## 22 0520 – Plumbing Design Criteria

1. Design Statement

    a. The new Plumbing systems shall have the following characteristics:

        i. Protection of the public water supply.

        ii. User safety and comfort.

        iii. Universal accessibility.

        iv. Energy responsiveness.

        v. Flexibility for future changes.

        vi. Durability

        vii. Protection from forming condensation

        viii. Ease of maintenance.

        ix. Reliability and redundancy.

    b. Every effort will be made to design, layout and install equipment in locations which will tend to encourage routine preventive maintenance by providing unencumbered access for maintenance personnel for operation, maintenance and replacement. Manual isolation valves will be provided to enable servicing, expansion of, renovation or construction of any part of the existing facility without interruption of services in adjacent areas.

2. All systems, equipment and fixtures shall be designed in accordance with the Massachusetts State Building Code, Massachusetts State Plumbing Code, applicable local Codes and Ordinances, the Owner's Design Guidelines, and good engineering practices.

3. The project shall purchase (furnish and install) domestically-produced products for all systems when possible.

4. Commissioning

    a. The Design Team shall provide fully integrated design documents to ensure all required Contractors are responsible for supporting the Commissioning activities for the proposed systems to be commissioned.

b. The Design Team shall coordinate with the project Commissioning Agent to incorporate all of their testing requirements into the contract specifications.

5. Sustainable Design Initiatives

   a. Plumbing systems and equipment with particular emphasis on sustainable design but are not limited to, the following:

      i. Premium Efficient Motors

      ii. Low Flow Plumbing Fixtures

      iii. Low VOC Sealants and Adhesives

      iv. Construction IAQ Management Plan

      v. Local Lab Vacuum Systems vs whole building distribution

      vi. Lab air, local lab systems

         1. All efforts shall be made for Lab spaces to have their own dedicated air compressor rather then using house air system.

6. Coordination of Work

   a. The project shall compare plumbing drawings and specifications with those of other disciplines and report any discrepancies between them to the project manager and obtain from the Architect written instructions for changes necessary in the mechanical or electrical work, to ensure that all work is installed in coordination and cooperation with other disciplines installing interrelated work. Before installation, the project shall make proper provisions to avoid interferences in a manner approved by the project manager. and equipment shall be adjusted to accommodate the new work with interferences anticipated and encountered during installation. The project team shall determine the exact routing and location of systems prior to fabrication or installation of any system component. Accurate measurements and coordination drawings are to be completed to verify dimensions and characteristics of the various systems' installations.

   b. Lines which pitch shall have the right-of-way over those which do not pitch. For example, waste piping shall normally have the right-of-way. Lines whose elevations cannot be changed shall have the right-of-way over lines whose elevations can be changed.

   c. Offsets, transitions and changes of direction in all systems shall be made as required to maintain proper headroom and pitch of sloping lines whether or not indicated on the drawings. The project team shall provide manual air vents and drains as required for his work to affect these offsets, transitions and changes in direction, as applicable.

d. All work shall be installed in a way to permit access (without damage to other parts) of valves, cleanouts, shock absorbers, traps and all other system components provided under this Contract requiring periodic replacement or maintenance. All piping shall be arranged in a manner to clear the openings of swinging overhead access doors, ceiling tiles and cleaning access doors in ductwork.

    i. Access to any and all components requiring servicing, adjustment, calibration, maintenance or periodic replacement shall be provided so that the Owner's operations personnel can freely gain access without removal of any materials other than the access panel or ceiling tile. Access shall be understood to mean free, clear and unobstructed from the floor up to the device and/or component being serviced.

    ii. Fire-rated access doors with closers shall be provided for all rated assemblies.

e. The Contract Drawings are diagrammatic only intending to show general runs and locations of piping, valves, equipment and specialties and not necessarily showing all required offsets, details and accessories and equipment to be connected. All work shall be accurately laid out with other disciplines to avoid conflicts and to obtain a neat and workmanlike installation which will afford maximum accessibility for operation, maintenance and headroom.

f. Discrepancies in scope of work as to who provides items, such as starters, disconnects, flow switches, electric control components, etc., shall be reported to the project team prior to signing of the Contract.

g. Where drawing details, plans and/or specification requirements are in conflict and where pipe is shown to be different between plans and/or between plans and sections or details, the most stringent requirement will apply. Plumbing systems and equipment called for in the specification and/or shown on the drawings shall be provided under this Contract as if it were required by both the drawings and specifications. However, prior to ordering or installation of any portion of work which appears to be in conflict, such work shall be brought to the project team’s attention for direction.

h. Final location of all outlets, sinks, faucets and trim shall be coordinated with the approved elevation plans and/or other architectural details, as applicable. Offsets of piping, added fittings, valves, elbows, flexible connections, etc., shall be provided to comply with the approved floor plans, elevation plans and/or installation details. Obtain approval of locations of all devices from the project team in the field, prior to installation.

i. Equipment and/or hoods, dishwashers, etc., or other type of equipment shown on the plumbing or architectural drawings shall be provided with services, such as piping, traps, drains, valves, etc.

j. Ensure drawings/specifications state required connections (manufacture, type, size, working pressure, etc.) for critical connections. RO/DI Systems require additional detail.

7. Coordination Drawings

a. Before materials are purchased, fabricated or work is begun, coordination drawings shall be prepared in cooperation with all trades for all floors/areas, including buried systems/services, showing the size and location of his equipment and lines, in the manner described herein under General Requirements. Any sections of difficult areas shown in the contract documents are for reference only and do not dictate how to layer or install the trades.

b. Coordination drawings are for the CM and Architects/Engineer use during construction and shall not be construed as shop drawings or as replacing any shop drawings. The coordination drawings, when corrected for actual "as-built" conditions, will be reviewed by the project team, corrected and become the Record Drawings to be submitted to the Owner for his use.

c. In addition to the regular coordination drawing review, the plumbing work will also be reviewed by the Architect/Engineer to ensure that the system and equipment arrangements are suitable to provide maintenance access and service as follows:

i. Valves and instrumentation should be grouped where possible and positioned in accessible locations.

ii. Valves on all insulated piping shall be furnished and installed with extended stem handles.

d. Prepare a complete set of computer-based drawings

i. Prepare a complete set of computer based as built drawings:

ii. Format shall be:

1. AutoCAD (Latest Version)

2. REVIT (Latest Version)

iii. The drawings shall indicate the layout of all specialty trade work as indicated herein and shall be designated as Coordination Drawings.

e. Highlight all fire rated partitions on the Coordination Drawings for appropriate coordination.

f. The main paths for the installation or removal of all MEP & FP equipment from mechanical and electrical rooms shall be clearly indicated on the Coordination Drawings.

g. Each of the specialty trades shall add its work to the base drawings with appropriate elevations and grid dimensions. Specialty trade information shall be required for mechanical rooms, crossovers and for spaces above ceilings where congestion of work may occur such as corridors and, where required, entire floors.

