

SECTION 220001

PLUMBING

(Filed Sub-Bid Required)

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

- A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01 - GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.
- B. Time, Manner and Requirements for Submitting Sub-Bids:
 - 1. Sub-bids for work under this Section shall be for the complete work and shall be filed as stipulated in the "INSTRUCTIONS TO BIDDERS".
 - 2. Each sub-bid submitted for work under this Section shall be filed as required by Section 44F of Chapter 149 of the General Laws, as amended.

Sub Sub-Bid Requirements: Plumbing Piping Insulation

<u>CLASSES OF WORK</u>	<u>REFERENCE PARAGRAPH</u>
Insulation	2.04

Reference Drawings: The Work of this Filed Sub-Bid is shown on the following CONTRACT DRAWINGS:

P000, P201, P202, P203, P211, P212, P213, P221, P222, P223, P231, P232, P233, P400, P401, P402, P501, P502, P503, P504, P600, P601, P602, P700, G000, G001, G002, C100, C200, C201, C400, C401, C500, C501, C502, S001, S002, S100, S104, S210, S211, S212, S213, S214, S215, S216, S217, S500, A020, A030, A031, A200, A211, A212, A213, A214, A215, A216, A217, A300, A500, A514, A520, A521, A580, A581, A582, A700, A701, A702, A703, A704, A720, A734, A800, A801, A802, A803, A804, A805, FS100, FS101, FS102, FS103.

1.2 RELATED DOCUMENTS

The "Standard Form of Agreement" AIA Document A101, 2007 Edition, Electronic Format, as published by The American Institute of Architects, together with all amendments and supplements as hereinbefore listed, shall apply and are hereby made a part of this section of the specifications.

The section of these specifications entitled “Special Condition”, “Minimum Wage Determination”, and Division 01 “General Requirements” shall apply and are hereby made a part of this section of the specifications.

1.3 REFERENCES

Conditions of the Contract and Division 1, General Requirements, apply to work of this Section. Where Paragraphs of this Section conflict with similar paragraphs of Division 1, requirements of this Section shall prevail.

The attention of this construction manager is directed to Part 3, Paragraph 3.01 of this Section, which contains instructions for commissioning of systems and equipment.

Examine Drawings and other Sections of Specifications for requirements that affect work of this Section.

1.4 SCOPE

Perform work and provide material and equipment as shown on Drawings and as specified or indicated in this Section of the Specification. Completely coordinate work of this Section with work of other trades and provide a complete and fully functional installation.

Sustainable Design Intent: Comply with the project requirements intended to achieve sustainable design measured and documented according to the LEED Green Building Rating System, of the US Green Building Council. Refer to SECTION 018113 SUSTAINABLE DESIGN REQUIREMENTS and SECTION 018113a LEED SCORECARD for certification level and certification requirements.

Furnish and install or perform the following, as shown on the drawings and as specified herein:

1. Interior sanitary waste and vent piping system to 10 feet outside interior face of foundation wall.
2. Interior storm drainage piping including primary roof drains to 10 feet outside interior face of foundation wall.
3. Provision of exterior grease trap with all associated grease waste sanitary piping, vent piping from exterior grease trap back into the building and extending through the roof.
4. Interior domestic water piping systems to 10 feet outside interior face of foundation wall.
5. Potable water systems.
6. Plumbing fixtures and trim.
7. Mixing valves
8. Gas-fired water heaters
9. Floor drains & Floor Sinks.
10. Floor drain trap priming valves, distribution boxes and trap primer piping.
11. Hose bibbs, roof hydrants and wall hydrants.
12. Insulation.
13. Valves.
14. Water hammer arrestors.

15. Backflow preventers.
16. Recirculation pumps and balancing valves
17. Elevator Sump Pumps
18. Oil/Water Separators
19. Interior Grease Interceptors
20. Fittings, unions, flanges and couplings.
21. Hangers, plates and inserts.
22. Cleaning, testing and disinfection.
23. All supplementary steel for piping and equipment support.
24. Guarantees.
25. Drilling for installation of inserts.
26. Vibration isolation and flexible connections.
27. Core drilling.
28. Scaffolding, hoisting and rigging.
29. Sleeves.
30. Provide penetration firestopping in accordance with Section 078410 Penetration Firestopping for all openings through fire rated partitions, horizontal assemblies, and smoke barriers used by this Trade Sub-Bidder. Owner's Project Manager will hire third party independent testing agency to perform destructive testing in line with requirements of the 9th edition of the building code. Trade contractors should include repair of destructive test penetrations after testing is complete. All partitions and floor assemblies are to be considered rated for the purpose of sealing penetrations.

Furnish following items for installation under other Sections:

31. Access panels
32. Starters.

1.5 SUBMITTALS

Shop Drawings

1. Sanitary waste specialties
2. Water heaters
3. Plumbing Fixtures
4. Grease interceptors
5. Exterior grease trap.

Plumbing Coordination Drawings For All Floors, Including Underslab, Showing:

6. Domestic water distribution
7. Sanitary waste & vent distribution
8. Stormwater distribution
9. Condensate receptors
10. Natural gas distribution
11. Venting and combustion air flues
12. All pipe sizing
13. All equipment locations
14. All fixture locations
15. All floor and roof drain locations

16. All valving throughout building
17. All access panel locations
18. All structural beam, slab and footing locations
19. Piping coordinated to other relevant MEPFP trades and architectural elements
20. Slab and structural steel penetration locations and sizes.

Product Data

21. Meters & Gauges
22. Valves
23. Hangers and Supports
24. Equipment
25. Valve numbering
26. Valve Schedule
27. Insulation
28. Water piping
29. Sanitary waste and vent piping
30. Water heaters
31. Plumbing Fixtures

Test Reports

32. Water piping
33. Sanitary waste
34. Water heater field test
35. Recirculation pump field test

Certificates

36. Water heaters
37. Grease interceptor

O&M Data

38. Water pumps
39. Water heaters
40. Fixtures
41. Mixing valves

Closeout Submittal

42. Water heater warranty

1.6 DEFINITIONS

As used in this Section, "provide" means "furnish and install" and "HVAC" means "Heating, Ventilating and Air Conditioning" and "POS" means "Provided under Other Sections". "Furnish" means "to purchase and deliver to the project site complete with every necessary appurtenance and support," and "Install" means "to unload at the delivery point at the site and perform every operation necessary to establish secure mounting and correct operation at the proper location in the project."

1.7 CONTRACT DOCUMENTS

Listing of Drawings does not limit responsibility of determining full extent of work required by Contract Documents. Refer to Architectural, HVAC, Electrical, Plumbing, Fire Protection, Structural, and other Drawings and other Sections that indicate types of construction in which work shall be installed and work of other trades with which work of this Section must be coordinated.

Except where modified by a specific notation to the contrary, it shall be understood that the indication and/or description of any item, in the drawings or specifications or both, carries with it the instruction to furnish and install the item, regardless of whether or not this instruction is explicitly stated as part of the indication or description.

Items referred to in singular number in Contract Documents shall be provided in quantities necessary to complete work.

Drawings are diagrammatic. They are not intended to be absolutely precise; they are not intended to specify or to show every offset, fitting, and component. The purpose of the drawings is to indicate a systems concept, the main components of the systems, and the approximate geometrical relationships. Based on the systems concept, the main components, and the approximate geometrical relationships, the contractor shall provide all other components and materials necessary to make the systems fully complete and operational.

Information and components shown on riser diagrams but not shown on plans, and vice versa, shall apply or be provided as if expressly required on both.

1.8 DISCREPANCIES IN DOCUMENTS

Where Drawings or Specifications conflict or are unclear, advise Engineer in writing before Award of Contract. Otherwise, Engineer's interpretation of Contract Documents shall be final, and no additional compensation shall be permitted due to discrepancies or unclarities thus resolved.

Where Drawings or Specifications do not coincide with manufacturers' recommendations, or with applicable codes and standards, alert Engineer in writing before installation. Otherwise, make changes in installed work as Engineer requires within Contract Price.

If the required material, installation, or work can be interpreted differently from drawing to drawing, or between drawings and specs, this contractor shall provide that material, installation, or work which is of the higher standard.

It is the intent of these contract documents to have the contractor provide systems and components that are fully complete and operational and fully suitable for the intended use. There may be situations in the documents where insufficient information exists to precisely describe a certain component or subsystem, or the routing of a component. In cases such as this, where the contractor has failed to notify the Engineer of the situation in accordance with Paragraph (A) above, the contractor shall provide the specific component or subsystem with all parts necessary for the intended use, fully complete and operational, and installed in workmanlike manner either concealed or exposed per the design intent.

In cases covered by Paragraph (D) above, where the contractor believes he needs engineering guidance, he shall submit a sketch identifying his proposed solution and the Engineer shall review, note if necessary, and approve the sketch.

1.9 MODIFICATIONS IN LAYOUT

HVAC, Plumbing, Fire Protection, and Electrical Drawings are diagrammatic. They indicate general arrangements of mechanical and electrical systems and other work. They do not show all offsets required for coordination nor do they show the exact routings and locations needed to coordinate with structure and other trades and to meet Architectural requirements.

In all spaces, prior to installation of visible material and equipment, including access panels, review Architectural Drawings for exact locations and where not definitely indicated, request information from Engineer.

Check Contract Drawings as well as Shop Drawings of all subcontractors to verify and coordinate spaces in which work of this Section will be installed.

Maintain maximum headroom at all locations. All piping, duct, conduit, and associated components to be as tight to underside of structure as possible.

Make reasonable modifications in layout and components needed to prevent conflict with work of other trades and to coordinate according to Paragraphs A, B, C, D above. Systems shall be run in a rectilinear fashion.

Where conflicts or potential conflicts exist and engineering guidance is desired, submit sketch of proposed resolution to Engineer for review and approval.

1.10 RELATED WORK IN OTHER SECTIONS

The following work is not included in this Section and will be performed under other Sections (abbreviation POS on Drawings means, "Provided Under Other Sections"):

1. Section 312000 – EARTH MOVING for excavation, backfill, and compaction required for sanitary sewerage system piping and structures.
2. SECTION 033000 CAST-IN-PLACE CONCRETE: Concrete work, including concrete housekeeping pads and other pads and blocks for vibrating and rotating equipment.
3. SECTION 017329 CUTTING AND PATCHING: Cutting and patching of masonry, concrete, tile and other parts of structure, except drilling for hangers, providing holes and openings in metal decks and core drilling.
4. SECTION 070002 ROOFING AND FLASHING: Flashing of roof penetrations and roof drains.
5. SECTION 083110 ACCESS DOORS AND FRAMES: Installation of access panels in floor, wall, furred space or above ceiling.
6. SECTION 090007 PAINTING: Painting, except as specified herein.
7. SECTION 260001 ELECTRICAL: Electric power wiring for equipment.
8. SECTION 051200 STRUCTURAL STEEL FRAMING: Structural supports necessary to distribute loading from equipment to roof or floor.

9. SECTION 015000 TEMPORARY FACILITIES AND CONTROLS: Temporary light, power, and heat for use during construction and testing.
10. SECTION 334000 STORM DRAINAGE UTILITIES: Area drains.
11. SECTION 102800 TOILET ACCESSORIES: The provision of toilet room accessories such as toilet paper holders, mirrors, and soap dispenser.
12. SECTION 018100 COMMISSIONING.
13. SECTION 220001 PLUMBING.

1.11 SITE VISIT

Before submitting bid, visit and carefully examine site to identify existing conditions and difficulties that will affect work of this section. No extra payment will be allowed for additional work caused by unfamiliarity with site conditions that are visible or readily construed by experienced observer.

1.12 EXISTING CONDITIONS AND PREPARATORY WORK

Before starting work in a particular area of the project, visit site and examine conditions under which work must be performed including preparatory work done under other Sections or Contracts. Report conditions that might affect work adversely in writing through Contractor to Engineer. Do not proceed with work until defects have been corrected and conditions are satisfactory. Commencement of work shall be construed as complete acceptance of existing conditions and preparatory work.

1.13 CODES, STANDARDS, AUTHORITIES AND PERMITS

Perform work in strict accordance with the rules, regulations, standards, codes, ordinances, and laws of local, state, and federal governments, and other authorities that have legal jurisdiction over the site. Materials and equipment shall be manufactured, installed and tested as specified in latest editions of applicable publications, standards, rulings and determinations of:

1. Local and state building, plumbing, mechanical, electrical, fire, health and Environmental department codes.
2. National Fire Protection Associates (NFPA).
3. American Insurance Association (A.I.A.) (formerly National Board of Fire Underwriters).
4. Occupational Safety and Health Act (OSHA).
5. Factory Mutual Association (FM).
6. Underwriters' Laboratories (UL).

Material and equipment shall be listed by Underwriters' Laboratories (UL), and approved by ASME, AGA, and FM for intended service.

Most recent editions of applicable specifications and publications of the following organizations form part of Contract Documents:

7. American National Standards Institute (ANSI).
8. American Society of Mechanical Engineers (ASME).
9. National Electric Manufacturers Association (NEMA).

10. American Society for Testing and Materials (ASTM).
11. American Water Works Association (AWWA).

Secure and pay for all permits and inspections required by any of the authorities having jurisdiction.

1.14 GUARANTEE AND 24 HOUR SERVICE

Guarantee Work of this Section in writing for two years following the date of beneficial occupancy by the User Agency. If the equipment is used for ventilation, temporary heat, etc. prior to initial beneficial occupancy by the Owner, the bid price shall include an extended period of warranty covering the one year of occupancy, starting from the initial date of beneficial occupancy by the User Agency. The guarantee shall repair or replace defective materials, equipment, workmanship and installation that develop within this period, promptly and to Engineer's satisfaction and correct damage caused in making necessary repairs and replacements under guarantee within Contract Price.

In addition to guarantee requirements of Division 01 and of Subparagraph A above, obtain written equipment and material warranties offered in manufacturer's published data without exclusion or limitation, in Owner's name.

Replace material and equipment that require excessive service during guarantee period as defined and as directed by Engineer.

Provide 24 hour service beginning on the date the project is first beneficially occupied by the Owner, whether or not fully occupied, and lasting until the termination of the guarantee period. Service shall be at no cost to OWNER. Service can be provided by this contractor or a separate service organization. Choice of service organization shall be subject to Engineer and OWNER approval. Submit name and a phone number that will be answered on a 24 hour basis each day of the week, for the duration of the service.

Submit copies of equipment and material warranties to Engineer before final payment.

At end of guarantee period, transfer manufacturers' equipment and material warranties still in force to Owner.

This Paragraph shall not be interpreted to limit Owner's rights under applicable codes and laws and under this Contract.

Part 2 Paragraphs of this Specification may specify warranty requirements that exceed those of this Paragraph.

Use of systems provided under this Section for temporary services and facilities shall not constitute Final Acceptance of work nor beneficial use by Owner, and shall not institute guarantee period.

Provide manufacturer's engineering and technical staff at site to analyze and rectify problems that develop during guarantee period immediately. If problems cannot be rectified immediately to the Owner's Project Manager's satisfaction, advise Engineer in writing, describe efforts to rectify situation, and provide analysis of cause of problem. Engineer will suggest course of action.

1.15 RECORD DRAWINGS

Comply with requirements specified in Division 01.

Drawings shall show record condition of details, sections, riser diagrams, control changes and corrections to schedules. Schedules shall show actual manufacturer and make and model numbers of final equipment installation.

1.16 BULLETINS, MANUALS, AND OPERATING INSTRUCTIONS, AND PROTECTION

Obtain at time of purchase of equipment, three hard copies of operation, lubrication and maintenance manuals for all items. Assemble literature in coordinated manuals with additional information describing combined operation of field assembled units. Manual shall contain names and addresses of manufacturers and local representatives who stock or furnish repair parts for items or equipment. Divide manuals into three sections or books as follows:

1. Directions for and sequence of operation of Plumbing system components. List valves, switches and other devices used to control system. Detail procedure to be followed in case of malfunctions. Include detailed approved flow diagrams and approved directory, showing valve numbers and locations and equipment or fixture controlled by valves.
2. Detailed maintenance and troubleshooting manuals containing data furnished by manufacturer for complete maintenance.
3. Lubrication instructions detailing type of lubricant, amount, and intervals recommended by manufacturer for each item of equipment. Include additional instructions necessary for implementation of first class lubrication program. Include approved summary of lubrication instructions in chart form, where appropriate.

Furnish three hard copies of manuals to Engineer for approval and distribution. Deliver manuals no less than 30 days prior to acceptance of equipment to permit User Agency's personnel to become familiar with equipment and operation prior to acceptance.

Provide framed and glazed charts as follows: Mount as directed by Architect.

4. Flow diagrams from first part of manual as described above.
5. Valve directory.
6. Lubrication chart from third part of manual.

Operating Instructions: Upon completion of installation or when Owner accepts portions of building and equipment for operational use, instruct Owner's operating personnel in any or all parts of various systems. Instructions shall be performed by factory-trained personnel. Owner shall determine which systems require additional instructions. Duration of instructions shall take equipment through complete cycle of operation (at least five working days). Make adjustments under operating conditions.

Each subcontractor shall be responsible for his work and equipment until finally inspected, tested, and accepted. Carefully store materials and equipment that are not

immediately installed after delivery to site. Close open ends of work with temporary covers or plugs during construction to prevent entry of obstructing material.

Each separate subcontractor+ shall protect the work and material of other trades that might be damaged by his work or workmen and make good all damage thus caused.

PART 2 - PRODUCTS

2.1 PLUMBING FIXTURES

Provide plumbing fixtures as shown on Architectural and Plumbing Drawings. Refer to the Plumbing Fixture Schedule on drawing P700.

Fixture trims, traps, faucets, escutcheons and waste pipes exposed to view in finished spaces shall be I.P.S. brass with polished chromium plating over nickel finish.

Enameled cast iron ware shall be thickness necessary to form fixtures of highest commercial grade. Treat exterior exposed surfaces not enameled with one coat of filler at factory.

Provide air gaps at least twice diameter of waste pipe between level of each supply opening (except outlets protected with vacuum breakers) and flood rim of fixture receptacle.

Set fixtures with wall outlet flanges at proper distance from floors and walls with closet setting compound or gasket.

Refer to Architectural and Plumbing Drawings for quantities, locations and mounting heights of fixtures provided under this Section.

Catalog designations and manufacturers' names are specified to establish standards of quality for performance and materials. Equivalent fixtures by Kohler, American Standard Co., Zurn, or Crane Co. may be submitted for approval.

Fixtures and Trim (to be provided as indicated on drawings):

1. Acceptable Manufacturers: Submit manufacturers not listed below for review and approval as specified for substitutions in Article Quality Assurance in this Section.
 - a. Vitreous China: American Standard, Crane, Zurn or Kohler.
 - b. Faucets: Chicago Faucet Co., Kohler, Franke or T & S Brass.
 - c. Self-Closing Faucets: Chicago Faucet Co., Kohler, Toto or Symmons.
 - d. Stainless Steel Sinks: Elkay, Just Manufacturing or Metcraft Inc.
 - e. Mop Service Basins: Crane, Fiat or Stern Williams.
 - f. Carriers and Supports: Zurn, Watts, or Jay R. Smith.
 - g. Thermostatic Mixing Valves: Leonard Valve Co., Powers Process Controls or Symmons.
 - h. Flush Valves: Sloan, Zurn, or Kohler
 - i. Stops and Supplies: Chicago Faucet Co., Kohler or McGuire.
 - j. P-Traps: McGuire, Sanitary-Dash, or Jameco.
 - k. Handicap Lavatory Insulators: McGuire, TCI Products or Truebro.
 - l. Drinking Fountains: Elkay, Halsey-Taylor or Oasis

2.2 PIPE MATERIALS

- A. Service: Below ground water (domestic) to ten feet outside of the building.
Pipe Material: Ductile iron, Class 52.
Fitting Material: Mechanical joints conforming to AWWA Class D.
Pipe Joint: Neoprene Gaskets.
- B. Service: Above ground water (domestic)
Pipe Material: Type L copper tubing, conforming to Federal Specification WW-T-799 hard temper.
Fitting Material: Wrought copper and bronze solder joints or ProPress.
Pipe Joint: Solder Joint, 95-5 solder lead free or Silverbrite solder.
- C. Service: Above ground, sanitary waste and vent and storm.
Pipe Material: Service weight cast iron no-hub conforming to CS301-72, or type DWV copper tube.
Fitting Material: Cast iron, cast brass, stainless steel or wrought copper drainage fittings to suit pipe material.
Pipe Joint: Gasket, screwed or soldered (50-50). Copper shall not be used for urinal waste. Silverbrite solder for pipe joints as specified.
- D. Service: Pumped discharge piping (Sewage ejectors and sump pumps).
Pipe Material: Schedule 40 galvanized steel.
Fitting Material: Class 125 galvanized cast iron.
Pipe Joint: Threaded connections.
- E. Service: Below ground, sanitary waste and vent and storm.
Pipe Material: Service weight cast iron bell and spigot with neoprene gasketed joints conforming to CS301-72, or type DWV copper tube.
Fitting Material: Cast iron, cast brass, stainless steel or wrought copper drainage fittings to suit pipe material.
Pipe Joint: Gasket, screwed or soldered (50-50). Copper shall not be used for urinal waste. Silverbrite solder for pipe joints as specified.
- Service: Natural Gas
Pipe Material: Schedule 40 Black Steel
Pipe Joint: Malleable Iron, Threaded (gas piping 2-1/2" and larger shall be welded)

2.3 VALVES

Each valve type shall be product of single manufacturer. Each system shall be provided with valves per code and as shown on drawings. Valves shall be installed to facilitate operation, replacement and repair. Provide access panels where valves are concealed

behind removable ceilings or walls. Provide shut-off valves for supply piping to individual pieces of equipment.

Gate Valves:

1. Water service entrance gate valve regardless of size shall be OS&Y.
 - a. Valves 3" and larger shall be iron body, bronze-mounted, and flanged end 200 psi cold working pressure. Provide Milwaukee Valve Model #F-2885A.
 - b. Gate valves manufactured by Jenkins, Apollo or Watts are approved equals.

Ball Valves:

2. Milwaukee Valve Model #BA-150 ball valves 3" and smaller on water services shall be 2 piece all bronze with full port-chrome plated ball, teflon seats, solder ends.
3. Ball valves on insulated piping shall have 2-1/4" extended stems.
4. Ball valves manufactured by Jenkins, Apollo or Watts are approved equals.

Check Valves:

5. Milwaukee Valve Model #1509, horizontal swing, all bronze with sweat ends.
6. Check valves manufactured by Jenkins, Apollo or Watts are approved equals.

Circulation Balancing Valves:

7. General
 - a. Shall be NSF 61 compliant.
8. For branches and risers:
 - a. Furnish and install as indicated on the plans, Circuit Solver in the domestic hot water piping. Circuit Solver shall be self-contained and fully automatic without additional piping or control mechanisms. Valve shall be Circuit Solver as manufactured by ThermOmegaTech or equivalent.
 - (1) Circuit Solver shall regulate the flow of recirculated domestic hot water based on water temperature entering Circuit Solver regardless of system operating pressure.
 - (a) When fully closed Circuit Solver shall bypass a minimum flow to maintain dynamic control of the recirculating loop and provide a means for system sanitizing.
 - (b) Circuit Solver shall be factory adjustable from 105F (40.5C) to 140F (60C) as required by project conditions. (other setpoints available, consult factory)
 - i. Circuit Solver shall modulate between open and closed position within a 10F (5.5C) range.
 - (c) Circuit Solver shall be available in sizes ranging from 1/2 inch NPT to 2" NPT.

- b. Circuit Solver body and all internal components shall be constructed of stainless steel with major components constructed of type 303 stainless steel.
 - (1) Circuit Solver sizes ½ inch through 2 inch shall be rated to 200 PSIG maximum working pressure.
 - (a) All Circuit Solvers shall be standard tapered female pipe thread, NPT.
 - (2) All Circuit Solvers shall be rated to 300F (121C) maximum working temperature.
 - (3) Circuit Solver shall be ANSI/AWWA C800 compliant.
 - (4) All Circuit Solvers shall be NSF-61 certified with zero lead content for use in all domestic water systems.
 - (5) Thermal actuator shall be spring operated and self-cleaning, delivering closing thrust sufficient to keep orifice opening free of scale deposits.
 - (a) Thermal actuator shall be rated for a minimum of 200,000 cycles.
 - c. Install Circuit Solver in each domestic hot water return piping branch beyond last hot water device in that branch.
 - (1) Provide suitable line size isolation valves before and after the valve, unions, and strainer.
 - (2) Provide suitable access panel as required in non-accessible ceilings and walls.
9. For Mains:
- a. Manufacturers:
 - (1) Watts LFCSM-61-S
 - (2) Caleffi North America 130
 - (3) Bell and Gossett Circuit setter
 - b. Furnish and install as shown on plans and with manufacturer's recommendations for calibrated balancing valves.
 - c. All valves to be of bronze or a metal copper-alloy body construction with multi-turn, Y-pattern globe design. Valves to have differential pressure read-out ports across valve seat area. Read-out ports to be fitted with internal EPT inserts and check valves. Valve bodies to have ¼" NPT tapped drain/purge port. Valves to have a concealed memory stop feature to allow valve to be closed for service and then reopened to set point without disturbing balance position. All valves to have a digital hand wheel to assure specific valve settings. Valves shall be designed for positive bi-directional shut-off.
 - d. Sweat ends.
 - e. MAXIMUM WORKING PRESSURE 200 psig
 - f. MAXIMUM OPERATING TEMPERATURE 250°F
 - g. Body: Bronze or Ametal copper-alloy.

- h. Seat: Glass and Carbon filled TFE or Ametal
- i. Readout Valves: Brass with EPT check valve
- j. Stem "O" Ring: EPDM

Backflow Preventers (BFP):

- 10. Provide reduced pressure backflow preventers with 150 psi working pressure, 210 degrees F temperature rating, separate strainer and gate valves on inlet and outlet. Provide spare parts kit with full set of seals, washers and test kit with 4-1/2" diameter all bronze casing pressure gages and fittings.
- 11. 2" and smaller BFP shall be all-bronze, threaded end, tested and certified under AWWA-ASSE standards: Watts LF909, Beeco 6C or Febco 835.

Backwater Valves:

- 12. Shall be as manufactured by Jay R. Smith, Zurn or Watts.
 - a. Backwater valves above grade, provide suitable access panel as required in non-accessible ceilings and walls.
 - b. Backwater valves installed buried below slabs on grade shall be made accessible:
 - (1) When crown of pipe is 12" or less below the finished floor, install cast iron extension and locate cover flush with finish floor.
 - (2) When crown of pipe is between 12" and 24" below finish floor, install valve in floor access box which shall be set with box cover flush with finish floor and box shall extend to below bottom of pipe, with cut outs for running pipe through.
 - (a) Access box shall have top, 4 sides and bottom.
 - (b) Box shall be of a durable material suitable for direct buy and top suitable for foot traffic.
 - c. When crown of pipe is further than 24" below finish floor, install valve in an access pit. The access pit shall allow for entry in order to service/maintain the valve and access the cleanouts.
 - (1) Precast units can be as manufactured by Park USA of Houston Tx. Park model # BWV-1, coordinate with the floor installation for interface with precast access pit.
- 13. Vertical, Ball Float Type
 - a. Coated cast iron body, plastic ball float, bronze backwater bushing, and replaceable neoprene seat.
- 14. In-line, Flapper Type
 - a. Coated cast iron body, hub inlet and offset spigot outlet, bronze threaded cover, automatic type valve seat and bronze flapper (flapper to hang slightly open during periods of non-operation).

Vacuum Breakers

- 15. Atmospheric vacuum breakers shall be all-bronze, for temperatures up to 210 degrees F: Watts 288A, Neptune 55 or Febco 710A.

2.4 INSULATION

Insulation shall be by Owens-Corning, Seton, or Manville.

Insulation shall be installed by insulation firm regularly specializing in this work and employing men particularly skilled therein. No covering applied by plumber's helpers will be acceptable.

Insulation installation shall meet manufacturer's recommendations. No insulation shall be applied until piping has passed tests required by authorities that have jurisdiction.

Insulation, jackets and adhesives shall be flame retardant and shall have ASTM E-84 fire hazard ratings of 25 flame spread, 50 smoke developed and 50 fuel contributed.

Insulation and jacketing shall be in accordance with following:

1. Hot water supply and return, shall be insulated with heavy density fiberglass with self-sealing lap and all service jacket (ASJ). Fittings and valves shall be insulated with two layers of pre-cut fiberglass blanket insulation jacketed with pre-formed PVC covers. Insulation shall be rated for maximum operating temperature of 450 degrees F. Insulation thickness shall be 1".
2. Cold water domestic and non-potable water supply piping, valves and fittings, and horizontal roof drain piping shall be insulated as specified for hot water supply and return piping. In addition, continuous vapor barrier shall be maintained. Use of staples or tacks shall not be permitted. Double wrapping of fittings insulated with blanket insulation is not required. Insulation thickness shall be 1".

Pipe hangers shall be outside insulation and shall incorporate 12", 26 gauge protection shields. Insulation on piping that passes through walls or partitions shall pass continuously through sleeves, except at fire walls, smoke partitions, and floor penetrations where space between sleeves and piping shall be firestopped with approved packing.

2.5 WATER HEATERS

Provide as indicated on the Domestic Water Heater Schedule on the drawings.

Provide pressure and temperature relief valve and vacuum relief valve.

1. Pressure and temperature relief valves shall be at least 3/4" and shall be rated and listed for heater input rating and required by ANSI and ASME Standards. Temperature relief valves shall be installed within top 6" of tank. Pipe relief to 6" above finish floor.
2. Vacuum relief valves shall meet ANSI standards requirements and shall be installed in cold water supply line at level above top of heater or tank.

Heaters shall have minimum standby heat loss in accordance with requirements of State Energy Code. Tank and heaters shall be factory insulated and jacketed.

All water heaters shall be furnished with a minimum warranty period of five years from date of installation for tank leakage.

2.6 HANGERS, ANCHORS, CLAMPS AND INSERTS

Provide adjustable clevis hangers for piping 3" and larger, and A band hangers for smaller piping. Support piping from building structure to maintain required grade and pitch of pipe lines, prevent vibration, secure piping in place, and provide for expansion and contraction. Secure hangers to inserts where practical. Hanger rods shall have machine threads.

Provide vertical brackets and guides for pipe risers at each floor and where horizontal piping is racked along walls. Trapeze hangers may be used where conditions permit. Provide extended hangers for insulated piping with 12" long galvanized insulation shields. Hangers for copper piping shall be copper or bronze or shall be coated for dielectric isolation.

Hanger rods shall be connected to beam clamp, UL-approved concrete inserts or Phillips or approved equal expansion shields. No ramset or shot shields will be allowed.

Hanger spacing shall meet requirements of state and local plumbing codes. In no case shall horizontal piping be supported at intervals greater than 10'-0".

Piping below basement or lowest level slab (that is, buried piping) need not be supported from structure if slab is not designed as structural slab.

Pipe supports, vertical and horizontal, shall not bear on sleeves.

Friction clamps shall be installed at base of plumbing risers and at each floor. Friction clamps shall not be supported from or rest on floor sleeves.

Horizontal piping shall be suspended from building by mild steel rod connecting pipe hanger to inserts, beam clamps, angle brackets and lag screws required by Building Construction in accordance with the following:

<u>Rod Size</u>	<u>Pipe Size</u>
3/8"	0" to 2"
1/2"	2-1/2" to 3-1/4"
5/8"	4" to 5"
3/4"	6"
7/8"	8" to 10"

Hangers on insulated lines shall be sized to fit the outside diameter of pipe insulation. Provide pipe covering protection saddles at hangers on insulated lines.

Piping at equipment shall be supported to prevent strains or distortions in connected equipment and control valves. Piping at equipment shall be supported to allow for removal of equipment, valves, and accessories with a minimum of dismantling and without requiring additional support after these items are removed.

Piping installed under this Section shall be independently supported from building structure and not from piping, ductwork, conduit or other trades. Supplementary steel, including factory-fabricated channels, required to meet the requirements specified herein, shall be provided by the Plumbing Subcontractor.

Maximum spacing of hangers on waste pipe shall be 5' and hangers shall be provided at all changes in direction. Hanger rods to support piping from the structure or supplementary steel shall not exceed 4' in total length.

2.7 FLOOR DRAINS

Setting Grades: Before setting any drains, Plumbing Subcontractor shall obtain from the General Contractor the exact information relative to finish grade at top of drains.

Drain Types: Floor drain outlets shall be of size noted on Drawings.

2.8 TRAPS AND STRAINERS

Traps:

1. Provide separate traps with integral cleanouts on fixtures and equipment that require connections to sanitary system, except:
 - a. on fixtures with integral traps, and
 - b. as shown on Drawings otherwise.
2. Traps exposed to view, including connecting drain lines, shall be chrome-plated. Traps shall be of sizes shown on Drawings but shall not be less than 1-1/2".

2.9 CLEANOUTS

Provide cleanouts in soil, waste and storm drainage piping on straight runs, at changes in directions and at foot of stacks and other points where required by inspecting authorities. Cleanouts shall suit construction in which they are to be installed.

Maximum horizontal distance on straight runs between cleanouts in piping 4" and smaller shall be 50 feet. In piping 5" and larger, maximum horizontal distance between cleanouts shall be 100 feet.

Cleanouts shall be same size as pipe 4" and smaller. Cleanouts for piping larger than 4" shall be not less than 4" in diameter. No reduction in cleanout sizes for pipe 4" and smaller is permitted.

Traps not integral with fixtures and in accessible locations shall have brass trap screw protected by water seal, and will be regarded as cleanout.

Bodies of cleanout ferrules in bell and spigot piping shall be standard pipe sizes conforming in thickness to that required for pipe and fittings, and shall extend not less than 3/4" above hub of pipe.

1. Cleanout plug shall be cast brass with raised nut 3/4" high.
2. Cleanouts in copper waste piping shall be soldered brass cleanout fittings with extra heavy brass screw plugs of same size as line.
3. Cleanouts in threaded waste piping shall be cast iron, drainage T pattern, 90 degree branch fitting with extra heavy brass screw plugs of same size as pipe.

4. Floor cleanouts in finished areas shall be cast iron body and frame with round adjustable scoriated secured nickel bronze top, J.R. Smith No. 4023 or approved equal.
5. Floor cleanouts in unfinished areas shall be cast iron body and frame with round adjustable scoriated secured cast iron top, J.R. smith No. 4220 or approved equal.

Provide test tees with cleanout plugs at foot of vertical soil, waste, acid waste and roof conductor lines and at each floor. Cleanouts on vertical lines concealed behind finished walls shall extend to back of finish wall; provide wall plate. Obtain Architect's approval for wall plate locations and reroute piping if necessary.

Cleanouts shall open in direction of flow of drainage line served or at right angles thereto.

Keep cleanout plugs clean and unimpeded. Prevent covering with cement, plaster or other permanent finishing materials.

2.10 THERMOMETERS AND PRESSURE GAUGES

Provide separable-well dial pressure gauges where shown on Drawings and where specified. Minimize restriction of flow in pipes by thermometers and gauges; ensure legibility from floor.

Thermometers shall be 9" vertical adjustable angle, hermetically-sealed with stainless steel cases, stainless steel stems, brass separable sockets and anti-parallax dials with raised jet black figures. Accuracy shall be within 1% over 2-240 degrees F scale range.

Pressure gauges shall be 4-1/2" with steel case. Provide brass gauge cock. Range shall be 0-100 psi.

2.11 EXTERIOR WALL HYDRANTS

Wall hydrant shall be anti-siphon, non-freeze, 3/4" Hydrant shall be Zurn Z-1310; J.R. Smith, Josam and Woodford are approved equals.

Hose bibb shall be 3/4" with vacuum breaker, Chicago Faucets No. 952. T&S Brass, Water Saver Faucet Co. and Woodford are approved equals.

2.12 WATER HAMMER ARRESTORS

Provide water hammer arrestors at fixtures with automatic solenoid or cylinder operated valves, automatic flush valves or quick-closing valves.

Fixtures and equipment in battery installation may use single water hammer arrestor properly sized for connected load.

Provide proper access to water hammer arrestors. Coordinate installation with access panel locations shown on architectural drawings.

Water hammer arrestors shall be Josam No. 1485, J.R. Smith Series 5000, Zurn 2-1700 Series, PPP SC series or approved equal.

2.13 UNIONS, FLANGES AND DIELECTRIC COUPLINGS

Unions: Provide union connections to fixtures and equipment such as hot water heaters. Union connections shall include unions, flanges, and compression fittings. Union connections on domestic water piping shall be bronze with minimum cold working pressure of 200 psi.

Dielectric Couplings: When domestic water piping system comes in contact with ferrous pipe, fittings, valves and other components of domestic water system, connections shall be made with dielectric flanges. Contact between ferrous stud bolts and non-ferrous bronze flanges shall be electrically insulated with non-metallic washers.

2.14 JOINTING COMPOUNDS

Provide pipe dope, Teflon tape, wax rings, neoprene gaskets and other jointing compounds required by best standard practice and only on service as recommended by manufacturer.

Apply putties and jointing compounds for plumbing fixtures and trim as recommended by manufacturers.

2.15 MOTOR STARTERS

Provide motors, contactors and controls, and furnish starters for entire plumbing installation. Provide control and related wiring, including interlocks. Power wiring between panelboard, disconnect switches to starters, and motors including remote and local combination pushbuttons and pilot light stations will be provided under other Sections.

Motors shall be NEMA Design B, constant speed, self-ventilated general purpose squirrel cage induction with Class B insulation unless specified otherwise. Motors shall have 1.15 service factor unless totally enclosed.

1. Motors voltage shall be as scheduled.

Starters that require interlocks or remote control shall be magnetic with HAND-OFF-AUTOMATIC switch in cover.

2. Each 3-phase, 60 Hz motor shall have magnetic starter with ON-OFF pushbutton. Other motors shall have manual starter with ON-OFF switch.

3. Control relays shall be for operation on 120 V, single-phase. Provide transformer of sufficient capacity within starter case.

4. Provide inverse time limit overload and under voltage protection in each leg and with pilot light.

5. Starters shall be by single manufacturer: Cutler-Hammer, Clark, Arrow Hart or approved equal.

2.16 SLEEVES AND PENETRATIONS

Pipe Sleeves

1. Sleeves through floors and through structural and fire-rated construction shall be Schedule 40 steel.
2. Sleeves through partitions and non-fire-rated construction shall be 26 gauge galvanized steel with lock longitudinal seams, or approved plastic pipe.
3. Provide waterproofing membrane locking devices at floors. Provide 150 lb. slip-on welding flanges at exterior wall penetrations.

Fire stop penetration seals in fire-rated construction shall be ceramic fiber (Proset Systems Firefill); mineral fiber (Manville Thermo-mat); or silicone foam (Dow RTV 3-6548). Provide mineral fiber board, matting or putty for damming and forming. Finish seals flush to wall surface and fill gaps with silicone adhesive sealant caulking (Dow 96-081 RTV or approved equal).

Packing for sleeves that do not require maintenance of fire rating shall be oakum, silicate foam, ceramic fiber or mineral fiber with approved sealant. Pack or foam to within one inch of both wall surfaces. Seal penetration packing with approved caulking and paintable water-proof mastic surface finish or silicone caulking.

Other Water-proof Pipe Penetrations

4. Modular mechanical penetration seals shall be interlocking synthetic rubber links shaped to fill annular space continuously, with galvanized carbon steel bolts, nuts and pressure plates to expand rubber seal between pipe and sleeve. Sleeve seal shall be water-tight.
5. Prefabricated modular sleeves shall be Mason Industries (SWS) or approved equal stiffened galvanized steel sleeves with preformed closed-cell elastomeric seal (non-fire-rated) or preformed mineral fiber or silicone foam seal (fire-rated).
6. Provide water-proof 1" single ring set in silicone and bolted to floor or wall at chipped and drilled penetrations.

2.17 TRAP PRIMERS

Trap primers shall be Precision Plumbing Products No. PR-500 or equal. Provide Model DU-x distribution units as required

JR Smith Model #2698 Prime-Eze water saver trap primer with P-trap connection.

Provide Trap primer type as dictated by the conditions in each area where required.

2.18 CENTRAL MIXING VALVE

Domestic hot water system mixing valve shall be Leonard Megatron Model #5NB-LF, or equal by Powers, Lawler, or Armstrong, rough brass finish mixing valve and components.

2.19 VALVE TAGS

Valve tags shall be engraved laminated plastic tags. Tags shall have black characters on white face, consecutively numbered and prefixed with letter P. Embossed or engraved aluminum or brass tags may be substituted if desired. Tags shall be at least 1/8" thick.

Tags shall be at least 1" diameter with numerals at least 3/8" high and attached by s hooks or chains.

2.20 PIPE IDENTIFICATION

Provide color-coded pipe identification markers on piping installed under this Section. Pipe markers shall be snap-on laminated plastic protected by clear acrylic coating. Pipe markers shall be applied after Architectural painting where such is required.

In general, 2" high legend shall be used for pipe lines 4" diam. and larger, and 3/4" high legend shall be used for pipe lines 3" diameter and smaller.

Markers shall be Seton, Setmark or approved equal.

Color banding shall meet ANSI A13.1-1975 and OSHA requirements.

Markers shall have legends and color coding with black letters:

Service	Legend	Background Color
Domestic Cold Water	DOMESTIC COLD WATER	Green
Domestic Hot Water	DOMESTIC HOT WATER	Green
Domestic Hot Water Return	DOMESTIC HOT WATER RETURN	Green
Sanitary Waste	SANITARY WASTE	Green
Sanitary Vent	SANITARY VENT	Green
Grease Waste	GREASE WASTE	Green
Storm Water	STORM WATER	Green
Natural Gas	NATURAL GAS	Yellow

2.21 ESCUTCHEONS

Escutcheons shall be heavy cast brass, chromium-plated, adjustable, and shall be of sufficient outside diameter to cover sleeve opening and shall fit snugly around pipe.

2.22 HOT WATER RECIRCULATION PUMPS

Domestic Hot Water recirculation pumps shall be by Grundfos, Magna series. Pump shall be the in-line type, oil lubricated 125 psi working pressure, 225 degrees continuous water temperature, bronze or steel construction, steel shaft, mechanical seal and

aquastat. Aurora Pump, Bell & Gossett, Hydromatic, Peabody Barnes, Weil, Weinman Pump and Zoeller are approved equal manufacturers.

2.23 ELEVATOR SUMP PUMPS

Provide sump pumps in elevator sump pits where noted on the plans and as specified on the Sump Pump Schedule shown on drawing P700.

Oil minder type pumps shall activate to remove water from elevator pits in accordance with ASME A17.1 and will provide pumping of water only, even if an oil condition is detected.

Pumps shall be provided with the following features:

1. NEMA 4x weathertight corrosion resistant enclosure.
2. Stainless steel sensor probe.
3. Single direct plug-in power source.
4. Alarms, lights, silence switch and remote monitoring circuit for oil, high liquid, and high amperage conditions.
5. System shall be factory assembled and tested to ensure quality of the entire system.

2.24 OIL/WATER SEPARATORS

Oil/water separators shall be furnished as specified on the Oil/Water Separator Schedule shown on drawing P700.

Provide seamless, molded polyethylene unit for below grade installation with field adjustable riser system, snap-in flow control and two (2) vent connections. Unit cover shall provide water/gas-tight seal and have a maximum 2,000 lbs. load capacity.

2.25 PRECAST CONCRETE VAULTS AND TANKS

- A. The precast reinforced concrete vault and tank structures shall be designed by a Massachusetts Registered Professional Engineer employed by the Construction Manager, in accordance with the applicable sections of the following references:
1. Commonwealth of Massachusetts State Building Code, latest edition.
 2. American Concrete Institute, ACI 318 "Building Code Requirements for Reinforced Concrete."
 3. AASHTO, "Standard Specifications for Highway Bridges."
 4. Precast Concrete Institute, "Manual for Quality Control for Plants and Production of Precast and Prestressed Concrete Products, MNL-116."
- B. The structures shall be designed for the following loads and possible combinations thereof:
1. Lateral soil pressure = 60 PCF (H), where H is the height from grade, as shown on the Contract Drawings, to the point of the structure being considered.
 2. Soil weight shall be assumed to be 120 PCF.
 3. AASHTO HS-20-44 loading.

4. Weight of precast concrete structure.
 5. Initial handling and erection loadings, including design of galvanized lifting hooks using a safety factor = 4.0.
- C. Investigate buoyancy and soil bearing considerations assuming the groundwater elevation is one-foot below the ground surface.
- D. Concrete shall have a minimum 28 day compressive strength of 5,000 psi using Type II or III Portland cement with 8% maximum content of tricalcium aluminate, ASTM C150. A "normal dosage" of air-entraining agent shall be added to the concrete during the mixing cycle. Reinforcement shall be deformed billet-steel ASTM A615 or 7-wire strand ASTM A416, Grade 270 (if prestressed).
- E. Dimensions and opening sizes and locations shall be as indicated on the Contract Drawings.
1. All concrete surfaces shall have a smooth finish, and the outside of the structures shall be coated with two coats of bituminous dampproofing. Bituminous dampproofing materials shall comply with Federal Specification SS-A-701. Each coat shall be applied at a rate of 65-square feet per gallon.

2.26 MANHOLE FRAMES AND COVERS

Frames and covers shall be of cast iron conforming to the requirements of ASTM A48, Class No. 30 and shall be manufactured by LeBaron Foundry, Inc. Brockton, Massachusetts, Neenah Foundry Company, Neenah, Wisconsin, Mechanics Iron Foundry Company, Roxbury, Massachusetts, or equal. Manhole covers shall be machined to fit securely and evenly on the frame. Frames and covers shall be designed to accept H20 loads, have a diamond surface finish, and frame height of 6 to 9-inches.

2.27 INTERIOR GREASE INTERCEPTORS

Provide grease interceptors as specified on the Grease Interceptor Schedule shown on drawing P700.

Units shall be steel construction, equipped with a recessed receiver, receiver cradle, and non-skid cover to be mounted flush with the finished floor.

J.R. Smith, Zurn, and Watts shall be considered approved equal manufacturers.

PART 3 - EXECUTION

3.1 COMMISSIONING OF EQUIPMENT AND SYSTEMS

The Engineer will check the completed installation either sequentially as different parts are completed, or when the entire installation is complete, at the sole option of the Architect.

3.2 SPECIAL RESPONSIBILITIES

Coordination: Cooperate and coordinate with work of other Sections in executing work of this Section.

1. Perform work so that progress of entire project including work of other Sections is not interfered with or delayed.
2. Provide information as requested on items furnished under this Section which shall be installed under other Sections.
3. Obtain detailed installation information from manufacturers of equipment provided under this Section.
4. Obtain final roughing dimensions or other information as needed for complete installation of items furnished under other Sections or by Owner.
5. Keep fully informed as to shape, size and position of openings for material or equipment to be provided under this and other Sections. Give full information so that openings required by work of this Section may be coordinated with other work and other openings and set sleeves in advance. In case of failure to provide sufficient information or set sleeves in proper time, provide cutting and patching to full satisfaction of Architect.
6. Provide information as requested as to sizes, number and locations of concrete housekeeping pads necessary for equipment provided under this Section.

Installation Only Items:

7. Where this construction manager is required to install items which it does not purchase, it shall coordinate their delivery and be responsible for their unloading from delivery vehicles and for their safe handling and field storage up to the time of installation. This trade shall be responsible for:
 - a. Any necessary field assembly and internal connections, as well as mounting in place of the items, including the purchase and installation of all dunnage supporting members and fastenings necessary to adapt them to architectural and structural.
 - b. Their connection to building systems including the purchase and installation of all terminating fittings necessary to adapt and connect them to the building systems.

Maintenance of equipment and systems: Maintain equipment and systems until Final Acceptance. Ensure adequate protection of equipment and material during delivery, storage, installation and shutdown, and during delays pending final test of systems and equipment because of seasonal conditions.

Use of premises: Restrict use of premises as directed by Architect and as specified below.

8. Remove dirt and debris, and keep premises clean. Upon completion of work, remove equipment and unused material. Put building and premises in neat and clean condition, and do cleaning and washing required to provide acceptable appearance and operation of equipment, to satisfaction of Architect and as specified under Cleaning Section 3.18.

9. It shall be this trade's responsibility to store his materials in a manner that will maintain an orderly clean appearance. If stored on-site in open or unprotected areas, all equipment and material shall be kept off the ground by means of pallets or racks, and covered with tarpaulins.
10. Do not interfere with function of existing sewers and water and gas mains and prevent debris from entering piping. Do not disrupt water services or other utilities for testing and connection of new work to existing.

Fireproofing:

11. Clips, hangers, clamps, supports and other attachments to surfaces to be fireproofed shall be installed, insofar as possible, before start of spray fiber work.
12. Piping and equipment that interfere with proper application of fireproofing shall be installed after completion of spray fiber work.
13. Patch and repair spray fireproofing cut or damaged during course of work specified under this Section. Trade responsible for damage shall bear cost of repair.

Temporary water supply and sanitary facilities: Special reference is made to Division 1 requirements for temporary facilities.

3.3 MATERIALS AND WORKMANSHIP

Work shall be neat and rectilinear. Piping shall run concealed except in mechanical rooms, stairways and areas without hung ceiling. Install material and equipment as recommended by manufacturer. Installation shall operate safely and without leakage. Work shall be properly and effectively protected and pipe openings shall be temporarily closed to prevent obstruction and damage before completion.

Except as specified otherwise, material and equipment shall be new. Provide supplies, appliances and connections necessary for complete and operational installation. Provide components required or recommended by OSHA and NFPA.

References to manufacturers and catalog designations are intended to establish standards of quality for performance and materials but imply no further limitation of competitive bidding.

Finish of materials, components and equipment shall be as approved by Architect and shall be resistant to corrosion and weather as necessary.

3.4 INSTALLATION OF EQUIPMENT

Avoid interference with structure and with work of other Sections, to satisfaction of Architect, required by codes and as necessary to meet manufacturer's installation and maintenance recommendations. Installation shall permit clearance for access to equipment for repair, servicing and replacement.

Distribute equipment loads properly on building structural members provided for equipment support under other Sections. Install and support roof-mounted equipment on structural steel provided under other Sections.

Provide hangers, supports, inserts, anchors, brackets, shelves, stands and legs as necessary for floor, wall or ceiling-mounted of equipment provided under this Section as shown on Drawings and as specified.

Provide steel supports and hardware for proper installation of hangers, anchors, guides, and other components.

Provide cuts, weights and other pertinent data required for proper coordination of equipment support provisions and installation.

Structural steel and supporting and hanging hardware shall meet ASTM Standards; use of steel and hardware shall meet requirements of Section Five of Code of Practice of American Institute of Steel Construction.

Verify site conditions and dimensions of equipment to ensure access for proper installation of equipment without disassembly that would affect warrantee. Report conditions that may prevent proper installation in writing before purchase or shipment of equipment.

3.5 EXPANSION PROVISIONS

Allow for expansion with offsets, loops, and other means, where necessary to protect piping systems as shown.

3.6 TAGS

Upon completion of work, attach engraved laminated plastic tags to valves. Tags shall have black characters on white face, consecutively numbered and prefixed with letter PLBG.

Embossed or engraved aluminum or brass tags may be substituted if desired. Tags shall be at least 1/8" thick.

Tags shall be at least 1" diameter with numerals at least 3/8" high and attached by s hooks or chains.

Nameplates, catalog numbers and rating identifications shall be securely attached to electrical and mechanical equipment with screws or rivets. Adhesives or cements will not be permitted.

3.7 ANCHORS AND INSERTS

Inserts shall be iron or steel of type to receive machine bolt head or nut after installation. Inserts shall permit adjustment of bolt in one horizontal direction and shall develop strength of bolt when installed in properly cured concrete.

Provide anchors as necessary for attachments of equipment supports and hangars.

3.8 PENETRATIONS AND SLEEVES

General

1. Provide pipe sleeves as specified and as shown on Drawings at penetrations of foundations, walls, slabs (except on-grade) partitions and floors. Sleeves shall meet NFPA-101 requirements and materials requirements of Part 2 of this Section.
2. Coordinate work carefully with architectural and structural work. Set sleeves in forms before concrete is poured. Provide core drilling as necessary to set sleeves if not set before concrete is poured, and to set sleeves in existing construction. Do not penetrate structural members without Architect's approval.
3. Sleeves for insulated pipe shall accommodate continuous insulation without compression.
4. Sleeves through floors shall be water-tight and shall extend two inches above floor surface.

Pipe Sleeves

5. Annular space between pipe or pipe insulation and sleeve shall be at least 1/4".
6. Sleeves are not required for slab-on-grade unless specified otherwise.
7. Sleeves through rated fire walls and smoke partitions shall maintain fire rating of construction penetrated.
8. Do not support piping risers on sleeves.

Installation, Testing, Listings and Approvals

9. Installation shall meet material manufacturer's recommendations exactly, particularly as regards preparation of surfaces, removal of foreign material safety requirements, ventilation and other installation details. Dam openings as recommended. Remove flammable materials used for damming and forming seals in fire-rated construction.
10. Sleeve penetration methods shall be water- and gas-tight and shall meet requirements of ASTM E-119 Standard Methods of Fire Tests of Building Construction and Materials.
11. Fire-stop penetration seal methods and materials shall be FM-approved and UL-listed as applicable.
12. Inspect foamed sealants to ensure that installations achieve manufacturer's optimum cell structure and color ranges.

3.9 ESCUTCHEONS

Install escutcheons around exposed pipe passing through finished floor, wall, or ceiling. Escutcheons shall be heavy cast brass, chromium-plated, adjustable, and shall be of sufficient outside diameter to cover sleeve opening and shall fit snugly around pipe.

3.10 FLASHING AND COUNTER FLASHING

Provide counter flashing for roof penetrations required under this Section including vents and roof drains.

Flashing of vents, roof drains and other penetrations of roof required under this Section shall be done under other Sections.

3.11 JOINTS AND CONNECTIONS

Joints and connections shall be permanent and shall be gas- and water-tight. Jointing shall be type specified for service indicated. Joints and connections shall meet requirements of manufacturers best recommended practice. All transitions between different piping materials shall be made using approved adapters. Adapters for transitions between two types of piping materials shall be manufactured for purpose intended.

3.12 INTERIOR WATER SUPPLY SYSTEM

Water supply piping shall be run as indicated on Drawings, including mains, supplies to fixtures and indicated equipment. Connections to fixtures shall be from top of mains, except as noted, and piping shall be pitched at least 1" in 40 feet so that it can be drained completely at low points with drain valves which shall be provided wherever necessary. Piping shall be pitched up toward fixtures for proper air relief. Provide automatic air vents with outlet piped to floor and gate valve ahead of air vents, where offsets cannot be vented by means of fixture connections.

Provide water hammer arrestors of correct size and type at end of each water branch and main.

Shut-off control valves on main distribution and branch lines shall be located for easy access and operation. Hot and cold water branches shall be valved with access panels provided at locations shown on Drawings, and determined in field. Provide shut-off valves on branches to individual rooms.

3.13 INTERIOR WATER PIPING

Provide a complete hot and cold water piping system to required areas as shown on Drawings and as specified.

1. Pipe used in piping assembly shall be clean and shall have ends square and reamed before putting into fittings.
2. Cut tube to required length with hacksaw or tube cutter designed for copper work.
3. Remove burrs from inside and outside of cut edge and clean end of tube with steel wool or and cloth until discoloration is removed and metal is smooth and bright.
4. Oxides shall be removed by sand cloth and brush.
5. Removal of oxides or discoloration of pipe and fittings by acids or self-cleaning flux is forbidden.
6. Apply a thin, uniform, and complete coating of reliable brand of soldering flux (Nokorode or Crest) to cleaned surfaces of tube and fittings.
7. When joints are soldered, remove excess solder with a cloth or brush leaving a fillet of solder in chamber at end of the fitting.
8. Piping must be true and plumb and with proper pitch for draining after soldering.
9. Lines of water piping shall be protected from water hammer by air chambers and shock absorbers. Where air chambers are used, extend branch piping upward at least 20 times the diameter of pipe. To install air chambers, pipe dropped into pipe spaces shall be carried full size as branches to fixtures with full size air chambers. Where shock absorbers (or shocks) are used, they shall be as

manufactured by Josam, J.R. Smith, or Zurn, shall conform to the Plumbing and Drainage Institute published requirements.

10. Connections to tanks and equipment shall be made with unions.
11. Provide valves required to isolate sections of piping system extending into areas scheduled for construction at a later date. Provide draw-off valves required to properly chlorinate system in sections for phasing of the building. Identify isolation and phasing valves with valve tags and include same on charts and as-built drawings.

3.14 INTERIOR SANITARY WASTE, DRAINAGE AND VENT PIPING

Provide waste drainage and vent lines as shown on Drawings. Vents shall extend through roof and shall increase to at least 4". Piping shall be assembled and installed without undue strains and stresses, and provision shall be made for expansion, contraction and structural settlement.

Interior horizontal sanitary waste drainage piping shall be installed in practical alignment at uniform grade of at least 1/8" per foot but 1/4" per foot where possible, and as shown on Drawings.

Vents from fixtures or line of fixtures, when connected to vent line serving other fixtures, shall be extended at least 6" above flood level rim of highest of fixtures to prevent use of vent line as waste. No vent terminal shall be directly beneath door, window or other ventilating opening of building, nor shall any vent be within 12 feet horizontally of such opening.

Provide sleeves for pipe that passes under or through wall.

Provide 3" air gap on equipment and drains that discharge to floor drains

Provide air gaps at least twice diameter of waste pipe between level of each supply opening (except outlets protected with vacuum breakers) and flood rim of fixture receptacle.

Piping shall be run straight and plumb and offsets shall be made at an angle of no less than 45 degrees. Threaded joints shall be as specified above.

Carefully lay out work in advance so pipes shall pass through opening and permit proper pitch to pipeline. Due to extensive system of ventilation and lighting systems coordinate work with work of other trades to avoid necessity of taking down work installed without prior checking.

3.15 CORE DRILLING

Plumbing Subcontractor shall provide core drilling required for installation of plumbing systems if sleeves are not set before concrete is poured as follows:

1. Subcontractor shall carry costs for core drilling.
2. General Contractor shall not be responsible for any circular penetrations required for proper installation of plumbing systems.
3. Locate required openings and prior to coring, coordinate opening with General Contractor and other trades.
4. Do not disturb existing systems.

5. Thoroughly investigate existing conditions in vicinity of required opening prior to coring.
6. Subcontractor shall be responsible for damages to building and building systems from coring operations.

3.16 TESTING OF PIPING SYSTEMS

General

1. Piping systems shall be subjected to testing water or air as noted and shall hold tight at the pressure head stated for the time interval required without adding air or water. While any system is being tested, required head or pressure shall be maintained until joints are inspected.
2. Tests shall be witnessed by inspector having jurisdiction and the Architect with 48-hour notice given these authorities.
3. Equipment, material and labor required for testing of various systems or part thereof shall be provided by Plumbing Subcontractor.

Sanitary (Gravity Systems)

4. Water test shall be applied to drainage systems either in their entirety or in sections after rough piping has been installed.
5. If applied to entire system, openings in piping system shall be tightly closed, except the highest openings, and system filled with water to point of overflow.
6. If system is tested in sections, each opening shall be tightly closed except highest opening in the section under test, and each section shall be filled with water but no section shall be tested with less than 10' head of water.
7. In testing successive sections, at least upper 10' of next preceding section shall be tested so that no joint of piping in building, except the uppermost 10' of the system shall be submitted to a test of less than a 10' head of water.
8. Water shall be kept in system for at least 15 minutes before inspection starts; the system shall then be made tight at all points.

Points of drainage systems tested with air instead of water shall be tested by attaching an air compressor testing apparatus to suitable opening and, after closing all other inlets or outlets, forcing air into systems until a uniform gauge pressure of 5 psi of sufficient pressure to balance a column of mercury 10" high. Pressure shall be held without introduction of additional air for a period of at least 15 minutes.

Interior Water Piping System: Upon completion of water supply systems or section thereof, system shall be tested and proved tight under a water pressure of 150 psi. Gauge shall be located on lowest new floor and pressure shall hold for a period of one hour without introducing additional water. Water used for testing shall be from a potable source of supply.

Testing Summary

9. W&V - with water to a 10 foot head for 15 minutes.
10. Water - with potable water to 150 psi for one hour.
11. Gas - with air to 6" mercury for ten minutes.

Defective Work: If inspection or tests show defects, such defective work or material shall be replaced and inspection and tests shall be repeated. Repairs to piping shall be made with new material. No caulking of screwed joints or holes shall be acceptable.

Additional Tests

12. Provide additional tests such as smoke pressure tests stipulated by regulations or as directed by authorities making the inspection.
13. Provide for any repeated test as directed by the Architect, to make all systems tight.
14. Visual inspections of joints and valves shall be made as directed by the Architect.

3.17 HOT WATER CIRCULATION SYSTEM BALANCING

The hot water circulation system shall be installed to maintain water system temperature within 10°F of the supply temperature (125°F supply = 115°F return).

Hot water shall be delivered to the outlet, connection or fixture within 15 seconds of operation of said outlet, connection or fixture.

1. Maximum non-circulated leg in the hot water circulation system is as follows, depicted by fixture flow rate, supply pipe size and 15 second maximum delivery time.

The system shall be balanced to flow as follows:

2. Maintain minimum 0.5 GPM flow rate through each of the branches in the circulation system.
3. Each riser shall flow a total GPM of the branches it serves.
4. The main return line(s) shall flow the total GPM of the risers connected to it.
5. The return line to the circulation pumps shall flow the total GPM of the main return lines.

All balancing valve stations must be accessible to properly balance the system.

Balancing procedure (proportional balancing)

6. Open fully all balancing valves on a single pump system. Open all valves to full position, including stop valves and return line balancing valves and close all bypass valves.
7. Remove, clean and/or replace all strainers.
8. Examine water in system to determine it is clean.
9. Check pump rotation and correct if necessary.
10. Check expansion tank to make sure it is not air bound and that the system is full of water.
11. Check all high points of water systems to make sure the piping is not air bound. Bleed off all trapped air in the system.
12. Check and set operating temperature of systems to design requirements.
13. If more than one branch circuit is used, start the balance procedure by reading all of the flows to the units in a branch. Each unit (leg) shall have its own balancing valve for flow balancing. Using readout probes, sequentially attach a differential pressure readout kit to the readout valves on each balancing valve.

14. Using the Balancing Valve Calculator, with the top hairline set on zero for the size balancing valve being read, read the flow corresponding to the pressure drop read with the readout kit.
15. Calculate the ratio of the actual flow to the design flow for each unit in the branch. This is the proportional flow rate. (Actual flow divide by design flow.)
16. Select the balancing valve with the lowest proportional flow rate. This balancing valve is left in the fully open position. Every other balancing valve in the branch is then reset to the same proportional flow rate.
17. If there are additional branches, repeat the steps in 8, 9 and 10 for each branch.
18. After all branches have been proportionately balanced, measure the full open flows on the balancing valve installed on the risers. Calculate the proportional ratio of each riser Circuit Setter and select the one with the lowest proportional ratio. This Circuit Setter is left fully open and the other riser balancing valves are adjusted to this same ratio as described in Step "11".
19. Upon completion of flow readings and adjustments, and after water balance is complete, permanently mark all balancing valves, cocks and balancing valve so that they can be restored to their correct position if disturbed. Properly set memory stops on all balancing valves so equipped.
20. After the Balancing Contractor sets all water flow balancing devices to proper design GPM, he shall mark the GPM flows on the piping schematic drawings.

Using balance valves as flow meters

21. Energize the zone, circuit and/or system pump(s) as applicable.
22. Using Readout Probes, sequentially attach a differential pressure readout kit to the readout valves on each Balancing Valve.
23. Read the differential pressure across the orifice of the Balancing Valve.
24. Using Side #2 of the Valve Calculator, set the hairline over the degree of closure as indicated by the part of the red plastic knob or indicator plate parallel to the degree of closure noted on the calibration plate, and read actual GPM flowing through the balancing valve opposite the gauge reading head loss noted in the white section of Side #2.

3.18 CLEANING

Clean systems thoroughly before testing. Fixtures, equipment, pipe, valves and fittings shall be free of grease, metal, cuttings, dirt and other foreign material. Remove protective covers. Fixtures (including lavatories, water closets and urinals) shall be cleaned and ready for use. Final cleaning of fixtures to be performed by others.

Repair stoppages, discoloration and damage to parts of building, finish and furnishings due to failure to properly clean piping system within Contract Price.

After completion of project, clean the exterior surface of equipment included in this section, including concrete residue.

3.19 DISINFECTION OF WATER SYSTEMS INTERIOR AND EXTERIOR

Water piping systems shall be thoroughly disinfected with a solution containing no less than 200 parts per million of available chlorine. Chlorinating materials shall be either liquid chlorine or sodium hypochlorite solution, shall be introduced into the system and

drawn to all points in the system. Disinfection solution shall be allowed to remain in system for 3 hours, during this time, valves and faucets shall be opened and closed several times. After disinfection, solution shall be flushed from the system with clear water until residual chlorine content is no greater than 0.2 parts per million.

Work shall be supervised by Owner and performed by approved chemical testing laboratory and results sent to the Architect or Architect's representative for verification.

Testing laboratory shall submit a summary of test procedure for approval prior to any work performed. Work shall be in accordance with Owner's requirements. Subcontractor shall provide valves required to disinfect water supply system in parts required by phasing of construction and to provide isolating valves and draw-off valves for proper containment, phasing and flushing.

3.20 WATER ENTRANCE (10'-0" ONLY)

Run water service piping for domestic water, beginning at discharge of main control valve in Water Service Room (Mechanical Room), as shown on Drawings.

When water pipe laying is not in progress, close ends of pipe with watertight plugs. If water enters pipe, flush and clean line.

Keep excavation for underground water main open until system has been tested, inspected and approved.

Piping shall be bedded as specified in Division 2.

3.21 EXTERIOR SANITARY SEWER (10'-0" ONLY)

Sanitary line ending 10'-0" outside the interior face of exterior building foundation wall shall run by gravity as shown on Drawings.

Check line and grade of piping with laser designed for purpose intended.

Plug open ends of piping when work is not in progress.

Piping shall be bedded as specified in Division 2.

3.22 CROSS CONNECTION PROTECTION

All potable water piping outlets and connections to equipment or machinery shall be protected against backflow by means of an air-gap or approved backflow preventer.

Backflow preventer type, application and installation shall comply with the State of Massachusetts, Department of Environmental Protection (DEP) Regulations.

Mount backflow preventers horizontally at heights and with clearances per DEP regulations.

1. Reduced pressure backflow preventers shall be installed between 36" to 48" above the floor with a minimum of 12" clear space all around.
2. Double check valve assemblies shall be installed with a minimum 36" spacer between check valves and mounted between 30" to 54" above the floor with 12" clear space all around.

Submit plans to DEP and obtain permit for each reduced pressure or double check valve backflow preventer installation and submit copies of permit to architect for record.

Provide indirect waste piping with funnel to receive discharge from reduced pressure backflow preventer atmospheric vents and spill through air gap into floor drain.

3.23 ACCESS AND ACCESS PANELS

Provide access to material or equipment which may need inspection, replacement, repair or service and coordinate their delivery with the installing Trade. If proper access cannot be provided, confer with Architect as to best method of minimizing effect of reduced access which may result.

Coordinate and prepare a location, size, and function schedule of access panels required to fully service equipment and deliver to a representative of the installing Trade.

Furnish access panels, doors and hatches for installation under other Sections where shut-off valves, control valves, check valves and other items which are installed under this Section require access and are concealed in floor, wall, furred space or above ceiling. Access panels shall be by Milcor, Knapp, Inland Steel or approved equal; coordinate selection with other Sections.

Lay-in and removable splined tile ceilings do not require access panels and each valve above ceiling shall have location marked with thumb tack on finished ceiling panel.

Access panels shall have same fire rating classification as surface penetrated.

Panel sizes to be determined by access requirements. Panels will be supplied by the Plumbing Subcontractor and installed by others.

3.33 CONCRETE STRUCTURES

A. The bases shall be supported on a compacted level foundation of gravel borrow a minimum 12 inches thick. Crushed stone may be substituted for gravel borrow if field conditions at the bottom of the excavation are wet.

1. Manhole risers and tops shall be installed using approved butyl-rubber type gasket for sealing joints of manhole risers and tops; jointing shall be performed in accordance with the manufacturer's recommendations. Manhole risers and tops shall be installed level and plumb. Water shall not be permitted to rise over newly made joints, nor until after inspection as to their acceptability. All jointing shall be done in a manner to ensure watertight joints. Openings shall be provided in the precast concrete manhole risers to receive entering pipes and these openings shall be made at the place of manufacture. Connection of sanitary pipes to manholes shall be made by means of a flexible rubber sleeve/boot cast integral with the structure sidewall.
2. Care shall be taken to ensure the openings are made to permit setting of the entering pipe at its correct elevation as indicated or directed. Manhole risers and tops shall be installed so the manhole steps shall be in alignment.
3. All holes used for handling shall be thoroughly plugged with non-shrink grout.
4. Cutting or tampering in the field, for purpose of creating new sidewall openings or

altering existing openings, will not be permitted without approval of the Engineer.

3.34 SETTING MANHOLE FRAMES AND COVERS

- A. Manhole frames shall be set with tops conforming accurately to the grade of the pavement or finished ground surface as indicated on the Contract Drawings or as directed. Frames shall be set concentric with the top of the manhole on a minimum of two courses of brick and a maximum of four courses in a full bed of mortar so the space between the top of the brick and mortar and the bottom flange of the frame shall be completely filled and made watertight. A thick ring of mortar extending to the outer edge of the concrete shall be placed all around the bottom flange. The mortar shall be smoothly finished to a height of 5 inches above the flange.
1. Only clean bricks shall be used in brick work to adjust frame elevations. The brick shall be moistened by suitable means.
 2. Manhole covers shall be left in place in the frame until completion of other work at the manholes.
 3. Frame castings for catch basins shall be set on a minimum of two courses of brick and a maximum of four courses in full mortar beds true to line and grade. Frames shall be set in a grout bed and the cement mortar shall be brought up to a height of not less than 5 inches above the bottom of the frames and made watertight. The castings of structures located within the pavement area shall not be completely set to the established grade until the bottom course of pavement has been laid. The final setting of all casting shall be performed at the proper stage of construction required by the Construction Manager's operations. No additional payment will be made for adjusting and resetting of any casting
 4. Clean all debris, mortar, and soil from the bottom of all structures prior to final acceptance of the project.

3.35 TRAINING

- A. The plumbing subcontractor shall thoroughly instruct the Owner, to complete satisfaction of the Architect and Engineer, in the proper operation of all systems and equipment provided. The Plumbing Subcontractor shall make arrangements, via the Architect, as to whom the instructions are to be given in the operation of the basic and auxiliary systems and the period of time in which they are to be given. The Architect shall be completely satisfied that the Owner has been thoroughly and completely instructed in the proper operation of all systems and equipment before final payment is made. If the Architect determines that complete and thorough instructions have not been given by the Plumbing Subcontractor to the Owner's representative, then the Plumbing Subcontractor shall be directed by the Architect to provide whatever instructions are necessary until the intent of this specification has been complied with. No extra compensation for such instruction will be allowed.
- B. The Plumbing Subcontractor shall provide the Owner's designated personnel instructions and training on the operation, and preventative maintenance of all plumbing systems and equipment. The instructions shall contain information deemed necessary by the Architect and shall include, but not be limited, to the following:

1. Instructional classes on equipment and systems operation for Owner's representative and building maintenance personnel, by engineering staff of Plumbing Subcontractor. Minimum of forty (40) hours of instruction for minimum of two (2) people and a maximum of twenty (20) people. Instruction shall include
 - a. Explanation of manual and its use
 - b. Summary description of the plumbing systems
 - c. Purpose of systems
2. All training classes and equipment instruction shall be recorded on digital media format by the Plumbing Subcontractor. Provide (3) copies on portable hard drives to the Owner and one to the Architect. At the Owner's discretion, the Plumbing Subcontractor shall provide sixteen (16) additional hours of instructions up to one year after the building has been occupied.

END OF SECTION