round or square cover plate of satin bronze for finished concrete floors and of nickel-brass elsewhere.

2.5 DRAINS

- A. Floor drains shall have outlets suitable for inside caulking. Provide suitable clamping device and extensions if required, where installed in connection with waterproofing membrane. Puncturing membrane other than for drain opening will not be permitted. All floor drains shall be furnished complete with 4-inch deep seal P-trap. All strainers shall be secured with vandal resistant screws unless noted otherwise. All floor drains shall conform to ASME A112.6.3 or CSA B79.
 1. For mechanical rooms, kitchen, dishwashing and janitor rooms: Josam 30000-E-VP Series coated cast iron floor drain, two-piece body with double drainage flange, WEJLOC invertible non-puncturing flashing collar, weepholes, bottom outlet, adjustable satin Nikaloy vandal resistant round or square medium-duty tractor strainer, and perforated stainless steel basket.
 2. For toilets, washrooms, and all other locations: Josam Series 30000-A-VP cast iron body and flanged collar, weepholes and vandal resistant six inch (diameter)(square) Nikaloy strainer.
 3. For ice machines: Josam Series 30000-E1-VP cast iron floor drain body, flashing collar, weepholes and vandal resistant Nikaloy adjustable extended rim strainer. Set top of rim flush with finished floor.
 4. Vestibule drain: Josam Series 30000A cast iron body and flanged collar, bottom outlet, weepholes and Series AF adjustable Nikaloy round strainer with 1/8 inch lip wide flange and threaded. Provide perforated stainless steel basket.
 5. Trap sealer: Sure Seal Model SS pre-assembled inline floor drain trap sealer. Sealer shall be constructed of high density polyethylene (HDPE) housing and keeper pin, heavy duty silicone diaphragm and soft EPDM sealing gaskets. Rated for floor ASSE-1072 AF-GW third party testing and listed by IAPMO. Provide in all floor drains.

2.6 FLOOR SINKS

- A. All drains shall have outlets suitable for inside caulking. Provide suitable clamping device and extensions if required, where installed in connection with waterproofing membrane. Puncturing membrane other than for drain opening will not be permitted. All floor sinks shall be furnished complete with 4-inch deep seal P-trap. (ASME A112.6.7)
 1. For kitchen locations in tight structural spaces: Josam 4950A Series with 7-1/4 inch diameter grate and 6 inch deep medium sump. This model not compatible with three-compartment sink. Provide aluminum dome strainer, double drainage flange with clamp, acid-resisting interior, bottom outlet and anti-tilting Nikaloy Super Flo grate.
 2. For kitchen locations at three-compartment sink with adequate space: Josam 49580A-NB Series with 11-1/8 inch grate and deep sump. Provide aluminum dome strainer, double drainage flange with 16-1/2 inch flange diameter. This dimension shall be verified in field by Contractor for installation. Provide clamp for waterproof membrane, acid resisting interior, bottom outlet and anti-tilting Nikaloy Super Flo grate.

2.7 TRAPS

- A. Provide traps on all sanitary branch waste connections from fixtures or equipment not provided with traps. Exposed brass shall be polished brass chromium plated with nipple, cleanout, and setscrew escutcheons. Concealed traps may be rough cast brass. Slip joints not permitted on sewer side of trap. Traps shall correspond to fittings on cast iron soil pipe and size shall be as required by connected service or fixture. Traps for equipment with acid-resistant drain system shall be of the same material specified for acid-resistant piping or Polypropylene. Provide 4 inch deep seal traps for all floor drains, floor sinks and hub drains.

2.8 WATERPROOFING

- A. Provide at points where pipes pass through membrane waterproofed floors or walls in contact with earth. Waterproofing shall consist of 6-pound sheet lead mopped-in between piles of waterproofing membrane. Flange out lead at opening for pipe and caulk into a cast iron pipe hub set just below line of membrane waterproofing to form watertight joint through floors.

2.9 INTERCEPTORS

- A. Grease interceptors shall be Josam 60115-SA Series or equal, epoxy coated fabricated steel with shallow on floor with 9 inch clear from top of interceptor to bottom of fixture with 35 gpm rating and 70 pounds grease capacity, 3 inch threaded connections, cascade bottom, internal air relief, visible double wall trap, removable baffles, gasketed non-skid cover bearing PDI seal, and flow control fitting. Unit shall be semi-automatic with grease recovery cone, flexible hose and grease draw-off valve. Provide flow control valve for maximum retention with air intake and vent. (PDI G101)

PART 3 – EXECUTION

3.1 INSTALLATION

- A. General:
 - 1. Suspended horizontal piping shall be supported by adjustable wrought steel clevis hangers. Chain, strap, wire or other make-shift devices will not be permitted as hangers or supports. Hangers on insulated pipes shall go around the insulation, with galvanized sheet steel saddle of sufficient size and thickness to prevent crushing of the insulation. Risers and stacks shall be securely supported and braced in an approved manner. Hangers for plastic piping shall be 4 feet apart. Hangers shall be located at all changes in direction and at each joint for suspended soil, waste or storm branches and mains.
 - 2. Install branch piping for waste from the respective piping systems and connect to all fixtures, outlets, casework, cabinets and equipment, including those furnished by the Owner or specified in other sections of these specifications. Approximate locations for roughing-in are shown on the contract drawings. No piping or roughing-in shall be started until data showing exact locations for equipment and connections required are provided by the Architect. This data shall then be used for roughing-in equipment. Individual traps and other connection components not furnished with the equipment, but required for a complete installation, shall be provided under this section of these

specifications. All exposed trim and fixture pipe, except in laundry, shall be chrome-plated.

3. Install trim and fittings provided with casework, cabinets, and laboratories, but not installed at point of fabrication.
4. Pipe shall be round and straight. Cutting shall be done with proper tools. Pipe, including plastic, shall be reamed to full size after cutting.
5. All pipe runs shall be laid out and scheduled to avoid interferences with other work.
6. Plastic pipe shall not be located in return air ceiling plenums, and shall not be located in above ceiling or attic spaces constructed of combustible material.
7. Plastic pipe shall not penetrate a fire assembly or smokestop. Transitions from metal pipe to plastic pipe must be a minimum of 36 inches away from fire assembly or smokestop penetrations.
8. Screwed joints for steel pipe shall be made with tapered threads, properly cut and all burrs removed. Pipe ends shall be reamed to full size of bore and all filings removed. Joints shall be made tight with an approved joint cement suitable for the service encountered and applied to the male threads only. A maximum of 3 threads shall show after joint is made up.
9. Caulked joints for cast iron sewer pipe shall be made by packing each joint two thirds full with pure tarred rope oakum, and filling remaining 1/3 full of molten lead. Minimum lead depth shall be 2-1/2 inches.
10. Compression gasket joints for cast iron sewer pipe shall be made with neoprene compression gaskets conforming to ASTM C-564 and suitable for use with hub and spigot pipe and fittings. Gaskets shall be installed in strict accordance with manufacturer's recommendations.
11. No-hub joints for cast iron pipes shall be made with neoprene gaskets (ASTM C564) and stainless steel clamps conforming to ASTM C564 AND ASTM C1277. Joints shall be made in accordance with manufacturer's recommendations.
12. Mechanical joints elastomeric sealing sleeve for cast iron pipe shall be in accordance with ASTM C564.
13. Solvent cement for PVC piping shall be handled in accordance with ASTM F402.

B. Piping shall conform to the following:

1. Waste and Rain Conductor:

a. Slope soil, waste and vent piping as follows:

Pipe Size	Minimum Pitch Down
Soil, waste, and vent	
2-1/2 inch & smaller	1/4 inch to the foot
3 inch & larger	1/8 inch to the foot

b. Changes in direction of piping shall be made with fittings. Changes in direction of drainage piping shall be made by the appropriate use of long-sweep 1/4 bends, 1/6, 1/8, or 1/16 bends, 45 degree wyes, 1/2 wyes, or a combination of these fittings, except that changes in direction of flow from the horizontal to the vertical may be made with short-sweep 1/4 bends.

c. Contractor is cautioned to locate and verify invert of existing sanitary and storm sewer and to coordinate inverts of new work to suit existing conditions.

- d. Sanitary sewer shall be provided complete with all plumbing fixtures, drains, etc., properly connected and vented in accordance with the applicable codes. All vents through the roof, including existing vents-through-roof where existing roofing is being replaced and roof slopes are revised, shall extend a minimum of twelve inches above the roof.

3.2 PROTECTION OF ELECTRICAL EQUIPMENT

- A. Refer to Specification Section 220000, Paragraph 3.01.C.1 for requirements for piping above electrical equipment.

3.3 TESTS

- A. General: Contractor shall provide all instruments, materials, and labor required. Tests shall be made in the presence of the Owner or Authority having jurisdiction or as otherwise directed by the Architect, who shall be given five (5) days notice by this Contractor of his readiness to perform such tests. Any leaks that develop during the tests shall be repaired by remaking the joint or replacing pipe and fittings. Temporary caulking will not be permitted. No piping shall be insulated or concealed until it has been tested, with results acceptable to the Architect. Except for plastic piping, air testing will be acceptable for other piping materials where permitted by the Virginia Uniform Statewide Building Code. Test systems either in its entirety or in sections.
- B. Testing of Existing Underground and Underfloor Sanitary and Storm Piping: The plumbing design of this facility involves connecting to existing underground and underfloor sanitary and storm sewer piping systems. The condition of this piping is unknown. Therefore, the underground piping systems shall be tested for leakage and adequate flow prior to connection of the new systems. These tests are described below.
 1. As soon as possible once construction activities commence, the Contractor shall isolate and test the existing underground sanitary and storm drainage piping for leakage and for proper flow by the following procedure:
 - a. Existing underground sanitary and storm piping shall be tested for proper flow at each fixture and drain connection, and cleaned by rodding if obstructions are suspected. If insufficient flow is observed at any fixture or drain, pipes in the affected area shall be rodded until obstructions are cleared. The discharge shall be observed at the nearest manhole outside the building on the system being tested. If, after the entire system is rodded, an obstruction is not found and the system still exhibits inadequate flow, the Architect/Engineer shall immediately be notified.
 - b. After verification of proper flow in the underground sanitary and storm drainage systems, the systems shall be tested for leaks. The discharge pipe shall be plugged at the nearest manhole outside the building on the system being tested, and all openings inside the building shall be tightly plugged except the highest opening of the section being tested. The system shall be filled with water to the overflow of the fixture or inlet at the highest opening, and shall hold full for 15 minutes. If the system fails to hold water for the specified time, the test shall be repeated for each branch line to determine the leak location. If the leak location cannot be determined after every section of the system has been tested, or if multiple leaks are found, the Architect/Engineer shall immediately be notified.