   Drawings shall indicate horizontal and vertical dimensions to avoid interference with structural framing, ceilings, partitions and other services. Indicate elevations relative to finish floor for bottom of piping. Sections shown in the contract drawings are diagrammatic only and all trades shall share and coordinate sectional views used.

   i. Specialty Trade shall include:

      1. Plumbing system
      2. HVAC piping and associated control systems
      3. Electrical
      4. Sheet metal work
      5. Fire protection system
      6. Automatic temperature control
      7. Fire alarm
      8. Security
      9. Telecommunications
      10. Pneumatic tube
      11. Commissioning Review and Comments

h. Upon completing their portion of the Coordination Drawings, each specialty trade shall sign, date and submit the Coordination Drawings to the CM, Architect/Engineer for review.

i. Where conflicts occur with placement of materials of various trades, the CM shall be responsible to coordinate the available space to accommodate all trades. Any resulting adjustments shall be initialed and dated by the affected specialty trade Contractor. The CM shall then final date and sign each drawing.

j. Fabrication of materials shall not start until Coordination Drawings have been signed, reviewed, and distributed to all parties as indicated herein.

k. Distribution of Coordination Drawings: (Modified for clarification)

i. The CM shall provide one print of each Coordination Drawing to:

1. Each specialty trade Subcontractor.
2. Owner.
3. General Contractor.
4. Architect (for record purposes).
5. Engineer.

l. After Distribution

i. Resolve all interferences not previously identified.

m. Coordination Drawings shall include but are not necessarily limited to:

i. Structure. (Beams, cross bracing, columns, gusset plates, etc.).

ii. Partition/room layout, including indication of smoke and fire resistance rated partitions.

iii. Ceiling layout and heights.

iv. Light fixtures.

v. Access panels.

vi. Sheet metal, heating coils, heat pumps, grilles, diffusers, duct flanges, and pipe hanger/supports and pipe support steel, guides, expansion compensators, kitchen exhaust access doors, and take-offs from the duct risers, etc.

vii. All heating piping and valves.

viii. Smoke and fire dampers including access doors.

ix. Soil, waste and vent piping.

x. Primary water and gas pipes.

xi. Major electrical, fire alarm, and security conduit runs (All sizes) panelboards, feeder conduit and racks of branch conduit (All). Motor control centers, starters and disconnects including shaft coordination for larger conduit riser junction boxes to ensure access for JBs and JBs sized to access all cables, and access to splice cables.

xii. Sprinkler piping and heads.

xiii. All equipment, including items in the Contract as well as Owner Furnished / Contractor Installed (O.F.C.I.) and Owner Furnished / Owner Installed (O.F.O.I.) items.

xiv. Equipment located above finished ceiling requiring access for maintenance and service. In locations where acoustical lay-in ceilings occur indicate areas in which the required access area may be greater than the suspended grid systems.

xv. Rainwater piping

xvi. Existing conditions, including but not limited to, Mechanical, Plumbing, Fire Protection and Electrical items.

xvii. ATC panels

xviii. Cable tray

xix. Beam Penetrations

n. All shaft coordination drawings shall be detailed with the appropriate sizes for all ducts, HVAC pipe, conduits, fire protection piping & Plumbing waste, vent, water, gases etc. Hanger support types, miscellaneous support steel shall be detailed to allow for proper clearances and appropriate insulation thickness. Shaft coordination drawings shall be submitted for review in plan and elevation views.

o. The Architect's response to all requests for information (RFI's) generated by the trade contractors shall be distributed to all other affected trades as if this information was contained in the original contract documents. In other words, the party that issues an RFI is responsible for distributing the information to all affected parties.

8. Record Drawings

a. The Plumbing Contractor shall maintain, current at the site, a set of Contract Drawings for his portion of the work on which he shall accurately show the actual installation of all work provided under his Contract indicating any variation from the Contract Drawings, in accordance with the General Conditions and Supplementary General Conditions.

Changes whether resulting from formal change orders, requests for information, or other instructions issued by the Architect shall be recorded. Include changes in sizes, location and dimensions of piping, equipment, etc.

b. Marked up drawings shall include all flow diagrams, schedules, details and control diagrams.

c. Upon completion of the project, each Contractor shall submit his marked-up drawings to the Architect for review and comment. After the Architect reviews and comments on this set of documents, each Contractor shall prepare as-built drawings on CAD using AutoCAD (Latest Version). When the work is completed, each Contractor shall provide 2 hard copies to the Architect for submittal to the Owner with all documentation and a set of reproducible drawing plots marked "As-Built" drawings. The Contractor shall bear all costs of producing the CAD "As-Built" drawings, providing all necessary drawing changes and printing the reproducible drawings for the work under his charge.

9. RO / DI Water System

a. The RODI system manufacturer shall provide a trained Factory Field Service Engineer or Technician for installation supervision, media loading, system start up, loop balancing and sanitization.

b. System start up shall include verification that all equipment and controls are in working order and that the system equipment provides the water quality as specified herein.

c. Training for the RODI system shall consist of a minimum of 8 hours of time for a factory-trained representative to train the Owner's operators on the theory of the equipment supplied as well as the operation of each piece of equipment.

d. Ensure drawings/specifications state required connections (manufacture, type, size, working pressure, etc.) for critical connections.

e. Quality Control- Develop and implement a statistically appropriate documented quality check on sink connections. (e.g., 10-20% of newly installed, 90-95% confidence interval, etc.) This quality check should include observations during installation, make up of components, inspection of components and final system check.

10.

11. Testing of Purified Water Systems

a. General

i. All piping systems shall be subjected to testing with water, nitrogen, gas or air as noted and shall hold tight at the pressure head stated for the time interval required without adding air or water. While any system is being tested, required head or pressure shall be maintained until all joints are inspected. All systems tested in the existing building shall be tested with air before water.

ii. All tests shall be witnessed by the GC/CM having jurisdiction and the Architect/Engineer, with 48 hour notice given these authorities.

iii. All equipment, material and labor required for testing any of the various systems or any part thereof shall be furnished by this Contractor.

b. High Purity Water Piping Systems: Upon completion of these piping systems, including cooling for a minimum of (1) hour and the system empty of water, a test using compressed nitrogen gas N.F. or clean dry air can be done with the pressures not to exceed 5 psi to determine any obvious leaks. A hydrostatic test shall be done by filling the system with product water and opening valves and vents to purge the system of any air. Begin pressurizing the system in 10 psi increments up to 100 psi and holding the pressure for a minimum of 2 hours and up to a recommended 12 hours. Due to the natural creep effects of plastic pipe, the pressure should be checked after 1 hour. If the drop is less than 10 psi, pump the pressure back up. At this time, the system may be pressurized to the system pressure. If the pressure decreases more than 10% and ambient temperatures have been maintained, consider the test a failure. If the pressure drops less than 10 psi after 1 hour, pump the pressure back up to system pressure. After 2 or 3 hours the pressure holds, the test will be considered a success. Refer to manufacturer's recommendations and procedures for additional information.

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

## 22 1110 – Plumbing Valves

1. Water Valves

a. Isolation/shut-off valves 3" and smaller shall be all bronze ball valves Watts Series B-6000, , Nibco 585-70, Hammond 8501 or Milwaukee BA100, full port Teflon seated ball and 2-piece valve body designed for 600 psi water.

i. The Apollo Factory has recommended that their ProPress ball valves not be used on the Cambridge campus. Longwood Campus has adopted this rule.

ii. Note that this only applies to valves that use ProPress type connections; threaded and solder connections are not affected. While these four types have been specifically identified, others might be affected also: Apollo Series 77V, 77VLF, 77W, and 77WLF.

b. Isolation/shut-off valves 4" and larger shall be NibcoF-510-S6-R-66FS, F-515-S6-F-66-FS, F-530-S6-R-66-FS or Watts Series G4000 and G4000 M1 bronze fitted ball valves, flanged ends, iron body, 200 psi WOG, .

c. Drain valves shall consist of ball valve with a single piece manufactured threaded cap. Provide at all low points in water piping system and at the base of all risers so that entire system may be drained, Apollo 78-103, Nibco 585-70 HC or Hammond 8501.

d. Check valves 3" and smaller shall be Nibco S-413 –W, solder end, bronze body swing check, bronze disk, 200 psi WOG.

e. Check valves larger than 4" shall be Watts Series 411, Nibco F-918B or Hammond IR1124, flanged end, iron body with epoxy coated trim, swing check, 200 psi WOG.

f. Balancing valves for hot water circulation shall be Circuit Setter type, Armstrong, B&G, Nibco or approved equal with memory stop and calibrated nameplate. Combination shut-off and balancing valves are unacceptable.

2. Drainage Valves

a. Ball valves on sewage and drainage ejector discharge piping shall be Nibco F-510-S6-R-66FS, F-515-S6-F-66-FS, F-530-S6-R-66-FS or Watts Series G4000 and G4000M1, flanged ends, 150 psi.

b. Check valves on sewage and drainage ejector discharge piping shall be Kennedy 106LW, Nibco F-918L+W or Hammond IR1124LW, iron body, flanged ends, bronze disc with lever and weight.

c. Gate valves for special waste ejector discharge shall be ASAHI/America, polypropylene, flanged ends with EPDM seals, bubble tight, quick opening valve, non-rising stem, 100 psi.

d. Check valves for special waste ejector discharge shall be ASAHI/America, polypropylene, flanged ends, with EPDM seals and seats, top entry, vertical or horizontal orientation.

e. Backwater valves J.R. Smith #7012 cast iron, bronze mounted, hub end, exterior shall be waterproofed, bolted and extended cover to suit finish floor or grade.

3. Mixing Valves

a. Bacnet compatible, Digital mixing valves shall be used for integration into BAS for monitoring and alarms.

b. Provide at each hot water heating system a master thermostatic mixing valve. The units shall be thermostatic controllers with check stops, strainers, outlet thermometer, volume control and chrome finish as detailed on the drawings. Lawler Series #800 high/low mixing valve, (#805-86108-05 for flow rates of 100 GPM at 10 PSID, #802-86008-05 for flow rates of 40 GPM at 10 PSID, #801-86208-05 for flow rates of 25 GPM at 10 PSID). Contact manufacturer for flow rates over 100 GPM. Leonard, Symmons, Powers or approved equal.

c. Emergency station (shower and eye/facewash) mixing valve shall be Lawler 911 E-85808-01 or approved equal. The valve shall be capable of high and low flows, positive hot water shut-off, integral cold-water by-pass, integral check stops, strainer, volume control, thermometer and control mechanism to fail open to full capacity flow of cold water in the

event of either the hot water supply is shut down or thermostatic control failure. Leonard, Symmons, Powers or approved equal.

d. Lavatories shall be provided with point of use mixing valves, Watts Model USG-B, Powers #480 or approved equal where required by code. Device shall comply with ASSE 1070 and shall have lock feature.

4. Natural Gas Valves

a. Valves 3" and smaller shall be Apollo Series 70-100-07, Nibco F.P. 600 or Hammond 8501-03, threaded bronze ball valve, 600 psi WOG.

b. Valves 4" and larger shall be Rockwell Figure 143, semi-steel, lubricated plug valve, flanged ends, wrench operated, 200 psig WOG.

c. Natural gas fire valves shall be Eiter Inner-Tite, flanged ends with spring activated fuse plug set to operate at 165°F. Shall conform to ANSI B16.1 and MSS-SP-71 Type 1.

d. All natural gas valves shall be approved by the state and local codes.

5. Pressure Reducing valves

a. The PRV shall be Watts ACV-115 Series. The valve shall maintain a constant downstream pressure regardless of demand fluctuations. The control shall be an adjustable, spring loaded, direct acting, normally open, diaphragm valve designed to permit flow when controlled pressure is less than the spring setting. The control system shall consist of an adjustable opening speed needle valve and adjustable closing speed flow control valve. The specification shall note when valves 6" and larger are to be installed with the stem in a horizontal position.

i. Provide pressure gauges and shut-off valves on inlet and outlet of all pressure reducing valves.

## 22 1120 Plumbing Piping

1. General

a. All systems under this Section shall be provided with valves to permit complete and/or sectional control of the system. They shall be located to permit easy operation, system isolation, replacement and repair. They shall be installed where shown on the drawings, or as herein specified. They shall be the product of the specified manufacturer.

b. All equipment shall be installed with isolation valves for service shut off. Equipment shut off valves shall be screwed ends, grooved or flanged. If screwed ends are provided, a union between equipment and valve shall be provided.

c. The Plumbing Subcontractor shall purchase (furnish and install), domestically-produced products for all systems when possible.

2. Water

a. Cement Lined Ductile Iron Pipe and Fittings

i. Below Ground Water Service Piping (4" and Larger)

1. Class 52 ductile iron pipe with cement lining, ANSI, AWWA C-A21.10, ANSI/AWWA C104-A21.4, ANSI C111-A21.11.

2. Fittings and special castings shall be Class 250 cement lined ductile iron and shall conform to ANSI A21.10. And A21.11. Joints shall be made with push-on Tyton joints or screwed flanges and shall be rodded and clamped. Incoming water services shall be provided with two (2) Dresser model 38 or Megalug 1100 Series flexible couplings.

b. Copper Tubing and Fittings

i. All Aboveground Potable and Non-Potable Water Systems

1. Tubing to be Type L hard temper with wrought copper fittings conforming to ASTM B88-and ASME B16.22. All joints shall be soldered with ASME AWS/A5.8 lead free solder.

2. ProPress copper tubing will be acceptable for all piping 2-1/2” and smaller.

3. The Plumbing Subcontractor shall match existing (use the same material) which exists in the building they are working.

c. Copper Tubing and Fittings

i. Type K Below Ground Water Systems (3" and Smaller)

1. Tubing to be Type K, soft temper brazed joints with bituminous coating. Conforming to ASTM B88 and fittings conforming to ASME B16.22.

d. Polypropylene Pipe and Fittings

i. All Aboveground and Below Ground Potable and Non-Potable Water Systems

1. Pipe shall be manufactured from a PP-R-CT resin meeting the short-term properties and long-term strength requirements of ASTM F 2389. The pipe shall contain no rework or recycled materials except that generated in the manufacturer’s own plant from resin of the same

specification from the same raw material. All pipe shall be made in an extrusion process. Domestic hot water shall contain a fiber layer (faser) to restrict thermal expansion. All pipe shall comply with the rated pressure requirements of ASTM F 2389. All pipe shall be certified by NSF International as complying with NSF 14, NSF 61 and ASTM F 2389 or CSA B137.11.

2. PPR-CT connections shall be heat fused.

3. Fittings shall be manufactured from a PP-R resin (Fusiolen) meeting the short-term properties and long-term strength requirements of ASTM F 2389. The fittings shall contain no rework or recycled materials except that generated in the manufacturer's own plant from resin of the same specification from the same raw material. All fittings shall be certified by NSF International as complying with NSF 14, NSF 61 and ASTM F 2389 or CSA B137.11.

3. Waste & Vent

a. Hubless Cast Iron Soil Pipe and Fittings

i. Aboveground Soil, Waste, Vent and Rainwater Piping

1. Hubless Cast Iron Soil Pipe: No-hub pipe with Husky SD-4000 soil pipe coupling manufactured by Anaheim Foundry, 4-band clamp. Sealing gasket shall be neoprene in accordance with ASTM C564, CISPI 301-75.

b. Hub and Spigot Cast Iron Soil Pipe and Fittings

i. Below Ground Soil, Waste, Vent and Rainwater Piping

1. Asphaltum coated, service weight, cast iron pipe and fittings with resilient neoprene push-on or lead and oakum joints, ASTM A72, ASTM C564-70.

2. Resilient Neoprene gaskets for 4" and smaller shall be lubricated as per manufacturer's recommendations and for 5" and larger on adhesive type lubricant shall be used.

3. PVC Plastic Pipe and Fittings

a. Below Ground Soil, Waste, Vent and Rainwater

i. Schedule 40, conforming to STM D4101 and D2665, solvent weld joint system as manufactured by Charlotte, G.F., Harvel or IPEX.

ii. Above Ground Soil, Waste, Vent and Rainwater Piping

1. Service weight cast iron pipe and fittings with resilient neoprene push-on joints. ASTM A72, ASTM C564-70.

c. Copper Tubing and Fittings

i. Waste and Vent Systems 2" and Smaller

1. Tubing to be Type L hard temper with wrought copper fittings conforming to ASTM B88-and ASME B16.22. All joints shall be soldered with ASME AWS/A5.8 lead free solder.

2. Shall not be used for urinal waste piping which shall remain cast iron. May be used for sewage ejector and sump pump discharge piping.

4. Storm

a. Hubless Cast Iron Soil Pipe and Fittings

i. Aboveground Rainwater Piping

1. Hubless Cast Iron Storm Pipe: No-hub pipe with Husky SD-4000 soil pipe coupling manufactured by Anaheim Foundry, 4-band clamp. Sealing gasket shall be neoprene in accordance with ASTM C564, CISPI 301-75.

b. Hub and Spigot Cast Iron Soil Pipe and Fittings

i. Below Ground Soil Rainwater Piping

1. Asphaltum coated, service weight, cast iron pipe and fittings with resilient neoprene push-on or lead and oakum joints, ASTM A72, ASTM C564-70.

2. Resilient Neoprene gaskets for 4” and smaller shall be lubricated as per manufacturer’s recommendations and for 5” and larger on adhesive type lubricant shall be used.

3. PVC Plastic Pipe and Fittings

a. Below Ground Soil, Waste, Vent and Rainwater

i. Schedule 40, conforming to STM D4101 and D2665, solvent weld joint system as manufactured by Charlotte, G.F., Harvel or IPEX.

ii. Above Ground Rainwater Piping

1. Service weight cast iron pipe and fittings with resilient neoprene push-on joints. ASTM A72, ASTM C564-70.

5. Gas

a. Schedule 40 Black Steel Pipe and Fittings

i. Black steel pipe Schedule 40 and conforming to ASTM A120-74 (seamless type). Fittings shall be black malleable iron screwed type conforming to ANSI B16.3-71 for pipe 2 1/2" and smaller.

ii. Pipe 3" and larger and for systems where pressure exceeds 14w.c. shall be welded with Schedule 40 socket welded forged steel fittings conforming to ASME B16.11.

iii. Gas piping dropping inside concrete block partitions shall be factory wrapped for corrosion protection.

iv. Mega press pipe fittings, Subject to Engineers approval up to 2 ½”

**22 1140 – Plumbing Specialties**

1. Flanges and Unions

a. Flanges

i. Flanges shall be companion type, faced and drilled for not less than 125# steam working pressure complete with necessary adapter, and shall be of size and material of adjacent piping.

b. Unions

i. Provide union connections to fixtures and equipment. Union connections include compression fittings, grooved couplings, and flared fittings.

1. Unions on copper piping shall be bronze minimum working pressure of 200 psi.

2. Unions on steel and iron shall be ferrous ground joint brass to iron, rated for the working pressure of the system.

c. Dielectric Fittings

i. Provide separation between copper and ferrous piping systems such as nipples, unions or flanges. Components shall be equal to Watts or Victaulic/Clear flow.

d. Solder

i. Domestic water, waste and vent: 95-5 lead free, ASTM B32.

2. Sleeves, Plates and Escutcheons

i. Refer to Section 220500.

3. Access Panels

a. Group together valves, traps, cleanouts, etc., concealed in suspended ceilings, walls and furred spaces to reduce the number of access panels, but all valves must be freely accessible for maintenance.

b. Furnish access panels of proper size to service all concealed traps, valves and cleanouts, but in no case less than 18" by 12" for valves, traps or cleanout, and 24" by 12" for (2) valves, traps or cleanouts, or more.

The exact number of panels shall be determined by the number, location and grouping of traps, valves and cleanouts which must be accessible for servicing and maintaining the plumbing systems. Panels below ceilings shall be key operated.

c. Panels shall have flush doors with #14 USCG steel door and trim #16 USCG steel frame, metal wings for fitting into construction, concealed hinges, and screwdriver operated stainless steel cam lock. Panels shall be shop coated with (1) coat of zinc chromate primer. Valves above removable ceilings shall have tiles marked with tile clips by this Contractor for identification, properly labeled. Panels in toilet rooms adjacent to urinals shall be Type 302, 18-gauge, stainless steel. All locks shall be universal with all building access panels locks.

4. Insulation

a. Scope: The following piping, fittings, and valves shall be insulated:

i. All interior water piping.

ii. Aboveground horizontal rain water piping past the elbow, down the vertical, including drain bodies.

iii. Water, rainwater waste piping in exterior furred ceiling spaces and overhangs.

iv. All piping insulation disturbed or removed as a result or renovation work.

v. All horizontal waste piping receiving cold water condensate.

vi. Handicap sinks and lavatory supply and waste piping.

b. Materials: The following materials are specified:

i. Pipe Insulation: Fiberglass similar to Owens Corning, Manville, Certain-Teed.

ii. Poly piping shall be insulated

iii. Fittings and Valves Insulation

1. Molded or fabricated fitting covers of equal thickness and identical in composition to adjacent pipe insulation, equal to Zeston pre-molded covers. At fittings and valves, the insulation vapor barrier shall be continuous and unbroken.

iv. All materials, including vapor barrier jackets, adhesives, etc., shall be fire retardant and asbestos free.

c. Insulation Thickness

i. The piping, fittings, and valves shall be insulated with the following minimum thicknesses:

1. Hot water and circulation piping: 1" thick on 1/2” to 1-1/4” pipe and 1-1/2” thick on 1-1/2” and larger pipe

2. Cold water piping: 1" thick

3. Rainwater Piping: 1" thick

4. Frost-Proofed Piping: 3” insulation, dual temperature fire retardant jacket

d. Finish

i. Concealed or Exposed: All service vapor barrier jacket (ASJ Fiberglass 24) on all exposed and concealed horizontal rain water conductor and all exposed and concealed horizontal and vertical water piping, except where flexible tubing insulation is used which requires no vapor barrier. Fittings shall be finished with pre-molded fitting covers.

e. Handicapped Lavatories and Sinks

i. Truebro Handi Lav-Guard, Brocar Products Trapwrap #C-500R or McGuire ProWrap insulation kit, 3-piece interlocking for "P" trap assembly and 2-piece kit for water supplies shall be white flexible vinyl insulation secured with nylon fasteners supplied.

5. Hose Bibbs and Wall Hydrants

a. Hose Bibbs

| | Toilet Rooms and Finished Areas | Mechanical Areas |
|---|---|---|
| Type: | Wall Mounted | Wall Mounted |
| Service: | Cold Water | Cold Water |
| Finish: | Chrome Plated | Rough Chrome/Brass |
| Body: | Brass | Brass |
| Handle: | Loose Tee | Loose Tee |
| Outlet: | 3/4" NPT | 3/4" NPT |
| Vacuum Breaker: | Atmospheric | Atmospheric |
| Listings: | ASME A112.18 / CSA B125.1<br>ASSE 1011 (vacuum breaker) | |
| Manufacturer: | | |
| Chicago | 952-CP | 998-XKRCF |
| T & S Brass | B-0722 | B-0736 |
| Woodford | 40HT | 40HT-RB |
| Speakman | SC-5911-IS | --- |

b. Wall Hydrant

| | Exposed | Recessed Box | | Ground | Post |
|---|---|---|---|---|---|
| Service: | Cold Water | Cold Water | Hot & Cold | Cold Water | Cold Water |
| Finish: | Chrome Plated | Nickel Bronze | | Bronze | Varies |
| Body: | Brass | Bronze | | Bronze | Bronze |
| Box or Casing: | N/A | Stainless steel or nickel bronze | | Nickel bronze | Galv Steel or Alum |
| Handle: | Loose Tee | Loose Tee | | Loose Tee | Loose Tee |
| Outlet: | 3/4" NPT | 3/4" NPT | | 3/4" NPT | 3/4" NPT |
| Vacuum Breaker: | Atmospheric | Atmospheric | | Atmospheric | Atmospheric** |
| Listings:* | ASME A112.18 / CSA B125.1, ASSE 1011 (vacuum breaker) | | | | |

| Manufacturer: | Non-Freeze | Mild Climate | Non-Freeze | Mild Climate | Non-Freeze | Non-Freeze | Non-Freeze |
|---|---|---|---|---|---|---|---|
| JR Smith | 5609QT | 5618 | 5509QT | 5519 | 5560QT | 5810 | 5910 |
| Zurn | Z1310 | Z1333 | Z1300 | Z1330 | Z1325 | Z1360 | Z1385 |
| Josam | 71350 | 71070 | 71300 | 71300 | 71650 | 71600 | --- |
| Mifab | MHY-16 | MHY-30 | MHY-26 | MHY-35 | MHY-45 | MHY-60 | MHY-65 |
| Wade | 8600 | 8607 | 8700 | 8707 | 8706 | 8800 | 8900 |
| Woodford | 67 | 74 | B67 | B74 | HCB67 | Y95 | Y30 |

| Notes: | a. *Wall hydrants are intended for irrigation purposes only. Does not meet NSF/ANSI-372 for Drinking Water.<br>b. **Non-freeze feature will not automatically function when vacuum breaker is specified. The vacuum breaker must be manually tripped to facilitate drainage of hydrant. |
|---|---|

6. Backflow Preventors

a. Building level backflows shall have redundancy

b. Acceptable Manufacturers and requirements

   i. Provide units approved by the authorities having jurisdiction, the following specified type is utilized to establish quality.

   ii. Contractor shall make application in the name of the Owner for the installation of the backflow preventors and pay any resultant fees.

c. Reduced Pressure Backflow Preventors

   i. 2" and Smaller: Watts#LF0095-U-QT, Apollo or Febco lead-free bronze body, stainless steel check seats, unions, strainer and shutoff valves.

   ii. 2 1/2" and Larger: Watts #LF909W-S-0S&Y, Apollo or Febco lead-free with bronze seats and stainless-steel trim, flanged, strainer and shutoff valves.

   iii. Provide an air gap fitting and full-size indirect waste to floor drain.

   iv. Provide at Janitors' Closets and kitchen sinks using chemical dispensers.

d. Provide spare parts for each type of installed unit. Provide inlet and outlet pressure gauges on units.

e. Pressure Vacuum Breaker

   i. Finished areas and locations unless otherwise noted: Watts #LF80MCQT, Apollo or Febco lead-free compact, chrome plated with integral shutoff valves.

   ii. Mechanical areas and concealed locations: Watts #LF800MCQT, Apollo or Febco lead-free rough brass, replaceable seats with shutoff valves.

Note: Units must be installed a minimum of 12" above the highest downstream point of use, the unit will discharge water.

f. Vacuum Breaker

i. For Hot or Cold Water: Watts #288A, Apollo #38-100 or Febco bronze, atmospheric vent, clean plated in exposed, finished areas. Note: Unit must be installed a minimum of 6" above the highest downstream point of use, the unit will discharge water.

g. Ice Maker

i. Provide dual check in-line backflow preventor suitable for continuous pressure application. Watts LF7R, chrome plated and in-field testable.

7. Trap Primers and Water Hammer Arrestors

a. J.R. Smith 5000 Series or Zurn Z-1700 Series - stainless steel "shoktrols" shall be installed on water supply lines to flush valves and to plumbing connected equipment equipped with fast acting valves to control water hammer. They shall be sized and selected in accordance with PDI Standard WH201 with access through wall access panels. Examples of such locations are as follows:

i. Flushometer valves

ii. Self-closing and metering faucets

iii. Prior to all pressure reducing valves

iv. Prior to all in-line solenoid valves

v. All laundry equipment

vi. Sterilizer water supplies

vii. Autoclaves

viii. Hose spray pre-rinse

ix. Glasswashers, cage washers and similar equipment

b. Trap Primers

i. Individual fixtures shall be primed by Precision Plumbing products, Inc., model Prime Rite, or Prime Pro. Device shall be machined brass with no springs or diaphragms. Mount 12” above trap to be primed.

ii. Multiple fixtures shall be primed by Precision Plumbing Products, Model PT-4 through 30 and rated for quantity of traps to be served. The priming manifold shall be capable of supplying 2 oz. of water per trap supply at 20 psig every 24 hours. The device shall be factory assembled and pre-piped complete with ball valve, water hammer arrestor, copper barrel hammer arrestor, copper barrel with piston, solenoid valve and 1/2” trap primer connections. Electronic connections include single point 120V, manual override switch

breaker, timer with relay. Unit shall be factory tested and supplied in a wall mounted steel cabinet.

iii. Install trap primers at all drains where trap seal is subject to evaporation, including open end drains (OEDs), mechanical room drains that do not receive indirect waste and toilet room floor drains.

8. Drainage Specialties

a. Before setting any drains, cleanouts or wall plates, obtain from the General Contractor the exact information relative to the finished grades of the top of the drains, equipment locations and partition locations. All drainage specialties shall be of the size noted on the drawings and shall be equal to the figure numbers scheduled below. Drainage specialties may be J. R. Smith Company, Zurn, Wade, Josam or Mifab.

b. Cleanouts

i. Cleanouts shall be furnished and installed at all locations required by applicable Codes, in accessible locations, at bottoms of soil and waste stacks, and other locations shown on the drawings and at each change of direction. All cleanouts shall be brought up to finished floor. Outlets shall be caulked or no hub type.

ii. Cleanouts occurring in floors finished with quarry, ceramic tile, brick or granite shall be equipped with flush scoriated round bronze covers and frames as selected by Architect to coordinate with color of flooring, equal to J.R. Smith #4046. Covers shall be adjustable in height.

iii. Cleanouts occurring in resilient tile floors or carpeted areas shall be equipped with flush round metal covers with frames, equal to J.R. Smith #4146 for tile and #4026 for carpet, with covers recessed to receive tile or carpet. Covers shall be adjustable in height.

iv. Cleanouts occurring in floors finished with plain concrete shall be equipped with heavy duty flush scoriated round cast iron covers with round frame equal to J.R. Smith #4226. Covers shall be adjustable in height.

v. Where cleanouts occur under the floors in unexcavated areas, they shall be brought up flush with the finish floor and fitted with a cover equal to J.R. Smith #4226 series, cast iron top.

vi. Cleanouts occurring in floors protected with membrane waterproofing shall be same as above, except with integral membrane flashing clamping collar.

vii. Cleanouts occurring in walls shall be equipped with flush smooth white metal covers, with 10 inch by 10 inch openings in square frames having anchoring lugs, equal to J.R. Smith #4735.

viii. All otherwise exposed or accessible cleanouts shall be equal to J.R. Smith #4420 or #4531 as required to suit the conditions at each point of application.

ix. Extension pieces and bodies of cleanouts shall be of cast iron and arranged to suit each condition of application.

x. All metal specified above shall be solid "nickel-bronze" having high nickel content, appearance of satin chrome, and corrosion and wear resistance qualities greater than bronze.

xi. Cleanouts shall be the full size of the pipelines to which they are directly connected, but need not be larger than 4 inches for pipe lines up to 10 inches, and shall be at least 6 inches for pipe lines 10 inches and up.

xii. Grade cleanouts shall be J.R. Smith #4890 with inside caulk mounted in cast iron 12" square frame and cover LeBaron #S512.

c. Floor Drains (FD)

i. All floor drains shall be the product of one manufacturer such as J.R. Smith, Wade, Josam, Zurn or Mifab.

ii. Drains located in waterproofed floors of composition materials or of other kinds, shall be fitted with all required flanges, clamping devices and trim required to assure watertight conditions, and they shall be made watertight. Provide all other miscellaneous devices, as required, for a complete installation as approved by Architect.

1. Type FD-A: Toilet Rooms, Shower Rooms and Plenums

a. J.R. Smith 2010-4-A-P075 floor and shower drain, duco-coated cast iron body with bottom outlet, combination invertible membrane clamp and adjustable collar with Type A polished, chrome plated strainer with flashing clamp device and trap primer.

2. Type FD-B: Mechanical Rooms

a. J.R. Smith 2233-A-P075, 12" diameter top drain, duco-coated cast iron body with bottom outlet, seepage pan and combination membrane flushing clamp and frame for anti-tilt heavy duty slotted grate with suspended sediment bucket and trap primer.

3. Type FD-C: Environmental and Cold Rooms

a. J.R. Smith 3750-P075 floor drain, duco-coated cast iron body with bottom outlet, combination invertible membrane

clamp and adjustable collar with polished nickel bronze strainer with oval funnel and trap primer.

4. Type FD-D: Darkrooms

    a. J.R. Smith 2005-F37-P075 floor drain, acid resistant epoxy coated finish cast iron body with bottom outlet, combination invertible membrane clamp and adjustable collar with raised lip, polished, nickel bronze stainer and trap primer.

5. Type FD-_____: Typical Lab Floors Glassware Washers and Sterilizers

    a. J.R. Smith 9692-6-14-P075, 12" x 12" sanitary floor receptor 6" sump depth, 14 gauge, all Type 304 (CF8) stainless steel light duty with non-tile, loose set full grate with 2-1/2" square center opening and anti-splash interior dome strainer and trap primer.

6. Type FD-_____: Vivarium Cage Washing Area and Tunnel Washing Area

    a. J.R. Smith 9693-8, 12" x 12" x 8" deep, 14 gauge, all Type 304 (CF8) stainless steel light duty sani-floor receptor with non-tilt, loose set full grate with 1/2" square openings and anti-splash interior dome strainer.

7. Type FD-_____: Ice Machines

    a. J.R. Smith 3510-P075 floor drain, duco-coated cast iron body with bottom outlet, combination invertible membrane clamp and adjustable collar with polished, nickel bronze strainer with 4" diameter funnel and trap primer.

8. Type FD-____: Flushing Drain

    a. J.R. Smith 2508, 25" square drain with acid-resistant coating, nickel bronze top and 1" non-potable cold water connection. Provide with Sloan Royal 110YC flush valve modified for bottom outlet and recessed in stainless steel cabinet.

9. Type FD-____: Flushing Rim Drain

    a. J.R. Smith 2500-H floor drain, duco-coated cast iron with acid-resistant coating and hinged bar grate.

d. Roof Drains (RD)

i. All roof drains shall be the product of one manufacturer such as J.R. Smith, Wade, Josam or Zurn.

1. Type RD-A: J.R. Smith 1010-RCU-AD, 16" diameter roof drain, duco-coated cast iron body with combination membrane flashing clamp/gravel guard and low silhouette aluminum dome, supplied with underdeck clamp and vandal proof secured top.

2. Type ORD-A: J.R. Smith 1080-RCU-AD, 16” diameter roof drain with integral 2” dam, duco-coated cast iron body with combination membrane flashing clamp/gravel guard and low silhouette aluminum dome, supplied with underdeck clamp and vandalproof secured top.

3. Type RD-B: J.R. Smith 1560, 3" x 10" oblique scupper drain, plain bronze body with gasket, plain bronze grate with integral membrane.

4. Type RD-C (Green Roof): J.R. Smith 1080-RCU-AD duel inlet, 16” diameter roof drain, duco-coated cast iron body with wide flange membrane flashing clamp, perforated stainless steel extension, gravel stop and low silhouette aluminum dome, supplied with underdeck clamp and vandalproof secured top.

5. Type D: J.R. Smith 1083-C-E-R-C-U (flat) or 1085-ERC (sloped) controlled flow 15" diameter roof drain, dura-coated cast iron body with combination membrane flashing clamp/gravel guard with adjustable flow rate assembly and polyethylene dome, supplied with underdeck clamp and vandalproof secured top. Provide extension as required and sump receiver; see detail for weir openings. Provide where roof detention is required.

6. Type E: (Overflow): J.R. Smith 1045C 15” diameter roof drain with fixed PVC standpipe, adjustable extension, duco-cast iron body, flashing clamp, gravel stop, polyethylene dome. Provide sump receiver, underdeck clamp, and vandal proof dome.

7. Type F: Froet

ii. Provide J.R. Smith 1710 vertical expansion joint at every drain location where the drain outlet piping connects directly to a vertical leader or when the horizontal offset is less than 10'.

iii. Overflow roof drain discharge to grade shall be:

1. J.R. Smith SQ-9-2039, stainless steel downspout covers suitable for piping from 4” to 15”, stainless steel frame with hinged perforated strainer.

e. Backwater valves to be installed on gravity waste lines shall be as follows:

i. Storm and Sanitary piping system valves shall be J.R. Smith 7022 line-size, coated cost iron body, hub inlet, spigot outlet, bronze threaded cover with automatic valve seat and flapper.

ii. Laboratory waste shall be J.R. Smith 7022, line size similar to that specified for storm and sanitary systems, except enamel coated interior with ABS removable cover or approved equal.

9. Thermometers

a. Thermometers shall be adjustable angle design of the separable well type and shall have a 9" cast aluminum case. The scale shall be white with black figures and graduations embossed on the scale. Thermometers shall be manufactured by Trerice Co., Ashcroft or Taylor Instrument.

b. Thermometers shall be furnished complete with all necessary sockets, wells, connectors and accessories required for installation suitable for the service in which installed. Extension necks shall be furnished for insulated piping.

c. Thermometers shall be furnished with the temperature ranges of 30° to 100°F for cold water, and of 30° to 240°F for hot water systems.

10. Pressure Gauges

a. Pressure gauges shall have brass movement, aluminum case, double strength clear glass window with black embossed figures and graduations on a white dial face, with 1% accuracy of scale range. Gauges shall be manufactured by Trerice Co., Taylor Instrument, Wika or Ashcroft.

b. Gauges shall be furnished with snubbers and needle valve shutoff valves.

c. Gauges shall be 4 1/2" diameter furnished with ranges that will locate the intended pressure at the point of application approximately midpoint on the range scale. Gauges for natural gas, vacuum and similar low pressure systems shall be gauges specifically designed for low pressure applications.

11. Water Meters

a. Refer to HMS Metering Standard requirements

12. Gas and Water Metering

a. Provide metering of natural gas services and domestic water for new building construction and mechanical systems renovations of existing buildings that will have significant natural gas or water loads; exceptions are for gas supplies to building emergency generators.

b. Pulse outputs from the meters shall be wired back to the nearest accessible building electrical meter "DI-type".

c. Refer to HMS Metering Standard requirements

13. Building Automation System

a. The building automation system shall be furnished and installed under another Section of these specifications. This Contractor shall provide the tees, pipe wells, valves, and caps to allow the connection from the BAS system to the plumbing points required. The pH probes, moisture content meter and resistivity probe shall be provided for BAS tie-in. The following table itemizes the equipment and location of the type of device necessary to connect to the BAS system.

| Service or Equipment | Pressure | Temperature | Flow | Trouble | Location |
|---|---|---|---|---|---|
| Water Meter | | | X | | Basement |
| Water Heaters | | X | | | Basement |
| Water Booster Pumps | X | | | X | Basement |
| Vacuum Pumps | X | | | X | Basement |
| Air Compressor | X | | | X | Basement |
| RO/DI | X | | X | X | Basement |
| Ejectors | | | | X | Basement |
| Animal Water System | | | | X | Basement |
| pH Neutralization System | | | | X | Basement |
| RO Reject System | | | | X | Basement |
| Manifold Gas System | | | | X | Basement |

## 22 3000 – Plumbing Equipment

1. Steam-Fired Water Heaters

    a. Heaters shall be Aerco, Maxi Therm, Patterson and Kelley

2. Domestic Water Boosters Pumps

    a. Variable Speed Packaged Pumping System

    b. Variable Speed Packaged Pumping System with Integrated Variable Frequency Drive Motors

        i. Furnish and install a pre-fabricated and tested variable speed packaged pumping system to maintain constant water delivery pressure. Grundfos BoosterPaQ Model; System shall provide _____ GPM at _____ PSI, with a minimum suction pressure of _____ PSI. System shall be _____V /_____ Phase.

ii. Each pump (4) shall provide_____ GPM at _____ TDH; _____HP. Allowed substitutions are Syncrhoflo and Canaris.

iii. The packaged pump system shall be a standard product of a single pump manufacturer. The entire pump system including pumps and pump logic controller, shall be designed, built, and tested by the same manufacturer.

iv. The complete packaged water booster pump system shall be certified and listed by UL (Category QCZJ – Packaged Pumping Systems) for conformance to U.S. and Canadian Standards.

c. Pumps shall be Grundfos or Syncroflo,

3. Hot Water Circulators

a. Pumps should be variable speed pumps.

b. Manufacturers shall include Taco, Grundfos, Bell and Gossett

4. Point-of-Use Water Heater

a. First option shall for all locations would be to use recirculating building system.

b. The unit shall include the following:

i. Two (2) heating modules.

ii. Replaceable filter.

iii. 3/4” connections.

iv. Maximum operating temperature of 180°F.

5. All water heaters shall be lead free.

**22 4000 – Plumbing Fixtures**

1. Water Closets

a. Refer to schedule on drawings for fixture types and model numbers.

i. Water closets shall be elongated, wall hung vitreous china, 1.1 GPF to 1.6 GPF, siphon jet with 1-1/2” top spud and cast iron nipples equal to American Standard or Afwall Millenniom Model 2257.101.

ii. Flushometer valve shall be exposed chrome plated, manual dual flush, sensor operated battery-powered, 1" I.P.S. screwdriver angle stop, protective cap with set screw, adjustable tailpiece, vacuum breaker and spud coupling, set screw escutcheon at wall. Flushometer valve shall have a non-clogging piston operating with a self-cleaning debris screen. Flushometer shall be Model WES-111 Sloan, Zurn or Toto.

iii. Seats shall be heavy duty, institutional, solid plastic seat for elongated bowl, open front less cover with self-sustaining check hinge, Bemis Model 1655CT / 1655SSCT.

iv. Fixtures designated for handicapped use shall be installed in accordance with the Americans with Disabilities Act as well as state and local codes.

2. Urinals

a. Refer to schedule on drawings for fixture types and model numbers.

i. Waterless Urinals will not be permitted.

ii. Urinals shall be wall hung, vitreous china, 1.0 GPF, 0.125 GPF siphon jet with 3/4" top spud, American Standard or Washbrook Universal Model 6590.001.

iii. Flushometer valves shall be exposed, chrome plated, sensor operated, battery-powered, 3/4" I.P.S. screwdriver angle stop, protective cap with set screw, adjustable tailpiece, vacuum breaker and spud coupling, set screw escutcheon at wall. Flushometer valve shall have a non-clogging piston operating with a self-cleaning debris screen. Flushometer shall be Sloan Model 186 ES-S TMO.

iv. Fixtures designated for handicapped use shall be installed in accordance with the Americans with Disabilities Act as well as state and local codes.

3. Lavatories

a. Refer to schedule on drawings for fixture types and model numbers.

i. Lavatories shall be vitreous china, self-rimming or wall hung and 8" faucet centers. American Standard or Ovalyn Undercounter Sink 0495.221, unglazed rim.

ii. The faucets shall be chrome plated,

1. Units should be 2 paddle type, tempered and have temperature adjustment available.

2. Equal to Sloan Solis EAF-275-ISM

3. Battery operated

iii. Drains shall be chrome plated, cast brass grid drain. Equal to manufacturer of supplied fixture.

iv. Fixtures designated for handicapped use shall be installed in accordance with the Americans with Disabilities Act as well as state and local codes.

4. Emergency Showers and Eye washers

a. All showers and eye washers shall comply with ANSI Z-358.

b. Provide tepid water to all emergency equipment fixtures.

c. Combination shower eyewash units in Mechanical Rooms shall be made of galvanized steel pipe and fittings and be equipped with ABS plastic shower heads, polished stainless steel pull rod, chrome-plated stay-open ball valves, two (2) spray heads and stainless steel bowl.

d. Emergency fixtures shall be Speakman.

e. All emergency fixtures shall be provided with a floor drain and trap primer.

5. Trim

a. Fixture Trim and Accessories: Provide fixtures complete with fixture carrier, faucet, drain outlet, tailpiece, P-trap, and stops and supplies.

i. Finish: All trim exposed to view shall be polished chrome plated.

ii. P-Traps: Cast brass adjustable P-trap with cleanout plug, ground joint and 17 gauge minimum weight extension with escutcheon. Provide Chicago or McGuire #8090 1 1/4" by 1 1/2" on lavatories and #8089 1 1/2" by 1 1/2" on sinks.

iii. Drain Outlets: Provide drain outlet of the same manufacturer as the fixture, faucet trim or McGuire 155 with chrome plated cast brass plug with 17 gauge minimum weight tailpiece. Provide 1 1/4" tailpiece on lavatories and 1 1/2" on sinks.

iv. Stops and Supplies: Chrome-plated brass with stop and loose key, Chicago or McGuire #170-LK, or # BV170-LK, escutcheon flexible riser. Refer to other Sections herein for information on transition between materials.

v. Joints between wall mounted fixtures and wall shall be sealed with caulk to match fixture color.

vi. All faucets, water coolers and drinking fountains shall be constructed of a lead free brass alloy and where applicable, shall be certified to comply with NSF 61 Section 9 Drinking Water Standard.

b. Water Conservation: Provide water conserving fixtures and trim compliance with the following maximum water use requirements. Provide variable pressure flow controls on showers, sinks and lavatory faucets.

i. Public Lavatories: 0.5 GPM for 9 second cycle

ii. Sinks (Low Flow): 0.5 GPM

iii. Lab Sinks 1.5 GPM

1. Alternates flows by exception only

iv. Water Closets (Low Flow): 1.28 GPF

v. Urinals (Low Flow): 0.125 GPF

vi. Shower Heads 1.5 GPM

1. Low-Flow Pressure-Compensating Traditional Showerhead

c. Fixture Supports

i. Acceptable Manufacturers: J.R. Smith, Zurn, Wade, or Josam.

ii. Provide floor mounted fixture support carriers for wall mounted fixtures including, but not limited to, water closets, urinals, lavatories, scrub sinks and clinical sinks. Fixture support shall support at least 250 lbs. for (5) minutes and 750 lbs. for bariatrics. Furnish complete with foot piece, all necessary bolts, nuts, washers and gaskets. The adjustable nipple for the water closets between the cast iron fitting and closet bowl shall be threaded cast iron. Secure all foot pieces to floor slab using four bolts per foot.

iii. Close coordination is required between the plumber and tile contractor in closet installation. Maintain 1/16" clearance between finished wall and back of closet and follow manufacturer's details in installing couplings to ensure tight seal at closet outlet. Closet hanging templates must be used.

1. Water Closets: Zurn ZR-1204-CC, J.R. Smith 230-CI

2. Lavatories: Zurn ZR-1231, J.R. Smith 700

3. Urinals: Zurn Z-1222, J.R. Smith 637

4. Bariatric Water Closets: Zurn Z-1203-N-XH-CC (750 lbs.)
   Zurn Z-1203-N-XB-CC (1000 lbs.)

6. Sustainable Design Initiatives

   a. The project has been registered under the USGBC LEED – NC Version 2.2 Green Building Rating System. Contractor responsibilities relative to the LEED Certification process in general and credit documentation in particular are defined in Division 1.

   b. Plumbing systems and equipment with particular emphasis on sustainable design and integral to LEED Certification include, but are not limited to, the following:

      i. Premium Efficient Motors

      ii. Low Flow Plumbing Fixtures

      iii. Low VOC Sealants and Adhesives

      iv. Construction IAQ Management Plan

      v. Heat recovery

      vi. Alternate use of waste water

7. Water Fountain/Bottle Fillers
   a. Halsey Taylor HydroBoost Bottle Filling Station & Single ADA Cooler Model number HTHB-HAC8SS-WF

## 26 6000 – Laboratory Plumbing systems

1. Piping

   a. The use of Mega Press for gas piping is acceptable for sizes 4” and below.

2. Regulators

3. Manifolds

   a. Provide specialty gas manifolds as indicated on the drawings. Manifolds shall be as manufactured by Spectra Gases, Western Enterprise or Middlesex Gases. Manifolds shall provide continuous supply of gas from multiple sources, the manifolds shall be provided with automatic changeover with dual in-line regulators and a line regulator to control the delivery pressure. An alarm switch shall be provided within the manifold case and shall be capable of remote alarms. Manifolds shall be provided with flexible stainless steel braided pigtails with check valves, shut-off valves, and individual header valves with handle grips at each cylinder.

b. The manifold for the CO2 system shall be the same except provided with cryogenic pigtails.

c. Manifolds shall be as follows:

i. Nitrogen:
Western Enterprises Model DS1000-7-X-Y-Z, or Newer Model

ii. Helium:
Western Enterprises Model DS1000-5-X-Y-Z, or Newer Model

iii. Argon:
Western Enterprises Model DS1000-3-X-Y-Z, Or Newer Model

iv. Oxygen:
Western Enterprises Model DS1000-9-X-Y-Z, Or Newer Model

v. CO2:
Western Enterprises Model DS1000-4-X-Y-Z, Or Newer Model

4. Outlets

a. Refer to schedules on drawings for fitting types and model numbers.

i. Lab fittings shall be chrome plated, indexed for specific service, pressure rated to meet requirements of specific service. All natural gas turrets shall be supplied with an integral check valve. Equal to Chicago faucets.

b. Furnish and install the following sink fittings or equivalent, laboratory outlets, fixtures, etc."

i. C - Cold Water Outlet - Peninsula Bench - CS – Drop
Chicago No. 937-E22 non-domestic cold water outlet

ii. G - Gas Outlets - Peninsula Bench – Drop
Two Chicago No. 909-C gas outlets - back to back

iii. V - Vacuum Outlets - Peninsula Bench – Drop
Two Chicago No. 987-LF-907 vacuum outlets - back to back

iv. A - Compressed Air Outlets - Peninsula Bench – Drop
Two Chicago No. 907 compressed air outlets - back to back

v. N - Nitrogen Outlet - Peninsula Bench – Drop
Two Chicago No. 937CH nitrogen outlets - back to back

vi. C1 Cold Water Faucet - