SECTION 22 05 00

COMMON WORK RESULTS FOR PLUMBING

PART 1 – GENERAL

1.1 REFER TO RELATED SECTIONS

A. Section 23 05 01 – Mechanical and Electrical Coordination
Section 23 05 02 – Basic Mechanical Requirements
Section 23 05 03 – Basic Mechanical Material and Methods

1.2 DESCRIPTION OF WORK

A. Except as otherwise specified under "Related work Not Included", the work of this Contract consists of furnishing all labor, materials, equipment and appliances necessary and required to completely do all Plumbing Work as indicated on the Drawings or described or referred to in the Specifications, including, but not limited to the following:

1. Complete exterior sanitary sewer system up to and connecting to the site civil work. Coordinate connection with Civil drawings.
2. Complete exterior domestic and fire protection water services, curb valves, etc. up to the site civil work. Coordinate connection point with Civil drawings
3. Exterior storm drainage piping, including drain inlets, frames, covers, grates, etc. up to the site civil work. Coordinate connection point with Civil drawings.
4. Complete interior storm water drainage systems with leaders, roof and area drains, and piping system conveying storm water drainage to site storm drainage system.
5. Complete interior sanitary, soil, waste and vent piping systems, including all required connections to all plumbing fixtures and equipment, house sewer, and connections to the site sanitary sewer system.
6. Complete interior domestic cold water system including connections to the site water system piping, cross connection control devices, remote readouts for water meter, and connection to all fixtures and equipment requiring cold water.
7. Complete interior domestic hot water distribution systems including connections to all fixtures and equipment requiring hot water, connections to hot water supply and hot water circulation systems, new hot water heaters and circulation pumps.
8. Plumbing fixtures and trim for same.
9. Furnishing of access doors for installation under another Division or Section of these Specifications.
10. Excavation and backfill for all work herein specified.
11. Make all plumbing connections required for equipment furnished under other Divisions or Sections of these Specifications.
12. Hose bibbs, wall hydrants, shock absorbers, vacuum breakers and backflow preventers.
13. Sleeves, hanger and supports.
14. Insulation for piping and equipment.
15. Apply for and obtain and pay for all permits, certificates, inspections and approvals required in connection with all Plumbing Work.
16. Shop drawings, samples and instructional manuals, tests and adjustments.
17. Installation of all fixtures furnished by Owner and/or furnished under other Divisions or Sections of the Specifications.
18. Provide roughing (water supplies, soil, waste, and vent piping) for all fixtures and equipment furnished and/or installed under other Divisions or Sections of these Specifications.
19. Sump pump assemblies.
20. All interlocking control wiring and conduit.
21. Concrete pads for pumps and equipment.
22. Color coding and stenciling of all piping systems.
23. Cutting and rough patching.

24. Cap flashing and prime painting.
25. Tests for all systems provided under this Section.
26. Where due to Union regulations or trade agreements, any of the work shown on the Drawings or specified herein is not considered Plumber's Work, this Contractor shall subcontract the work in question, but this Contractor shall be held responsible for the complete installation.
27. It is not the intention of these Specifications to describe nor the Contract Drawings to show in detail, all the various pieces of apparatus and appurtenances and their connections. This Contractor shall, as part of the Contract, furnish and install all incidentals, such as pipe, fittings, valves, etc., required to complete the installation of the equipment. This Contractor shall refer to Architectural Drawings and Plumbing Drawings for exact location of fixtures including type and quantities. This Contractor shall be responsible for providing isolation valves in locations suitable to isolate equipment, risers, building sections, etc. This Contractor shall be responsible for providing and connecting all fixtures and equipment.
28. All work described in the Specifications and not shown on the Drawings, or vice versa, shall be installed in a manner similar to the work shown or described.
29. Plumbing Contractor shall provide temporary water service on the site to the locations indicated by the Construction Manager, on the site temporary fire protection water, all in accordance with requirements of the state and local codes, the Water Company and the Fire Department. Plumbing Contractor to pay all fees and obtain all permits required in connection with the water services.
30. Prepare and submit to the Engineer, all drawings, applications, test reports, correspondence, etc., as required in connection with the approval and installation of the backflow preventors and/or double check valves, as indicated on the Drawings or as required by the New York State Department of Health. Contractor shop drawings shall be suitable for filing with authority approving the installation. Engineer shall sign and seal as Engineer of Record.

1.3 RELATED WORK NOT INCLUDED

A. The following principal items of work shall be provided under other Sections; the General Contractor shall be responsible for coordinating the purchase of this work from other trades:

1. Finish painting.
2. Furnishing of toilet room accessories.
3. Installation of access doors. This Contractor shall furnish access doors.
4. Kitchen equipment, including hoods and fire protection system for same, booster heaters and trim.
5. Base flashing for roof drains, and piping passing through roofs.
6. All electrical power wiring conduits, etc., for pumps, equipment, etc., shall be provided under Division 26.
7. Drainage piping from HVAC equipment to and spilling over floor drain, mop sink, sump or roof, except as noted.
8. Temporary toilets and water supply.
9. Finish patching.
10. Sheet metal gutters and leaders.

1.4 VISITING THE PREMISES

A. This Contractor, before submitting his bid on the work, shall visit the site and familiarize himself with all visible existing conditions. As a result of having visited the premises, this Contractor shall be responsible for the installation of the work as it relates to such visible existing conditions.

B. The submission of a bid will be considered as acknowledgment on the part of the bidder of his visitation to the site.

1.5 QUALITY ASSURANCE

A. Manufacturer's Instructions

1. In addition to the requirements of these Specifications, comply with the manufacturer's instructions and recommendations for all phases of the work.

B. Standards and Codes
Comply with the latest editions of the following:

Building Code of New York State
New York State Plumbing Code.
National Fire Codes (N.F.P.A.)
Local Gas Utility Rules and Regulations.
Local Municipal Rules and Regulations.
Local Fire Department requirements.
Local Water Company Rules and Regulations.
Other State and Local Authorities having jurisdiction.
F.M. and/or F.I.A. regulations.

C. All work and material not specifically described, but required for a complete and proper installation of the work of this Section, shall be provided by the Contractor and shall be new, first quality of their respective kinds, and subject to approval of the Architect.

D. All water supply connections to plumbing fixtures and other equipment to be installed under this Division shall be in accordance with the rules relative to submerged inlets and protective methods to be applied to prevent contamination of water as required by Local and State Regulations.

E. Manufacturing firms regularly engaged in manufacture of this material with characteristics and capacities required, whose products have been in satisfactory use in similar service for not less than 10 years.

F. Provide product produced by the manufacturers, which are listed in Section "Approved Manufacturer's List".

G. Provide equipment whose performance, under specified conditions, is certified by the manufacturer.

H. All piping shall be domestically manufactured and shall be by the same manufacturer.

I. All work shall be done by a licensed Plumbing Contractor.

1.6 CONCRETE WORK

A. All concrete equipment bases that are installed on vibration isolators, all anchor and thrust blocks and all piping supports in trenches shall be provided under the work of this Section. All formed and poured-in-place concrete work including equipment housekeeping pads, sumps, etc., will be provided under another Division or Sections of these Specifications. The General Contractor shall be responsible for coordinating the purchase of this work from other trades.

B. This Contractor shall furnish all required templates for anchor bolts, and dimension drawings for housekeeping pads and sumps. All concrete provided under the work of this Section shall be in accordance with that specified under other Division or Sections of these Specifications. The General Contractor shall be responsible for coordinating the purchase of this work from other trades.

1.7 REPLACEMENT OF SURFACING

A. Where required by operations under this Section, the Contractor shall remove and replace all damaged street pavements, curbs, sidewalks, walkways, grassed areas and landscaped areas which are to remain, in a manner equal to their original condition when new.

B. In those cases where final surfaces cannot be placed immediately, a temporary surfacing of two inches of bituminous concrete shall be placed and maintained. This shall be removed before placement of final surfacing.

C. Landscaping and grassed areas shall be preserved and/or replaced to the satisfaction of the Architect.

D. See additional requirements elsewhere in this specification.

1.8 COOPERATION WITH OTHERS

A. The Plumbing Contractor shall cooperate with other trades whose work is to be correlated with his work, in order to avoid field interference, improper elevations, or inaccessible work. Any extra expense occasioned by lack of cooperation by this Contractor shall be borne by him.

1.9 GREEN BUILDING REQUIREMENTS AND PERFORMANCE CRITERIA

A. Green Building Performance Criteria:

1. All field-applied concrete admixtures, adhesives, sealants, paints and coatings used for interior applications shall meet the volatile organic compound (VOC) and chemical component limitations as defined by EPA and USGBC.

B. Green Building Submittal Requirements:

The Contractor and their sub-contractors shall submit the GREEN BUILDING CERTIFICATION items listed herein.

1. GBMCF: Submit a completed GREEN BUILDING MATERIALS CERTIFICATION FORM. Information to be supplied for this form shall include:

    a. Cost breakdowns for the materials included in the Contractor or sub-contractor's work. Cost breakdowns shall include total cost plus itemized material costs for and VOC containing products.
2. Validation: Published product literature or manufacturer's letter of certification (on the manufacturer's letterhead) validating all information, other than costs, provided in the GBMCF.
3. Cut Sheets: Product cut sheets for materials listed in the GBMCF. Cut sheets shall be submitted with the Contractor or Trade Contractor's stamp, confirming that the submitted products are the products installed in the Project.
4. VOC Content: Material Safety Data Sheets (MSDS), published product literature, or manufacturer's signed certification (on manufacturer's letterhead) stating the VOC content of all applicable products.
5. Submittal Package: The GREEN BUILDING submittal information shall be assembled into one (1) package per Section or trade, and sent to the Consultant for review. Incomplete or inaccurate Green Building submittals may be used as the basis for rejecting the submitted products or assemblies.

PART 2 – NOT USED

PART 3 – NOT USED

END OF SECTION

SECTION 22 05 13

PLUMBING MOTORS AND STARTERS

PART 1 - GENERAL

1.1 SUBMITTALS

A. Submit manufacturer's product data.

1. Motors: Identify by unit served. Include:
   a. Voltage
   b. Phase
   c. Horsepower
   d. Frame
   e. Insulating class
   f. Efficiency
   g. Power factor
   h. Index number
   i. Speed
   j. Starting characteristics
2. Starters: Identify by motor served. Include:
   a. Enclosure, NEMA Type
   b. NEMA size
   c. Accessories, switches, transformers, etc.
   d. Wiring diagram
   e. Auxiliary contacts
   f. Thermal overload size
3. Submit as part of packaged unit submittals when purchased as part of item of equipment.

1.2 SINGLE MANUFACTURER

A. Provide all motors, except those factory mounted, by a single manufacturer.

B. Provide all starters, except those factory mounted, by a single manufacturer.

C. "Factory mounted" means "as part of a packaged unit" where the motor is not purchased separately from the driven equipment.

PART 2 - PRODUCTS

2.1 MOTORS (OTHER THAN FACTORY MOUNTED)

A. Manufacturers:

1. Design Basis: Reliable
2. Other Acceptable Manufacturers:
   a. General Electric
   b. Westinghouse
   c. U.S. Motor
3. Factory mounted motors may be by equipment manufacturer's standard supplier.

B. Bearings: Ball bearings, grease lubricated with grease fittings.

C. Enclosure: As required by location.

D. Service Factor: 1.15.

E. Full-Load Operation: At 105ºF and altitude of project.

F. Insulation:

1. Constant Speed: Class B.
2. Variable Frequency Controlled: Class F.

G. Efficiency Ratings:

1. All motors one horsepower and larger, except as noted, shall be premium efficiency motors, in accordance with NEMA Standard MGI-2003 (Tables 12-12 and 12-13) and New York State Energy Code.

H. Electrical Characteristics:

1. Refer to sections 23 05 01, Mechanical and Electrical Coordination.
2. Motors ½ hp and smaller shall be 115-volt single phase.
3. Motors ¾ hp and larger shall be three phase, of voltage shown in Electrical Section of Contract Documents.

I. Multi-speed Motors:

1. Motors may be one or two winding, 1800/900 RPM.

J. Variable Speed Drives:

1. All motors operated by a variable speed drive shall be rated for inverter duty.
2. Motor insulation shall be rated for 1600-volt peak.
3. All motors shall be NEMA MG-1, Part 31 compliant.
4. See additional requirements elsewhere in this specification.

2.2 MOTORS (FACTORY MOUNTED)

A. Provide premium efficiency motors.

2.3 VARIABLE FREQUENCY DRIVES

A. All motors operated by a variable speed drive shall be rated for inverter duty. Motor insulation shall be rated for 1600 volt peak.

B. All motors shall be NEMA MG-1, Part 31 compliant.

C. See additional requirements elsewhere in this specification.

2.4 STARTERS

A. Manufacturers:

1. Allen Bradley
2. Cutler-Hammer
3. General Electric
4. Square D

B. General:

1. Starters shall be standard NEMA sizes and UL listed.

C. Type: Across the line except where noted.

D. Enclosure: NEMA Type as required for location. Provide stainless steel enclosures in wash down areas, kitchens, dishwasher areas, exterior spaces, and any other areas where equipment will be exposed to moisture. Provide space heater and any necessary transformer within the enclosure as required to maintain the minimum internal temperature required by the manufacturer.

E. Overload Protection:

1. Type: Trip-free thermal overload relay.
2. Location: Each ungrounded conductor.
3. Reset: Manual.
4. Ambient Temperature Compensation: Provide where required.
5. Overload protection to be sized for nameplate running amps.

F. Auxiliary Contacts:

1. Provisions to add three without removing starter from enclosure.
2. Number: Provide three per starter as required for control sequence, and one (1) auxiliary contact.
3. Switchable type, easily changed from N.O. to N.C. without removing from its mounting.

G. Switches in Cover:

1. Manually Controlled: Three wire start-stop.
2. Automatically Controlled: Hand-off-automatic.
3. Start and stop indicating lights.
4. Equipment not designed to run continuously: Off-Automatic.

H. Control Transformer:

1. Provide when line voltage exceeds 208 volts.
2. Secondary wiring shall have one leg fused and the other grounded.
3. Secondary voltage not to exceed 120 volts.

I. Provide starters for all motors as follows:

1. Single phase motors less than ½ hp.
   a. With internal overload protection: None.
   b. Without internal overload protection:
      1) Manually Controlled: Manual starter.
      2) Automatically Controlled: Magnetic starter.
2. Single phase motors ½ hp and larger:

a. Manually Controlled: Manual starter.
b. Automatically Controlled: Magnetic starter.

3. Three Phase Motors: Magnetic starter.

J. Soft Start Starters:

1. Provide Y-Delta or solid state reduced voltage starters for all motors 50hp and larger.
2. Starter shall limit starting voltage to 200% of full load voltage.

K. Multi-Speed Starters:

1. Starters shall be suitable for the type multi-speed motor selected.
2. Provide time delay for automatic transfer from high to low speed.

L. Disconnecting Means:

1. All starters provided shall be combination starter-disconnect type unless specifically stated otherwise on drawings.

PART 3 - EXECUTION

3.1 MOTORS

A. Install motors on motor mounting systems so coupling or belt drive is properly aligned. Provide proper belt tension. Dowel direct coupled motors.

3.2 STARTERS

A. Deliver to installer of electrical work.

B. All safety devices shall be wired so that they will stop the motor with a hand-off-automatic switch in the hand as well as the automatic position.

END OF SECTION

SECTION 22 05 23

PLUMBING VALVES

PART 1 - GENERAL

1.1 SUBMITTALS

A. Manufacturer's Data: Submit manufacturer's product data including:

1. Dimensions
2. Sizes
3. End Connections
4. Weights
5. Installation instructions
6. Instructions on repacking and repairing valves.
7. Range of flow for balancing valves and plug valves.
8. Pressure reducing valves.
9. Backflow preventors.
10. Backwater valves.
11. All other applicable valves.

B. Valve Tag List: Refer to Section 22 05 53 of the Specifications.

PART 2 – PRODUCTS

2.1 GENERAL

A. Where type or body material is not indicated, provide valve with pressure class selected from MSS or ANSI standards, based on the maximum pressure and temperature in the piping system.

B. Except for balancing or when otherwise indicated, provide valve of same size as connecting pipe size.

C. Unless specifically required by note or symbol, all water valves shall be ball valves. If ball, butterfly, globe, plug, or balancing valves are called out by note or symbol, only that type of valve is acceptable.

D. Butterfly valves may be used for valves larger than 6" in non-balancing applications when pressure and temperature ratings are adequate.

E. Where pipe sizes overlap, contractor has the option of threaded or flanged valves.

F. Where grooved pipe mechanical coupling systems are accepted, provide flange adapters to mate with valves as specified below. Valves manufactured by the mechanical coupling system manufacturer shall not be used unless they meet all of the specified requirements for a given valve.

G. All valves shall be domestically manufactured.

H. Valves used for domestic water service shall be bronze or stainless steel. Iron and brass body valves are not acceptable. Comply with NSF-61 for lead free potable water piping.

I. All valves shall be of a design which the manufacturer lists for the service and shall be of materials allowed by the latest edition of the ASME Code for pressure piping for the pressure and temperature contemplated, unless a higher grade or quality is herein specified.

J. Valve packing compression is to be independent of the stem, ball or handle systems. All valve stems are to be blowout proof. Packing shall be accessible without disturbing the insulation.

K. Plug or gate valves shall not be used on any services without approval by the Vassar Department of Planning, Design and Construction.

L. All valves used for vent or drain services on water systems shall have a brass hose connection with cap and chain.

2.2 GLOBE VALVES

A. Manufacturers:

1. Design Basis: Milwaukee
2. Other Acceptable Manufacturers:
   a. Viega
   b. Crane
   c. Nibco
   d. Powell
   e. Gruvlok
   f. Stockham
   g. Hammond

B. Globe valves shall be of all bronze with composition disc, threaded, propress, or brazed joint ends as required by piping system in which they are installed.

C. All iron valves in potable water systems shall be NSF 61 listed and FDA approved epoxy coated cast iron valve bodies with bronze seats

D. Except where otherwise noted, all valves for use with copper tubing shall be as follows:

2" AND SMALLER	UNDER 200 PSI	Milwaukee Model 1502 Bronze, 125 PSI SWP, 200 PSI WOG, Rising Stem, Screw Bonnet, Bronze Disk, MSS SP-80, Type 1, Solder Ends. Milwaukee Model 502 for Threaded Ends.
2 ½" AND LARGER	UNDER 200 PSI	Milwaukee Model F-2981 Iron, 125 SWP, 200 WOG, Non-Shock, Solid Disc, Bolted Bonnet, Gland Packed, Flanged Ends

2.3 ANGLE VALVES

A. Manufacturers:

1. Design Basis: Milwaukee
2. Other Acceptable Manufacturers:
   a. Viega

b. Crane
c. Nibco
d. Stockham
e. Hammond
f. Gruvlok

2" AND SMALLER	UNDER 300 PSI	Milwaukee Model 595T Bronze Body, 150 WSP, 300 WOG, Threaded, Union Bonnet, Angle Bronze Disc, with Solder Joint Adapter.
2" AND SMALLER	UNDER 200 PSI	Milwaukee Model 504 Bronze Body, 125 PSI, SWP, 200 PSI WOG, Bronze Disc, Threaded Bonnet, with Solder Joint Adapter.

2.4 SWING CHECK VALVES

A. Manufacturers:

1. Design Basis: Nibco
2. Other Acceptable Manufacturers;
   a. Viega
   b. Crane
   c. Milwaukee
   d. Powell
   e. Stockham
   f. Victaulic (for Grooved Pipe Systems)
   g. Gruvlok
   h. Hammond

B. Check valves up to and including 2" shall be all bronze swing check type with threaded, propress, or brazed joint ends.

C. For domestic water use up to 2" piping: Horizontal swing, regrinding type ASTM B 584 Alloy C87850 body, 200 PSI CWP, Y Pattern, Renewable PTFE Seat and Disc, MSS-SP-80, NSF-61 for potable water.

1. Model: T-413-Y-LF

2.5 SILENT/WAFER CHECK VALVES

A. Manufacturers:

1. Design Basis: Milwaukee

2. Other Acceptable Manufacturers:
   a. Viega
   b. Metra Flex
   c. Hammond
   d. Nibco
   e. Tyco
   f. Gruvlok
   g. Stockham

2" AND SMALLER	UNDER 200 PSI @ 250 °F	Milwaukee Model 548T Bronze Body and Trim, Center Guided, Single Disc, 250 PSI Rating.
2½" AND LARGER	UNDER 200 PSI @ 150 °F	Milwaukee Model 8800 Iron body, Stainless Steel Trim, Center Guided Double Disc, 200 PSI Rating.

B. All iron valves in potable water systems shall be NSF 61 listed and FDA approved epoxy coated cast iron valve bodies with bronze seats

C. Where application or building height causes working pressure to exceed 125 psi, provide silent check valves 3" & up: Milwaukee 1800, 250 lb. WSP, semi-steel.

D. Double disc or bi-folding disc type valves are not acceptable.

2.6 BUTTERFLY VALVES

A. Manufacturers:
1. Design Basis: Milwaukee
2. Other Acceptable Manufacturers:
   a. Viega
   b. Crane
   c. Keystone
   d. Nibco
   e. Victaulic (for Grooved Pipe Systems)
   f. Hammond Watts
   g. Bray
   h. Gruvlok
   i. Stockham

B. All iron valves in potable water systems shall be NSF 61 listed and FDA approved epoxy coated cast iron valve bodies with bronze seats

C. Hydronic Service (less than 250ºF): 200 psi WOG, cast or ductile iron fully lugged body, integral extended neck to clear insulation, integral top plate for actuator mounting, stainless steel stem, upper and lower lubricated bushings, field replaceable hard back seat with integral stem and flange seals, machined disk seating areas, rated for minimum 200 psi dead end service with no downstream flange. Liner to be compatible with operating fluid. Conform to MSS-SP67.

1. Model: Figure CL223E.

D. Provide 10 position locking lever handler for valves 6" and smaller. Infinite position memory stop lever handle for all valves 6" and smaller used for balancing. Chain wheel operator where required.

E. Butterfly valves in size 2½" - 12" shall be of the flanged body style. All valves shall be suitable for use with ANSI 125 or 150 pound flanges. Bodies shall be cast. Valves shall be rated at 200 psi and provide drip-tight shutoff at differentials up to 200 psi. Bodies of all flangeless wafer valves shall have 4 flange bolt guides to center the body in the pipeline. Size ½" – 2", use ball valve.

F. Lug body valves shall have a retained seat and shall provide tight shutoff up to the full valve rating on dead end or isolation service without the use of downstream flanges.

G. Bearings shall be self-lubricated TFE coated stainless steel. Shaft seals shall be provided to prevent leakage and to protect bearings from internal or external corrosion.

H. Seats shall be of material suitable for use with potable water. Seats shall be of the reinforced resilient type and shall be field replaceable and shall also act as a body liner to prevent flow from contacting the body casting. Seats shall have flange sealing to provide a positive seal without use of flange gaskets.

I. Shafts shall be one piece and shall be of 416 stainless steel. Shafts shall be finish ground to minimize bearing and shaft seal wear. Operating shaft to be supported axially and radially at input end by permanently lubricated bronze thrust and sleeve bearings.

J. Discs shall be aluminum bronze. The disc-to-shaft connections shall be type 316 stainless steel. Pins, shaft and disc of all valves shall be individually machined and completely interchangeable.

K. Latch lock levers shall provide automatic, positive latching in the open, closed or eight intermediate positions. These valves shall allow locking in any position with a standard padlock. Infinite position levers shall allow manual throttling and locking in any position from open to close. External disc position indicators shall be provided.

L. All manually actuated valves 8" and larger shall be operated using a cast iron housed handwheel actuator available in standard, weatherproof, or buriable constructions (as required) with optional chain wheel, crank, or 2" square nut input. All units to have adjustable open and closed position stops with provision to prevent accidental adjustment changes.

M. Provide valves rated for elevated pressure where operating pressures exceeds 125 psi.

N. Grooved end steel pipe butterfly valves 2” through 12” shall be ductile iron, nickel-plated ductile iron disc, type 416 stainless steel two-piece stem, disc shall be offset from the stem centerline to provide continuous 360 degree seating, EPDM seat and seal material. Valve shall have a lever handle or gear operator with handwheel. Valve shall be suitable for bubble tight shutoff, dead-end and bi-directional service at 300 psi full rated pressure. Victaulic Vic-300 MasterSeal™.

2.7 BALL VALVES

A. Manufacturers:

1. Design Basis: Nibco
2. Other Acceptable Manufacturers:
   a. Viega
   b. Apollo
   c. Dyna Quip
   d. Hammond
   e. Milwaukee
   f. Watts
   g. Gruvlok
   h. Stockham

B. Cast bronze, 150, SWP, 600 WOG (min), ASTM B283 Alloy C69300 ball, two piece design, blow-out proof stem, adjustable packing gland nut (allowing handle to be removed without leaking) TFE seats, MSS-SP-110, NSF-61 for potable water.

1. Model: T-685-80-LF - full.port.

C. Provide the following where required:

1. Extended stems for insulated valves.
2. Memory stop device for balancing applications.
3. Tee handle for tighter areas.
4. Hose end and cap for drain.
5. Mounting pads for actuator.
6. Provide “stop and drain” for compressed air.
7. Ball Valves up to 2” may be used for all water services, globe valves and balancing cocks.
8. Ball valves shall be bronze body, 316 stainless steel ball and stem, Teflon seats and seals threaded ends, 400 psig cold W.O.G. Worchester No. 411T-SE or equal.

A. Minimum flow coefficients (Cv):

Size	Cv
½”	8
¾”	14
1”	35
1¼”	46
1½”	75
2”	105
2½”	300
3”	390
4”	680

2.8 CIRCUIT SETTERS (CS)

A. Manufacturers:

1. Design Basis: Bell & Gossett Circuit Setter Plus

2. Acceptable Manufacturers:
   a. Viega
   b. Taco

B. Valves ½” to 3”:
1. Valve body shall be constructed out of lead free brass
2. Valve shall include a ball valve constructed in 304 Stainless Steel.
3. Valve shall be AB1953 and CSA certified and compliant with Vermont 152S, Maryland House Bill HB372, Senate Bill S.3874, and NSF/ANSI-372.
4. Valve body shall include two pressure/temperature ports.
5. Valve body shall include a drain valve port.
6. Valve shall utilize a calibrated nameplate with a memory stop.
7. Valve shall utilize a reduced port design that provides velocity head recovery.
8. Valve temperature range shall be from -4°F (-20°C) to 250°F (121°C)

C. Valves ½” to 2” pipe size, NPT, sweat, or press-fit.
D. Valves 2 ½’ and 3” pipe size, NPT, flanged, or grooved.

2.9 DOMESTIC WATER PRESSURE REDUCING VALVE

A. Manufacturer (2½” and smaller):

1. Design Basis: Watts Model 223S
2. Other Acceptable Manufacturers:

a. Febco
b. Wilkins

3. Construction:
   a. Seal: Renewable, stainless steel.
   b. Strainer: Stainless steel.
   c. Diaphragm: High temperature resistant.

B. Manufacturer (3" and larger):

1. Design Basis: Watts Model: ACY 115-2 (3" through 12")
2. Other Acceptable Manufacturers:
   a. Febco
   b. Wilkins
3. Construction: "Quadseal", non-edged seat, 100% fused epoxy finish, stainless steel seats through 8", FDA approved diaphragm.

C. The valve shall maintain a constant downstream pressure regardless of varying inlet pressure. This valve shall be a hydraulically operated diaphragm-actuated, angle pattern valve. It shall contain a resilient synthetic rubber disc, having a rectangular cross-section, contained on three and one-half sides by a disc retainer and forming a tight seal against a single removable seat insert.

D. The diaphragm assembly containing a valve stem shall be fully guided at both ends by a bearing in the valve cover and an integral bearing in the valve seat. This diaphragm assembly shall be in the only moving part and shall form a sealed chamber in the upper portion of the valve separating operating pressure from the line pressure.

E. The diaphragm shall consist of nylon fabric bonded with synthetic rubber and shall not be used as a seating surface. Packing glands and/or stuffing boxes are not permitted and there shall be no pistons operating the valve or pilot controls. All necessary repairs shall be possible without removing valve from the line.

F. The pilot control shall be a direct-acting, adjustable, spring-loaded, normally open, diaphragm valve designed to permit flow when controlled pressure is less than the spring setting. The control system pressure is less than the spring setting. The control system shall include a fixed orifice.

2.10 EXTERIOR WATER SERVICE VALVES

A. Furnish and install all underground control valves and valve boxes for water service and branches as indicated on the Drawings.

B. All gate valves shall be similar and equal to Stockham G743-0 N.R.S. iron body, bronze mounted, double disc, parallel seat, mechanical joint, with operating nut. Valves shall be open left. Other manufacturer will be accepted when required by Local Authorities.