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- c. After all flow and leak tests have been completed, the Contractor shall submit the test results in writing to the Architect/Engineer.
 2. All repairs required to existing underground sanitary and storm drainage systems to be reused, where deficiencies are discovered during testing or construction, shall be addressed by change order, or shall be addressed separately by the owner.
 - C. Soil, Waste and Vent Systems: Conduct tests before trenches are backfilled or fixtures are connected. Conduct water test or air test, as directed in accordance with the Virginia Uniform Statewide Building Code and this specification.
 1. Water Test: If entire system is tested, tightly close all openings in pipes except highest opening, and fill system with water to point of overflow. If system is tested in sections, tightly plug each opening except highest opening of section under test, fill each section with water and test with at least 10-foot head of water. In testing successive sections, test at least upper 10 feet of next preceding section so that each joint or pipe except uppermost 10-foot head of water. Keep water in system, or in portion under test, for at least 15 minutes before inspection starts. System shall then be tight at all joints.
 2. Final Test: When required by the Building Inspector, conduct as directed in accordance with Virginia Uniform Statewide Building Code and this specification. Either one of the following tests may be used:
 - a. Smoke Test: After fixtures are permanently connected and traps are filled with water, fill entire drainage and vent systems with smoke. When smoke appears at stack openings on the roof, the stack openings shall be closed and a pressure equivalent to a 1-inch water column shall be held for a test period of not less than 15 minutes. Chemical smoke prohibited.
 - b. Peppermint Test: Introduce two ounces of peppermint into each line or stack.
 - c. Air Test: Air test shall be made by forcing air into the system until obtaining a uniform gauge pressure of 5 psi or sufficient to balance a 10 inch column of mercury. This pressure shall be held for a test period of not less than 15 minutes. Testing procedures in excess of 5 psi can result in a dangerous situation and shall not be allowed. Plastic piping shall not be tested using air.
 - D. Optional tests for connections to existing systems: After installation of piping and connecting to existing systems, and where herein before specified tests are impractical, test all new piping under actual operating conditions and prove tight to the satisfaction of the Architect.
- 3.4 CLEANING
 - A. After tests have been successfully completed, thoroughly flush the interior drainage system.
 - B. Remove trash, plaster, dust, paint spots and all foreign matter from inside and outside of all fixtures and equipment.
 - C. The Contractor shall check each length of pipe before it is put in place to make certain there is not foreign material (stones, sand, etc.) in the systems. Provide temporary bypass around equipment if or as required. All plumbing pipes shall be thoroughly flushed with water to remove construction debris before final connections are made to equipment and fixtures.

3.5 REPORTS

- A. Reports of cleaning and testing: Contractor shall verify *in writing before completion of the job* that all specified cleaning procedures and tests have been performed, with results as specified or as required by codes.

END OF SECTION 221300

SECTION 224000 - PLUMBING FIXTURES

PART 1 - GENERAL

1.1 CONDITIONS

- A. The applicable provisions of Section 22 00 00, PLUMBING GENERAL REQUIREMENTS, are hereby made a part of the section and the Contractor is cautioned to read Section 22 00 00 carefully as items of work applicable to this section are included in Section 22 00 00.

1.2 DESCRIPTION OF WORK

- A. The work to be performed under this section of the specifications comprises the furnishing of all labor and materials and the completion of all work of this section as shown on the drawings and/or herein specified.
- B. In general, the work included under this section consists of, but is not limited to, the following:
 - 1. Plumbing Fixtures
 - 2. Plumbing Trim

1.3 RELATED WORK

- A. Section 22 00 00, PLUMBING GENERAL REQUIREMENTS.

1.4 SUBMITTALS

- A. In accordance with Section 22 00 00, PLUMBING GENERAL REQUIREMENTS, furnish the following:
 - 1. Manufacturer's Literature and Dimension Cuts:
 - a. Plumbing Fixtures & Carriers
 - b. Plumbing Faucets & Flush Valves
 - c. Plumbing Traps and Fittings
 - d. Plumbing Supplies & Stop Valves
 - e. Plumbing Equipment

PART 2 - PRODUCTS

2.1 GENERAL

- A. Fixtures equal to those as hereinafter specified shall be furnished and installed complete with all supplies, waste and vent connections, all fittings, all necessary hangers and supports, bolt caps, faucets, valves and traps. All trim, except in Janitor's Closets, shall be brass with polished chromium plated finish with chrome setscrew escutcheon at wall, except fixture supply pipes

may be chromium plated copper with chrome setscrew escutcheons at wall. Traps shall be cast brass (17 gauge) with cleanout plug. All fixtures shall be white except as otherwise indicated. Handicapped lavatories and sinks shall have both water supplies and trap insulated and wrapped with Handy-Shield (by Plumberex), Handi Lav-Guard (by Truebro) or Prowrap (by McGuire). Where below deck mixing valve or electronic faucet are specified, provide Zurn Model Z6900-V9 vandal guard enclosure or equal by Truebro. Color shall be white and fasteners shall remain out of sight.

2.2 ACCEPTABLE MANUFACTURERS

A. Subject to compliance with requirements

Water Closets:	Kohler, American Standard, Toto, Sloan, Zurn
Lavatories:	Kohler, American Standard, Toto, Zurn
Sinks:	Food Service Provided
Flush Valves:	Delany, Zurn, Sloan
Faucets:	Kohler, Chicago, T & S, Zurn, American Standard, MR Direct
Water Closet Seats:	Kohler, Olsonite, Bemis, Church
Carriers:	J.R. Smith, Zurn, Josam, Mifab
Mop Sink:	Florestone, Aquaglass, Fiat

2.3 CODE COMPLIANCE

A. Manufacturer's shop drawings shall indicate that fixtures, fittings and equipment meet specified codes. Fixtures, fittings or equipment materials for potable water system shall not contain lead. All plumbing fixtures, flush valves, faucets, and fittings designated for handicapped installation, shall meet ICC/ANSI A117.1-2003 and The Americans with Disabilities Act 2010 (ADA) requirements. Fittings and fixtures that are connected to potable water systems shall meet the 1996 Safe Water Drinking Act and the 2011 Reduction of Lead in Drinking Water Act, and where applicable shall meet NSF Standard 61 and shall be labeled and certified. Faucets that supply drinking water shall comply with NSF 9.

B. Codes:

1. Vitreous china fixtures - ASME/ANSI A112.19.2M; ICC/ANSI A117.1-2003; ADA
2. Flush valves - ASSE 1037 with ASSE 1001 vacuum breaker on flush valves; ICC/ANSI A117.1-2003; ADA
3. Lavatory and closet carrier - ASME/ANSI A112.6.1
4. Stainless steel plumbing fixtures (sinks) - A112.19.3M; ICC/ANSI A117.1-2003; ADA
5. Faucets - ASSE 1025; ASME A112.18.1; ICC/ANSI A117.1-2003; ADA; NSF Standard 61 Section 9

2.4 STOPS

A. Provide lock-shield, loose-key or screw driver pattern polished chromium plated angle stops, with each hand sink faucet, sink faucet or lavatory faucet. Locate stops below fixture in accessible location. Flush valves shall be furnished with integral stops.

2.5 ESCUTCHEONS

- A. Heavy duty solid type chrome plated brass with set screws.

2.6 ROSETTA SPRAY NON-AERATED CONTROL DEVICE

- A. Smooth, bright stainless steel or satin finish, chrome plated metal Rosetta spray non-aerated flow device shall provide non-aeration, clear, coherent Rosetta spray control flow device that will not splash in basin. Device shall also have a flow control restrictor and have vandal resistant housing.
- B. Flow Control Restrictor:
 - 1. Capable of restricting flow to 0.5 GPM for lavatories and for sinks. See fixture specification for GPM requirement for each fixture.
 - 2. Compensates for pressure fluctuation maintaining flow rate specified above within 10 percent between 25 and 80 psig.
 - 3. Operates by expansion and contraction, eliminates mineral/sediment build-up with self-clearing action, and is capable of easy manual cleaning.
- C. Device manufactured by OMNI Products, Inc.

2.7 THERMOSTATIC MIXING VALVE

- A. Provide on all lavatories and hand sinks Watts Model Series LFUSG-B-M2 under-sink Guardian ASSE 1070 thermostatic tempering valve for single fixture applications. Set valve for minimum 105 Deg. F, maximum 109 Deg. F.

2.8 FIXTURES

Designation Handicapped Fixture Type (ADA)

WC Water closet: American Standard AFWall 2257.101; Kohler Kingston K-4325, 1.28 GPF water saving, vitreous china, elongated siphon jet bowl, wall hung, 1-1/2 inch top spud, Bemis #1655CT white extra heavy duty solid plastic open front seat without cover, check hinge. Sloan 111-1.28, Delaney "Flushboy Ultra" U402-1.28 flush valve mounted 11-1/2 inches above bowl with vacuum breaker and vandal-resistant control cap assembly. Provide ADA approved handle. Mount top of rim 17 inches above finished floor. Provide coordinated closet carrier similar to Josam 12000 Series "Chase Saver" carrier with applicable "Unitron" fitting. Carrier will need to be coordinated in field with concrete floor structure to provide possible offset piping.

L Lavatory: American Standard Lucerne 0355.012, 20-1/2 inch x 18-1/4 inch, Kohler Chesapeake K-1728, 19-1/4 inch x 17-1/4 inch, vitreous china, 4-inch centers, wall hung, concealed arms, faucet ledge, American Standard Monterrey 5502.170VP 4-inch center, 0.5 GPM flow device, vandal-resistant wrist blade handles, 7723.018 offset drain with perforated grid drain and tailpiece or Kohler K-7404-KE Triton faucet, 0.5 GPM flow device, K-16010-5 vandal resistant wrist blade handles, K-7131-A offset drain with perforated

grid strainer and tailpiece. Mount top of front rim 34 inches above finished floor. Provide concealed arms carrier similar to Josam 17100 single or 17100-BB double floor-mounted lavatory carrier with leveling and securing screws, structural uprights and block bases.

MS Mop Sink: Fiat Model MSB-2424, 24 inch x 24 inch x 10 inch molded stone mop service basin, with Fiat E-77-AA bumper guard, stainless steel drain body, combination S.S. dome strainer and lint basket, Fiat 830-AA supply fitting with vacuum breaker, four arm handles, integral stops, wall brace, pailhook, threaded spout, Fiat 832-AA rubber hose and wall hook and Fiat 889-CC mop hanger.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Supports and Fastenings: Secure all fixtures, equipment and trimmings to partitions, walls, etc., with brass through bolts, toggle bolts, expansion bolts, or power set fasteners, as required. Exposed heads of bolts and nuts in finished rooms to be hexagonal, polished chromium plated brass with rounded tops.
- B. Through Bolts: For freestanding marble and metal stud partitions.
- C. Toggle Bolts: For hollow masonry units, finished or unfinished.
- D. Expansion Bolts: For brick or concrete or other solid masonry. To be 1/4-inch bolts, 20 threads per inch, and to extend at least three inches into masonry; to be fitted with loose tubing or sleeves extending into masonry. Wood plugs, fiber plugs, lead or other soft metal shields are prohibited.
- E. Power Set Fasteners: May be used for concrete walls, shall be 1/4-inch threaded studs, 20 threads per inch, and shall extend at least 1-1/4 inches into wall.
- F. Tightly cover and protect fixtures and equipment against dirt, water and chemical or mechanical injury.
- G. Where water closets are wall mounted and lavatories are wall mounted, seal between water closet and wall and lavatory and wall, with a silicon caulking compound. Where fixtures are white in color, the caulking compound shall be white. Where fixtures are stainless steel, use transparent caulking compound.

3.2 CLEANING

- A. At completion of all work, fixtures, exposed materials and equipment shall be thoroughly cleaned.

END OF SECTION 224000

SECTION 226000 - NATURAL GAS SYSTEM

PART 1 - GENERAL

1.1 CONDITIONS

- A. The applicable provisions of Section 22 00 00, PLUMBING GENERAL REQUIREMENTS, are hereby made a part of this section and the Contractor is cautioned to read Section 22 00 00 carefully as items of work applicable to this section are included in Section 22 00 00.

1.2 DESCRIPTION OF WORK

- A. The work includes providing a complete gas piping system including, but not necessarily restricted to, the following:
 - 1. Natural gas piping system from gas meter.
 - 2. Installation and connections to miscellaneous equipment furnished by Owner.
 - 3. Connections to fixtures and equipment provided under other sections of these specifications.
 - 4. Miscellaneous work as described herein, as shown on drawings, and as required for a complete system.

1.3 RELATED WORK

- A. Section 22 00 00, PLUMBING GENERAL REQUIREMENTS.

1.4 SUBMITTALS

- A. Manufacturer's shop drawings shall indicate that fixtures and equipment meet specified codes. In accordance with Section 22 00 00, PLUMBING GENERAL REQUIREMENTS, furnish the following:
 - 1. Manufacturer's Literature and Data:
 - a. Piping
 - b. Valves
 - c. Gas Pressure Regulators
 - d. Pipe supports

PART 2 – PRODUCTS

2.1 PIPE SUPPORTS, PIPE SLEEVES, AND WALL CEILING PLATES

- A. Provide in accordance with specifications in Section 22 00 00, PLUMBING GENERAL REQUIREMENTS.

2.2 INTERIOR GAS PIPING--NATURAL GAS

- A. Pipe: Black steel, ASTM A 53 Grade B or A 106, Schedule 40.
- B. Nipples: Steel, ASTM A733, Schedule 40.
- C. Fittings, 2 Inches and Smaller: Malleable iron, ASME B16.3. (Threaded)
- D. Joints: Threaded ends (ASME B1.20.1). Pipe-joint compound or tape applied to male threads only; Welded. Do not use gas fitters cement, except on outlet caps.
- E. Gas piping installed in concealed locations shall not have unions, tubing fittings or running threads.
- F. Gas Regulator Vent Piping Above Grade: Same as natural gas piping above grade.

2.3 EXTERIOR ABOVE GROUND AND UNDERGROUND GAS PIPING--NATURAL GAS

- A. Pipe: Black steel, ASTM A 53 Grade B Schedule 40, or A 106, Schedule 40.
- B. Nipples: Black steel.
- C. Joints: Threaded ends (ASME B1.20.1). Pipe-joint compound or tape applied to male threads only; Welded. Do not use gas fitters cement, except on outlet caps.
- D. Factory applied Republic Steel Company plastic covering "X-TRU-COAT", for all exterior piping and fittings. Joints for exterior and underground piping and fittings shall be primed with "X-TRU-TAPE" primer and finished with "X-TRU-TAPE".

2.4 EXTERIOR UNDERGROUND GAS PIPING--NATURAL GAS

- A. All underground gas piping material shall meet specifications set forth by Local Gas Supplier.
- B. The joining of any underground gas piping shall be performed according to the manufacturer's procedures. Installer shall meet the qualification requirements set forth under U.S.D.O.T. CFR 192, and be subject to random inspection by Local Gas Supplier personnel.
- C. Underground gas piping and fittings shall be coated, wrapped, or protected as required and approved by Local Building Inspector.

2.5 VALVES

- A. General: Each item shall have threaded or flanged, connections as applicable to match joints specified for its respective service.
- B. Gas Valves:
 - 1. 4 Inches and Smaller: Bronze two piece ball valve, chrome plated ball, CSA & Underwriters Laboratories listed.

2. Medium Pressure Gas System line regulators shall be isolated for testing with Jomar Model T-203 Blue Cap Gas Ball Valves on high pressure and low pressure sides of regulator. Valve shall have side pressure test port.

PART 3 – EXECUTION

3.1 INSTALLATION

A. General:

1. Suspended horizontal piping shall be supported by adjustable wrought steel clevis hangers. Where supports bear on copper pipe, they shall be copper plated. Chain, strap, wire or other make-shift devices will not be permitted as hangers or supports. Risers shall be securely supported and braced in an approved manner. Hangers or roof supports for metal piping shall be spaced not over 6 feet apart for pipes 1/2 inch or smaller, 8 feet apart for 3/4 inch pipes and not over 10 feet apart for pipes 1 inch or larger. Hangers shall be located at all changes in direction and at each joint.
2. Install branch piping for gas from the respective piping systems and connect to all valves, cocks, and equipment, including those furnished by the Owner or specified in other sections of these specifications. Approximate locations for roughing-in are shown on the contract drawings. No piping or roughing-in shall be started until data showing exact locations for equipment and connections required are provided by the Architect. This data shall then be used for roughing-in equipment. Individual components not furnished with the equipment, but required for a complete installation, shall be provided under this section of these specifications.
3. Install trim and fittings provided with casework, cabinets, and laboratories, but not installed at point of fabrication.
4. Pipe shall be round and straight. Cutting shall be done with proper tools. Pipe shall be reamed to full size after cutting.
5. All pipe runs shall be laid out and scheduled to avoid interferences with other work.
6. Install valves with stem in horizontal position. All valves shall be easily accessible. Isolation valves shall be installed at each major piece of equipment and at other points indicated or required for isolation or sectionalizing purposes. Pipe shall be supported so that weight of pipe is not on valve body.
7. Exterior underground gas piping shall have a minimum of 24 inch cover unless indicated otherwise on drawings.
8. Unions in gas piping shall be ground seat type.
9. Screwed joints for steel pipe shall be made with tapered threads, properly cut and all burrs removed. Pipe ends shall be reamed to full size of bore and all filings removed. Joints shall be made tight with an approved joint cement suitable for the service encountered and applied to the male threads only. A maximum of 3 threads shall show after joint is made up.
10. Welded joints shall be fusion welded by qualified welders in accordance with ANSI B31.1 Section 6, unless otherwise required.
11. Gas:
 - a. Install natural gas piping with plugged drip pockets at low points and ahead of the connection to each piece of equipment. Entire gas piping installation shall be in accordance with requirements of Virginia Uniform Statewide Building Code.
 - b. Minimum slope shall be 1/4 inch per fifteen feet in direction opposite flow.

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- c. Installation of gas transmission systems and liquid petroleum pipelines shall obtain a degree of safety performance required by 49 CFR, Part 192 and 195, if applicable.
 - d. Shut-off cock shall be provided at each burner, if not provided with the respective equipment.
 - e. Provide a shutoff valve with test port on upstream and downstream side of all line medium pressure regulators. Downstream test port shall be installed not less than 10 pipe diameters downstream of regulator outlet.
 - f. All natural gas line and appliance regulators exposed to the weather must be rated for outdoor use.
 - g. All natural gas regulators located where unit may be submerged during floods, shall be provided a special anti-flood type breather vent fitting.
- B. Bonding of Gas Piping: All metal gas piping attached to the building shall be bonded in accordance with the requirements of the current edition of NFPA 70, Article 250.104(b) and Section 26 05 26 of the Electrical Specifications.

3.2 TESTS

- A. General: Contractor shall provide all instruments, materials, and labor required. Tests shall be made in the presence of the Owner or Authority having jurisdiction or as otherwise directed by the Architect, who shall be given five (5) days notice by this Contractor of his readiness to perform such tests. Any leaks that develop during the tests shall be repaired by remaking the joint or replacing pipe and fittings. Temporary caulking will not be permitted. No piping shall be concealed until it has been tested, with results acceptable to the Architect.
- B. Gas System: Gas piping shall be tested and inspected in accordance with Virginia Uniform Statewide Building Code.

3.3 CLEANING

- A. Remove trash, plaster, dust, paint spots and all foreign matter from all piping and equipment.
- B. The Contractor shall check each length of pipe before it is put in place to make certain there is not foreign material (stones, sand, etc.) in the systems. Provide temporary bypass around equipment if or as required.

3.4 REPORTS

- A. Report of cleaning and testing: Contractor shall verify ***in writing before completion of the job*** that all specified cleaning procedures, tests and sterilizing have been performed, with results as specified or as required by codes.

END OF SECTION 226000