C. All valves shall be installed complete with concrete supporting pads and valve boxes and valve covers. All of the foregoing shall be included in the price of valves. Valve boxes shall be set so the tops are flush with proposed finished grade. They shall be reset if required to meet finished paving or grade.

D. All valve boxes, top and bottom sections and covers shall be manufactured by "Kennedy," Fig. 121 as specified for the fire service coated with coal tar pitch varnish and word "WATER" cast on cover.

E. The deep box type yard hydrants shall be cast brass non-freeze with ¾ inch hose connection, vacuum breaker and a bleed-off connection on valve body to drain the casing, for 5'-0" bury, as manufactured by J.R. Smith Fig. No. 5810-VB, MIFAB #HY 6800-8, or equal. At least six (6) cubic feet of crushed stone (French drain) shall be provided at the drip valve.

2.11 LOCAL EQUIPMENT AND FIXTURE PRESSURE REGULATORS

A. Furnish and install a CASH-ACME type HER or approved equal water pressure reducing valve on all cold and hot water branch lines for food service laboratory and medical equipment as provided under other Division of Sections of this Specification. Pressure reducing valves shall be of the differential type, self-contained, single seated, direct acting, spring locked type with no diaphragm. Valve body and spring housing shall be bronze and all other parts shall have a corrosion resistance equal to bronze.

B. All valves shall be sealed against leakage including a top cap over the adjusting screw.

C. Internal parts subject to wear shall be replaceable without removing valve from the pipe line, valve shall be provided with means to adjust outlet pressure setting.

D. Valves shall have sufficient water capacities to provide required rates of flow and shall be set at discharge pressure as required by the point of use.

2.12 BACKFLOW PREVENTER

A. Backflow Preventer, Reduced Pressure Zone Type, Food Service Applications

1. Design Basis: Watts No.SS009QT Series
2. Other Acceptable Manufacturers:
   a. Febco
   b. Wilkins
3. Construction: Stainless steel trim and body, complete with test cocks, resilient seat, shut-off valves, and air gap fitting.
4. Complies with ASSE STD 1013

B. Backflow Preventer, Reduced Pressure Zone Type (Domestic Water Service, Irrigation System Connection)

1. Manufacturer:
   a. Design Basis: Watts No. LF909, (1/2" through 10") unless otherwise specified on the drawings.
   b. Construction: Bronze body, stainless steel trim, complete with test cocks, resilient seat, shut-off valves, and air gap fitting.
   c. Other Acceptable Manufacturers:
      1) Beeco
      2) Febco
      3) Wilkins
2. Complies with ASSE STD 1013.

3. The reduced pressure backflow preventer shall consist of two separately spring loaded "Y" type check valves and one differential relief valve having two diaphragms separated by a spacer. This device shall automatically reduce the pressure in the "zone" between the check valves. Should the pressure differential, normally 4.5 psi, drop to 3.0 psi, the relief valve shall open, dumping the liquid to atmosphere and maintain the proper differential. A small hose in the spacer will bleed to atmosphere if either diaphragm is damaged, giving visual evidence of diaphragm failure. Both check valves shall be serviceable without removing the device from the line. RPZ shall be rated to 150 psi working pressure and 212°F water temperature. Backflow preventers 2" and smaller shall have bronze bodies and bronze trim. 2-1/2" and larger shall have cast iron bodies with epoxy coating and bronze trim. Backflow preventers shall be similar to Watts 900 or approved equal.

4. Vertical assemblies (Z- or N-pattern) shall only be used where space limitations do not allow for a horizontal assembly. Vertical assemblies shall be similar to Febco LF880V or approved equal.

5. Backflow preventer shall be NSF-61 listed and FDA approved.

C. Backflow Preventers – Double check detector assembly for fire protection service and domestic water Service:

1. Manufacturer:
   a. Design Basis: Watts No 709DCDA unless otherwise specified on the drawings.
   b. Construction: Epoxy coated cast iron body, replaceable bronze seats.
   c. Other Acceptable Manufacturers:
      1) Beeco
      2) Febco
      3) Wilkins
2. Complies with ASSE STD 1048.
3. Where used in potable water system, preventer shall be NSF-61 listed and FDA approved.

D. Backflow Preventer (Atmospheric Vacuum Breaker)

1. Manufacturer:
   a. Design Basis: Watts No. 008 Series (3/8" through1")
   b. Construction: Bronze body, ball valve shut offs.
   c. Other Acceptable Manufacturers:
      1) Beeco
      2) Febco
      3) Wilkins
2. Complies with ASSE STD 1020.
3. Provide vacuum breakers on water supply piping to each fixture and equipment with submerged inlets, and on faucets and outlets, within the building, to which hose can be, or is attached, forming a submerged inlet. Set vacuum breakers in exposed readily accessible locations and at least 6'-6" above finished floor. Vacuum breakers shall be chrome plated brass, T&S Brass No. B-929-A watts 008 or approved equal. Vacuum breakers shall comply with ASSE STD 2010.

2.13 BACKWATER VALVE

A. Provide backwater valve where indicated on the Drawings.

B. Backwater valve shall be similar to Zurn No. 1095-6 or MIFAB BV 1000, cast iron, hub inlet and offset spigot outlet, cast iron cleanout and plug for caulking into top hub of cleanout opening, automatic type bronze valve seat and flapper which hangs open during periods of non-operation.

PART 3 - EXECUTION

3.1 GENERAL

A. Comply with the following requirements:

1. Install valves except butterfly with stems pointing up, and as close to vertical as possible. Butterfly valves to be offset at least 10° from vertical.
2. Install valves at each piece of equipment, fixture or appliance so that the supply and return services can be shut off to remove the item without draining the remainder of the piping system.
3. Install valves where required for proper operation of piping and equipment, including valves in branch lines where necessary to isolate sections of piping. Install isolation valves at each concession, bathroom group and riser. Locate valves so as to be accessible.
4. Combination balancing and shut-off valves may be used instead of a separate balancing valve and shut-off valve if the valve has a memory stop and the manufacturer lists its use as a leak-proof service valve.
5. Provide drain valves at main shut-off valves, low points of piping and apparatus.
6. Provide separate support where necessary.
7. Do not allow meter connections of balancing valves to point downward.

8. Install valves so bypass valves are accessible.
9. Furnish all valves as indicated on the plans, or as may be required for the proper control of the pipe lines installed under this Specification, so that any fixture, line or piece of apparatus may be cut out for repair without interference or interruption of the service to the rest of the Building. All water valves shall have a minimum working pressure of 125 psi, water rated unless otherwise noted on the Drawings or specified herein. All valves shall be of one manufacture. Provide valves with elevated pressure rating matched to service conditions where pressure exceeds 125 psi..
10. Drain valves shall be 3/4" heavy cast brass with composition washers with male thread for hose connections.
11. Provide at the high point of hot water piping system a 1/2" automatic IBBM air relief valve, 125 PSI, WOG Class. Pipe drain to spill over adjacent floor drain or service sink.
12. All valves on the exterior domestic and fire protection water piping shall comply with Local Water Company.
13. All valves shall have the trademark of the manufacturer and the guaranteed working pressure cast or stamped on the body of the valve. All globes, etc., shall be of one manufacturer and working pressure cast or stamped thereon.
14. The exterior valves shall conform to all applicable requirements of American Water Works Association C500-61 Standard for Gate Valves for Fire Water Work Service.
15. The entire plumbing systems shall be supplied with valves so located, arranged and operated as to give a complete regulating control to all fixtures and apparatus
16. Install check and globe valves on downstream side of the shutoff valve on hot water circulating riser and branch lines.
17. Valves, where exposed and used in connection with finished piping, shall be same finish as the pipe.
18. Provide shut-off valves and check valves on each pump discharge line.
19. All valves used on branch piping to bathroom and kitchens shall be all bronze type globe valves with discs suitable for service to which they are connected.
20. Install valves where required for proper operation of piping and equipment including valves in branch lines necessary to isolate sections of piping. Locate valves so as to be accessible.
21. Install valves with bodies of metal other than cast iron where thermal or mechanical shock is indicated or can be expected to occur.
22. Do not install bronze valves and valve components in direct contact with steel, unless bronze and steel are separated by dielectric insulator. Install bronze valves where corrosion is indicated or can be expected to occur.
23. Select and install valves with outside screw and yoke stems, except provide inside screw non-rising stem valves where headroom prevents full opening of OS&Y valves.
24. Except as otherwise indicated, install ball, globe, and butterfly valves to comply with ANSI B31.1. Where throttling is indicated or recognized as principal reason for valve, install globe valves.
25. Limit selection and installation of valves with non-metallic discs to locations indicated and where foreign material in piping system can be expected to prevent tight shutoff of metal seated valves.
26. Select and install valves with renewable seats, except where otherwise indicated.

B. All valves of a given type shall be of one manufacturer.

C. Provide extended stems on insulated system to prevent interference of operator with insulation.

D. Provide chain wheel operators for valves more than 7’ – 0” AFF in mechanical rooms and wherever shown on drawings.

E. If permitted, Grooved end valves shall be installed in accordance with the manufacturer's guidelines and recommendations. All grooved end valves shall be the products of a single manufacturer. Grooved end shall be clean and free from indentations and projections. A factory-trained field representative shall provide on-site training for contractor's field personnel in the installation of grooved piping products. Factory-trained representative shall periodically review the product installation. Contractor shall remove and replace any improperly installed products.

3.2 VALVE APPLICATION

Domestic Hot and Cold Water ½" – 2"	Ball Valve
Domestic Hot and Cold Water 2½ " – 10"	Butterfly Valve
Domestic Hot and Cold Water - 6" and larger	Butterfly Valve

3.3 CHECK VALVE INSTALLATION

A. Swing and Check Valves:

1. Install only in horizontal lines unless absolutely impractical. If installed vertically, flow shall be upwards.
2. Do not install in pump discharge piping.

B. Silent Check Valves:

1. Install in all pump discharge lines.
2. Silent check valves may be installed in vertical pipes with flow down upon Engineer's review for each instance.

C. Installation of Check Valves:

1. Wafer Check Valves: Install between 2 flanges in horizontal or vertical position.
2. Horizontal Lift Check Valve: Install in horizontal piping line with stem vertically upward.
3. Vertical Lift Check Valve: Install in vertical piping line with upward flow with stem vertically upward.
4. Air Compressor Lift Check Valve: Install in air compressor discharge line.
5. Spring Loaded Horizontal Lift Check Valve: Install in horizontal piping line with stem vertically upward.

3.4 BACKFLOW PREVENTOR

A. Provide backflow preventors as follows:

1. Reduced pressure at make-up for hydronic systems.
2. Vacuum breaker at all hose bibs.
3. Reduced pressure on domestic water entry.
4. Reduced pressure on irrigation systems.
5. Stainless steel reduced pressure on water lines to carbonated beverage dispensers, ice makers and other food service equipment.
6. Vacuum breaker at all mop sinks.
7. Double detector check at fire protection water service.

B. Provide reduced pressure type master backflow preventer on main domestic water supply and to each fixture and equipment requiring same as indicated on the Drawings and governed by the applicable codes. This shall include, but not be limited to, mechanical equipment, kitchen equipment and equipment specified in other divisions.

C. Provide drain opening and pipe to nearest floor drain or service sink.

3.5 CIRCUIT SETTERS

A. All circuit setters shall be installed per manufacturer's recommendations. Provide manufacturers recommendation for required straight pipe for inlet and outlet connections to provide accurate ratings. Setting shall be as required for proper balanced flow to equipment.

B. Provide circuit setters on all hot water return lines and any other lines requiring controlled flow.

END OF SECTION

SECTION 22 05 29

PLUMBING PIPE SUPPORTS AND ANCHORS

PART 1 - GENERAL

1.1 STANDARDS

A. Comply with MSS Standard Practice SP-58, SP-69 and SP-89, published by Manufacturer's Standardization Society of the Valve and Fitting Industry for type and size.

1.2 SUBMITTALS

A. Submit manufacturer's product data on the following:

1. Hangers other than clevis type.
2. Anchors.

B. Submit structural calculations for trapeze type supports.

PART 2 – PRODUCTS

2.1 PIPE HANGERS

A. General:

1. Use adjustable pipe hangers on suspended pipe. Trapeze hangers may be used at the Contractor's option. Contractor shall be responsible for sizing supports.
2. Chain, wire or perforated strap hangers will not be permitted.
3. Isolate hangers in contact with dissimilar materials with dielectric hanger liners. Tape is not acceptable.
4. Provide supports between piping and building structure where necessary to prevent swaying.

B. Hanger Rods:

1. Exposed in public areas: Zinc electroplated steel.
2. Concealed or in service areas: Black threaded steel.
3. Outside, exposed to weather: Hot dipped galvanized.

C. Spot Concrete Inserts: Steel case and expander plug for threaded connection with lateral adjustment, top slot for reinforcing rods and lugs for attaching to forms.

1. Size inserts to match size of threaded hanger rods.
2. Inserts to be UL and FM listed.
3. Minimum 1000 lb. Capacity with ½" rod.

D. Channel Type Inserts:

1. Standard channel support with anchor tabs on 4" centers, and nail holes for attaching to forms.
2. Styrofoam inserts to prevent wet concrete seepage.
3. Minimum 2000 pounds/foot capacity.

E. Expansion Anchors:

1. For use only in renovations or where modifications to piping layouts require installation away from pre-installed insert locations.
2. Inserts shall be of the drill, insert, expand type. Power driven fasteners are not acceptable for piping.
3. Contractor shall select the appropriate type based on the following:

Rod Size	Maximum Working Load
3/8	600 pounds
½	1100 pounds
5/8	1800 pounds
¾	2700 pounds

F. Steel Structure Attachments:

1. Contractor may select welded or mechanically attached. All mechanically attached supports shall have jam nuts or other means to prevent loosening. Maximum loading requirements are as follows:

Rod Size	Maximum Working Load
3/8	600 pounds
½	1100 pounds
5/8	1800 pounds
¾	2700 pounds

G. Single Hangers:

1. Piping 2" and smaller: MSS type 1, Clevis hanger or type 7 adjustable swivel ring hanger. Minimum 180 pounds design load.
2. Piping 2" and smaller (steel): Clevis hanger, Anvil Fig. No. 260, F & M Fig. No. 239, Paterson Fig. No. 100.
3. Piping 2" and smaller (copper): Adjustable wrought iron, Anvil Fig. No. CT-65, F & M Fig. No. 364, Paterson Fig. No. 100 CT
4. Piping 2½" and larger: MSS type 1 Clevis hanger.
5. Piping 2½" to 4" (steel): Adjustable swivel pipe roll, Anvil Fig. No. 181, F & M Fig. No. 2729, Paterson Fig. No., 16.
6. Piping 2½" to 4" (copper): Adjustable wrought ring, Anvil Fig. No. CT-69.
7. Piping 5" and above: Two rod roller hanger, Anvil Fig. No. 171, F & M Fig. No. 170, Paterson Fig. No., 142.
8. Bare copper pipe: Above hangers, plastic or Neoprene coating, sized for copper pipe O.D. and copper coated for identification.
9. Insulated pipe: Hangers to be sized for O.D. of insulation. Hangers shall not penetrate any insulation.
10. Cast iron pipe above hangers sized for O.D. of cast iron pipe.
11. Hanger wire, cable or perforated metal strapping are not acceptable.

H. Trapeze hangers and wall supports:

1. Channel strut or structural steel shapes. Contractor shall follow channel strut manufacturers guidelines for loading or provide structural steel supports designed by a professional Engineer, licensed in the state where the project is located.
2. All piping shall be attached to the support by means of a channel strut clamp, U-bolt, or pipe rollers which will maintain lateral position of the pipe but allow longitudinal movement. Provide dielectric isolation between all dissimilar metals.
3. All insulation shall be continuous at supports. Do not notch or penetrate insulation.
4. Kindorf or similar materials used for support of small piping shall not be used for piping 3" or larger.
5. ½" through 3": Unistrut type channel and steel clamp.
   a. Use Hydrosorb cushions on copper pipe.

6. 4" and Over: Welded steel bracket and wrought steel clamp.

I. Vertical Supports: Provide steel riser clamp at each floor penetration or every 14 foot supported from wall bracket. Do not anchor riser clamps. In exposed locations, coordinate clamp locations with Architect.

J. Hangers:

1. General: Adjustable wrought steel clevis with locking nut attachment.
2. Multiple or Trapeze: Steel channels with welded spacers and hanger rods.
3. Hanger Sizes and Spacing:
   a. For drain piping, conform to the code requirements for spacing, and the following table for hanger rod sizes.
   b. For plumbing piping, conform to the following table:

PIPE TYPE	PIPE SIZE	MAXIMUM HORIZONTAL SPACING	MAXIMUM VERTICAL SPACING	MINIMUM HANGER ROD SIZE
Steel Pipe	½"	6'-0"	At every story height	3/8"
	¾" thru 1¼"	8'-0"		3/8"
	1½" and 2"	10'-0"		3/8"
	2½" thru 3½"	12'-0"		1/2"
	4" and 5"	12'-0"		5/8"
	6"	12'-0"		3/4"
Copper or copper-alloy tubing	1¼" and smaller	6'-0"	At each story height no greater than 10'	3/8"
Copper or copper-alloy tubing	1½ " and larger	10'-0"	At each story height no greater than 10'	3/8"
Copper Pipe	½" thru 1"	8'-0"	At every story height no greater than 10'	3/8"
	1¼" thru 2"	10'-0"		3/8"
	2½" thru 3"	10'-0"		1/2"
	4"	10'-0"		5/8"
	6"	10'-0"		¾"
Cast Iron Soil	2"	5' And Each Joint	At base and at each story height no greater than 15'	3/8"
	3" to 5"	5' And Each Joint		½"
	6"	5' And Each Joint		5/8"
	8" to 12"	5' And Each Joint		¾"

K. Insulated Pipe Supports:

1. Size pipe supports for outside diameter of pipe insulation.
2. It is not acceptable to cut or notch insulation at support locations.

L. Pipes over five inches and over 120º: Provide cast iron roller supports.

M. Beam clamps - Hangers supported from floor steel shall be approved I beam clamps. I beam clamps for hangers supporting piping 2 inches and smaller shall be C & P Fig. No. 148 adjustable beam clamps. For piping 2-1/2 inches and larger, I beam clamps shall be wrought steel. C & P Fig. No. 268 or equal.

N. Hangers for copper piping shall be copper plated.

2.2 INSULATION INSERTS

A. Pipe shall be protected at the point of support by an insert of high density, 100 psi, waterproofed calcium silicate, or Hi-Low Temp insert, encased in a sheet metal shield. Insert to be same thickness as adjoining pipe insulation. Insulation insert to extend one inch beyond sheet metal shield on all “cold” lines. If pipe hanger spacing exceeds ten feet and for all pipe roller applications, utilize double layer shield on bearing surface.

B. Provide 180º insulation inserts when utilizing clevis hangers. Provide 360º insulation inserts at all trapeze and wall supports.

2.3 PIPE ANCHORS

A. Manufacturers:

1. Design Basis: Flexonics
2. Other Acceptable Manufacturers:
   a. Adsco
   b. Keflex
   c. Hilti

B. Model AC with threaded ends and welded angle brackets for steel pipe.

C. Model AC copper tube with solder ends and steel angle brackets brazed to tubing for copper tube.

D. Anchors may be field fabricated similar to manufactured products specified.

2.4 PIPE GUIDES

A. Manufacturers:

1. Basis of Design: B-line.
2. Other Acceptable Manufacturers:
   a. Fee & Mason
   b. Anvil
   c. M-Co
   d. PHD

B. Any of the Following:

1. Spider Type: B3281-7.
2. Roller Type: 2 sets of rollers on opposite sides of pipe.
3. Slide Type: B3893 with hold down lugs.
   a. Not for use with cold piping.
4. Light duty, 1½” and smaller copper: U bolt or channel strut clamp (B2417) allowing clearance from O.D. of pipe or insulation.

2.5 ROOF MOUNTED PIPING

A. Manufacturers:

1. Miro Industries, Inc.
2. Portable Pipe Hangers, Inc.
3. Approved Equivalent.

B. Description: Where roofs are not being replaced, piping on roof shall be supported by an engineered prefabricated portable pipe system specifically designed to be installed on the roof without roof penetrations, flashing or damage to the roofing material. The system shall consist of recycled rubber or plastic bases, hot dipped galvanized or stainless steel frame with threaded rods and suitable pipe hangers and supports. The system shall be custom designed to fit the piping and conduits to be installed and the actual conditions of service.

C. Piping on areas of roof being replaced shall be installed on pipe curbs bearing on roof structure and flashed into roofing material.

D. Provide seismic restraints as required for seismic zone.

PART 3 – EXECUTION

3.1 INSTALLATION OF PIPE SUPPORTS

A. Adequately support piping from the building structure with adjustable hangers to maintain uniform grading where required and to prevent sagging and pocketing.

1. Provide supports between piping and building structure where necessary to prevent swaying.
2. Do not support pipe from other pipe or equipment.
3. Provide thrust restraints at all changes in direction on 8" and larger cast iron piping with no hub or hub and spigot fittings.

B. Install hangers to provide minimum ½" clear space between finished covering and adjacent work.

1. Place a hanger within one foot of each horizontal elbow.
2. Space hangers generally as called for in Table in Part 2, Products.

C. Use hangers, which are vertically adjustable 1-½" minimum after piping is erected.

D. Use inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams wherever practicable.

1. Set inserts in position in advance of concrete work.
2. Where concrete slabs form finished ceiling, finish inserts flush with slab surface.
3. Do not penetrate concrete "TT" legs for piping inserts. Do not penetrate the stressed (i.e. lower) chords of any structural member.

E. Provisions for Movement: Install hangers and supports:

1. To allow controlled movement of piping systems.
2. To permit proper movement between pipe anchors.
3. To facilitate the action of expansion joints, expansion loops, bends and offsets.
4. To isolate force due to weight or expansion from equipment connections.

F. In general, attach hangers to upper chord of roof trusses and floor joists, using long rods to facilitate pipe movement.

G. Anchors:

1. Arrange piping such that pipe expansion and contraction is accommodated by controlled movement of the pipe within the pipe supports. Provide sufficient offsets in branch piping to accommodate movement of main piping due to expansion and contraction. Where this is not possible due to magnitude of expansion or building geometry, securely anchor piping where required for a proper installation and to force the pipe expansion in the proper direction.

2. Anchors shall be suitable for the location of installation and shall be designed to withstand not less than five times the anchor load.
3. Anchor vertical pipes by means of clamps welded around pipes and secured to wall or floor construction. Anchor at bottom of riser only but provide guides for vertical thermal movement.
4. All anchors shall be separate and independent of all hangers, guides, and supports. Anchors shall be of heavy blacksmith construction suitable in every way for the work approved by the Architect. Anchors shall be welded to the pipe and fastened to the structure with bolts.
5. Anchors shall be fabricated and assembled in such a form as to secure the piping in a fixed position. They shall permit the line to take up its expansion and contraction freely in opposite directions away from the anchored points: and shall be so arranged as to be structurally suitable for particular location, and line loading. Submit details for approval.

H. Assume the responsibility for the proper transfer of the loads to the piping systems to the structure. No additional cost to the owner should be expected for any corrective work during construction.

I. Provide necessary structural members, hangers, and supports of approved design to keep piping in proper alignment and prevent transmission of injurious thrusts and vibrations. In all cases where hangers, brackets, etc., are supported from metal decking and/or concrete construction, care shall be taken not to weaken decking and/or concrete or penetrate waterproofing. Hangers supporting piping expanding into loops, bends and offsets shall be secured to the building structure in such a manner that horizontal adjustment perpendicular to the run of piping supported may be made to accommodate displacement due to expansion. All such hangers shall be finally adjusted, both in the vertical and horizontal direction, when the supported piping is hot.

J. Provide supplemental bolted steel in all locations where drilling of slab will create unacceptable noise in adjacent spaces.

K. Where piping is run near the floor and not hung from the ceiling construction but is supported from the floor, such supports shall be of pipe standards with base flange and adjustable top yoke similar to C & P Fig. 247 or equal.

L. All vertical piping shall be anchored by means of heavy steel clamps securely bolted or welded to the piping, and with end extension bearing on the building.

M. Vertical runs of pipe not over 15 feet long shall be supported by hangers placed not over one foot from the elbows on the connecting horizontal runs.

N. Vertical runs of pipe over 15 feet long but not over 60 feet long and not over 6 inches in size, or not over 30 feet long and not over 12 inches in size, shall be supported on heavy steel clamps. Clamps shall be bolted tightly around the pipes and shall reset securely on the building structure without blocking. Clamps shall be welded to the pipes or placed below couplings. Clamps shall be type 8, Federal Specification WW-H-171C, unless other types are approved.

O. Piping in trenches shall hang from angle iron cross supports provided by the Contractor with two coatings of red lead primer and final coat of black asphaltum paint.

P. Hanger rods shall be attached to preset concrete inserts with steel reinforcing rod through the insert and both ends hooked over the reinforcing mesh. For pipes 4 inches and larger, rods shall extend through concrete slab above where they shall be attached to steel bearing plates 6" x 6" x 1/4".

Q. Piping shall not be hung from other piping, ducts, conduits or from equipment of other trades and no vertical expansion shields will be permitted. Hanger rods shall not pierce ducts.

R. All piping running on walls shall be supported by means of hanger suspended from heavy angle iron wall brackets. No wall hooks will be permitted.

END OF SECTION

SECTION 22 05 53

PLUMBING IDENTIFICATION

PART 1 - GENERAL

1.1 SUBMITTALS

A. Submit manufacturer's product data on the following:

1. Plastic Pipe Markers and method of application.
2. Engraved Plastic Laminate Sign.

PART 2 - PRODUCTS

2.1 GENERAL

A. Except as otherwise indicated, provide manufacturer's standard products.

B. Where more than a single type is specified for an application, selection is Installer's option, but provide a single selection for each application.

2.2 PLASTIC PIPE MARKERS (TYPE A)

A. Provide manufacturer's standard pre-printed, flexible or semi-rigid, permanent, color-coded, plastic-sheet pipe markers, complying with ANSI A13.1.

B. For Pipes Less Than Six Inches (including insulation if any): Provide full-band pipe markers, extending 360º around pipe at each location, fastened by one of the following methods:

1. Snap-on application of pre-tensioned semi-rigid plastic pipe marker.
2. Adhesive lap joint in pipe marker overlap.
3. Taped to pipe (or insulation) with color-coded plastic adhesive tape, not less than ¾" wide; full circle at both ends of pipe marker, tape lapped 1-½".

C. For Pipes Six Inches and Larger (including insulation if any): Provide either full-band or strip-type markers, but not narrower than 3 x letter height, taped to pipe (or insulation) with color-coded plastic adhesive tape, not less than 1-½" wide; full circle at both ends of pipe marker, tape lapped 3".

D. Lettering: Manufacturer's pre-printed wording which conforms to contract document system descriptions.

E. Where work is an extension or alteration of an existing system, new markers shall match existing terminology for systems which are modified or added by this work.

F. Arrows: Print each pipe marker with arrows indicating direction of flow, either integrally with piping system service lettering or as a separate unit of plastic (to accommodate both directions).

2.3 STENCILING (TYPE B)

A. Using a color contrasting to the surface to identify, spray or brush paint through neatly cut stencils.

B. Lettering shall conform to wording on contract documents. Size shall be in accordance with ANSI A13.1.

2.4 BACKGROUND COLOR AND STENCILING (TYPE C)

A. In addition to the requirements above, paint a background color band in accordance with ANSI A13.1.

2.5 VALVES TAGS

A. Brass Valve Tags: Provide manufacturer's standard 19 ga brass tag; approximately 1-½" round wit ½" high black filled numbers and 3/16" top hole.

1. Numbers shall be sequential in accordance with schedule below.
2. Provide separate numbering for each legend sequence. Provide separate sequences for the following:
   a. Plumbing (PLBG)
   b. Domestic Cold Water (DCW)
   c. Domestic Hot Water (DHW)
   d. Domestic Hot Water Return (DHWC)
   e. All other systems (No legend)

B. Valve Tag Fasteners: Manufacturer's standard chain (wire link or beaded type), or S-hooks.

2.6 VALVE SCHEDULE

A. Provide schedule for each piping system, as defined on the drawings, and below, typewritten and reproduced on 8-½" x 11" bond paper.

B. Tabulate valve number, piping system, system legend (as shown on tag), location of valve (room or space), and variations for identification (if any).

C. Provide piping schematic for each system as defined below in Part 3.

D. In addition to mounted copies, furnish extra copies for maintenance manuals as specified.

E. Valve Schedule Frames: For each page of the valve schedule, provide a glazed frame, with screws for removable mounting on masonry walls.

2.7 ENGRAVED PLASTIC-LAMINATE SIGNS

A. General: Provide engraving stock melamine plastic laminate, 1/16" thick, black with white core (letter color).

B. Fastening:
1. Screws
2. Rivets
3. Permanent Adhesive

C. Lettering and Graphics:

1. Coordinate names, abbreviations and other designations used in the mechanical identification work, with the corresponding designations shown, specified or scheduled in the construction documents.

PART 3 - EXECUTION

3.1 GENERAL

A. Where identification is to be applied to surfaces which require insulation, painting or other covering or finish, install identification after completion of covering and painting.

B. Install identification prior to installation of acoustical ceilings and similar removable concealment.

3.2 PIPING SYSTEM IDENTIFICATION

A. General: Install pipe markers on piping of the following systems and include arrows to show normal direction of flow.

1. Domestic water piping (hot, cold, tempered; 120º hot, 140º hot, hot water re-circulating, etc.).
2. Plumbing vent and sanitary (above grade) piping.
3. Storm piping.

B. Locate pipe markers and color bands as follows wherever piping is exposed to view in occupied spaces above accessible ceilings, in accessible maintenance spaces, including chases, and above ceiling:

1. Near each valve and control device.
2. Near each branch, excluding short take-offs for fixtures and terminal units. Mark each pipe at branch, where there could be a question of flow pattern.
3. Near locations where pipes pass through walls, floors, or ceilings, or enter non-accessible enclosures.
4. Near major equipment items and other points of origination and termination.
5. Spaced intermediately at maximum spacing of 25’ along each piping run.
6. Within 6’ of access doors above otherwise non-accessible ceilings and chases.

C. Type:

1. Normally exposed to view - Type A or C.
2. Normally concealed from view - Type B.

3.3 VALVE IDENTIFICATION

A. Provide valve tag on every valve, cock and control device in each piping system; exclude check valves, valves within factory fabricated equipment units, plumbing fixtures faucets, hose bibs, and shut-off valves at plumbing fixtures, and similar rough-in connections of end-use fixtures and units. List each tagged valve in valve schedule for each piping system.

1. Shut off valves located at least 10’ from fixture(s) shall be provided with valve tag unless otherwise directed by Engineer.

B. Mount framed valve schedules with piping schematics where directed by Architect.

C. Identify each valve tagged on as-built drawings.

3.4 NON-POTABLE WATER IDENTIFICATION

A. Provide an engraved plastic laminate sign.

1. Legend: “Non-Potable Water”.
2. Location: At each outlet of piping between backflow preventer and equipment served. (e.g. Boiler Room hose bibb).

END OF SECTION

SECTION 22 05 93

TEST-ADJUST-BALANCE

PART 1 - GENERAL

1.1 RESPONSIBILITY

A. A work of this section shall be completed by a sub-contractor of the Plumbing contractor.

B. The Balancing Contractor shall not be a sub-contractor of any other Division 21, 22 or 23 Contractor.

1.2 QUALITY ASSURANCE

A. Qualification:

1. The firm shall be an independent testing and balancing firm specializing in testing and balancing of environmental systems.
2. The firm shall have an experience record of not less than five (5) years experience in the testing and balancing industry.

B. Registration: Work shall be done under the supervision of a professional engineer registered in the jurisdiction of the work. Engineer shall be available for all meetings and interpretation of all materials in the report.

C. Pre-qualification of Testing and Balancing Contractor.

1. The firm must have experience and qualifications satisfactory to the consulting mechanical engineer and must be accepted by him prior to bidding.
2. Firms desiring approval to provide work under this section shall submit a booklet indicating procedures and data forms that they would use in the performance of the work.
3. Only firms which have been approved by the engineer may provide work under this section.

PART 2 – PRODUCTS (NOT APPLICABLE)

PART 3 - EXECUTION

3.1 GENERAL

A. Sequence work to commence after completion of system and start-up procedures and schedule completion of work before Substantial Completion of Project.

B. Examine the installed work and conditions under which testing is to be done to ensure that work has been completed, cleaned and is operable.

C. Notify the Contractor in writing of conditions detrimental to the proper completion of the test-adjust-balance work.

1. Do not proceed with the work until unsatisfactory conditions have been corrected.
2. Provide Engineer/Architect with a copy of the notification.

D. Adjust flows to within 10% of values shown. If design flows cannot be obtained within specified limits the Balancing Contractor will perform the following (at the minimum):

1. Measure and record major pressure drops in the system.
2. Consult with the Engineer and Installer as required.
3. Upon receiving written directions to proceed and after any corrections are performed, re-balance affected portion of system.

E. Optimization: Work closely with the plumbing contractor to optimize setpoints.

1. Establish the minimum water differential pressure for variable or bypass flow system.
2. Establish the position of valve and sequencing relays.
3. Confirm suitable operation of all backflow prevention devices.
4. Confirm proper operation of hot water return system.
5. Confirm proper flow through all heat exchangers.

F. Patch holes in insulation and housings which have been cut or drilled for test purposes, in a manner recommended by the original Installer.

G. Make all final readings for each system at the same time, and after all adjustments have been made.

H. Mark equipment settings, including control positions, balancing cocks, circuit setters, valve indicators, to show final settings at completion of test-adjust-balance work.

1. Mark with paint or other suitable permanent identification material.

I. Check all new thermal overloads.

1. Identify improperly protected equipment in report.

J. All piping and equipment shall be tested; labor including standby electrician, materials, instruments and power required for testing shall be furnished unless otherwise indicated under the particular section of the Specification.

K. Tests shall be performed in the presence and to the satisfaction of the Architect and such other parties as may have legal jurisdiction.

L. In no case shall piping, equipment, or accessories be subjected to pressure exceeding their ratings.

M. All defective work shall be promptly repaired or replaced and the tests shall be repeated until the particular system and component parts thereof receive the approval of the Architects.

N. Any damage resulting from tests to any and all trades shall be repaired and damaged materials replaced, all to the satisfaction of the Architect.

O. The duration of tests shall be as determined by all authorities having jurisdiction, but in no case less than the time prescribed below.

P. Equipment and systems which normally operate during certain seasons of the year shall be tested during the appropriate season. Tests shall be performed on individual equipment, systems, and their controls. Whenever the equipment or system under test is interrelated and depends upon the operation of other equipment, systems and controls for proper operation, functioning and performance, and latter shall be operated simultaneously with the equipment or system being tested.

Q. All pumps and piping systems shall be completely balanced by the adjustment of the plug cocks, globe valves or other control devices, to obtain the flow quantities indicated on the design drawings.

3.2 DOMESTIC WATER SYSTEMS

A. Before any adjustments are made:

1. Check temperature control valve operation.
2. Check pump rotation.
3. Adjust pressure reducing valve.
4. Remove any roughing strainer screens in systems.

B. Procedure:

1. Measure and report all domestic water recirculation systems by all of the below means which are applicable.
   a. System, pump, branch, or terminal flow measuring stations.
   b. Terminal or heat exchanger pressure drop, compare to submittal data.
   c. Plot operating point on system graph.

3.3 DETAILED REQUIREMENTS

A. Measure, adjust and report the following:

1. Pumps (including ejectors and sump pumps):
   a. Water flow
   b. Inlet and outlet pressure
   c. Motor amps and KW
2. Heat Exchangers:
   a. Cooler fluid inlet and outlet temperatures
   b. Cooler fluid flow
   c. Warmer fluid inlet and outlet temperatures
   d. Warmer fluid flow

3.4 REPORT

A. Provide a general information sheet listing:

1. Instruments used:
   a. Most recent calibration date.
2. Method of balancing.
3. Altitude correction.
4. Manufacturer’s performance data for all air devices used.

B. Provide data sheets for all equipment, including motors and drives, listing:

1. Make
2. Size
3. Serial number
4. Capacity Rating
5. Amperage
6. Voltage input
7. Thermal heater size for each motor
8. Operating speed of driver and driven devices
9. Any additional pertinent performance data

C. Include design and final values for all items listed in Detailed Requirements, and totals for each system.

D. Provide data sheets showing:

1. Instrument used
2. Velocity reading
3. Manufacturer's free area factors

E. Provide recap sheet with explanation for each device not meeting specified performance.

F. Provide a set of prints with equipment, inlets and outlets marked to correspond to data sheets.

3.5 COMMISSIONING

A. Provide all necessary personnel, tools and equipment to comply with the commissioning scope.

END OF SECTION

SECTION 22 07 00

PLUMBING INSULATION

PART 1 - GENERAL

1.1 SUBMITTALS

A. Submit manufacturer's product data on the following:

1. Insulation.
2. Jackets, coatings and protective finishes.
3. Sealers, mastics and adhesives.
4. Fitting covers.

1.2 FLAME AND SMOKE RATINGS

A. Provide insulation tested on a composite basis (insulation, jacket, covering, sealer, mastic and adhesive) complying with the following for:

1. Flame Spread: 25 or Less
2. Smoke Developed: 50 or Less
3. Method: ASTM E84 (NFPA 255), UL 723

B. Accessories such as adhesives, mastics, cements, tapes and cloths for fittings shall have component ratings as listed above. All products shall bear UL labels indicating the above are not exceeded.

1.3 PRODUCT DELIVERY

A. Deliver insulation products in factory containers bearing manufacturer's label showing fire and smoke hazard rating, density and thickness.

B. Protect insulation against, dirt, water, chemical and mechanical damage. Do not install damaged insulation; remove from project site.

C. Store insulation in original wrappings and protect from weather and construction traffic.

1.4 DEFINITIONS

A. Exposed Location: Located in mechanical rooms or other areas exposed to view.

B. Concealed Location: Located in pipe chases, furred spaces, attics, crawl-spaces, above suspended ceilings, or other locations not exposed to view.

1.5 STANDARDS

A. Comply with the latest edition of National Commercial and Industrial Insulation Standards.

B. Provide certifications or other data as necessary to show compliance with these Specifications and governing regulations. Include proof of compliance for test of products for fire rating, corrosiveness, and compressive strength.

PART 2 - PRODUCTS

2.1 PIPE INSULATION

A. Manufacturers:

1. Design Basis: Johns-Manville
2. Other Acceptable Manufacturers:
   a. Armacell
   b. Foster
   c. Owens-Corning
   d. Knauf
   e. KFlex USA
   f. Imcoa
   g. Pittsburgh Corning

B. Materials:

1. Fiberglass Pipe Insulation with Vapor Barrier: Johns-Manville Micro-Lok heavy density pipe insulation with AP-T jacket or Owens-Corning Fiberglass Corp. ASJ/SSL-11.
2. Fiberglass Pipe Fitting Insulation: Johns-Manville “Zeston” fitting covers with factory-cut fiberglass insulation insert. Insulation blanket with foil tape and tie wire will not be accepted.
3. Flexible Unicellular Pipe Insulation: Armstrong Armaflex, II or Therma-cel By Nomaco.
4. Cellular glass with vapor barrier coating: Pittsburgh Corning.
5. Rigid Closed Cell Insulation: ITW Insulation Trymer 2000 XP(not for use indoors).
6. Vapor Barrier Mastic: Foster 30-65 or Childers CP-34; permeance shall be 0.03 perms or less per ASTM E96. Mastic must meet California Dept. of Public Health (CDPH) Standard Method Ver. 1.1,2010 Small Scale Environmental Chamber Test for VOCs. for CA Specification 01350 and LEED IEQ 4.2.
7. Weather Barrier Mastic: Foster 46-50 or Childers CP-10/11. For use on hot service pipe.
8. Lagging Adhesive: Foster 30-36 or Childers CP-50AMV1.
9. Fiberglass Adhesive: Foster 85-60 or Childers CP-127.

C. Thickness: (Thickness listed below are minimum required. Provide thickness required by Local Building or Energy Codes).

1. Service (Domestic) Water Piping:
   a. Hot:
      1) 1½ ” and Smaller: 1½ ”
      2) 2” and Larger: 2”:
      3) Non Recirulated Runouts up to 2” and 8 feet long: ½"
   b. Cold: 1½”
2. Storm Water:
   a. All Sizes: 1”
3. Solar Collector Supply and Return Piping:
   a. Inside House: 1½”
   b. Below Grade: 1½”
   c. All Other: 2”
4. All Heat Traced Piping:
   a. Size 2” and smaller: 1½”
   b. Size 2½” and larger: 2”

D. Application: Unless otherwise indicated, use the following:

1. Inside, concealed: Fiberglass with a maximum K factor of 0.22 BTU/inch per sq. ft. per degree F. per hour at 75˚F. mean temperature with factory-applied all service vapor proof jacket. Density shall be not less than 3 lbs. per cubic foot. For hot pipe insulation, insulation shall be suitable for 250˚F.
2. Inside, exposed: Fiberglass pipe insulation with vapor barrier and PVC jacket (jacket not required in mechanical rooms).
    a. A vapor barrier mastic compatible with the PVC shall be applied around the edges of the adjoining pipe insulation and on the fitting cover throat overlap seam. The PVC fitting cover is then applied and shall be secured with pressure sensitive pearl gray Z-Tape along the circumferential edges. The tape shall extend over the adjacent pipe insulation and have an overlap on itself at least 2" on the downward side.
    b. 2 or more layers of the Hi-Lo Temp insulation inserts shall be applied with the first layer being secured with a few wrappings of fiberglass yarn.
    c. Qualifications for Using Insulation: Use one Hi-Lo Temp insert for each additional 1" of pipe insulation.
    d. Fitting Cover: the temperature of the PVC fitting cover must be kept below 150˚F by the use of proper thickness of insulation and by keeping the PVC cover away from contact with, or exposure to, sources of direct or radiant heat.
3. Outside, protected: Fiberglass pipe insulation with vapor barrier and aluminum jacket.
4. Outside, exposed to weather: Rigid closed cell pipe insulation with aluminum jacket.
5. Below grade or slab:
    a. Pipe size 1½” and less: Single piece of flexible closed cell insulation slipped over soft annealed copper tube without slitting insulation.
    b. Pipe size 2” and larger: Pre-Insulated System (Perma-Pipe, or equal) with rigid closed cell insulation and shrink fit jacket.
6. PVC: 1½” thick fiberglass (duct) insulation, or 1” heavy density pipe insulation installation to meet ASTM E84 (NFPA 255) flame spread and smoke developed ratings.
7. All fittings, valves and flanges for pipe sizes 4" and larger shall be insulated with fabricated mitered segments of pipe insulation of same thickness as the adjoining pipe insulation, secured with no. 20 gauge galvanized annealed steel wire and covered with Zeston 2000 molded PVC fitting covers as manufactured by Manville or equal.
8. Direct contact between pipe and hangers will not be accepted. Hangers shall pass outside of a metal saddle which shall cover a section of high density insulation of sufficient length to support pipe without crushing insulation. Hangers shall not pierce insulation and all vapor barriers shall be unbroken and continuous. High density insulation shall be one of the following:
    a. Foam glass.
    b. Fiberglass, high density, minimum of 7 lb. material or heavier.
    c. High density calcium silicate insulation.
9. Provide vapor barrier dams at locations and intervals recommended by the insulation manufacturer, maximum 20’ spacing.

2.2 EQUIPMENT INSULATION

A. Manufacturer:

1. Design Basis: Johns Mansville
2. Other Acceptable Manufacturers:
    a. Armstrong
    b. Certainteed
    c. Owens-Corning
    d. Knauf
    e. Pittsburgh Corning

B. Materials:

1. Insulation: 3" thick flexible board type insulation. 3 PCF glass fiber insulation with all purpose jacketing. Maximum thermal conductivity .27 BTU-IN/(hr-FT^2-ºF) at 150ºF. Glass fibers oriented such that insulation will conform to rounded shapes while maintaining high compressive strength.
2. Jacketing Material: PVC or aluminum jacketing material, except as otherwise indicated. Seal all joints.
3. Fiberglass: Johns-Manville Micro-Lok 850 insulation with APT jacket.
4. Flexible Unicellular Insulation: Armstrong Armacell sheet form.

C. Application:

1. Equipment Insulation Accessories: Provide staples, bands, wire, wire netting, tape, corner angles, anchors, stud pins, metal covers, adhesives, cements, sealers, mastics and protective finishes as recommended by insulation manufacturer for applications indicated.

PART 3 - EXECUTION

3.1 GENERAL

A. Verify acceptability of all materials which are to be used in air plenums (above ceiling, etc.). Materials must meet all requirements of Local Building Code and Authority having jurisdiction.

B. Insulation Packing:

1. Piping:
   a. Wherever piping penetrates walls, partitions, floor slabs, etc., the space between the piping and the sleeve shall be packed with mineral wool and sealed with approved type non-hardening caulking compound for sleeves through exterior walls.
2. Material:
   a. Packing material shall be rockwool insulation as manufactured by United Stated Gypsum Co. or equal and shall comply with Fed. Spec. HH-1-558, Form A, Class 4, K=0.24, melting point 2000˚F.

C. All Lines That Are Electrically Traced

1. The basic insulation shall be dual temperature, Manville Micro-Lok piping insulation, 1½" thick. The insulation shall be sized to accommodate the electric heat tracing applied against the pipe surface.
2. Finish for insulation shall be .02 aluminum.

D. Contractor shall examine location where this insulation is to be installed and determine space conditions and notify the Architect in writing of conditions detrimental to proper and timely completion of the Work.

E. Do not proceed with the Work until unsatisfactory conditions have been corrected.

3.2 GENERAL INSTALLATION

A. Install insulation in accordance with manufacturer's written instructions, and with recognized industry practices, to ensure that insulation complies with requirements and serves intended purposes.

B. Coordinate with other work as necessary to interface installation of insulation with other components of systems.

C. All insulating materials shall be applied only by experienced workmen, in accordance with the best covering practice. All piping equipment shall be blown out, cleaned, tested and painted prior to the application of any covering. Adhesives, sealers and mastics shall not be applied, when the ambient temperature is below 40˚F, or surfaces are wet.

3.3 PIPE INSULATION

A. Insulate the following:

1. Domestic hot water piping.
2. Domestic cold water piping above ground and under slab.
3. Roof drain bodies and all horizontal storm water piping.
4. Solar energy system piping.
5. All existing piping which is currently insulated and which is modified as a result of this work.
6. Crotons
7. Heat traced piping.
8. All storm piping in areas provided with humidification control.

B. Installation:

1. Install insulation on pipe system subsequent to testing and acceptance of tests.
2. Install insulation materials with smooth and even surfaces. Insulate each continuous run of piping with full length units of insulation, with a single cut piece to complete the run. Do not use cut pieces or scraps abutting each other.
3. Clean and dry pipe surfaces prior to insulating. Butt insulation joints firmly together to ensure a complete and tight fit over surfaces to be covered.
4. Extend piping insulation without interruption through pipe clamps, hangers, walls, floors and similar piping penetrations, except where otherwise indicated.
5. Install protective metal shields and saddles where needed to prevent compression of insulation.
6. Except as noted, cover valves, flanges, fittings and similar items in each piping system with equivalent thickness and composition of insulation as applied to adjoining pipe run.
   a. Install factory-molded, pre-cut or job-fabricated units (at Installer's option), except where a specific form or type is indicated.
   b. Do not cover:
      1) Valve operators. Provide extended valve stems as required to maintain continuous insulation and vapor barrier.
      2) Nameplates or identification tags.
   c. Provide removable access for:
      1) Strainers.
      2) Other components requiring access for service.
7. Mark location of unions and flanges covered by insulation with permanent paint or ink, or approved label.
8. Maintain integrity of vapor-barrier jackets on insulation of cold pipes and storm drainage piping, and protect to prevent puncture or other damage. Insulation on cold surfaces where vapor barrier jackets are used shall be applied with a continuous, unbroken vapor seal. Hangers, supports, anchors, etc., that are secured directly to cold services shall be adequately insulated and vapor sealed to prevent condensation.
9. Inserts shall be installed at hangers for insulated piping. Inserts between the pipe and pipe hangers shall consist of rigid pipe insulation of equal thickness to the adjoining insulation and shall be provided with vapor barrier where required. Insulation inserts shall not be less than the following lengths:

2-1/2" pipe size and smaller	6" long – 18 GA
3" to 6" pipe size	9" long – 16 GA
8" to 10" pipe size	12" long – 12 GA

10. Provide 18 gauge galvanized metal shields between hangers or supports and pipe insulation. Form shields to fit insulation. Extend shields up to centerline of pipe. Make shields same length as that specified above for inserts.
11. Where insulation is specified for piping, insulate similarly all connections, vents, drains, and any piping connected to system.
12. Fill surface imperfections such as chipped edges, small joints or cracks and voids or holes with insulation material and smooth all such areas with a skim coat of insulating cement.

13. Seal ends of sections with Foster 30-65 or Childers CP-34 vapor barrier mastic and reinforcing mesh to crate moisture dams at:
    a. 20 ft. intervals.
    b. Valves and fittings.
    c. All hangers and supports.
14. On underground pipe insulation, install unicellular insulation on pipe without slitting insulation. Seal all transverse joints with adhesive.
15. Replace existing insulation removed or damaged because of work of this project.
16. Insulate new pipes and replace insulation on existing pipes to remain where insulation was removed or damaged by demolition or revisions.
17. Insulate between fingers of spiders in alignment guides.
18. Insulate between pipe and pipe slide.
19. All domestic water piping installed within piping chases behind fixtures (“crotons”) must be fully insulated to the back of the wall behind the fixture.
20. All equipment shall be insulated, including circulator pumps, circuit setters, strainers, etc. Provide valve and trim extensions as required to maintain the minimum insulation thickness.
21. Perform all work in a neat and workmanlike manner. Poor work (as determined by Architect or Engineer) will be cause for rejection.
22. Specialties shall be insulated to match those of the systems to which they are connected.
23. No insulation shall be installed until the piping systems have been hydrostatically tested as specified elsewhere to the satisfaction of the Engineer.

3.4 OUTDOOR PIPE INSULATION

A. Install insulation with butt joints of half pipe sections staggered. Insulation shall be held in place with strapping tape. Install aluminum jacket with all joints lapped to shed water. Apply a bead Foster 95-44 or Childers CP-76 metal jacketing sealant at all transverse and longitudinal seams. Secure with aluminum bands, minimum of 2 per jacket section.

3.5 EQUIPMENT INSULATION

A. Install insulation materials with smooth and even surfaces and on clean and dry surfaces, after inspection and release for insulation application.

1. Re-do poorly fitted joints.
2. Do not use mastic or joint sealer as filler for gaping joints and excessive voids resulting from poor workmanship.

B. Maintain integrity of vapor-barrier on equipment insulation and protect it to prevent puncture and other damage.

C. Apply insulation using the staggered joint method for both single and double layer construction, where feasible. Apply each layer of insulation separately.

D. Do not insulate handholes, cleanouts, ASME stamp and manufacturer’s nameplate.
Provide neatly beveled edge at interruptions of insulation.

E. Do not apply insulation to equipment above 125° F.

F. Heat Exchanger + Converters

1. Cover top and both sides of exchanger with 24 gauge galvanized steel panels with 1” flexible unicellular insulation cemented to the inside of the panels.
2. Panels shall be easily removable and easy to re-install.
3. Adhere flexible unicellular insulation to end plates with Armstrong No. 520 adhesive.
4. Insulate with 2" thick fiberglass, 3# density U.L. Labeled insulation and hexagonal mesh wire screen finished with glass jacket adhered and coated with two coats of Foster 30-36 or Childers CP-50AMV1 lagging

adhesive. Flanges shall be treated as specified under Hot Pipe Insulation.

G. Domestic Water Tanks:
1. Insulate domestic water tanks (hot and cold) with 2 inches of pipe and tank insulation of 1½ inches of rigid fiber glass board (if not originally insulated from the factory).

H. Cold Equipment (At or below ambient equipment):
1. Includes plumbing system equipment such as expansion tanks, vessels, filters, etc.
2. Insulate cold equipment with 2 inches of pipe and tank insulation or 2 inches of rigid fiberglass board.
3. Vapor barrier to be provided on cold equipment insulation.
4. The Contractor shall have the option of using 2" thick fiberglass Bend-A-Board insulation with .016" thick aluminum jacket with lock seams at longitudinal seams and ½" aluminum bands 12" on center at traverse joints. Joints and jacket shall provide complete protection for the insulation.

3.6 PROTECTION AND REPLACEMENT

A. Replace damaged insulation which cannot be repaired satisfactorily, including any damage to continuous vapor barrier or damage due to moisture saturation. The insulation installer shall advise the Contractor of required protection for the insulation work during the remainder of the construction period, to avoid damage and deterioration.

END OF SECTION

SECTION 22 08 00

PLUMBING SYSTEM COMMISSIONING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes: The Work of this Section shall include but not be limited to the following:

1. Systems and equipment Start-Up and Functional Performance Testing.
2. Validation of proper and thorough installation of Division 22 systems and equipment.
3. Generic Start-Up Documentation for mechanical systems and equipment.
4. Development of final Start-Up Documentation for mechanical systems and equipment.
5. System Start-Up and Turn-Over procedures.
6. Systems balancing verification.
7. Coordination and execution of Training Events.

B. Related Sections

1. The Cx process references many related Sections, particularly Section 01 91 00 - General Commissioning. It is important for all Contractors subject to the Cx process to be familiar with Section 01 91 00.
2. Refer to Section 01 91 00 for a complete list of Sections on Related Work.

1.3 GENERAL DESCRIPTION

A. Commissioning (Cx) is the process of ensuring that (i) all building systems are installed and perform interactively according to the design intent; (ii) that systems are efficient and cost effective and meet the Owner's operational needs; (iii) that the installation is accurately documented; and (iv) that the Operators are adequately trained. Commissioning serves as a tool to minimize post-occupancy operational problems, and establishes testing and communication protocols to advance the building systems from installation to optimized, fully-dynamic operation.

B. Commissioning Authority (CxA) shall work with the Contractor and the design engineers to direct and oversee the Cx process and perform Functional Performance Testing.

C. The Commissioning Plan outlines the Cx process beyond the Construction Contract, including design phase activities and design team/owner responsibilities. The specification Sections dictate all requirements of the commissioning process relative to the construction contract. The Cx Plan is not part of the construction contract, although it is available for reference at the request of the Contractor.

D. This Section outlines the Cx procedures specific to the Division 22 Contractors. Requirements common to all Sections are specified in Section 01 91 00 and Section 01 91 10 This Section and other sections of the specification details the Contractor's responsibilities relative to the Cx process.

1.4 SCOPE

A. The following are included in the Scope of Commissioning on this project:

B. Plumbing Systems

1. Domestic hot water

1.5 DEFINITIONS AND ABBREVIATIONS

A. Refer to Section 01 91 00 for a complete list of Definitions and Abbreviations.

1.6 REFERENCE STANDARDS

A. Refer to Section 01 91 00 for a complete list of Reference Standards.

1.7 DOCUMENTATION

A. In addition to the documentation required in Section 01 91 00, Contractor shall provide to the CxA the following per the procedures specified herein, in the Cx Plan, and in other Sections of the specification:

1. Factory Test Reports: Contractor shall provide any factory testing documentation or certified test reports required by the specifications. These shall be provided prior to Acceptance Phase. Factory Test Reports should be provided in PDF electronic format. These may include but are not limited to:

a. Pump Capacity

2. Field Testing Agency Reports (other than TAB): Provide all documentation of work of independent testing agencies required by the specification. These shall be provided prior to Acceptance Phase. Field Testing Agency Reports should be provided in PDF electronic format. These may include but are not limited to:

a. Pipe Pressure Testing
b. Gas Cross-Contamination
c. Potable Water Disinfection

1.8 SEQUENCING AND SCHEDULING

A. Refer Section 01 91 00.

1.9 COORDINATION MANAGEMENT PROTOCOLS

A. Coordination responsibilities and management protocols relative to Cx are initially defined in Section 01 91 00 and the Commissioning Plan, but shall be refined and documented in the Construction Phase Cx Kick-Off meeting. Contractor shall have input in the protocols and all Parties will commit to scheduling obligations. The CxA will record and distribute.

1.10 CONTRACTOR RESPONSIBILITIES

A. Refer to Section 01 91 00: Detailed Contractor responsibilities common to all Divisions are specified in Section 01 91 00. The following are additional responsibilities or notable responsibilities specific to Division 22.

B. Construction Phase

1. Provide skilled technicians qualified to perform the work required.
2. Provide factory-trained and authorized technicians where required by the Contract Documents.
3. Prepare and submit required draft Start-Up Documentation and submit along with the manufacturer's application, installation and start-up information.
4. Provide assistance to the CxA in preparation of the specific Functional Performance Test (FPT) procedures. Contractors, subcontractors and vendors shall review FPT procedures to ensure feasibility, safety and equipment protection and provide necessary written alarm limits to be used during the tests. Damage caused to equipment performed in accordance with the approved procedures will be the responsibility of the Contractor.

5. Thoroughly complete and inspect installation of systems and equipment as detailed throughout Contract Documents, as required by reference or industry standards, and as specifically indicated elsewhere this Section.
6. Start-Up, test/adjust/balance, and Turn-Over systems and equipment prior to functional performance testing by the CxA. Approved Start-Up Documentation shall be in accordance with Contract Documents, reference or industry standards, and specifically in Part I of this Section.
7. Record Start-Up on approved Start-Up Documentation forms and certify that the systems and equipment have been started and or tested in accordance with the requirements specified above and in Section 01 09 00. Each task or item shall be indicated with the Party actually performing the task or procedure.

C. Acceptance Phase

1. Assist CxA in functional performance testing. Assistance will generally include the following:

a. Manipulate systems and equipment to facilitate Functional Performance Testing (as specified in Section 01 91 00 and Section 01 91 10; in some cases this will entail only an initial sample);

b. Provide any specialized instrumentation necessary for Functional Performance Testing;

D. Warranty Phase

1. Maintain record documentation of any configurations, set ups, parameters etc, that change throughout the period.
2. Provide representative for off season testing as required by CxA.
3. Respond to Warranty issues as required by Division 1 and the General Conditions.

1.11 EQUIPMENT SUPPLIER RESPONSIBILITIES

A. Refer to Section 01 91 00.

1.12 CONTRACTOR NOTIFICATION AND SCHEDULING

A. Refer to Section 01 91 00.

1.13 START-UP DOCUMENTATION

A. Refer to Section 01 91 00.

1.14 EQUIPMENT NAMEPLATE DATA

A. Refer to Section 01 91 00.

1.15 FUNCTIONAL PERFORMANCE TESTING

A. Contractor shall participate in the initial samples of Functional Performance Testing as stipulated in Section 01 91 00 and Section 01 91 10.

1.16 FPT ACCEPTANCE CRITERIA

A. Acceptance criteria for tests are indicated in Section 01 91 10 and in the specification Sections applicable to the systems being tested. Generally, unless indicated otherwise, the criteria for acceptance will be that specified with the individual system, equipment, component, or device.

1.17 TRAINING

A. Contractors, Subcontractor, Vendors, and other applicable Parties shall prepare and conduct training sessions on the installed systems and equipment they are responsible for per the requirements of Section 01 91 00 and the individual Specifications.

1.18 SYSTEMS MANUAL AND O&M DOCUMENTATION CONTENT - PREPARATION AND LOGISTICS

A. Refer to Section 01 91 00 the individual Specifications.

PART 2 - PRODUCTS

2.1 INSTRUMENTATION

A. General: All testing equipment used by any Party shall be of sufficient quality and accuracy to test and/or measure system performance with the tolerances specified. If not otherwise noted, the following minimum requirements apply:

B. Temperature sensors and digital thermometers shall have a certified calibration within the past year and a resolution of + or - 0.1°F.

C. Pressure sensors shall have an accuracy of + or - 2.0% of the value range being measured (not full range of meter) and have been calibrated within the last year.

D. All equipment shall be calibrated according to the manufacturer's recommended intervals. Calibration tags shall be affixed or certificates readily available.

E. Standard Testing Instrumentation: Standard instrumentation used for testing air and water flows, temperatures, humidity, noise levels, amperage, voltage, and pressure differential in air and water systems shall be provided by CxA.

F. Special Tools: Special equipment, tools and instruments (only available from vendor, specific to a piece of equipment) required for testing equipment, according to these Contract Documents shall be included in the base bid price to the Contractor and turned over to the Owner upon project completion.

2.2 WEB-BASED COMMISSIONING PORTAL

A. All general and major subcontractors participating in the Cx process shall use the web-based Cx Portal ('Portal') to document the Cx procedures. The Portal is a Web-based Internet hub used to electronically collaborate and coordinate activities and deliverables throughout the Cx process. The Portal is hosted by the CxA and shall be accessible to all Parties participating in the Cx program. The Portal provides a common location to store Start-Up Documentation, Functional Performance Tests and results, project documents and deliverables. It also serves as a collaborative email hub to facilitate, automate, and track communications between Parties relating to the Cx process.

B. Refer to Section 01 91 00 the individual Specifications for additional information and requirements for using the Portal.

PART 3 - EXECUTION

3.1 GENERIC START-UP DOCUMENTATION - GENERAL

A. Part III of this Section outlines 'generic' or minimally acceptable Start-Up Documentation (which are defined to include both 'Start-Up Checks' and 'Start-Up Tests') and individual systems training requirements for systems and equipment. These procedures are the direct responsibility of the Contractor as a basic element of validating that the installation is correct per normal quality control practices. These items shall provide a minimally acceptable guideline for required Contractor development of Start-Up Documentation. Contractor shall synthesize these minimum requirements along with their own internal quality control practices, those of the manufacturer, and any applicable codes and standards to develop specific and itemized final Start-Up Documentation specific to the equipment and systems installed on this project.

B. Section 01 91 00 defines the systems and equipment Start-Up process in detail and provides definitions for Start-Up Documentation, including the generic Start-Up Documentation provided below.

3.2 START-UP DOCUMENTION COMMON TO ALL SYSTEMS

A. The following Start-Up Documentation (Checklists and Tests) shall be considered common to all systems:

1. Checkout shall proceed from lower level devices to larger components to the entire system operation.
2. Verify labeling is affixed per specification and visible.
3. Verify prerequisite procedures are done.
4. Inspect for damage and ensure none is present.
5. Verify system is installed per the manufacturer’s recommendations.
6. Verify system has undergone Start-Up per the manufacturer’s recommendations.
7. Verify that access is provided for inspection, operation and repair.
8. Verify that access is provided for eventual replacement of the equipment.
9. Verify that record drawings, submittal data and O&M documentation accurately reflect the installed systems.
10. Verify all gauges and test ports are provided as required by contract documents and manufacturer’s recommendations.
11. Verify all recorded nameplate data is accurate.
12. Verify that the installation ensures safe operation and maintenance.
13. Verify specified replacement material/attic stock has been provided as required by the Contract Documents.
14. Verify all rotating and moving parts are properly lubricated.
15. Verify all monitoring and ensure all alarms are active and set per Owner’s requirements.
16. Complete all nameplate data and confirm that ratings conform to the design documents.

3.3 VALVES

A. Include all applicable ‘Start-Up Checks Common to All Systems”. Additional Start-Up Checks and Tests are as follows.

B. Start-Up Checks: Perform the following checks during start-up and as specified in manufacturer's instructions:

1. Operate all valves, manual and automatic, through their full stroke. Ensure smooth operation through full stroke and appropriate sealing or shutoff.
2. Verify actuators are properly installed with adequate clearance.
3. Verify all valves are labeled per the construction documents. Confirm that concealed valves are indicated on the finished building surface.
4. For automatic pneumatically-operated valves, verify spring range and adjust pilot positioners where applicable.
5. For electronically operated valves, check the stroke and range.
6. For all automated valves controlled by a program, ensure that the minimum and maximum stroke and ranges on the valves are coordinated with the limits entered in the program.

3.4 METERS AND GAUGES

A. Include all applicable ‘Start-Up Checks Common to All Systems”. Additional Start-Up Checks and Tests are as follows.

B. Start-Up Checks: Perform the following checks during start-up and as specified in manufacturer's instructions:

1. Adjust faces of meters and gauges to proper angle for best visibility.
2. Clean windows of meters and gauges and factory-finished surfaces. Replace cracked and broken windows, and repair scratched and marred surfaces with manufacturer's touch-up paint.
3. For meters and gauges requiring temporary manual connection of read-out device such as pressure taps on a flow measuring device, ensure threads are clean and that connection can be made easily.
4. Meters and gauges requiring manual connection of readout device shall be installed with adequate access to allow connection of device with normal tools.

3.5 PLUMBING IDENTIFICATION

A. Start-Up Checks: Perform the following checks:

1. Verify all valve tags, piping, duct, and equipment labeling corresponds with drawings and indexes and meets requirements specified. Correct any deficiencies for all piping and duct systems.
2. Adjusting: Relocate any mechanical identification device which has become visually blocked by work of this division or other divisions.
3. Cleaning: Clean face of identification devices, and glass frames of valve charts.

3.6 PLUMBING INSULATION

A. Include all applicable ‘Start-Up Checks Common to All Systems”. Additional Start-Up Checks and Tests are as follows.

B. Start-Up Checks: Examine all piping, systems and equipment specified to be insulated.

1. Ensure quality of insulation. Patch and repair all insulation damaged after installation.

2. Ensure the integrity of vapor barrier around all cold surfaces.

3.7 PIPING - GENERAL

A. Include all applicable ‘Start-Up Checks Common to All Systems”. Additional Start-Up Checks and Tests are as follows.

B. Start-Up Checks: These procedures apply to all installed piping systems, including underground site utilities.

1. Inspect all piping for proper installation, adequate support (with appropriate vibration isolation where applicable) and adequate isolation valves for required service.
2. Submit welding certifications as required by the applicable specification section or referenced ASME specification.
3. Submit certified welding inspection results per the applicable specification section or referenced ASME specification. ASME B31.1 requires 100% inspection based on pressure class.
4. Provide notification of pipe cleaning and flushing activities.
5. Flush and clean all piping and clean all strainers. Provide documentation of all related procedures.
6. Ensure adequate drainage is provided at low points and venting is provided at high points.
7. Ensure facilities to effectively drain and fill the system are in place.
8. Ensure air is thoroughly removed from the system as applicable.
9. Ensure all piping is adequately supported and anchored to allow expansion. Bump across-the-line pumps and inspect for excessive pipe movement.
10. Provide notification of pressure testing.
11. Pressure and/or leak test all applicable systems in accordance with the requirements in the applicable sections, ASME B 31.1 and 39.1 as applicable.
12. Sterilize applicable piping systems as specified in the individual Sections and as required by regulatory authorities.
13. Submit pressure test reports that document the pressure testing results with certification of the results.
14. Verify the operation of applicable safety relief valves, operating controls, safety controls, etc. to ensure a safe installation.
15. Set and adjust fill, pressure, or level controls to the required setting.

3.8 AC MOTORS

A. Include all applicable ‘Start-Up Checks Common to All Systems”. Additional Start-Up Checks and Tests are as follows.

B. Start-Up Checks: Perform the following checks during start-up and as specified in manufacturer's instructions:

1. Verify proper alignment, installation, and rotation.
2. Verify properly sized overloads are in place

C. Start-Up Tests: Perform the following tests, measurements, or procedures during start-up and as specified in manufacturer's instructions:

1. Measure insulation resistance, phase balance, and resistance to ground.
2. Measure voltage available to all phases. Measure amps and RPM after motor has been placed in operation and is under load.
3. Record all motor nameplate data.

3.9 BEARINGS

A. Include all applicable ‘Start-Up Checks Common to All Systems”. Additional Start-Up Checks and Tests are as follows.

B. Start-Up Checks: Perform the following checks during start-up and as specified in manufacturer's instructions. This applies to all bearings on fans, pumps, compressors, and other equipment installed under this Division.

1. Check alignment as applicable.

2. Lubricate all bearings per the manufacturer’s instructions. When bearing is used for temporary conditioning, lubricate on manufacturer’s recommended frequency and document it.

C. Start-Up Tests: Perform the following tests, measurements, or procedures during start-up and as specified in manufacturer's instructions:

1. Use infrared thermometer to measure temperature at peak conditions. Ensure temperature is below manufacturer’s recommendations.

2. For bearings in drives with motors over 10 HP, use a vibration meter and measure the maximum peak-to-peak acceleration. Compare it to the Vibration Severity Chart. Rectify any condition causing severity indicated as “Rough” or worse.

3.10 PUMPS

A. Include all applicable ‘Start-Up Checks Common to All Systems”. Additional Start-Up Checks and Tests are as follows.

B. Refer to ‘AC Motors’ in this Section.

C. Refer to ‘Bearings’ in this Section.

D. Refer to Division 22 Section "Testing, Adjusting, and Balancing" for detailed requirements for testing, adjusting, and balancing hydronic systems.

E. Start-Up Checks: Perform the following checks during start-up:

1. Check suction lines connections for tightness to avoid drawing air into the pump.
2. Clean and lubricate all bearings.
3. Check motor for proper rotation. Rotation shall match direction of rotation marked on pump casing.
4. Check that pump is free to rotate by hand. For pumps handling hot liquids, pump shall be free to rotate with the pump hot and cold. If the pump is bound or even drags slightly, do not operate the pump until the cause of the trouble is determined and corrected.
5. Clean associated strainers.
6. Check that the proper overloads have been installed in the starter and are the correct size.
7. Verify that the integrity of the vibration isolation is maintained throughout the support and the connections.
8. Align pump within manufacturers recommended tolerances.

9. Ensure all associated piping has been cleaned, tested, and deaerated.
10. Verify that all thermometers and gauges are installed, are clean and undamaged, and are functional.

F. Start-Up Tests: Perform the following tests, measurements, or procedures during start-up:

1. Start the pump per the manufacturer's instructions.
2. Check the general mechanical operation of the pump and motor.
3. Verify that check valve seal is appropriate.
4. Check noise and vibration levels and ensure they are within the manufacturer's recommended tolerances.
5. Check that the NPSH is with that allowable for the operating condition.
6. Refer to Division 22 Section "Testing, Adjusting, and Balancing" for detailed requirements for testing, adjusting, and balancing hydronic systems.

3.11 CONTROLLERS AND CONTROL PANELS

A. Include all applicable 'Start-Up Checks Common to All Systems". Additional Start-Up Checks and Tests are as follows.

B. Start-Up Checks: Perform the following checks during start-up:

1. Ensure devices are properly installed with adequate clearance for maintenance and with clear labels in accordance with the record drawings.
2. Ensure that terminations are safe, secure and labeled in accordance with the record drawings.
3. Check power supplies for proper voltage ranges and loading.
4. Ensure that wiring and tubing are run in a neat and workman-like manner, either bound or enclosed in trough.
5. Check for adequate signal strength and acceptable bandwidth utilization on communication networks.
6. Check for stand-alone performance of controllers by disconnecting the controller from the LAN. Verify the event is annunciated at Operator Interfaces. Verify that the controlling LAN reconfigures as specified in the event of a LAN disconnection.
7. Ensure that all outputs and devices fail to their proper positions/states.
8. Ensure that buffered and/or volatile information is retained through power outage.
9. With all system and communications operating normally and all trends functioning, sample and record update/annunciation times for critical alarms fed from the panel to the Operator Interface.
10. Check for adequate grounding of all BAS panels and devices.
11. Run self-diagnostic routines and ensure they are functional
12. Check the memory allocation and loading to ensure adequate and excess capacity is available and that it will not affect control functionality.

3.12 PLUMBING FIXTURES

A. Include all applicable 'Start-Up Checks Common to All Systems". Additional Start-Up Checks and Tests are as follows.

B. Start-Up Checks: Perform the following checks during start-up:

1. Inspect each installed fixture for damage. Replace damaged fixtures and components.
2. Test fixtures to demonstrate proper operation upon completion of installation and after units are water pressurized. Replace malfunctioning fixtures and components, then retest. Repeat procedure until all units operate properly.
3. Operate and adjust faucets and controls. Replace damaged and malfunctioning fixtures, fittings, and controls.
4. Operate and adjust disposers, hot water dispensers, and controls. Replace damaged and malfunctioning units and controls.
5. Adjust water pressure at drinking fountains, electric water coolers, and faucets, shower valves, and flushometers having controls, to provide proper flow and stream.

6. Replace washers of leaking and dripping faucets and stops.
7. Clean fixtures, fittings, and spout and drain strainers with manufacturers' recommended cleaning methods and materials.

3.13 WATER HEATERS

A. Include all applicable ‘Start-Up Checks Common to All Systems”. Additional Start-Up Checks and Tests are as follows.

B. General: Provide the services of a factory-authorized service representative to test and inspect unit installation, provide start-up service, and demonstrate and train Owner's maintenance personnel as specified below.

1. Check for adequate combustion air.
2. Check for piping connections leaks.
3. Check for clear vent.
4. Test and adjust operating and safety controls. Replace damaged and malfunctioning controls and equipment.

C. Training: Train Owner's maintenance personnel on procedures and schedules related to start-up and shutdown, troubleshooting, servicing, and preventative maintenance. Review data in Operating and Maintenance Manuals.

3.14 HYDRONIC PIPING

A. Include all applicable ‘Start-Up Checks Common to All Systems”. Additional Start-Up Checks and Tests are as follows.

B. Start-Up Checks: Perform the following checks during start-up:

1. Prepare hydronic and test piping in accordance with applicable Section and ASME B 31.9 and/or B 31.1
2. Flush system with clean water in accordance with applicable Section.
3. Clean strainers.
4. Check expansion tanks to determine that they are not air-bound and that the system is completely full of water.
5. Set automatic fill valves for required system pressure.
6. Check air vents at high points of systems and determine if all are installed and operating freely (automatic type) or to bleed air completely (manual type).
7. Set and coordinate automatic fill pressure and relief valve settings.

C. Start-Up Tests: Perform the following tests, measurements, or procedures during start-up:

1. Chemical Treatment: Provide a water analysis prepared by the chemical treatment supplier to determine the type and level of chemicals required for prevention of scale and corrosion. Perform initial treatment after completion of system testing.

3.15 SITE SANITARY AND STORM SEWERS

A. Test completed sewer lines with light or reflected light. Test shall show clear unobstructed view between manholes. All of the Work will be subject to the final approval of the Architect.

B. The construction of the sewer line shall be inspected by the Architect and Local Authorities.

C. The completed sewer systems, including all mains, laterals, and manholes shall be limited to a maximum leakage limit of 1000 gallons per inch of diameter, per day, per mile.

D. Any completed collection system or partial system failing to meet the maximum allowable infiltration requirements shall be reconstructed or sealed in a manner acceptable to the Architect and the Local Authorities.

E. The gravity sanitary sewer lines shall have all openings tightly closed with screw plugs, or equal device. The piping shall be filled with water and proven tight under a pressure equal to 10'-0" head of water for a minimum of two (2) hours. Water level must remain constant throughout test without addition of water.

3.16 SITE AND UNDERGROUND WATER PIPING

A. The new water main shall be given pressure and leakage tests in Section of approved length all as directed and approved by the Architect. Hydrostatic and leakage tests shall conform to AWWA C600-64 requirements. For these tests, this Contractor shall furnish a water meter and a pressure gauge. This Contractor shall furnish and install suitable temporary testing plugs, valves or caps for the pipeline, all necessary pressure pumps, pipe connections, other similar equipment, and all labor required. All expenses involved in making leakage and pressure tests shall be borne by this Contractor. The meter gauge shall be installed by this Contractor in such a manner that all water entering the Section under test will be measured and the pressure in the Section indicated, and shall be kept in use during both tests. The Sections of pipe to be tested shall be filled with water of approved quantity and all air shall be expelled from the pipe.

B. The new water main shall be subject to a hydrostatic test of 200 psi gauge, after the pipe is laid and the trench partially backfilled (joints shall be left exposed). The test pressure shall be applied to each valved section and maintained for a period of two (2) hours with no more than 2 psi loss of pressure. If this Contractor cannot achieve the specified pressure and maintain it for a period of two (2) hours, the section under test shall be considered as having failed to pass the pressure test.

C. If the section tested shall fail to pass the pressure test or the leakage test, or both, this Contractor shall do everything necessary to locate, uncover, and repair or replace the defective pipe, fitting, joint, etc., without extra cost to the Owner.

D. If, in the judgment of the Architect, it is impractical to follow the foregoing procedures exactly for any reason, required modifications in procedures shall be made, but in any event, this Contractor shall be responsible for the ultimate tightness of the lines within the above leakage requirements.

3.17 INTERIOR DOMESTIC WATER SYSTEMS

A. Domestic cold, hot and hot water circulation system: The entire water supply system shall be tested to a hydrostatic pressure of 150 pounds per square inch or 1-1/2 times the system pressure, whichever is greater, at lowest point of the water system in the building, and proved tight at this pressure before fixtures are installed. Water supply piping, if in any way concealed by structural work, shall be tested to the aforesaid pressure and proved tight before pipes are concealed.

B. The test pressure shall be held for a period of not less than two (2) hours. The piping system shall be considered tight if the drop in pressure does not exceed 2 pounds per square inch during the test period. If the pressure drop exceeds 2 pounds, all repairs and alternations in the piping system necessary to meet the test shall be made.

C. Refer to Section 22 10 00 for sanitizing requirements of the domestic water system.

3.18 INTERIOR SANITARY WASTE AND STORM WATER SYSTEMS

A. The entire piping of the sanitary system and of the storm water system shall be tested with water in accordance with the plumbing code and the Local Plumbing Inspector's requirements and proved tight before the trenches are backfilled or fixtures connected.

B. All drainage and vent systems shall be filled with water and proven tight under a 10'-0" head over new Building Roof for a minimum of two (2) hours, Water level must remain constant through test without adding water.

C. After all fixtures have been permanently connected to the sanitary system and the system is completed, a smoke test shall be applied to the sanitary system, and the entire system proved tight to the satisfaction of the Architect, when filled with smoke under pressure equal to 1" column of water. The smoke shall be produced by a smoke generating machine and not be chemical mixtures.

3.19 ADJUSTMENT AND BALANCING OF DOMESTIC WATER SYSTEM

A. Scope: Balance all domestic hot water and hot water re-circulation systems.

B. Before any adjustments are made:

1. Check temperature control device operation (mixing valves, external temperature control devices, etc.)
2. Check rotation of pumps.
3. Adjust pressure reducing valves.
4. Verify proper operation of ASME pressure and temperature relief valves.

C. Using flow meters, adjust the quantity of water circulated by each pump and the flow in each branch of the hot water re-circulation systems.

3.20 SEQUENCING ILLUSTRATION

A. Reference Section 01 91 00.

END OF SECTION

SECTION 22 08 01

COMMISSIONING AGENT REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Refer to section 22 08 00 for commissioning requirements and Division 1 for additional information.

1.2 DESCRIPTION OF THE WORK

A. This Section covers the Scope of Work for the Commissioning Agent (CA) who will be hired by the Owner.

B. The Commissioning Agent shall oversee the commissioning of plumbing systems as described in Section 22 08 00. The CA shall prepare precommissioning and functional performance test checklists to be used by the Contractor. Prepare and publish a commissioning plan. Witness startup and operational tests of equipment and systems. Perform observations of the mechanical systems throughout construction and prepare the final commissioning document.

C. The CA shall have authority to direct and schedule tests. The CA shall have no authority to direct changes to the construction of the systems.

1.3 COMMISSIONING PLAN

A. The CA shall prepare a plan listing the parties involved with their responsibility, scope, definitions, safety concerns, design criteria, attendance schedules, commissioning schedules, and commissioning manual requirements.

1.4 COMMISSIONING FORMS

A. Review 100% CD's. Provide written summary of how each commissioned item of equipment should operate. Include calculations verifying scheduled capacity.

B. The CA shall develop forms similar to that in Section 22 08 00 for the Contractors use during the commissioning process. The forms shall become part of the final commissioning manual. Forms shall be provided for each piece of commissioned equipment and system. Any deviations from the design shall be noted and proved by the Owner prior to acceptance. Each form shall be signed by the Contractor, CA and Owner prior to acceptance of a system or piece of equipment.

1.5 COMMISSIONED EQUIPMENT

A. All pumps as scheduled

B. Hot water heaters

C. All other scheduled equipment

1.6 COMMISSIONED SYSTEMS

A. All plumbing systems in new and renovated spaces, refer to Section 22 08 00 for additional requirements.

1.7 PROJECT OBSERVATIONS

A. The CA shall perform observations of the commissioned equipment and systems twice a month at a minimum and more as required to keep pace with construction. The CA shall note progress and any deviations of the construction documents shall be brought to attention of the Contractor and Owner for resolution. The CA will have no authority to direct changes or corrections to the system. Observation reports shall be published to the Owner, Architect and Contractor and shall be part of the final commissioning manual.

1.8 OPERATIONAL AND START-UP TESTS

A. The CA shall witness start-up tests and collect documentation of the tests. The CA shall notify the Architect and Contractor of any deviations from the contract documents. Any deviations shall be corrected or accepted by the Owner prior to acceptance.

B. After the Contractor has submitted in writing that the systems are completed, the CA shall schedule and direct operational tests of the systems. These tests shall be as described in Section 22 08 00. The results shall be documented and made part of the commissioning manual. Any deviations from the design shall be brought to the attention of the Architect and Contractor. Any deviations shall be corrected or accepted by the Owner prior to acceptance.

1.9 COMMISSIONING MANUAL

A. The CA shall prepare the final commissioning manual. The manual shall provide a complete history of the commissioning process and shall include:

1. Design and Energy Codes.
2. Commissioning Plan.
3. Completed Commissioning Forms.
4. Completed Observation Reports.
5. Completed Start-up Reports.
6. System Operational Tests.
7. Final sequence of operation to be achieved.
8. Summary of building operation as commissioned, noting deviations from design.
9. Design Criteria (extended from Design Documents by CA).
10. Written summary of normal startup and operating procedures for each commissioned item of equipment.

The manual shall be a three ring binder with tabs for each section. Provide 5 copies.

END OF SECTION

SECTION 22 10 00

PLUMBING PIPING AND ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplemental Conditions of the Construction Contract and Division 1 Specification Sections (General Requirements), apply to this Section.

1.2 SUBMITTALS

A. Submit manufacturer's data on the following:

1. Water hammer arresters.
2. Roof drains, floor drains, floor sinks, cleanouts and area drains.
3. Downspout nozzles.
4. Water meter and meter pit.
5. Trap primers.
6. Trap guards.
7. Cleanouts.
8. Dissimilar Metals.
9. Pipe Sleeves.
10. Stack Sleeves.
11. Grease interceptor.
12. Thrust Blocks
13. Drip Pans.

1.3 STANDARDS

A. Materials shall comply with the latest editions of the following standards.

1. Plumbing Code of New York State
2. Vassar College Facility Design & Construction Standards
3. Town of Poughkeepsie
4. Cast iron: ASTM A-74-87
5. Cast iron pipe fittings ASTM A-888
6. Cast iron pipe couplings ASTM C-564
7. Copper pipe:
   a. Type K, L, M: ASTM B88
   b. DWV: ASTM B306-88
8. Ductile iron pipe: ASTM A377-89
9. All potable water piping and fixtures should be compliant with NSF-61 requirements for lead free piping
10. All piping shall be domestically manufactured and shall be by the same manufacturer.
11. ANSI/UL 263: Fire test of building construction and materials.

1.4 RELATED WORK

A. Section 22 05 29 Pipe Supports and Anchors.

PART 2 - PRODUCTS

2.1 DOMESTIC WATER PIPING AND ACCESSORIES

A. Comply with NSF-61 for lead free potable water piping.

B. Above Ground Inside Building, Size 6" and Under:

1. Pipe: Copper, hard temper, Type L, ASTM B88.
2. Fittings:
   a. Wrought copper, or cast bronze.
   b. ASME B16.22 wrought copper fittings or ASME B16.18 bronze castings with copper tube dimensioned grooved ends (flaring of tube and fitting ends to IPS dimensions is not permitted).
3. Solder:
   a. 95-5 tin antimony (no lead), ASTM B32.

C. Above Ground Inside Building (Mechanical Couplings), Size 6" and under:

1. Pipe: Copper, hard temper, Type L, ASTM B88.
2. Fittings:
   a. ASME B16.22 wrought copper fittings or ASME B16.18 bronze castings with copper tube dimensioned grooved ends (flaring of tube and fitting ends to IPS dimensions is not permitted.
3. Solder
   a. Couplings shall be Installation-Ready, stab-on design, for direct 'stab' installation onto roll grooved copper tube without prior field disassembly and no loose parts. Housings shall be ductile iron cast with offsetting, angle-pattern bolt pads, coated with copper-colored enamel. Gasket shall be Grade "EHP" EPDM, suitable for hot water up to 250 deg F, and plated steel bolts and nuts.
4. Refer to section 22 05 21 for other acceptable joining methods

D. Above Ground Inside Building, Size 8" and larger:

1. Type L copper.
   a. Grooved mechanical couplings and fittings as described above for 8" size.
2. Stainless steel pipe with mechanical couplings minimum 175 psi WWP.
   a. Stainless Steel Grooved End Fittings: Manufactured of stainless steel conforming to ASTM A403, WPW, WPW/S9, or CR/S9, or shall be fabricated from stainless steel pipe conforming to ASTM A312 with factory grooved ends. Fittings shall be type 316/316L stainless steel.
   b. Mechanical Couplings for Stainless Steel Pipe: Manufactured in two or more segments of cast stainless steel conforming to ASTM A351, A743, and A744, pressure-responsive, synthetic rubber gasket and type 316 stainless steel bolts and nuts conforming to ASTM A193, Grade B8M, Class 2.
      1) Rigid Type: Cast with key designed to clamp the bottom of the groove to provide an essentially rigid joint. Victaulic Style 489.
      2) Flexible Type: Use in locations where vibration attenuation and stress relief are required. Victaulic Style 77S.
   c. Ductile Iron Couplings for Stainless Steel Pipe: Two or more segments of cast ductile iron conforming to ASTM A536, designed to clamp the bottom of the groove to provide an essentially rigid joint. Gaskets shall be pressure-responsive, synthetic rubber (UL classified in accordance with ANSI/NSF-61 for hot (180 deg F) and cold (86 deg F) domestic water service) and plated steel bolts and nuts. .

E. Below Ground Inside Building, Size 2" and Under:

1. Pipe: Copper, annealed, Type K.
2. Fittings: Wrought copper, brazed.

F. Below Ground Outside Building, 3" and Over:

1. Ductile pressure pipe, tar coated, cement lined:
   a. Pipe: ANSI A21.51, Class 50.
   b. Fittings: ANSI 21.10.
   c. Rubber Gaskets: ANSI 21.11.

G. Use approved fittings for connections between dissimilar pipe systems.

2.2 PRESS FIT JOINING SYSTEM FOR DOMESTIC WATER PIPING

A. Manufacturer

1. Viega ProPress
2. Elkhart Products, Express

B. Material

1. Press Fittings: Copper press fittings. Must comply with ASME B16.18 or B16.22.
2. O-Rings: EPDM
3. Fittings shall be rated for 0°F to 250°F, and 250 psi.

C. Application

1. Locations where Engineer has determined that traditional hot joining methods are not possible at a specific location. Specific approval for each case required.

D. Press-Connect Fitting: Copper press-connect fittings shall conform to the material and sizing requirements of ASME B16.18 or ASME B16.22 O-rings for copper press-connect fittings shall be EPDM.

E. Copper press-fittings shall be installed in accordance with the manufacturer's installation instructions. The tubing shall be fully inserted into the fitting and marked at the end of the fittings. The fitting alignment shall be checked against the mark on the tubing to insure the tube is fully engaged (inserted) in the fittings. The joints shall be pressed using a pressing tool and jaws, or jaw set, approved by the manufacturer.

F. Alignment of the correct area on the fittings with the corresponding correct area of a crimping sling is critical.

When the installer has confirmed that positioning and alignments are correct and other proper installations procedures have been followed, crimping can take place with the band remaining in the groove.

Installer shall use manufacturer provided alignment and dimension guides or employ equivalent measures when none are provided by manufacturer.

G. Tools used to complete joint shall be manufacturer approved for the fitting being installed.

2.3 TRAP PRIMERS (TP)

A. Manufacturers:

1. Design basis: PPP as noted in Plumbing Fixture Schedule.
2. Construction: Corrosion resistant brass. "O" rings shall have a flexibility range of -40°F to 450°F.
3. Provide distribution units for connector points as shown on plans.
4. Complies with ASSE STD 1018.

2.4 TRAP GUARDS (TG)

A. Manufacturers:

1. Design basis: ProSet Trap Guard
2. Construction: A flexible tube made of elastmeric material that is treated to roll up when water is passing through drain.
3. Install in floor drains and floor sinks from 2" up to and including 4" as shown on plans indicated with a (TG) behind drain designation.
4. Use of trap guards subject to approval by local authority.

2.5 WATER HAMMER ARRESTER (Shock Absorber)

A. Manufacturers:
1. Design Basis: Zurn Shoktrol Z-1700
2. Construction: Stainless Steel, Bellows
3. Other Acceptable Manufacturers:
   a. Josam
   b. Sioux Chief
   c. J.R. Smith
   d. MIFAB-WHB
4. Standards: PDI WH201, ASSE STD 1010.

B. Install permanently sealed water hammer arrestors on all hot and cold water branches and headers to plumbing fixtures whether it is indicated on the Plumbing Drawings or not.

C. Shock absorbers are to be of size and location in accordance with the manufacturer's recommendations and with DPI Standard WH 201 and shall be PDI approved. Provide accessibility to all shock absorbers.

D. Provide shock absorbers at the top of water risers and at all quick closing valves, solenoid valves and at equipment such as sterilizers, washers, etc.

2.6 WATER METER

A. Water meter to be Neptune or Metron-Farnier and shall be read in cubic feet. Meter to be complete with plate or basket strainers, three valve bypasses and pressure gauge on bypass.

B. Provide meter, pit, and cover in accordance with Water Supplier's standards and instructions.

1. Meter shall be furnished by the Contractor in accordance with Water Supplier's standard specification.

C. Meter shall be located in building or in an exterior pit as indicated.

2.7 SANITARY AND VENT PIPING (WITHIN BUILDING)

A. Above Ground:

1. Cast iron hub and spigot, neoprene gasket.
2. Cast iron no hub, neoprene gasket and stainless steel sleeve joint (as allowed by jurisdiction). ASTM A888, CISPI 301.

B. Underground:

1. Cast iron hub and spigot, with oakum packing and caulked molten lead in one continuous pour or neoprene gaskets. ASTM A74.

C. Underground (outside the building):

1. SDR 35 PVC, with solvent welded joints. ASTM D 1784, ASTM D 3034, ASTM D 3212, ASTM F 477. "FERNCO" connection are NOT allowed.

2.8 HEAVY DUTY NO HUB COUPLINGS

A. Use on the following:

1. Sanitary vent piping 4" and larger.
2. Sanitary piping 3" and larger.
3. All storm piping.

B. 1-1/2", 2", 3" and 4": 3" wide 304 stainless steel shield; (4) minimum stainless steel clamps; fixed and "floating" eyelet.

C. 5" and over: 4" wide 304 stainless steel shield, with six (6) stainless steel clamps mounted in series.

D. Torque to minimum 80 inch pounds or per manufacturer's recommendation.

E. Acceptable manufacturers: Husky Series 4000 or Mission Heavy Weight.

2.9 STANDARD DUTY NO HUB COUPLINGS

A. Standard duty couplings shall conform to CISPI 310-85: 0.008" thick corrugated stainless steel. ASTM A888.

B. Use of the following:

1. Sanitary vent piping up to and including 3" piping.
2. Sanitary piping up to and including 2" piping.
3. As allowed by jurisdiction.

C. Torque to inch pounds per manufacturer's recommendation.

D. Acceptable manufacturers: Tyler, Mission, AB&I, Clamp All, Huskey.

2.10 PUMPED SANITARY PIPING (ABOVE & BELOW GRADE)

A. 125 lb. galvanized steel, threaded.

B. Galvanized ductile iron grooved pipe fittings, designed for cut grooved joint.

1. Grooved End Fittings: ASTM A536 ductile iron or ASTM A53 forged or fabricated carbon steel, galvanized in accordance with ASTM A153.
2. Grooved Mechanical Couplings: Two ASTM A 536 ductile iron housings, galvanized to ASTM A153. Pressure-responsive, synthetic rubber gasket, Grade "T" Nitrile suitable for pumped sanitary piping, and plated steel bolts and nuts.
   a. Rigid Type: Housings shall be cast with offsetting, angle-pattern bolt pads to provide system rigidity and support and hanging in accordance with ASME B31.1 and B31.9.
      1) 2" through 8" Sizes: "Installation Ready" stab-on design, for direct 'stab' installation onto grooved end pipe without prior field disassembly and no loose parts. Victaulic Style 107H QuickVic.
      2) 10" and 12" Sizes: Standard rigid coupling. Victaulic Style 07 Zero-Flex.
   b. Flexible Type: Use in locations where vibration attenuation and stress relief are required.

1) 2" through 8" Sizes: "Installation Ready" stab-on design, for direct 'stab' installation onto grooved end pipe without prior field disassembly and no loose parts. Victaulic Style 177 QuickVic.
2) 10" and 12" Sizes: Standard flexible coupling. Victaulic Style 75 and 77.

C. Hub and spigot or no hub couplings are not allowed.

2.11 SOIL AND VENT PIPING ACCESSORIES

A. Use approved fittings for connections between dissimilar pipe systems.

B. Acceptable Manufacturers:
1. Josam
2. Wade
3. Zurn
4. J.R. Smith
5. Jones Spec
6. Watts Ancon

C. Cleanout Plugs:

1. Material: Cast bronze or brass.
2. Type: Countersunk.
3. Threads: ANSI B2.1.

D. Wall Cleanout Covers:

1. Type: Frameless, round, low profile plate.
2. Material: Stainless steel or chrome plated brass.
3. Attachment: Single exposed flush screw.
4. Finish:
   a. Non-painted surfaces: Bright polished.
   b. Surfaces to be painted: Prime coat.

E. Floor Cleanouts:

1. Body: Standard round Duco cast iron.
2. Attachment: Bronze screws.
3. Sleeve: Full thickness of floor slab.
4. Top:
   a. Shape:
      1) Where floor covering has rectangular pattern: Square.
      2) Other areas: Round.
5. Cover:
   a. For Vinyl Tile and Similar Floor Coverings: Recessed to receive inset of floor material.
   b. For carpeted floor covering provide carpet cleanout marker.
   c. Other areas: Nickel bronze scoriated finish.

F. Exterior Cleanouts to Grade:

1. Material: Duco cast iron.
2. Ferrule: Caulk type.
3. Plug: Cast bronze countersunk type.

G. Vandal-Proof Caps

1. Material: Duco cast iron.
2. Attachment: Recessed Allen set screw.

H. Backwater Valve:

1. Body: Duco cast iron.
2. Valve: Bronze.
3. Provide cleanout cover.
    a. Locate in accessible manhole.

2.12 SANITARY SEWER PIPING (BELOW GRADE-EXTERIOR TO BUILDING)

A. Match material and methods specified in Division 33 for sitework sanitary sewer system or as listed below.

B. Use approved fittings for connections between dissimilar pipe systems.

C. Ductile iron bell and spigot.

2.13 STORM WATER PIPING (INSIDE BUILDING)

A. Above Ground:

1. Cast iron, hub and spigot, neoprene gasket joints.
2. Cast iron no hub, neoprene gasket and heavy duty no hub couplings.

B. Underground:

1. Cast iron hub and spigot, with oakum packing and caulked molten lead in one continuous pour or neoprene gasket.
2. Cast iron, hub and spigot, neoprene gasket joints.

2.14 STORM WATER PIPING (BELOW GROUND-EXTERIOR TO BUILDING)

A. Match material and methods specified in Division 33 for sitework storm sewer system or as listed below.

B. Match materials and methods specified for sanitary sewer piping above.

C. Use approved fittings for connections between dissimilar pipe systems.

2.15 STORM DRAINAGE PRODUCTS

A. Roof Drain: (RD)
1. Material: Cast Iron
2. Dome: Cast Iron
3. Include:
    a. Combined flashing collar and gravel stop.
    b. Extension for insulation.
    c. Under-deck clamp.
    d. Sump receiver.
    e. Expansion joint.

B. Overflow Roof Drain: (OD)
1. Same as Roof Drain Type 1 except:

a. Provide removable water dam. Top of water dam shall be 4” above low point of roof.
2. Provide (1) overflow roof drain for every roof drain shown.

C. Downspout Nozzle
1. Material: Cast Bronze
2. Manufacturer: Zurn
3. Model: 1770

D. See Plumbing Fixture Schedule and Plumbing Fixture specification for additional information.

2.16 GREASE INTERCEPTOR

A. Materials:

1. Pre-formed or cast concrete.

B. Capacity: See plans.

C. Design:

1. Comply with the Town of Poughkeepsie.
2. Two compartment.
3. Two access manholes with ladders and manhole covers. Covers to be cast with “Sewer”.
4. See detail shown on plans for general requirements.

2.17 DISSIMILAR METALS

A. Connections between pipe, fittings, hangers and equipment of dissimilar metals shall be insulated against direct contact one with the other, by using a high quality or grade of dielectric insulated material

B. Dielectric unions or insulated couplings shall be installed between copper or brass piping material and steel piping material or steel tanks. Unions or insulated couplings shall be used for pipe sizes 2” and smaller, and dielectrically gasketed flanges and sleeves for pipes 2-1/2” and larger.

C. Dielectric fittings shall be installed between copper and steel piping systems to prevent galvanic corrosion. Body shall be ductile iron or steel, zinc electroplated, with LTHS high temperature, polyolefin polymer lining and grooved or threaded ends. Victaulic Style 47.

2.18 PIPE SLEEVES

A. Any pipe required in walls and floors shall be provided with a pipe sleeve.

B. Provide watertight sleeves for all pipes penetrating exterior foundation walls and waterproof floor areas and where such areas are noted on the Architectural and Structural Drawings.

C. Except where indicated or specified otherwise, provide and install Schedule 40 galvanized steel sleeves for all piping passing through concrete walls or floor slabs. Sleeves shall be securely set in the framework and where not specified otherwise shall be of such length as to extend flush with each face of the wall in which they are installed, 3" above unfinished floor and 2" above the finished floor or tile, as applicable. Sleeves in kitchen and laundry areas shall be chrome plated.

D. Sleeves shall have an internal diameter of at least 1" larger than the outside pipe size diameter of the pipe passing through them. Sleeves in exterior foundation walls shall be James B. Clow and Sons, No. F-1430 or F-1435, or approved equal, extra-heavy cast iron wall sleeves with intermediate integral flange. Cast iron wall sleeves with intermediate integral flange. Cast iron sleeves shall be set with end flush with wall faces.

E. Where sleeves penetrate waterproofing, install caulking between pipes and pipe sleeves as follows:

1. Pack oakum to a depth of 1" between pipe and pipe sleeve at a location permitting 3" of sealant to be installed above the oakum.
2. Fill space above oakum to a depth of 3" with sealant similar and equal to Igas Joint Sealer as manufactured by Silka Chemical Corporation.

F. Sleeves for gas piping shall extend 4 inches beyond exterior face of wall and 1 inch beyond inner face.

G. Sleeves in waterproof floors shall be as manufactured by Zurn Inc. or equal, cast iron sleeve with integrally cast flange and flashing device.

2.19 STACK SLEEVES

A. Stack sleeves for pipes passing through roof shall be equal to Zurn Z-195-10 or MIFAB R1900 with cast iron body, adjustable flashing ring, rust resistant bolts, and under deck clamp. The adjustable flashing ring shall be caulked after it is in the proper position. The space between the flashing sleeve and the pipe passing through same shall be caulked watertight.

2.20 CLEANOUTS

A. Provide easily accessible cleanouts at base of vertical stacks and leaders; at ends of horizontal drainage lines and at intervals not exceeding 50 ft.; at each change of direction; on hand holes of running traps; and where indicated to make entire drainage system accessible for roding. Provide at least 18 inch clearance to permit access to cleanout plugs.

B. Cleanouts for cast iron pipe shall consist of tapped extra heavy cast iron ferrule caulked into cast iron fittings, and extra heavy brass screw plug with solid hexagonal nut.

C. Cleanouts turning out through walls and up through floors shall be made by long sweep ells of "Y" and 1/8 bends with plugs and face or deck plates to conform to architectural finish in room. Where no definite finish is indicated on the Architectural and/or Mechanical Drawings, wall plates shall be chrome plates cast brass and floor plates shall be nickel bronze. Screws in cleanouts in finished areas shall be vandal-proof.

D. Cleanouts shall be full size at the pipe up to 6" inclusive. On larger size piping 6 inch size plugs shall be used.

E. The following list indicates the various types of cleanout desired at various locations indicated on the Drawings. These cleanouts have been selected from the catalog of Zurn and are representative of quality design and finish desired. Cleanouts of Josam Mfg. Co., or J.R. Smith, or MIFAB, or approved equal may be submitted provided they meet fully in every respect (such as material, weight, clamping features, finish, etc.). The characteristics and quality of the cleanout shall be as follows.

1. Cleanout fitting in vertical stacks shall consist of tapped tees, capable of receiving a rough brass raised head cleanout plug; Zurn 1460-8 or MIFAB #C-1400S-9.
2. Cleanouts in Mechanical Equipment Room shall be Zurn 1420-25 or MIFAB #C1100 XR-4-Z.
3. Cleanouts in finished areas shall be Zurn Z-1420-3 or Z-1400HD or MIFAB #C1100 TS-1 with recess for tile floors.
4. Cleanouts in Dex-O-Tex waterproof floors shall be Zurn No. Z-1405-18 or MIFAB #C1100XR-4-Z with extra heavy duty top.
5. Cleanouts for 3 or more fixtures piped horizontally shall be extended to wall cleanouts, and shall be Zurn No. Z-1470 or MIFAB #C1430.

F. All cleanout plugs shall be brass and lubricated with graphite before installation.

G. Cleanouts will not be allowed to be located in inaccessible locations.

2.21 DRIP PANS

A. In so far as possible, piping shall not be installed within the ceiling or exposed in operating and delivery rooms, nurseries, food preparation centers, food serving facilities, food storage areas, central services, electronic data processing areas, electric closets, and other sensitive areas.

B. When overhead piping in these areas in unavoidable, provide aluminum drip pans with indirect waste extended and spilled to a safe place.

2.22 DOMESTIC WATER PIPING – PEX – DEDUCT ALTERNATE (ONLY IF ACCEPTED BY OWNER AND ENGINEER)

A. Contractor shall submit a deduct alternate for the use of PEX for domestic for domestic hot and cold water piping 1" and smaller.

B. Additional Reference Standards:

1. ASTM F1807: specification for metal insert fittings utilizing a copper crimp ring for SDR9 cross-linked polyethylene (PEX) tubing
2. ASTM F2023: test method for evaluating the oxidative resistance of cross-linked (PEX) tubing and systems to hot chlorinated water.
3. ASTM F2159: specification for plastic insert fittings utilizing a copper crimp ring for SDR9 cross-linked polyethylene (PEX) tubing
4. ASTM F3347: Standard Specification for Metal Press Insert Fittings with Factory Assembled Stainless Steel Press Sleeve for SDR9 Cross-linked Polyethylene (PEX) Tubing
5. ASTM F3348: Standard Specification for Plastic Press Insert Fittings with Factory Assembled Stainless Steel Press Sleeve for SDR9 Cross-linked Polyethylene (PEX) Tubing
6. ASTM F876: specification for cross-linked polyethylene (PEX) tubing
7. ASTM F877: specification for cross-linked polyethylene (PEX) plastic hot and cold water distribution systems.
8. AWWA C904: cross-linked polyethylene (PEX) pressure pipe, ½ in. (12 mm) through 3 in. (76 mm), for water service
9. CAN/ULC S102.2: standard method of testing for surface burning characteristics of flooring, floor covering and miscellaneous materials and assemblies.
10. CSA CAN/CSA B137.5: cross-linked polyethylene (PEX) tubing systems for pressure applications.
11. Viega PureFlow System Engineering Specifications
12. NSF 14: plastic piping component and related materials
13. NSF 61: drinking water system components – health effects

C. Project Conditions:

1. The location of a manifold with valves shall be accessible and in an area not subject to freezing. Proper support of the manifold shall be provided.

2. PEX tubing and manifolds shall not be left exposed in direct sunlight for extended periods of time – short periods not exceed 15 days.

D. Manufacturer

1. Viega LLC

E. All PEX piping shall be insulated per specification section 220700, no expections.

F. Only straight lengths of PEX tubing/piping will be accepted, the use of roll/coil type is not acceptable.

G. Material

1. Tubing Standard: Viega PureFlow PEX high-density cross-linked polyethylene tubing shall be manufactured to the requirements of ASTM F876 and meet the standard grade hydrostatic pressure ratings from Plastic Pipe Institute in accordance with TR-4/03. The following three standard grade ratings are required:
   - 200 degrees F (93 degrees C) at 80 psig (551 kPa)
   - 180 degrees F (82 degrees C) at 100 psig (689 kPa)
   - 73.4 degrees F (23 degrees C) at 160 psig (1102 kPa)

   a. Chlorine testing: According to ASTM F876 shall meet or exceed the following end use condition.
      1) End use conditions of : 100% @ 140°F. Per PEX 5306 (CL5).
   b. UV testing: According to ASTM F876 PEX tubing products shall meet or exceed the following exposure limits.a. Viega PureFlow PEX 6 month

2. Fitting Standard: PureFlow Press fittings shall be manufactured from UNS, C87700, C87710 Bronze or Radel R® polymer, meeting the requirements of ASTM F877 and ASTM F3347 (metallic) or ASTM F3348 (polymer) tested as a system with Viega PureFlow PEX tubing. The PureFlow Press sleeve shall be manufactured out of a 304 grade or better stainless steel and have three view holes (attached sleeve) to ensure proper PEX tubing insertion. The attached sleeve fitting will incorporate a tool locator ring that shall be in place while making a proper press connection. The PureFlow Press connection shall be made with a Viega supplied ratcheting PureFlow Press hand tool or PureFlow Press power tool.

3. Manifolds:

   a. Copper Manifolds: Shall be copper material having a male or female solder, ProPress or PureFlow Crimp inlets. All outlets shall be PureFlow Press, PureFlow Crimp or ProPress fittings. Shall be provided by the Cross-linked Polyethylene system manufacturer.
   b. Provide access door as required to provide access to manifolds.

4. Adapter Fittings: PEX adapter fittings shall conform to one of the following ASTM standards; F877, F1807, F2159, or ASME B1.20.1 and be listed to the CSA B137.5. The adapter fittings shall mate to NPT threads, copper tubing, copper fittings or ProPress fittings.

H. Source Quality Control

1. The PEX tubing and fitting manufacturer shall maintain a third party listing of the tubing and fittings. The tubing and fittings shall be certified in accordance with ANSI/NSF 14/61 to verify suitability to transport potable water. The tubing and fittings shall have the mark “NSF-pw”, “cNSF® us pw-G”, or “NSF 61” permanently marked on the product to verify the material listing.

2. The manufacturer of the PEX tubing and fittings shall maintain a quality control program in accordance with ISO 9001 or NSF International in the manufacturing plant to assure that the tubing and fittings are continually being produced to the required standard. The tubing and fittings shall be certified as complying with NSF 14.

PART 3 - EXECUTION

3.1 GENERAL

A. Testing: Test in accordance with the applicable Plumbing Code.

B. Connections to Equipment Furnished Under Other Sections:

1. Make final connections to all equipment shown on drawings as connected to supply and/or drain piping.
2. Furnish all devices necessary for final connection, including:
   a. Tail pieces

b. Stops
c. Supplies

C. Corrosion Protection:

1. Provide isolation between concrete or mortar and any copper pipe.
2. All below grade piping shall be adequately protected from corrosion.

D. Comply with Section 22 05 29 Pipe Supports and Anchors for pipe support requirements.

3.2 INSTALLATION OF DOMESTIC WATER PIPING AND PRODUCTS

A. Install all horizontal water piping level and parallel to building construction (except piping noted to be drained down slope toward drain at 1/8" /ft. min.). Make any changes in direction with fittings, don't kink or bend. All vertical piping to be plumb. Provide dielectric isolation between uninsulated pipe and hangers. Provide plastic grommets when going through metal studs. Tape is not acceptable for dielectric isolation.

B. Water Hammer Arrestors: Install arresters as shown on the drawings and as described in this specification. At minimum any branch line connected to a flush valve shall have one arrestor.

C. Disinfection:

1. After installation of all fixtures served, fill all domestic water lines with a chlorine-water solution of 50 parts per million minimum.
2. Hold solution in pipe for at least 24 hours.
3. Open and close all valves 3 times during chlorination.
4. Waste chlorine solution from each outlet.
5. Measure solution at end. If not 10 ppm, repeat.

D. Meters:

1. Install water meter in accordance with Water Supplier's standard.

E. It is the intent that each part of the plumbing systems shall be complete in all details and all lines provided with all control valves as indicated on Drawings, or as may be required for the proper control of the pipe lines under this Section so that any fixture, line or piece of apparatus may be cut out for repair without interference or interruption of the service to the rest of the building.

F. The Contractor shall examine carefully the architectural plans and details and familiarize himself with all conditions relative to the installation of piping, particularly where same is concealed behind furring or in hung ceilings. In no case shall the Contractor permit his pipes to be exposed beyond finished plaster lines unless specifically shown on Drawings. He shall consult with the other trades in the building and install his piping in such a way as to least interfere with the installation of other trades. All piping installed in finished areas shall be completed concealed within hung ceilings, furrings, soffits, pipe spaces.

G. The water piping shall all be installed so as to drain, and branches shall not be trapped, but shall have continuous pitch. Where necessary to raise or lower mains, the same shall be provided with a drip and shall be properly valved and capped.

H. Piping shall be installed, whether indicated or not, so as to rise and/or drop to clear any and all conduits larger than 1", lighting fixtures, ductwork and heating mains, to maintain the desired clear heights. The Contractor shall consult with the other trades and facilitate the erection of the equipment and piping.

I. Run piping straight and as direct as possible, in general forming right angles with or parallel to walls or other piping. Risers shall be erected plumb and true.

J. After cutting, all pipes shall be reamed out to full bore and before erection the inside of all pipes shall be thoroughly cleaned.

K. No piping or work shall be concealed or insulated until all required tests have been satisfactorily completed and work has been approved by the Architect and all other authorities having jurisdiction.

L. Expansion loops and anchors shall be provided on all hot water and hot water circulation mains. Expansion loops shall be made with four elbows and three lengths of pipe, except as otherwise noted on the drawings. All loops shall be prestressed.

M. Grooved joint piping systems shall be installed in accordance with the manufacturer's guidelines and recommendations. All grooved couplings, fittings, valves, and specialties shall be the products of a single manufacturer. Grooving tools shall be of the same manufacturer as the grooved components. The gasket style and elastomeric material (grade) shall be verified as suitable for the intended service as specified. Gaskets shall be molded and produced by coupling manufacturer. Grooved end shall be clean and free from indentations, projections, and roll marks in the area from pipe end to groove for proper gasket sealing. A factory-trained field representative shall provide on-site training for contractor's field personnel in the proper use of grooving tools and installation of grooved piping products. Factory-trained representative shall periodically review the product installation. Contractor shall remove and replace any improperly installed products.

3.3 PRESS FIT SYSTEMS

A. Fittings and piping shall be joined in accordance with manufacturer’s installation guidelines.

1. Tubing shall be fully inserted into fitting.
2. Mark all tubes at shoulder of fitting.
3. Press joints using manufacturer approved tool.

B. All press fit systems shall have a preliminary water pressure test at 50 psi to confirm all fittings are properly pressed. This test is in addition to the that required by the system.

3.4 INSTALLATION OF SANITARY AND VENT PIPING

A. Couplings: Apply standard and heavy duty couplings as specified.

B. Gaskets: Install gaskets in accordance with manufacturer’s recommendations for the use of lubricants, cements, and other special installation requirements.

C. Joint Adapters: Make joints between cast iron pipe and other types of pipe with standard manufactured cast iron adapters and fittings.

D. Cleaning Piping:

1. Clear the interior of pipe of dirt and other superfluous material as the work progresses.
2. Place plugs in the end of uncompleted pipe at the end of the day or whenever work stops.

E. Test Plugs:

1. Provide test plugs in floor drains and roof drains at the time of installation.
2. Leave test plugs in place for the duration of construction until sewer or drainage system is complete.

F. Expansion:

1. Provide a vertical expansion joint at each connection to roof drain unless an offset is provided.
2. Where piping crosses building expansion joints, provide expansion joints to allow for building movement.
3. Refer to Section 22 30 00 for additional requirements.

G. Vent Flashing:

1. Provide 4 lb. sheet lead (24” x 24” minimum).
2. Extend lead 5” above the vent and turned down into vent pipe.

H. Vent Location: Do not install vents within 2 ft. of roof edge, parapet, wall line, or an “on-the-roof structure” and within 10 ft. of any air intake.

I. Do not support interior grease, sand or oil interceptors from floor extension. Provide supplemental support structure.

J. The size of storm, soil, waste, water, and vent piping shall be as determined by the local rules and regulations for plumbing and drainage, except where specifically noted to be larger by the Specifications or plans; and all fixed rules of installation as set forth in the Rules and Regulations shall be followed as part of the Specifications.

K. The Contractor shall examine carefully the architectural plans and details and familiarize himself with all conditions relative to the installation of piping, particularly where same is concealed behind furring or in hung ceilings. In no case shall the Contractor permit his pipes to be exposed beyond finished plaster lines unless specifically shown on Drawings. He shall consult with the other trades in the building and install his piping in such a way as to least interfere with the installation of other trades. All piping installed in finished areas shall be completed concealed within hung ceilings, furrings, soffits, pipe spaces, etc.

L. Branch connections of the drainage systems shall be made with "Wye" and long "Tee-Wye" fittings, short 1/4" bends, common offsets and double hubs will not be permitted. Short "Tee-Wye" fittings are to be used in vertical piping only.

M. Piping shall be installed, whether indicated or not, so as to clear any and all conduits, lighting fixtures, ductwork and heating mains, to maintain the desired clear heights. The Contractor shall consult with the other trades and facilitate the erection of the equipment and piping. Gravity systems shall have priority.

N. Run piping straight and as direct as possible, in general forming right angles with or parallel to walls or other piping. Risers shall be erected plumb and true.

O. After cutting, all pipes shall be reamed out to full bore and before erection the inside of all pipes shall be thoroughly cleaned.

P. No piping or work shall be concealed or insulated until all required tests have been satisfactorily completed and work has been approved by the Architect and all other authorities having jurisdiction.

Q. Cleanouts shall be provided at foot of all stacks, all changes of directions, at the ends of branch runs where shown, every 50'-0" and as required by Code, and shall be terminated as described under cleanouts.

R. The house drains must be run at a minimum grade of 1/8" per foot downward in the direction of flow. Wherever possible, a 1/4" per foot pitch shall be maintained. Branch connections to stacks from fixtures shall pitch 1/4" per foot where possible. Attention is again called to the necessity of maintaining the ceiling heights established. All piping installed in finished areas shall be completed concealed within hung ceilings, furrings, soffits, pipe spaces, etc.

S. Furnish and install complete systems of ventilating pipes from the various plumbing fixtures and other equipment to which drainage connections are made. Ventilating pipes shall be connected to the discharge of each trap and shall be carried individually to point 6” above the ultimate overflow level of the fixture before connecting with any other

vent pipe; in general, this will be approximately 3'-6" above the finished floor. Branches shall be arranged to pitch back to fixtures.

T. The individual vent pipes shall be collected together in branch vent lines and connected to vent stacks, in general paralleling soil and waste stacks. Wherever possible, vent stack offsets shall be made with 45 degree fittings. The heels of vent stacks shall be connected to adjacent soil stacks for purpose of draining condensation where possible. The waste of a fixture shall be connected to the base of each vent stack for the purpose of washing out any scales or dirt which may accumulate, or the soil stack shall be used to wash out the heel of the vent.

U. The tops of all soil and waste stacks shall be extended as additional ventilating pipes. The tops of all ventilating stacks shall run independently through the roof. Pipes smaller than 4" size shall be increased to 4" by means of approved increasers before passing through the roof slab.

V. Vent piping sized less than 1½" will not be allowed, even if shown on the drawings or permitted by Code.

W. All open vent pipes that extend through a roof shall be terminated at least 24 inches above the roof, except that where a roof is to be used for any purpose other than weather protection or maintenance, the vent extension shall be run at least 7 feet above the roof.

3.5 INSTALLATION OF STORM DRAINAGE PIPING (ABOVE GROUND WITHIN BUILDING)

A. Couplings: Use heavy-duty couplings on all no hub storm piping above grade. Do not use no hub couplings on piping more than 20 feet below the drain fixture unless offsets are made down through buildings in no more than 20 feet increments. Utilize galvanized steel pipe with screwed or grooved mechanical fittings.

B. Gaskets: Install gaskets in accordance with manufacturer's recommendations for the use of lubricants, cements, and other special installation requirements.

C. Joint Adapters: Make joints between cast iron pipe and other types of pipe with standard manufactured cast iron adapters and fittings.

D. Cleaning Piping:

1. Clear the interior of pipe of dirt and other superfluous material as the work progresses.
2. Place plugs in the end of uncompleted pipe at the end of uncompleted pipe at the end of the day or whenever work stops.

E. Test Plugs:

1. Provide test plugs in floor drains and roof drains at the time of installation.
2. Leave test plugs in place for the duration of construction.

F. Roof Drains:

1. Install drains on the center line of roofing reinforcement.
2. Clamp flashing into drain flashing collar.
3. Install domes immediately after completion of roof installation.

G. Expansion:

1. Provide a vertical expansion joint at each connection to roof drain unless an offset is provided.
2. Where piping crosses building expansion joints, provide expansion joints to allow for building movement.
3. Refer to Section 22 30 00 for additional requirements.

H. Downspout Nozzles: Install with flange secured to wall at base of concealed storm leaders that discharge through the building wall above grade.

I. Cleanouts shall be provided at foot of all stacks, all changes of directions, at the ends of branch runs where shown, every 50'-0" and as required by Code, and shall be terminated as described under cleanouts.

J. The house drains must be run at a minimum grade of 1/8" per foot downward in the direction of flow. Wherever possible, a 1/4" per foot pitch shall be maintained. Branch connections to stacks from fixtures shall pitch 1/4" per foot where possible. Attention is again called to the necessity of maintaining the ceiling heights established. All piping installed in finished areas shall be completed concealed within hung ceilings, furrings, soffits, pipe spaces, etc.

K. Piping shall be installed, whether indicated or not, so as to clear any and all conduits, lighting fixtures, ductwork and heating mains, to maintain the desired clear heights. The Contractor shall consult with the other trades and facilitate the erection of the equipment and piping. Gravity piping shall have priority.

L. Run piping straight and as direct as possible, in general forming right angles with or parallel to walls or other piping. Risers shall be erected plumb and true.

M. After cutting, all pipes shall be reamed out to full bore and before erection the inside of all pipes shall be thoroughly cleaned.

N. No piping or work shall be concealed or insulated until all required tests have been satisfactorily completed and work has been approved by the Architect and all other authorities having jurisdiction.

O. Branch connections of the drainage systems shall be made with "Wye" and long "Tee-Wye" fittings, short 1/4" bends, common offsets and double hubs will not be permitted. Short "Tee-Wye" fittings are to be used in vertical piping only.

P. Connection to roof drain shall be installed in conjunction with the roofing called for under another Division or Section of these Specifications and at such times as designated by this Contractor, so that the building is adequately protected during construction from damage by storm water. All piping shall be adequately and properly supported, and all joints shall be made up as hereinafter specified.

3.6 INSTALLATION OF SANITARY SEWER AND STORM WATER PIPING (EXTERIOR TO BUILDING)

A. Couplings: See Part 2 for use of couplings.

B. Lay piping true to the grades and alignment indicated with unbroken continuity of invert.

C. Install gaskets in accordance with manufacturer’s recommendations for the use of lubricants, cements and other special installation requirements.

D. Install cast iron hub and spigot pipe under roads and paved areas.

E. Clear the interior of piping of dirt and other superfluous material as the work progresses. Maintain a swab or drag in the line and pull past each joint as it is completed.

F. Place plugs in the end of uncompleted conduit at the end of the day or whenever work stops. All taps on active systems must be completed during the same day started.

G. Flush lines if required to remove collected debris.

H. Make joints between cast iron pipe and other types of pipe with standard manufactured cast iron adapters and fittings.

I. Grout joints between cast iron pipe and concrete pipes thoroughly with cement mortar to make watertight joint.

J. Inspect conduit to determine whether line displacement or other damage has occurred. Make inspection after lines between manholes, or manhole locations, have been installed and approximately 2 ft. of backfill is in place and at completion of the project.

K. If the inspection indicates poor alignment, debris, displaced pipe, infiltration or other defects, take whatever steps are necessary to correct such defects to the satisfaction of the Architect/Engineer.

L. Set grade cleanouts located in unpaved and asphalt paved areas in 12” x 12” x 4” concrete pad by this contract.

M. After trench has been excavated in accordance with these Specifications, pipes shall be carefully lowered by suitable rigging and placing as herein provided. Pipe shall not be rolled into trench.

N. The Contractor shall plug or cap any remaining open ends which result from the removal of existing pipe which is to be abandoned. The open ends shall be plugged or capped with cast iron plugs or caps. Live ends of pipe shall be plugged or capped and backed with concrete to provide sufficient bearing equal to the pressure in the pipe times the area of the pipe as directed by the Architect.

O. All water lines shall have at least 4'-0" cover at all points. These depths shall be increased where necessary for making connections or for avoiding subsurface structures, drainage, sewer or other facilities.

P. Piping shall be properly aligned, graded and supported. Piping shall be of correct lengths to permit the joints to be made up without springing or forcing. Change in direction shall be made by use of fittings. Piping shall not be deflected from a straight line at joints in either horizontal or vertical plane, except as authorized by the Architect, and not to exceed the recommendations of the manufacturer.

Q. The Contractor shall make all crossing as required by conditions encountered during construction at no additional expense to the Owner, including, but not limited to telephone conduits, cold water distribution, electric service, sanitary sewers, storm water drains and steam tunnels.

R. The work includes providing material and labor for the installation of elbows, tees, short lengths of pipe, concrete thrust blocks, concrete encasement or supports and such other incidentals which will provide an adequate clearance from an existing utility line and/or sufficient cover.

S. The Contractor shall be responsible for all damage to utilities and repair same at his own expense to the satisfaction of the Architect.

T. Provide vertical and horizontal separation between new sewers and water mains in accordance with Codes and Standards requirements.

U. Reaction or thrust backing shall be applied at all bends, tees, reducers, plugs, caps, valves and dead ends for the water main. Size and shape of concrete backing shall be as approved by the Architect, but in any case shall be sufficient to provide bearing equal to the pounds of pressure multiplied by the area of the pipe.

V. Backing shall be of concrete and shall be placed between solid ground and the fitting to be anchored. Backing shall be placed so that the pipe and fitting joints will be accessible for repair, unless otherwise directed by the Architect. Provide tie rods set into concrete.

W. From the center line of the pipe to a depth of one foot above the top of the pipe, the trenches shall be backfilled by hand with approved materials placed in 3 inch layers and hand tamped to compaction.

X. The Contractor for construction, excavation and demolition operations at or near underground facilities shall use Industrial Code 53 of Title 12, Rules and Regulations of the State of New York, to verify and/or locate existing utilities in the area of the proposed new utility services. The telephone number to contact Code 53 in New York State is 1-800-245-2828.

Y. At the completion of all new buried piping, the contractor shall provide a video of the interior of all of the new piping to verify integrity of joints.

3.7 THRUST BLOCKS

A. This Work shall cover the installation of concrete thrust blocks as shown on the plans or as required.

B. Thrust blocks shall be composed of concrete aggregates meeting ASTM Specification C-33 and Portland Cement meeting ASTM Specification C-150 Portland Cement or C-175 for Air Entrained Portland Cement. Mix shall not be leaner than 1 cement, 2-1/2 sand, 5 stone, having a compressive strength of not less than 200 psi in 36 hours when using high early cement and 7 days when using standard cement.

C. Thrust blocks shall be applied or ordered at bends, tees and hydrants where changes in pipe diameter occur at reducers or in fittings.

D. Thrust blocks shall be placed between solid ground and the fittings to be anchored. The area of bearing on fitting and on ground in each instance shall be that required by the Architect. The concrete shall be placed so that the pipe and fitting joints will be accessible for repair unless otherwise directed by the Architect.

3.8 PIPE ROUTING VERIFICATION

A. All drainable fixtures must have verification of proper routing.

B. Verification must be performed on all new construction and when existing systems are modified.

C. Verification must include positive identification using tracer dyes. Vassar College Customer Service must be notified prior to using dyes.

D. Vassar College personnel or a designated representative must witness verification testing.

E. Documentation of the dye test verification must be presented to Vassar College Environmental Health & Safety Office (EH&S). Forms are available from EH&S upon request.

3.9 TRAP PRIMERS

A. Install all trap primers and required distribution units as shown on plans and as required by manufacturers recommendations.

3.10 TRAP GUARDS

A. Install elastomeric trap guards in specified floor and sink drains as indicated on plans.

3.11 WARNING TAPE AND TRACER WIRE

A. Tracer Wire - #12 HMW-PE yellow jacket, 45 mil solid copper shall be installed to enable electronic locating of the utility.

B. Warning Tape

1. Colored plastic or metalized, installed 12 to 18 inches above all Utilities, but no less than 6 inches below grade.

2. Where required, use warning tape: (per AIA MssterSpec) Acid – and alkali-resistant Polyethylene film warning tape manufactured for marking and identifying underground utilities, 6 inches wide and 4 mils this, continuously inscribed with a description of the utility.

3. Tape Colors: Provide tape colors to utilities as follows:

Red: Electric

Yellow: Gas, oil, steam, and dangerous materials

Orange: Telephone and other communications.

Blue: Water systems

Green: Sewer systems

3.12 NON-CONDUCTIVE PIPING PROTECTION

A. Tracer Wire

1. A tracer wire shall be taped to the top center of all direct buried nonconductive utilities. This type of utility shall include, but not limited to, all plastic or FRP Pipes or conduits. This Specification also applies to storm drain and sanitary sewer pipes that do not run a straight line and/or both ends are not visible from the surface.

2. The tracer wire shall be terminated at a readily accessible location, reachable from above ground, and shall not be beyond reach in a confined area.

B. Warning Tape

1. In addition to the tracer wire all direct buried utilities must have a plastic warning tape. (See paragraph 3.10 above).

3.13 PEX SYSTEMS (ONLY WHERE APPROVED BY OWNER AND ENGINEER)

A. The installing contractor shall carefully examine the PEX tubing for defects, cuts, abrasions, cracks, fading color, or blemishes. There shall be no cracks or heavy deformations of the tubing. Fittings and manifolds shall be checked for any signs of abuse. Any damaged tubing or fittings shall be rejected.

B. Preparation

1. Viega PureFlow PEX tubing: Cross-linked polyethylene tubing shall be cut with a PEX tubing cutter. The tubing shall be cut squarely and neatly to permit a proper connection between the tubing and fitting.

C. Installation

1. Pressure rating: Install components having a pressure rating equal to or greater than the system operating pressure.

2. Install PEX tubing that is free of blemishes, cuts, gouges, kinks or noticeable fading of color.

3. Changes in direction: Install fittings for all changes in direction. PureFlow Press connections: PureFlow Press fittings shall be made in accordance with the manufacturer's installation instructions. The Stainless press sleeve shall be placed over the end of the squared off PureFlow PEX tubing while fully inserting the fitting barb into the tubing. Full tubing insertion shall be verified by a visual confirmation of PEX being present through the view holes before engaging a press connection. Full insertion for an attached sleeve connection means tubing must be completely visible in at least two view holes and partially visible in the final view hole. The PureFlow Press connection shall be made with a Viega supplied ratcheting PureFlow Press hand tool or PureFlow Press power tool.

4. Threaded joints: Threaded joints shall have a potable water listed joint sealant tape applied to the male threads only. Tighten joint with a wrench and backup wrench as required.

5. PEX tubing protection: Protect PEX tubing from exposure to direct and indirect sunlight exposure. PEX tubing shall be stored under cover, shielded from direct and indirect sunlight when material is stored for any length of time.

6. Penetration protection: Provide allowance for thermal expansion and contraction of PEX tubing passing through a wall, floor, ceiling or partition by wrapping with pipe insulation, or by installing through an appropriately sized sleeve. Penetrations of fire resistance rated assemblies shall maintain the rating of the assembly.I

7. Horizontal support: PEX tubing must be supported every 32" horizontally with Viega approved suspension clips or plastic insulators.

8. Vertical support: PEX tubing must be supported at each floor or ceiling penetration and every four feet in between.

END OF SECTION

SECTION 22 30 00

PLUMBING EQUIPMENT

PART 1 - GENERAL

1.1 SUBMITTALS

A. Submit manufacturer's product data for the following:

1. Domestic water heaters.
2. Domestic hot water storage tanks.
3. Pumps.
4. Sump Basins.
5. Warranty and service policies.
6. Escutcheons.
7. Traps.
8. Thermostatic mixing valve.
9. Unions.
10. Laundry Mate.
11. Hose Bibbs.
12. Wall Hydrants.
13. Thermometers.
14. Pressure Gauges.
15. Vacuum Breakers.
16. Fixed air gaps.
17. Hot water mixing valve station.
18. Flow control fittings.
19. Drains.
20. Thrust Blocks.
21. Manhole frames and covers.
22. Catch-basins and covers.
23. Tie-rods.
24. Water Meter(s)

1.2 WARRANTY

A. Water Heater and Storage Tank:

1. Furnish a certificate of warranty outlining heater manufacturer's lining warranty.
2. The warranty shall not be on a pro-rated basis.
3. The heater will have a five year service policy including labor, which will cover replacement labor and freight costs under certain conditions.
4. Initiation and/or continuation of warranty coverage shall not be dependent upon annual inspections, regular replacement of anode rods, or water chemistry.
5. Complete copies of all warranties and service policies, including all exclusions and conditions, will be presented to the owner as part of the submittal package.

B. Storage Tanks:

1. Linings for Storage tanks shall have a 15-year warranty covering manufacturing or material defects, leaks, and/or the production of rusty water.

1.3 QUALITY ASSURANCE

A. The water heater will operate at specified thermal efficiency when tested by an independent laboratory to ANSI Z21.10.3. The water heater shall comply with the thermal efficiency, standby loss, and all other requirements of the latest version of ASHRAE 90.1 and all state and local energy codes.

B. The water heater will be constructed and stamped in accordance with Section IV, Part HLW of the ASME code. The storage section of the water heater will be National Board Registered for a working pressure of 150 psi and will be pressure tested at 1-1/2 times working pressure. The heating section of the water heater will be National Board Registered for a working pressure of 150 psi and will be pressure tested at 1-1/2 times working pressure.

C. All water heaters used in food service applications shall be NSF approved.

D. Electric water heaters shall be U.L. listed.

PART 2 - PRODUCTS

2.1 ELECTRIC WATER HEATER

A. Manufacturers:

1. Design Basis: As scheduled on drawings
2. Other acceptable manufacturers:
   a. PVI
   b. State
   c. Rheem
   d. Rudd
   e. Bradford White
   f. A.O. Smith

B. Construction:

1. The storage section of the water heater shall be ASME HLW stamped and National Board Registered for a maximum allowable working pressure of 150 psi and pressure tested at 1-1/2 times working pressure.

2. All tank connections/ fittings shall be nonferrous. Tank shall be equipped with a ball-type drain valve. Tank design will include a manway sized access to the tank interior.

3. The storage tank shall be an unlined pressure vessel constructed from phase-balanced austenitic and ferritic duplex steel with a chemical structure containing a minimum of 21% chromium to prevent corrosion and mill certified per ASTM A 923 Methods A to ensure that the product is free of detrimental chemical precipitation that affects corrosion resistance. The material selected shall be tested and certified to pass stress chloride cracking test protocols as defined in ISO 3651-2and ASTM G123 - 00(2005) “Standard Test Method for Evaluating Stress-Corrosion Cracking of Stainless Alloys with Different Nickel Content in Boiling Acidified Sodium Chloride Solution.”

4. Waterside surfaces shall be welded internally utilizing joint designs to minimize volume of weld deposit and heat input. All heat affected zones (HAZ) shall be processed after welding to ensure the HAZ corrosion resistance is consistent with the mill condition base metal chemical composition. Weld procedures

(amperage, volts, welding speed, filler metals and shielding gases) utilized shall result in a narrow range of austenite-ferrite microstructure content consistent with phase balanced objectives for welds, HAZ and the base metal.

5. All internal and external tank surfaces shall undergo full immersion passivation and pickling processing to meet critical temperature, duration and chemical concentration controls required to complete corrosion resistance restoration of pressure vessel surfaces. Other passivation and pickling methods are not accepted. Immersion passivation and pickling certification documents are required and shall be provided with each product.

6. Materials shall meet ASME Section II material requirements and be accepted by NSF 61 for municipal potable water systems. Storage tank materials shall contain more than 80% post-consumer recycled materials and be 100% recyclable.

7. Water contacting tank surfaces will be non-porous and exhibit 0% water absorption.

8. Lined or plated storage tanks will not be acceptable.

9. Water heaters that require anodes will not be acceptable.

10. Heating elements will be rated at 9 kW and 40 watts per square inch heat density

11. Heating elements will be sheathed in Incoloy. Each element will individually mount to the tank by means of a four-bolt bronze flange over stainless steel studs with an o-ring seal. A fused magnetic contactor will be supplied for each power circuit. Maximum current per circuit will be 50 amps on three-phase units.

12. Water heater will meet the requirements of ASHRAE 90.1– 2010.

13. Water Heater Trim

    a. As a minimum, the heater will be equipped with the following:
        1) electronic low water cutoff
        2) an immersion operating thermostat
        3) immersion temperature limiting device
        4) an ASME rated temperature and pressure relief valve
        5) and options as selected on form PV 8130

    b. Operating and safety controls shall meet the requirements of UL

    c. The water heater shall employ an electronic operating control with digital temperature readout. Operator shall be capable of connecting to a building automation system through serial connection using Modbus RTU protocol.

    d. A protocol gateway for BacNet MSTP/IP will be provided

2.2 STORAGE TANKS

A. Domestic Hot Water Storage Tanks:

1. Manufacturers:
    a. Design Basis: PVI
    b. Other Acceptable Manufacturers:
        1) Rheem
        2) Rudd
        3) State

4) Cemline
5) Lochinvar
6) A.O. Smith

2. Type: Vertical
3. Construction:
   a. All tank connections/ fittings shall be nonferrous. Tank design will include a manway sized access to the tank interior.
   b. The storage tank shall be an unlined pressure vessel constructed from phase-balanced austenitic and ferritic duplex steel with a chemical structure containing a minimum of 21% chromium to prevent corrosion and mill certified per ASTM A 923Methods A to ensure that the product is free of detrimental chemical precipitation that affects corrosion resistance. The material selected shall be tested and certified to pass stress chloride cracking test protocols as defined in ISO 3651-2and ASTM G123 - 00(2005) “Standard Test Method for Evaluating Stress-Corrosion Cracking of Stainless Alloys with Different Nickel Content in Boiling Acidified Sodium Chloride Solution.”
   c. Waterside surfaces shall be welded internally utilizing joint designs to minimize volume of weld deposit and heat input. All heat affected zones (HAZ) shall be processed after welding to ensure the HAZ corrosion resistance is consistent with the mill condition base metal chemical composition. Weld procedures (amperage, volts, welding speed, filler metals and shielding gases) utilized shall result in a narrow range of austenite-ferrite microstructure content consistent with phase balanced objectives for welds, HAZ and the base metal.
   d. All internal and external tank surfaces shall undergo full immersion passivation and pickling processing to meet critical temperature, duration and chemical concentration controls required to complete corrosion resistance restoration of pressure vessel surfaces. Other passivation and pickling methods are not accepted. Immersion passivation and pickling certification documents are required and shall be provided with each product.
   e. Materials shall meet ASME Section II material requirements and be accepted by NSF 61 for municipal potable water systems. Storage tank materials shall contain more than 80% post-consumer recycled materials and be 100% recyclable
   f. Water contacting tank surfaces will be non-porous and exhibit 0% water absorption.
   g. Lined or plated storage tanks will not be acceptable.
   h. Storage tank will not require anodes of any type and none will be used.
   i. Insulation: Fiber glass per ASHRAE 90.1
   j. Jacket: Steel
   k. Finish: Baked enamel
   l. Working Pressure: 150 psig
   m. Working Temperature: 180º
4. Accessories:
   a. Tank drain.
   b. Thermometer with range from 30ºF to 200ºF.
   c. Temperature pressure relief valve.
5. Certification: ASME HLW stamped and National Board Registered
6. Warranty: 25 year coverage (15 years full, 10 years prorated)

B. Expansion Tanks:

1. Manufacturers:
   a. Design Basis: Amtrol, Inc.
   b. Other Acceptable Manufacturers:
      1) Taco
      2) GFC Corp
      3) J.J. Finnigan
2. Type: Diaphragm.
3. Design Temperature: 180º.
4. Design Pressure: 150 psig.

5. Precharge Pressure: shall match cold system static pressure at location of heater.
6. Liner: Rigid polypropylene.

2.3 PUMPS

A. General:

1. Statically and dynamically balance rotating parts.
2. Construction shall permit complete servicing without breaking piping or motor connection.
3. Pumps operate at 1750 rpm unless scheduled otherwise.
4. Pump connections shall be flanged.
5. For duplex sump pumps/sewage ejectors provide a remote mounted alternating panel.

B. In-Line Circulating Pumps:

1. Manufacturers:
   a. Design Basis: Bell & Gossett.
   b. Other Acceptable Manufacturers:
      1) Armstrong
      2) Taco
      3) Grundfos
2. Model Series: ecocirc XL B
3. Pump shall be Lead-Free Bronze Body Construction.
4. Description:
   a. Type: In-line circulating pumps.
   b. Casing: Lead-Free Bronze for 125 psi working pressure.
   c. Rotor: Permanent Magnet.
   d. Shaft: AISI 420 Stainless Steel.
   e. Bearings: Carbon Sleeve.
   f. Gasket/O-Ring: EPDM
   g. All Other Wetted Parts: AISI 304 Stainless Steel
   h. Motor Type: Electronically Commutated Motor / Permanent Magnets
   i. Motor Insulation Class: F
5. Maximum Working Pressure: 175 PSI
6. Maximum Working Temperature: 230 F
7. The pump shall have the following control modes built in:
   a. Constant speed
   b. Constant Pressure
   c. Proportional Pressure
   d. Night Mode
   e. Set Point Temperature
   f. Differential Temperature
8. Pump shall be furnished with an onboard user interface
9. Readings and settings on the pump:
   a. Control and display panel
   b. Operating status
   c. Warning and alarm
   d. Errors and working log history
   e. Dry running detection
10. Input/Output
    a. 2x analog inputs (0-10v / 4-20mA)
    b. 1x external temperature sensor input
    c. 1x start/stop input
    d. 1x status output

e. Pump shall have the ability to communicate with the BMS system.

C. Oil-Minder Sump Pumps (Elevator Pits):

1. Manufacturers:
   a. Design Basis: Stancor
   b. Other acceptable manufacturers:
      1) Weil
2. Provide pump and control systems capable of pumping water while containing oil. The system shall function automatically and shall provide for an alarm and separate LED lights in the event of:
   a. The presence of oil in the sump
   b. High liquid in the sump, or
   c. High amps or a locked rotor condition.
3. LED lights shall be provided for:
   a. Power
   b. Pump run function.
4. Pump:
   a. The pump shall be a submersible type, capable of pumping up to 37' TDH and 74 GPM.
   b. The pump shall be approved to UL 778 standards and shall include thermal and overload protection.
   c. The motor shall be rated ½ H.P., 1 phase, 115V and capable of operating continuously or intermittently.
   d. The motor housing shall be constructed of #304 stainless steel and mechanical seats shall be housed in a separate oil-filled compartment.
5. Control:
   a. The main control shall be approved to UL 508 standards and housed in a gasketed Nema 4X enclosure with a see-through window for observation of operating functions.
   b. The control shall be equipped with an 8-pin twist lock receptacle, dual solid state Oil-Minder relays with variable sensitivity settings, an over current relay, self-cleaning stainless steel sensor probe, high decibel warning horn with alarm silencing switch, dual floats, clearly marked terminal board and remote monitoring contact.
   c. A Nema 4X junction box with 8-pin twist-lock electrical receptacle and 25' (additional lengths available in 25' increments) of mating 8 conductor cable shall be provided.
   d. All cables between the pump and junction box shall be 16' long and the cable and plug from the control unit shall be 8' long.
   e. The control unit, junction box, pump, floats and sensor shall be factory assembled as a complete, ready-to-use system and shall be tested and approved as a complete system by a nationally recognized testing laboratory.
   f. The system shall allow for the main control to be located outside of the elevator hoistway to be monitored for all functions without having to enter the elevator shaft.

D. Sump Basins:

1. Acceptable Manufacturers:
   a. AK Industries.
   b. Topp Industries.
   c. Fiberbasin Incorporated.
2. Material: Fiberglass reinforced polyester.
3. Minimum Wall Thickness:
   a. At Flange: ½"
   b. At Hubs: 3/8"
   c. Other Areas: 3/16"
   d. Top flange to be extended for support to suspend unit from structural slab.
4. Connections: To accommodate piping shown on drawings.
5. Cover Attachment: Tapped bronze inserts in flange for bolt down cover.
6. Size: As shown on drawings, or, if not shown, of size determined by pump manufacturer.

7. Basin Cover:
   a. Material: Steel.
   b. Provision for Lifting: Ring or handle.
   c. Cut-Outs: For removal of cover without disturbing piping or wiring.

2.4 PIPE EXPANSION COMPENSATORS

A. Any breaks or damage to the piping system or to the Work of other Sections within the period of the guarantee due to improper provision for expansion and contraction must be replaced at this Contractor's expense.

B. This Contractor is to provide for expansion of pipes by providing expansion compensators and/or expansion loops and shall provide anchors at pump discharge and suction line. All expansion loops shall be pre-stressed.

C. Make adequate provisions for proper expansion and contraction of piping. At connections of branches to water mains, risers and at connections to heaters, coolers and other equipment, provide sufficient number of elbow swings to allow for proper expansion and contraction of piping. Provide adequate elbow swings, expansion compensators, expansion loops or approved type extension joints, wherever noted, indicated, or required to allow for proper expansion and contraction of mains and risers.

D. This Contractor shall provide, where necessary to absorb expansion and contraction in hot water recirculation, pipe lines (except at building expansion joints) 3 inches and smaller and for system pressure less than 50 psi, Flexonics Model HP expansion compensators having two-ply phosphor bronze elbows and brass shrouds and end fittings, as manufactured by U.O.P. Flexonics Division, Bartlett, Illinois. All internal parts shall be of non-ferrous metals. Service pressure shall be external to the bellows. Compensators shall have integral guides extending the full length of the bellows travel. Compensators shall have external positive anti-torque devices to prevent twist.

E. This Contractor shall provide as shown on the plans and/or where necessary to absorb expansion and contraction in hot, hot water recirculation and larger and for system pressures exceeding 50 psi, Flexonics controlled-flexing expansion joints as manufactured by U.O.P. Flexonics Division, Bartlett, Illinois, or approved equal, with plate steel flanges having ANSI drilling, pipe nipple ends beveled for welding, by hydraulically formed from a stainless steel reinforcing neck ring and control rings shall be of a design to limit movement of each corrugation, as well as to carry hoop stresses caused by internal pressures. Where required, the bellows shall be annealed and/or stress relieved. Before assembly, the corrugated bellows must be pickled to remove all scale formed by annealing and passivated to provide that maximum corrosion resistance.

F. All lines in which expansion joints are installed must be securely anchored and guided in accordance with Manufacturer's recommendations.

G. Provide expansion loops/joints in all hot water and hot water circulating piping which exceeds 145 feet developed length, horizontally or vertically without offsets, and as indicated on the drawings.

2.5 ESCUTCHEONS

A. This Contractor shall provide escutcheons on all exposed pipe wherever they pass through floors, ceilings, walls or partitions.

B. Escutcheons for pipes passing through outside walls shall be Ritter Pattern and Casting Co., No. 1, solid, cast brass, flat type secured to pipe with set screws.

C. Escutcheons for pipes passing through floors shall be Ritter Pattern and Casting Co., No. 36A, split hinged, cast brass chromium plated type.

D. Escutcheons for pipes in unfinished areas shall be cast iron, secured with set screws.

2.6 TRAPS

A. Each fixture and piece of equipment requiring connection to the drainage system shall be separately trapped by means of a water seal trap placed as close to the fixture as possible.

B. All running traps on drains, etc., shall have inlet handhold cleanouts and brass plug cleanouts in bottom. Cast iron trap in ground shall have bottom plug omitted. All exposed P traps shall have bottom cleanouts and shall be chromium plated brass.

2.7 THERMOSTATIC MIXING VALVE

A. For Gang lavatories with single mixing valve: Primary/Master Mixing Valve: Leonard Model TM-186-1520B-LF-CP-BWE-EXP-TOP. Valve assembly shall be listed to ASSE 1017 and 3rd party approved as lead free. Valve shall be rated to 125 psig, 1¼" inlets and 1½" outlet, 1 GPM minimum flow and 80 GPM flow capacity at 15 psi system pressure drop. Valve shall include a dial thermometer and ball valve on the outlet, locking temperature regulator, adjustable limit stops set for 120°F (49°C), and integral hot and cold supply check stops. Valve shall be factory pre-assembled and tested, chrome plated finish. Bi-metal thermostat shall be warrantied for a minimum of 10 years. Provide a baked white enamel, surface mounted cabinet including 16 gauge body, 12 gauge door, hinged left hand door with cylinder lock where indicated on drawings.

B. For individual lavatory sinks: Temperature Limiting Devices: Leonard Model 170-LF (3/8"). Valve shall be listed to ASSE 1070 and 3rd party approved as lead free. Valve shall be rated to 125 psig, 3/8" inlets/outlet, 0.25 GPM minimum flow and a maximum of 2.7 GPM flow capacity at 15 psi system pressure drop. Valve to include locking temperature regulator and integral hot and cold supply checks. Valve options maybe include a dial thermometer, ball valve on the outlet, chrome plated (-CP) finish. Bi-metal thermostat shall be warrantied for a minimum of 10 years.

C. For individual hand sinks: Temperature Limiting Devices: Leonard Model Model 270-LF (1/2"). Valve shall be listed to ASSE 1070 and 3rd party approved as lead free. Valve shall be rated to 125 psig, 1/2" inlets/outlet, 0.25 GPM minimum flow and a maximum of 7.5 GPM flow capacity at 15 psi system pressure drop. Valve to include locking temperature regulator and integral hot and cold supply checks. Valve options maybe include a dial thermometer, ball valve on the outlet, chrome plated (-CP) finish. Bi-metal thermostat shall be warrantied for a minimum of 10 years.

D. Temperature Limiting Devices: Leonard Model 170-LF (3/8"), Model 270-LF (1/2") or Model 370-LF (3/4"). Valve shall be listed to ASSE 1070 and 3rd party approved as lead free. Valve shall be rated to 125 psig, 3/8" inlets/outlet (170-LF), 1/2" inlets/outlet (270-LF), 3/4" inlets/outlet (370-LF), 0.25 GPM minimum flow (170-LF and 270-LF) or 0.5 GPM minimum flow (370-LF) and a maximum of 2.7 GPM flow capacity at 15 psi system pressure drop (170-LF) or 7.5 GPM (270-LF and 370-LF). Valve to include locking temperature regulator and integral hot and cold supply checks. Valve options maybe include a dial thermometer, ball valve on the outlet, chrome plated (-CP) finish. Bi-metal thermostat shall be warrantied for a minimum of 10 years.

E. Provide a ASSE 1070 thermostatic mixing valve at each public lavatory whether indicated or not.

2.8 UNIONS

A. Where required: On inlet and outlet of all apparatus and equipment having connections 2" and smaller. Where valves are adjacent to equipment unions shall be on downstream side of valves.

B. Type:

1. Steel piping: Malleable iron, WOG female pattern, brass seat, ground joint, 300 lb.
2. Copper tubing: Ground joint, 150 lb. WOG pattern.
3. For piping over 2" flanged joints to be used.

C. Gaskets shall be 1/16" thick similar to Garlock or Cranite factory cut, one piece.

2.9 HOSE BIBBS

A. Hose bibbs shall be Chicago Faucets #952, MIFAB #HY-9241, or approved equal, with vacuum breaker and loose key except as specified herein. Combination hot and cold hose bibbs shall be Chicago #305-VBC.P., MIFAB #HY-8500, or approved equal; modify for piped mounting less loose flange.

2.10 WALL HYDRANTS

A. Provide 3/4" non-freeze wall hydrants where indicated on Drawings. Wall hydrants shall be Zurn A-1315, MIFAB MHY-15 or approved equal, all bronze with bronze working parts throughout, renewable nylon seat, nickel bronze face.

2.11 THERMOMETERS

A. Thermometers shall be the adjustable angle, red reading mercury type with 7" black baked enamel case, black on white scale, range from 30˚F. to 240˚F., and separable brass socket. Thermometers shall be so installed and adjusted that they are easily readable from a normal standing position on the floor, U.S. Gauge "Multi-angle".

2.12 PRESSURE GAUGES

A. Pressure gauge shall have 3-1/2" diameter black enamel cast aluminum case threaded brass ring with heavy glass, phosphor bronze bushed rotary precision movement and dial range of 0 to 200 psi for water service; Trerice Co. No. 500X or approved equal, with brass tee handle cock.

2.13 FIXED AIR GAPS

A. Provide where indicated on the Drawings or required by Code a fixed air gap to prevent contamination due to back flow in the stationary drain line. Air gap shall be Zurn No. Z-1025 or MIFAB MI- CAG to suit piping installation. Finish shall match piping connection.

2.14 HOT WATER MIXING VALVE STATION

A. Primary/Master Mixing Valve: Leonard Model TM-186-20200B-LF-CP-BWE-EXP-TOP. Valve assembly shall be listed to ASSE 1017 and 3rd party approved as lead free. Valve shall be rated to 125 psig, 2” inlets/outlet, 1 GPM minimum flow and 129 GPM flow capacity at 15 psi system pressure drop. Valve shall include a dial thermometer and ball valve on the outlet, locking temperature regulator, adjustable limit stops set for 120°F (49°C), and integral hot and cold supply check stops. Valve shall be factory pre-assembled and tested, chrome plated finish. Bi-metal thermostat shall be warrantied for a minimum of 10 years.

B. Where identified on the drawing, Primary/Master Mixing valve shall be Powers Model LFIS150VL. Lead free digital water temperature control and monitoring system shall feature full-color touchscreen interface which is configurable on location and does not require factory pre-programming. System shall control water temperature to +/- 2°F in accordance with ASSE 1017 and during periods of low/zero demand and feature a user-programmable high temperature alarm. Unit shall feature Feed Forward or Predictive Control which anticipates changes in system demand and adjusts valve pre-emptively to maintain mixed set point. Controller shall be password protected and feature a user-adjustable outlet temperature range of 80 - 180°F and an approach temperature of 2°F. System shall digitally monitor inlet pressure and temperature, mixed outlet temperature, mixed outlet set point, pressure and flow/BTUs, as well as return temperature without the use of an external module. System shall control an engineer specified recirculation pump based on user-set return temperature limits. Controller shall integrate with building automation systems through Bacnet and Modbus protocols and feature local and remote temperature alarms. System will also feature a user-set and controlled, high-temperature sanitization mode for use as part of user’s safe and properly designed thermal bacteria eradication protocol. In the event of a power failure or loss of cold water,

system will close the hot water supply. System should be mounted on a heavy-duty welded strut with corrosion resistance coating and factory tested as a complete unit.

C. Where identified on the drawing, Primary/Master Mixing valve shall be Powers Model LFIS075VL. Lead free digital water temperature control and monitoring system shall feature 3.5" full-color touchscreen interface which is configurable on location and does not require factory pre-programming. System shall control water temperature to +/- 2°F in accordance with ASSE 1017 and resist "temperature creep" during periods of low/zero demand. Controller shall be password protected and feature a user-adjustable outlet temperature range of 60 – 180°F with high and low temperature alerts, and an approach temperature of 2°F. System shall digitally control and monitor mixed outlet temperature. Controller shall integrate with building automation systems (separate module not required) through BACnet and Modbus protocols and feature local and remote temperature alarms. System shall provide monitoring and visibility of mixing valve assets across multiple locations/sublocations. System shall offer the ability to remote temperature control for owner and admin levels. App shall be capable of sending system alerts via text and/or email and prioritizes alerts based on levels of safety and potential liability. System offers three user levels for security. System will feature a user-set, high-temperature sanitization mode for thermal disinfection of bacteria and a programmable temperature set back feature to improve energy efficiency. System will also feature high speed actuator with override feature. In the event of a power failure, system will open full cold supply. In case of a loss of cold water, the system will close hot water supply.

D. Hot water mixing system shall be listed/approved to ASSE 1017, cUPC, NSF, CSA 24/UL873 and BTL (BACnet Testing Laboratories)

2.15 FLOW CONTROL FITTINGS

A. Provide flow control fittings as manufactured by the Dole Valve Company or approved equal. Flow control valves are to be installed in accordance with the manufacturer's recommendations and shall be provided for all sinks, lavatories and electric water coolers.

B. All Lavatories: Dole Model #FMA 3/8" male pipe inlet and 3/8" female pipe outlet for rigid hot and cold supply risers. Flow rate 0.5 gpm.

C. All sinks including equipment with sinks, mop receptors, service sinks and kitchen sinks, showers: Dole Model #FMC male pipe inlet and 1/2" female pipe outlet for hot and cold supply risers. Flow rates 4 gpm for service sinks and mop receptors 3 gpm for kitchen and casework sinks, 2.5 gpm for showers.

D. Electric Water Coolers: Dole Model #F3/4C male pipe inlet and 3/8" female pipe outlet for cold supply riser. Flow rate 0.5 gpm.

E. All exposed to view flow control fittings shall be chrome plated nickel, or nickel plated.

2.16 DRAINS

A. Drains shall have heavy cast iron, with double drainage flange and weep holes, with outlet connections as indicated and of sizes indicated on Drawings. Drains (except as noted) shall be furnished with high polished brass tops consisting of one-piece rim secured to the body and vandalproof spanner type screws, solid brass grate with reinforcing members on underside. Removable sediment basket shall be of heavy duty one-piece construction as specified hereinafter. All strainers or grates shall be secured with vandalproof spanner type screws, unless otherwise specified.

B. All drains in membrane waterproof floor shall be equipped with 6 lb. lead flashing or 20 oz. soft rolled sheet copper and secured to the flashing flange with brass bolts and cast iron clamping device. Flashings shall bond not less than 1'-0" on all sides into membrane waterproofing.

C. On roofs, furnish and set, in conjunction with the roofer, and when directed by the General Construction Contractor, approved roof drains of cast iron unless otherwise indicated.

D. Flashing of 6 lb. or 20 oz. soft rolled sheet copper 34" x 34" shall be furnished and installed at each roof drain by means of non-puncturing type flashing clamping device.

E. Set all drains in such a way that the floor finish and top of the drain will be plumb and flush with finish floor without requirements for future additional extension, modifications, etc.

F. When Dex-O-Tex and/or vinyl waterproof floor is indicated on the Architectural Drawings, all drains must be provided with required flanges.

G. Provide trap primers in all locations where a hose bib is not shown within 10' of a drain.

H. All drains, except as noted, shall be similar to or equal to Zurn, J.R. Smith, Josam, Wade or Ancon and shall be as follows:

1. Roof Drains R.D. - Similar and equal to no. Z-100-ERC or MIFAB #R 1200 BUV dura-coated cast iron body with combination flashing collar and gravel stop, cast iron dome, underdeck clamp and sump receiver and perforated extension collar to accommodate roof insulation. Drain must be applicable for each roof construction.

2. Floor Drains F.D. (Mechanical and Concealed Equipment Rooms) - Similar and equal to No. Z-505 or MIFAB #F1340-Y-14-4-F-50 Funnel cast iron body and flashing collar with cast iron tractor grate and flat bottom strainer. No. Z-414 cast iron funnel attached to grate, where indicated on the Drawings.

3. Floor drains F.D. (Finished Area, Shower, etc) - Similar and equal to No. ZN-415-B cast iron body, flashing collar, square nickel bronze top and ZN-414 funnel or MIFAB #F1100 C S5-1 F – 4 -1 funnel attached to grate where indicated on the Drawings.

4. Floor Drains F.D. (Kitchen) - Similar and equal to No. Z-525 or MIFAB #F1100 C S8-1 cast iron body, flashing collar, adjustable square nickel bronze top, flat bottom strainer.

5. Floor Sink F.D. - Similar and equal to No. ZN-1815-4 or MIFAB #FS 1720-22 cast iron porcelain enameled, with dome strainer, flashing flange with nickel bronze grate.

6. Area Drains F.D. - No. Z-550 or MIFAB #F1320 CY-14-1 cast iron, Duracoated, bottom outlet, non-puncturing flashing clamp device, extension, non-tilting grate with minimum free drainage area of 27 sq. inches. Drains in finished areas shall have polished nickel bronze top and grate.

7. Drain in Trenches F.D. - Z-615 or MIFAB #F1440-90-C-4-5 - Site outlet and modified to 12" open top drain, cast iron, with sediment bucket.

8. Floor Drains:

   a. Refer to Architectural drawings for exact locations and additional installation requirements.
   b. Install floor drains with P-traps and vent as required.
   c. Install drains on the center line of sheet lead pan and/or membrane in waterproofed areas and in floors above lowest floor.
   d. Clamp pan and/or membrane into drain flashing collar.
   e. Install strainers immediately after completion of finish floor installation.
   f. Coordinate locations with mechanical equipment.
   g. Install trap primers at all drains where a hose bib is not shown within 10' of drain.
   h. Provide extra heavy duty grates/strainers in locations subject to vehicular traffic.

2.17 TIE-RODS

A. Provide tie-rods for the site water main.

B. Tie-rods shall comply with NFPA 24, Specification and pipe manufacturer's recommendations.

C. Special consideration shall be given at the service entrance to the building. Provide auxiliary ties to the foundation wall, to equalize building and pipe settling.

PART 3 - EXECUTION

3.1 DOMESTIC HOT WATER HEATER

A. Installation:

1. Install water heaters level and plumb in accordance with manufacturers' written instructions and referenced standards.
2. Make connections between water heaters and domestic water piping system with dielectric unions.
3. Install isolation valves at both cold water and hot water connections to water heater.
4. Furnish and install copper drain piping from temperature and pressure relief valve for water heater. Furnish drain full size of relief valve opening and extend as indicated.
5. Furnish and install acid neutralizer, if required by manufacturer. Pipe discharge of neutralizer to drain to nearest floor drain or approved receptacle.

B. Adjusting:

1. Provide start-up and adjustment by factory authorized personnel. A copy of the start-up report shall be provided to the owner.
2. Upon completion of water heater installation, verify satisfactory control operation under maximum demand conditions as recommended by manufacturer.
3. Adjust discharge water temperature as required. Make control adjustments required.

C. Start-up:

1. Start up on the unit will be performed by factory trained and authorized personnel. A copy of the startup report will be provided to the owner.

3.2 STORAGE TANKS

A. Install storage tank level and plumb in accordance with manufacturers written instructions and referenced standards.

B. The storage tank shall be completely factory packaged on a single skid, requiring only job site hookup to plumbing. The heater shall be insulated to ASHRAE 90.1-2010 requirements, jacketed with enameled steel panels, and mounted on heavy-duty channel skids. The heater shall fit properly in the space provided and installation shall conform to all local, state, and national codes.

3.3 IN LINE CIRCULATING PUMPS

A. Install pumps to allow complete removal without dismantling connecting piping. Provide air cock and drain connection on horizontal pump casings.

B. Provide line sized gate valve and strainer on suction and line sized soft seated check valve and globe valve or plug valve on discharge.

C. Support pump and piping so that weight of pipe is not carried on pump casing. Additionally, support such that neither pump nor piping is supported by associated equipment.

D. Provide manual switch and aquastat where required.

E. Verify motor position is in accordance with manufacturer's installation instructions.

3.4 SUMP PUMPS

A. Provide union in discharge piping above floor.

B. Provide gate valve above floor.

C. Provide lift check valve close to pump discharge.

D. Install and adjust float control.

E. Test pump staging and float operation by flooding pit to simulate operation. Test shall be observed by Engineer or Owner Representative.

F. The alignment of all pumps shall be checked and each pump shall be properly aligned after the piping is completed and before the pumps are placed in service.

G. Mechanical seals and shaft sleeves shall be replaced by this Contractor without charge in the event the unusual wear of faulty operation occurs during guarantee period.

H. Where pump's components are or may come in contact, although the materials may basically be similar, use hardness differentials of at least 50 Brinell to prevent seizure and reduce wear.

I. Provide shaft packing or seals compatible with the pump design, fluid handled and in accordance with the manufacturer's recommendations.

J. Balance pump's impellers and all other moving components statically and dynamically.

K. Completely align and level pumps, motors and bases. Where pumps and motors are shipped as a unit, realign them in the field.

L. Grout equipment base plates completely to provide a rigid-non- deflecting support.

M. Install and align mechanical seals in accordance with the manufacturer's recommendation.

N. Provide water supply for cooling and lubrication of seals and/or packing where required.

O. Provide flexible connection for pumps. Provide spring hangers for piping for pump to partition or wall penetration.

P. Pump operation must be stable without pulsation, vibration or internal recirculation. Pump operating characteristic curves must meet the following requirements:

1. The pump operating point must fall on or below an impeller diameter curve which is not more than 85% of the maximum diameter impeller which can satisfactorily operate in the casing.
2. The pump operating point must fall below the point of no flow head pressure.
3. Pump operating point must be to the right of the midpoints of the peak efficiency curves. Selected efficiency shall be not more than 3% points below maximum efficiency.

4. A 10% increase in head pressure over the specified will result in not more than a 20% reduction in GPM and will not affect the stability of the pump

Q. Where initial and ultimate operating conditions are specified, these shall be achievable by changing the pump impeller with no modifications to the casing.

R. Upon completion of the installation, test all equipment under field operating conditions to demonstrate capability of the equipment to meet specification requirements.

S. Submit results of factory tests with the equipment shop drawings. Include result of factory and field tests in the Instruction Manual.

T. Perform field tests to demonstrate the ability of the pumping equipment to meet contract requirements. Compile and certify the following data:

1. Water flow, GPM, at rated head.
2. Shutoff head.
3. Operating kilowatts for measured voltage, amperes, power factor.

3.5 DRAINS

A. Contractor shall protect drains immediately upon installation. Drain grates shall be covered throughout construction to prevent construction debris from entering the drainage system.

B. Contractor shall test all drains just prior to turnover to confirm all drains, traps and pipes are clear and draining properly.

C. Drains, traps and pipes that are found to be clogged upon testing shall be cleaned and/or replaced, water jetted and scoped by a camera immediately, at no additional cost to the owner.

D. The contractor shall be responsible for a set period of time after project completion to clean drains, traps and pipes that do not appear clogged upon testing.

END OF SECTION

SECTION 22 30 01

COPPER SILVER IONIZATION SYSTEM

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes commercial copper silver ionization equipment.
   1. Provide complete commercial-type copper silver ionization treatment system for Legionella control within the building's water system. Designed for both continuous and proportional automatic operation. The system shall include a full assembly with flow cell(s), controller(s), flow meter, flow switch, remote monitoring system, copper piping, shut-off valves, drain valves, balancing valves, support stand, and all devices necessary for fully operational system.

B. The entire system (electronic control unit, flow cell(s), and interconnection wire) shall be ETL (UL-979 Water Treatment Appliances, UL-508 Industrial Control Equipment, and UL-1081 Swimming Pool Pumps, Filters, and Chlorinators), and CSA C22.2 (No. 14 Industrial Control Equipment; No. 108 Liquid Pumps, and No. 68 Motor Operated Appliances) certified.

C. The system shall be capable of true closed loop proportional control. Proportional control is defined as the ability to automatically, incrementally, and instantaneously adjust the output of the copper and silver ions proportionate to flow rates (water consumption) measured by a flow meter. The system shall maintain a constant level of required copper/silver ions and prevent over or under ionization during high and low water consumption periods.

1.2 SUBMITTALS

A. Submit manufacturer's product data for the following:

   1. Manufacturer's name
   2. Engineering Data Sheet.
   3. Product Data: Include efficacy data, operating characteristics of selected models, rated capacities, furnished specialties, accessories, and weights (shipping, installed, and operating)
   4. Shop Drawings:
   5. Wiring diagrams detailing field-installed wiring for power and controls.
   6. EPA Certificate of Compliance
   7. NSF Certificate of Compliance
   8. Installation and Operation Manual
   9. Maintenance Program: Maintenance Services specified in this Section
   10. Warranty: Special warranty specified in this Section
   11. Water Quality Report: Water Quality Test specified in this Section
   12. Submit manufacturer's product data for the following:

1.3 QUALITY ASSURANCE

A. The entire system (electronic control unit, flow cell(s), and interconnection wire) is ETL (UL-979 Water Treatment Appliances, UL-508 Industrial Control Equipment, and UL-1081 Swimming Pool Pumps, Filters, and Chlorinators), and CSA C22.2 (No. 14 Industrial Control Equipment; No. 108 Liquid Pumps, and No. 68 Motor Operated Appliances) certified.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for the intended use

C. Codes and Standards

   1. CSA Compliance in accordance with CSA C22.2 No. 14, No. 68, and No. 108

2. EPA Compliance in accordance with EPA Office of Prevention, Pesticides, and Toxic Substances
3. NSF Standard: Provide system constructed in accordance with NSF/ANSI Standard 61
4. UL Compliance listed and labeled in accordance with UL 979, UL 508, UL 1081 requirements

D. ASHRAE: Comply with ASHRAE Standard 188: Legionellosis: Risk Management for Building Water Systems

E. State Requirements: System shall comply with local state requirements

F. Listing and Labeling:

1. The terms "listed" and "labeled" shall be as defined in the National Electrical Code, Article 100

G. Manufacturer/Product Selection: The Drawings indicate sizes, profiles, and dimensional requirements of copper silver ionization systems. Copper silver ionization systems having equal performance characteristics with deviations from indicated dimensions and profiles may be considered, provided deviations do not change the design concept or intended performance. The burden of proof of equality is on the proposer

1.4 WARRANTY

A. Provide standard product warranty for copper silver ionization system including:

1. 5 year warranty on all non-consumable components that fail in materials or workmanship

1.5 MAINTENANCE SERVICE

A. Agreement to Maintain: Prior to Substantial Completion, submit 4 copies of Manufacturer's "Agreement for Continued Service and Maintenance" for copper silver ionization system, for Owner's acceptance. Offer terms and conditions for furnishing chemicals and providing continued testing and servicing to include replacing materials and equipment. Term of agreement shall be for 1 year with option for one-year renewal. Services shall include:

1. Monthly copper/silver level testing
2. Quarterly legionella testing (e.g. test legionella levels at most remote sink)
3. Maintenance of copper silver ionization system to ensure proper operation

1.6 SPARE PARTS

A. Provide owner with one spare copper silver ionization flow cell per installed flow cell.

PART 2 - PRODUCTS

2.1 ELECTRIC WATER HEATER

A. Manufacturers: LiquiTech

2.2 GENERAL DESCRIPTION

A. Factory-assembled, commercial copper silver ionization systems having capacities and for electrical characteristics indicated Product Data Submittal

2.3 COPPER SILVER IONIZATION SYSTEM

A. General: Single or multiple flow cells with the capabilities to ionize the total capacity of the required system as scheduled on the drawings

B. Flow Cell

1. Flow cell shall have a minimum working pressure of 150 PSI at 150°F.
2. Flow cell shall include consumables with the composition set by the manufacturer based on the water quality

C. Flow Cell Fittings

1. Flow cell fittings shall include two (2) CPVC threaded adaptors shipped loose, sized to the corresponding flow cell, and shall be installed by the installer

D. Flow Meter

1. Flow meter shall be manufactured from aluminum
2. Flow meter shall be ultrasonic, non-invasive, transit time flow meter
3. Flow meter shall be able to measure water consumption and provide digital read out via the digital display
4. Flow meter shall be shipped loose and shall be installed by the installer

E. Controller

1. Controller shall be high speed switching power supply up to 10 amps at 100 V DC, closed loop proportional controller, metal powder coated cabinet with 3/16 inch tempered glass inset on door, NEMA 12, operating temperature of 32°F to 131°F. 120/240 V, 60 Hz, single phase.
2. Controller shall aggregate monitoring points via the output from the manufacturer interface that communicates to both a remote telemetry and management system (REMS) platform (for remote monitoring) and visually on the local control panel. Controller shall monitor at a minimum the following system parameters:
   a. System Amps
   b. System Volts
   c. System Water Usage
   d. System GPM
3. Controller shall be capable of true closed loop proportional control. Proportional control is defined as the ability to automatically, incrementally, and instantaneously adjust the output of the copper and silver ions proportionate to flow rates (water consumption) measured by a flow meter. The system shall maintain a constant level of required copper/silver ions and prevent over or under ionization during high and low water consumption periods.
4. Controller shall be configured, controlled, and monitored from either the local control panel, or remotely (Building Management System) via 4-20 mA inputs and outputs
5. Controller shall include dry contacts for alarm conditions to connect to BAS

F. Remote Telemetry and Management System (REMS)

1. REMS shall allow for 24/7 monitoring of system: inputs and outputs, alarm conditions, control parameters, and copper/silver output and is communicated directly with Manufacturer’s remote cloud based interface

2.4 ACCESSORIES

A. Threaded rods to provide additional support for each flow cell.

2.5 WATER TESTING SETS

A. Provide complete water testing set for each flow cell including but not limited to:

1. Thermometer and standard operating procedure for proper water testing and verification/validation of the system (Third party testing/verification/validation services can be sourced through the manufacturer)

PART 3 - EXECUTION

3.1 WATER QUALITY TEST

A. Prior to purchase/ordering of copper silver ionization system, contractor, at their own expense, shall collect water sample and send to manufacturer for final selection. Copy of water quality test shall be provided with official submittal to engineer

B. When submitting water quality test, also utilize manufacturer specific “engineering data sheet” with all required information filled out

3.2 INSPECTION

A. Examine areas and conditions under which copper silver ionization system is to be installed, and substrate which will support the copper silver ionization system. Do not proceed with work until unsatisfactory conditions have been corrected in a manner acceptable to owner, design engineer, and equipment supplier

3.3 CONNECTIONS

A. Water Distribution Piping: The Drawings indicate the general arrangement of piping, fittings, and specialties. The following are specific connection requirements:

1. Install piping adjacent to maintain services clearances per manufacturer’s recommendations
2. Connect copper water piping to units with shutoff valves, balancing valves, and unions. Additionally, provide a full-size valved bypass with balancing vales around unit
    a. Where copper silver system piping connections are dissimilar metals, install dielectric unions for joints 2” and smaller and install dielectric flanges for joints 2-1/2” and larger.
3. Install drains as indirect wastes to spill into open drains or over floor drains

B. Grounding: Connect unit components to ground in accordance with the National Electrical Code

3.4 INSTALLATION

A. Install copper silver ionization system in accordance with manufacturer’s installation instructions, and with State and local code requirements.

B. Layout: Flow cells shall be installed downstream of any softeners, if applicable. There shall be isolation valves and bypass so that the flow cell can be completely isolated from the water system during maintenance. These valves shall be separate from any balancing valves installed on the flow cell. There shall be a shut off valve for the bypass line.

C. Location: Flow cell shall not be located near electrical boxed or outlets and in a location where it is easily accessible for maintenance by a technician standing on the floor. It should be positioned no more than 54” above the floor. Controller shall be mounted to ensure there is adequate space to open the controller door and service the controller.

D. Design: Locate on the domestic hot water return system, limiting the flow rate through the flow cell to a maximum of 25 gpm if required. System shall be installed with a bypass that allow the domestic hot water return to operate during times of maintenance.

E. Design: Shut off, drain, and vent valves shall be installed before and after the flow cell for maintenance by a technician

F. Orientation: Flow cell shall be mounted vertically and have adequate clearance for maintenance by a technician.

G. Alignment: Flow cell shall be aligned with the female couplers within 0.125 inches in both the axial and lateral directions.

H. Support: Pipes leading into and out of the flow cell shall be rigidly braced and supported to prevent vertical, horizontal, and lateral movement during maintenance. Flow meter shall be mounted and braced so that it will not move.

I. Support: Threaded rods shall be installed through flange bolt holes connecting top and bottom flanges to prevent both axial spread and lateral movement.

J. Electrical: There shall be a dedicated 110/220 volt power source with dedicated 20 amp supply available for each controller.

K. Internet: There shall be access to a LAN port to allow the system to sync with REMS for remote capabilities.

3.5 FIELD QUALITY CONTROL

A. Flush and clean copper silver ionization system upon completion of installation, in accordance with manufacturer's startup instructions

B. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.

C. Operational Test: After electrical circuitry has been energized, stat units to confirm proper unit operation.

D. Sample copper silver ionization system effluent at one week intervals after start-up, for period of 3 weeks and prepare certified test report for each required water performance characteristic

3.6 DEMONSTRATION

A. Startup Services: Provide the services of a factory-authorized service representative or manufacturer to provide start-up service and to demonstrate the operation of the equipment, accessories and controls

B. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment

3.7 STARTUP

A. Startup of copper silver ionization systems shall occur after hot water system is operational

B. Startup schedule shall be as follows:

1. Weeks 1 & 2:

a. Customer training.

1) General: At a time mutually agreed upon between the Owner, Contractor, and Manufacturer, the Manufacturer shall provide the services of a factory trained and authorized representative to train Owner's designated personnel for a minimum of four hours on the operation and maintenance of the equipment provided under this section.
2) Content: Training shall include but not be limited to:

a) Overview of the system and/or equipment as it relates to the facility as a whole.
b) Operation and maintenance procedures and schedules related to startup and shutdown, troubleshooting, servicing, preventive maintenance and appropriate operator intervention.

c) Review data included in the operation and maintenance manuals. Refer to Division 1 Section "Operating and Maintenance Data."

3) Certification: Manufacturer shall submit to the Contractor a certification letter stating that the Owner's designated representative has been trained as specified herein. Letter shall include date, time, attendees and subject of training. The certification letter shall be signed by the Manufacturer and the Owner's representative indicating agreement that the training has been provided.

4) Schedule: Contractor shall schedule training with Owner with at least 21 days' advance notice to the Manufacturer.

b. Perform baseline copper tests
c. Startup system in continuous control mode. Slowly increase output over several days
d. Establish a copper level – 0.20 to 0.40 ppm higher than baseline

2. Week 3 & 4

a. Allow system to level off. Fine tune if necessary
b. Owner shall sample the treated water and provide samples to a laboratory to perform copper/silver tests, ICP (inductive coupled plasma) or AA (atomic absorption) – fine tune if necessary. Laboratory testing shall be part of service agreement paid for by the owner, if service agreement is chosen.

3. Weeks 4, 5, & 6

a. Remove flow cells and inspect. Removal of flow cells and inspection shall be part of service agreement paid for by the owner, if service agreement is chosen.
b. Establish cleaning frequency (per discussion between owner and Manufacturer)

C. Perform the following before start-up final checks in the presence of an authorized factory representative:

1. Water piping systems tests completed.
2. Check for piping connections leaks.
3. Test operation of safety controls and devices.

D. Perform the following start-up procedures in the presence of an authorized factory representative:

1. Energize circuits.
2. Adjust operating controls.

E. Certification: Contractor shall submit to the Engineer a certification letter stating that the system has been installed and tested per the manufacturer's installation instructions and signed by the authorized factory representative.

3.8 CLOSEOUT PROCEDURES

A. Owner's Instructions: Provide services of manufacturer's technical representative for up to 48 hours on site time to accomplish the following:

1. On site prior to copper silver ionization system to correct discrepancies
2. Copper silver ionization startup
3. Set up and program controller supplied with copper silver ionization system
4. On site for Owner training
5. Schedule training with Owner, provide at least 14 day notice to Contractor and Engineer of training date.

3.9 MAINTENANCE

A. Service provider shall provide equipment maintenance program for copper silver ionizations equipment.

B. Maintenance program shall include, at minimum, the following timeframes of activities:

1. Weekly – Water usage and flow monitoring and flushing protocols;
2. Monthly - Exchange of copper silver ionization flow cells for preventative cleaning;
3. Monthly - Copper Silver Ion testing in plumbing piping system to ensure program validation;
4. Quarterly - Legionella testing for program validation;
5. Annually – Manufacturer staff engineer to perform annual site visit to examine copper silver ionization system, ensure consistent operation, train facility staff, and answer questions;
6. As Needed - Recalibration of each flow cells once a year;
7. As Needed – Replacement of consumable copper silver bars to maintain effectiveness and efficacy of the system;

C. Maintenance program shall include remote monitoring services provided by manufacturer to ensure equipment functionality;

END OF SECTION

SECTION 22 40 00

PLUMBING FIXTURES

PART 1 - GENERAL

1.1 SUBMITTALS

A. Submit manufacturer's product data for plumbing fixtures and accessories, in accordance with Division 1.

PART 2 - PRODUCTS

2.1 GENERAL

A. All manufacturers are listed in alphabetical order and not by preference.

B. Provide factory fabricated fixtures.

C. Provide trim, carriers, valves and accessories as required for complete installation. All carriers are floor mounted unless otherwise noted. All carriers shall be bolted down to floor structure.

D. Comply with Local, State and Governing ordinances concerning maximum water requirements of plumbing fixtures: Tank type W.C. and flush valve type W.C. = 1.1- 1.6 gal./flush; lavs =0.5 GPM; urinals = 0.05- 1.0 gal./flush and showers = 2.5 GPM. Fixture performance shall be better than code limits where specified fixture offers improved performance.

E. All fixtures used for potable water service should be compliant with NSF-61. Provide fixtures which meet or exceed standards of the Federal Reduction of Lead in Drinking Water Act, Safe Drinking Water Act and Lead Contamination Control Act, NSF Standard 61, Section 9. All components in the waterway to be lead free.

F. See Architectural Drawings for fixture requirements. Fixtures specified in this plumbing specification shall be provided only if a suitable fixture is not specified in the architectural drawings or specifications.

2.2 PLUMBING FIXTURES

A. Refer to Architectural drawings for design basis of all plumbing fixtures.

B. All fixture trimmings, including faucets, strainers, escutcheons, shower head and arm, water closet supplies, stops, waste trap, escutcheons, visible hanger or chair carrier nuts shall be made of brass and shall be polished chromium plated. All material to be specified as chromium plated and shall be thoroughly and evenly applied and guaranteed not to strip or peel. All chromium plating on plumbing fixture trim shall be in accordance with Federal Spec. WW-P-54lb for grade "R" plating. Manufacturer shall submit certification that all chrome plating on finished trim meets aforementioned Federal Specification. All plated work shall be highly buffed. Plastic, zinc or white metal will not be approved.

C. All fixtures shall be free from imperfections, true as to line, angles, curves and color, smooth, watertight, nameplate in every respect and practically noiseless in operation. Fixtures as specified are given as a typical standard and they or other approved fixtures shall be furnished, set and connected in good substantial, neat and workmanlike manner.

D. All fixtures, specified to be vitreous ware, shall be fixed vitreous china ware of the best quality, non-absorbent and burned so that the whole mass is thoroughly fused and vitrified, producing a material white in color which, when fractured, will show a homogenous mass, close grained and free from pores. The glazing and vitreous china fixtures shall be white, thoroughly fused and united to the body, without discoloration, chips, or flaws, and shall be free from

craze. Warped or otherwise imperfect fixture will not be acceptable.

E. Each supply fixture, casework fixture and equipment, shall be separately controlled by its own stops. Locate as required on wall, above floor or as directed.

F. All faucets shall have metal handles.

G. All trim shall be permanently stamped with manufacturer's identification and visible after installation.

H. All fixtures, faucets, flush valves, etc., are to be ADA compliant, unless specifically noted otherwise.

2.3 WATER CLOSETS

A. Design Basis: As scheduled

B. Flush Valve: As scheduled

C. Combination water closet carriers and drainage fittings shall be Zurn Z-1203 and 1204 Series, MIFAB MC -10 L /R or MC -13 R/L, or approved equal with feet bolted to construction.

2.4 WATER CLOSET SEATS

A. General Construction: Unless otherwise specified seats shall be heavy duty solid plastic, have molded-in bumpers, concealed self-sustaining check hinge with stainless steel posts and pintles. Seat shall have an antimicrobial compound as an integral part of the plastic and shall match shape of bowl (elongated or regular).

2.5 LAVATORIES

A. Design Basis: As scheduled

B. Faucet: As scheduled

C. Unless otherwise specified, all lavatories are white.

D. Provide offset P traps on all ADA lavatory installations similar to American Standard 7723.018 grid strainer, polished chrome finish.

E. McGuire Mfg. TPC20FR (Pair) 1/4" offset threaded tailpieces.

F. McGuire Mfg. LF165LK (Pair) 3/8" SPS wall supplies with loose key stops with McGuire Manuf. 127038 cast brass set screw escutcheons.

G. McGuire Mfg. 8902C, 1-1/4" x 1-1/2" chrome plated cast brass "P" trap with cleanout plug.

H. McGuire Mfg. 2127C, 1-1/2" SPS chrome plated brass trap nipple and cast brass set screw escutcheon.

I. Supported on Zurn ZX-1231 or MIFAB MC – 41 (250 - lbs - load) concealed chair carrier with concealed arms and block feet bolted into construction.

J. All exposed piping serving plumbing fixtures that may be used for ADA purposes shall have traps and supplies insulated per ADA requirements.

2.6 MOP SINK BASIN

A. Design Basis: As scheduled

B. Faucet: As scheduled

C. Drain: Stainless steel, flat strainer, 3" IPS.

D. All mop sink faucets shall have a vacuum breaker and integral check valves.

E. Faucet shall be chrome plated with pail hook.

2.7 SHOWERS

A. Design Basis: As scheduled

B. Features: Single handle, automatic pressure and temperature balancing, and volume control, forged brass body with ceramic valving, adjustable temperature stop and polished chrome handle.

C. Heads and Arm: Polished chrome plated brass.

D. Shower valves shall turn off from hot to cold.

2.8 STAINLESS STEEL SINKS

A. Design Basis: As scheduled

B. Faucet: As scheduled

C. Mounting: Countertop, self-rimming.

D. Trap: 1½" adjustable, cast brass.

E. Stops: Loose key, ½" FPT, flexible supply, flange.

F. Provide chrome plated brass tailpiece and grid strainer.

2.9 ELECTRIC WATER COOLERS

A. Design Basis: As Scheduled

B. Industry Standards: Provide water coolers with UL and ARI labels, and which meet or exceed standards of the Safe Drinking Water Act and Lead Contamination Control Act, NSF Standard 61, Section 9. All components in the waterway to be lead free.

C. Accessories:

1. Automatic pressure regulator.
2. Stop and supply.
3. Cast brass P-trap.
4. Front push button activation.
5. Removable grid strainer.
6. Provide bottle filler when indicated.

D. Required mounting frame.

E. Evaporator and Chiller: All copper construction.

F. Finish: Heavy gauge stainless steel with No. 4 satin finish.

G. Units to meet all NSF and ADA standards.

H. Coordinate with Division 26 for power connection

2.10 BATHTUB

A. Design Basis: As scheduled

B. Faucet: As scheduled

C. Symmons "Visu-Temp" #1-2110VT tub-shower control unit or Leonard Model # 6700 – S D2L – HO3 – TS.

D. McGuire Mfg. trip lever waste and overflow.

2.11 EQUIPMENT FURNISHED UNDER OTHER SECTIONS

A. Provide all materials necessary to make final connections to equipment furnished under other Sections of these Specifications including:

1. Tail pieces
2. Stops
3. Supplies
4. P traps, standard and/or offset
5. Escutcheons

B. All fixture trimmings, including faucets, strainers, escutcheons, shower head and arm, water closet supplies, stops, waste trap, escutcheons, visible hanger or chair carrier nuts shall be made of brass and shall be polished chromium plated. All material to be specified as chromium plated and shall be thoroughly and evenly applied and guaranteed not to strip or peel. All chromium plating on plumbing fixture trim shall be in accordance with Federal Spec. WW-P-54lb for grade “R” plating. Manufacturer shall submit certification that all chrome plating on finished trim meets aforementioned Federal Specification. All plated work shall be highly buffed. Plastic, zinc or white metal will not be approved.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General: Install each fixture with P trap with cleanout plug, easily removable for servicing and cleaning.

B. Provide chrome plated, rigid supplies to fixtures with stops, reducers and escutcheons. Flexible supplies will not be permitted.

C. Finish wall and floor penetrations when exposed to view in finished areas with set screw type, chrome plated brass escutcheons.

D. Set plumbing fixtures level and plumb, spaced in accordance with architectural dimensioned drawings, and securely install to be rigid. Install wall mounted lavatories, urinals and water closets with wall carriers mounted to the floor. Solidly attach floor mounted carriers for all fixture to floor using proper fasteners based on floor construction. Securely anchor flush valves behind or within walls to be rigid and not subject to movement due to push or pull action on the valve.

E. Cover fixture bolts with china bolt caps of the same color where required.

F. All wall mounted fixtures to be caulked between fixture and wall.

G. Refer to Architectural drawings and ADA standards for fixture mounting heights.

H. The Contractor shall make all plumbing connections to all equipment and fixtures requiring such connections as shown on Drawings whether the equipment and fixtures are furnished under this Section or other Divisions or Sections. Investigate the equipment furnished under other Divisions or Sections to determine if combination fittings have a means of shutoff or required the installation of check valves, backflow preventors and/or pressure reducing valves. Make final connections to such, including installations of all special traps, supplies, control valves, etc. furnished with such equipment, and furnish all material necessary that is not supplied with the equipment.

I. The Contractor shall leave valved water connections in equipment spaces and other locations where shown for the use of other trades or other Sections. On each valved outlet for equipment with submerged inlets, provide a backflow preventor after the shut-off valve. .

J. Fixture supplies and traps as specified, shall be chrome plated brass, where exposed to view. Where concealed from view in cabinets, etc., they may be rough brass. All fixture supplies shall have stops.

K. As soon as installed, all metal fixture trimming shall be thoroughly covered by this Contractor with noncorrosive grease which shall be maintained until all construction work is completed.

L. Upon completion of the Work, test flush valves and faucets for leaks or drips and adjust same for quiet operation.

M. All fixtures shall be left thoroughly clean. All plated or polished fittings, pipes and appliances shall be coated with non corrosive grease, immediately after installation, and shall be finally polished and free from all marks and foreign substances.

N. Equipment and all connections shall be in accordance with the rules relative to submerged inlets, and shall be provided with all necessary vacuum breakers and check valves, in accordance with the applicable codes.

O. Connection between any fixture with a floor outlet and the flange shall be made with an approved prepared gasket that shall be a germicide, absolutely gas and fumeproof, watertight, stain-proof, containing neither oil nor asphaltum, and which will not rot, harden or dry under any extreme of climate change, and must adhere on wet surfaces.

P. Each fixture shall be separately trapped, using the type and size of trap called for specifically in the Specifications, or the type required by the Plumbing Code. The traps shall be approved type.

Q. All fixtures requiring hot and cold water shall have the cold water faucet on the right hand side of the fixture and the hot water faucet on the left hand side of fixture.

R. The Contractor shall be responsible for protecting against injury from the building materials, acids, tools and equipment, all plumbing fixtures equipment, etc., provided under Plumbing Work Sections.

S. No slip joints will be permitted on water piping.

T. Double compartment sinks or lavatories shall be provided with faucet, trap, supplies, etc., for each compartment.

U. Funnel drains and/or floor drains shall be provided for the air conditioning, heating and refrigeration work as required.

3.2 CLEANING AND ADJUSTING

A. Cleaning:

1. Clean strainers, traps, aerators, and valves of debris, sand and dirt.
2. At completion, thoroughly clean plumbing fixtures and equipment.
3. All fixtures shall be left thoroughly clean. All plated or polished fittings, pipes and appliances shall be coated with Vaseline, immediately after installation, and shall be finally polished and free from all marks and foreign substances.

B. Adjusting:

1. After cleaning and flushing operations are accomplished, adjust flush valves, faucets, showers, bubblers for proper flow.

3.3 PROTECTION

A. Protect fixtures and related components from damage before, during, and after installation to date of Final Acceptance or Owner move-in. Provide protective coverings or other protection as required.

B. Inspect each installed unit for damage to finish. If feasible, restore and match finish to original at site; otherwise, remove fixture and replace with new unit. Feasibility and match to be judged by Architect or Engineer.

C. Remove cracked or dented units and replace with new units.

D. Contractor shall be responsible for replacing damaged fixtures or components.

3.4 SERVICES TO FIXTURES AND EQUIPMENT FURNISHED UNDER OTHER SECTIONS

A. The list of equipment for the project shall be reviewed by this Contractor, who shall include in the Contract price the costs for installing all equipment as herein specified and as claimed by the Trade Unions as Plumbing Work.

B. Refer to Architectural and Plumbing Drawings for exact locations of equipment and fixtures. Provide all materials, equipment and appliances necessary and required to complete the installation of all Hospital casework and equipment, including but not limited to the following: plumbing, roughing and final connections, valves, stops, trim, escutcheons, fittings, traps, etc. Install faucets, trim, etc., furnished with the equipment provided by others.

C. Unless otherwise detailed on Drawings, roughing of proper size and capacity for equipment indicated on Architectural, Heating and Ventilation, Plumbing or Electrical Drawings or provided under another Division or Section shall be provided and installed in such a manner and location that final connection can be made with a minimum of work and without cutting patching permanent walls, partitions, ceilings or floors. Drawings are of necessity, schematic, for special equipment as exact roughing and requirements may vary with different manufacturers.

END OF SECTION

SECTION 22 55 22

ELECTRIC HEATING CABLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. The requirements of the General Conditions, Supplementary Conditions and Division 26 Materials and Methods, Grounding, and Wires and Cables.

1.2 SUMMARY

A. Furnish and install all electric heating cable systems as specified herein and as required for freeze protection, and heating of piping, valves, fittings, drains, etc., as indicated on the Drawings. Division of work shall be as follows:

1. Plumbing and HVAC Contractors shall provide the heating cables and power distribution panels with alarm breakers, and ground fault protection.
2. The Electrical Contractor shall receive the power distribution panels and heating cables from the plumbing Contractor and install and provide power wiring to the heat trace cables.
3. The Temperature Controls Contractor shall provide and install low voltage wiring to the BMS system and assign alarm points for each panel.

1.3 REFERENCE STANDARDS

A. Each electric heating cable system and all components shall be designed, manufactured and tested in accordance with the latest applicable UL, NEMA, and ANSI Standards as well as NFPA 70 - National Electrical Code (NEC) UL508A, with City of New York Amendments.

B. All equipment and material to be furnished and installed on this Project shall be UL or ETL listed and bear an MEA listing as necessary for the City of New York in accordance with the requirements of the authorities having jurisdiction, and suitable for its intended use on this Project.

1.4 SUBMITTALS

A. The following submittal data shall be furnished according to the General Conditions and shall include, but not be limited to:

1. Electric Heat Tracing System including cables, fittings, thermostats, installation details, circuit capacities, operational details, power distribution panel for group control, etc.

B. Submit Shop Drawings for review prior to installation. Shop Drawings shall show the overall system and each circuit, control locations, cable lengths, current required for each circuit and feed points. Provide a summary sheet of the entire system with capacity data for each line, valve, etc. See Section 26 05 02 for Shop Drawing requirements.

1.5 WARRANTY

A. Comply with the requirements of the General Conditions and Section 26 05 02.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Manufacturers:

1. Design Basis: Chromalox
   a. Model: SRL – Self-Regulating Low Temperature.

2.2 ELECTRIC HEAT TRACING SYSTEM FOR WATER PIPING

A. Heat tracing system shall be designed to maintain the water temperature within the piping to at least 40ºF, but not greater that 80 ºF, with an ambient temperature of 0ºF. The piping will be insulated as specified in Division 22 in Section titled “Plumbing Insulation”.

B. Heating cables shall be UL listed electrical heating strips. The electric heat tracing may be a self regulating type of parallel circuit construction consisting of a continuous inner core of self regulating conductive material between two parallel copper bus wires suitable for operation on 120, 208 or 277 Volts, 60 hertz, single phase power. The heat tracing strips shall be capable of being cut to the desired length in the field. Operating energy shall be conserved by the self regulating feature of the heater materials, which automatically controls heat output in proportion to the heat requirement.

1. Self regulating at all points along its length.
2. 90% power reduction from 40ºF pipe temperature to 150º pipe temperature.
3. No overheating if crossed.
4. Provide outer jacket and braided copper shield for use inside roof drain leaders or on piping without a ground path.
5. UL listed and approved for use in New York State.
6. Provide tee, splice, and end seal kits as required by the manufacturer.
7. Provide digital thermostat in a NEMA 4x enclosure, with 30 amp solid state relay.

C. The heat trace cabling shall be controlled by a digital thermostat (Chromalox model DTS) specifically designed and built dedicated for heat trace systems. The thermostat shall include a 30A solid state relay, 120 volt 1 phase power, selectable soft start, programmable high & low alarms, and internal pipe stand.

PART 3 - EXECUTION

3.1 SCOPE AND REQUIREMENTS

A. Furnish and install a complete electric heating cable system, including but not limited to cable, panels, ambient air sensors, aquastats, and controls, on all water piping, fittings, drains, valves, and valve bonnets as indicated on the Drawings. The Electrical Subcontractor shall coordinate the cable installation with the Mechanical and Plumbing Subcontractors. See drawings for scope and locations.

B. All installation and materials furnished shall meet the NEC requirements and be Underwriters Laboratories listed for the application.

C. The installation and all materials, conductors, conduit, etc. utilized between the electric heating cable system, controls and distribution panels shall be as specified.

D. After the piping has been successfully pressure tested, heating cables shall be installed parallel to the pipe or by spiraling the strip to obtain the heating capacity required. All cables and components shall be installed as recommended by the manufacturer by properly trained personnel using the manufacturer specified tools and procedures and as specified herein. The heating cables shall be banded to the pipe with fiberglass tape per manufacturer recommendations. After the piping has been insulated, appropriate caution signs or markings shall be provided at frequent intervals along the pipeline in accordance with NEC requirements.

E. Heat trace cable shall be installed by a licensed electrician. Plumbing contractor shall subcontract this work to a licensed electrician if plumbing contractor is not a licensed electrician.

F. Apply the heat trace cable on the pipe after pressure testing.

1. Do not spiral wrap on pipe.
2. Make one wrap at valves.
3. Secure to pipe with methods approved by manufacturer.

G. Apply warning labels required by NEC code every 10 feet of linear heat trace visibly located outside of the insulating jacket. These labels also provide an area to write circuit information.

H. Heat trace shall be sized as follows, based on 0ºF ambient, to maintain 40ºF pipe temperature:

PIPE SIZE	1" INSULATION	2" INSULATION
Less than 2"	3 w/ft.	3 w/ft
2", 2½", 3"	5 w/ft	3 w/ft
4", 5", 6"	8 w/ft	5 w/ft
8", 10", 12"	(2 cable circuits) 8 w/ft ea.	8 w/ft

I. Provide heat tracing on all pipes installed within the intake, relief and exhaust shafts.

J. Provide heat trace on all pipes installed in enclosed perimeter shafts where separated from the exterior only by precast panels.

K. The Electrical Subcontractor shall test all electric heating cable systems for short circuits, grounds and insulation resistance. Test with 1000 VDC to a minimum resistance of 20 mega ohms.

3.2 FIELD TESTING

A. Refer to Section 26 05 03 for additional testing requirements for electric heating cable systems.

END OF SECTION

SECTION 22 90 00

PROJECT CLOSEOUT

PART 1 – GENERAL

1.1 WORK INCLUDED

A. The contractor shall summarize and document adherence with the requirements of the specifications for project closeout including:

1. Copies of all warranties
2. Operation & Maintenance Manuals
3. Required tests
4. Test and balance reports
5. Record drawings
6. Permit requirements
7. Valve tag list

B. The contractor shall compile a closeout manual which shall include:

1. A list of all required tests and a place for signoff of date completed.
2. A list of all submittals with dates of acceptance by the engineer.
3. A schedule indicating dates for beginning testing and startup of equipment and dates of tests to be witnessed by the engineer, or designated representative, as required by the specifications.
4. Test procedures to be used for life safety systems.
5. Project close out check list.

C. The final closeout manual shall include the following:

1. Test reports as required by the specifications with signoff by the appropriate individual (engineer, architect, building official, etc.).
2. Documentation indicating all equipment is operating properly and is fully accessible for maintenance.
3. Copies of all warranties.

D. This section only includes the requirements for documentation of the contract documents, by the contractor, for project completion. This section does not in any way decrease the scope of any of the drawings or specifications.

1.2 SUBMITTALS

A. Within 90 days after notice to proceed submit a preliminary closeout manual with the following:

1. A list of all required tests.
2. Preliminary schedule showing major milestones for completion of the plumbing systems.

B. Within 30 days of the first major milestone submit the completed closeout manual as described in Part 1.

C. Within 2 weeks of substantial completion submit a completed “Project Closeout Check List”, and the Final Closeout Manual.

D. Listed below is a checklist for use by the contractor. This list is not all inclusive for this project.

Project Close-Out Summary – Plumbing

- ☐ All required submittals have been submitted and either been approved or modified in accordance with the Engineer's "make corrections noted" comments.
- ☐ All equipment has been started up and is functioning within manufacturers' recommendations without any undue noise or vibration. (Submit a list of equipment with startup dates. Provide list at a point 65% into construction schedule).
- ☐ All vibration isolation has been installed and is operating properly.
- ☐ Access doors have been installed as required for concealed equipment, water hammer arrestors, valves, controls, actuators, etc.
- ☐ All equipment has been installed with the manufacturers recommended service clearances and is fully accessible for required maintenance.
- ☐ All equipment and piping is labeled per specifications.
- ☐ All action items are complete as listed in the action items reports. Submit a list of action items with sign off by Architect or Engineer for record. Punch list to be completed prior to turn over of building.
- ☐ Contractor to test all drains to verify that they are clear and draining properly upon project completion.
- ☐ Operation and maintenance manuals submitted with table of contents and required documentation for extended warranties.
- ☐ Factory Testing documented and submitted for record.
- ☐ Record drawings submitted per specifications.
- ☐ PART 2 – PRODUCTS (Not Used)

PART 3 – EXECUTION

3.1 EQUIPMENT STARTUP AND TESTING

A. Prior to completion and punchlist by the engineer, the contractor shall startup and test each piece of equipment as required by the specifications. The contractor shall provide documentation of all required tests with signoff of by the appropriate individual (engineer, architect, and building official).

3.2 COORDINATION WITH OTHERS

A. The Division 21 through 23 contractor shall coordinate his requirements with the General Contractor to ensure the other building systems are completed to the point that they will not adversely affect the operation of the Division 21 through 23 systems.

3.3 PUNCH LISTS

A. The contractor shall submit in writing that the project is ready for final review by the engineer.

B. Once the project is ready for final review the engineer will create a punch list of any corrections or deficiencies.

C. The contractor shall complete all punch list items and provide a letter to the architect after completion stating all items have been completed or reasons why they were not completed.

D. Upon receipt of this letter the engineer will verify that the punch list has been satisfactorily completed.

END OF SECTION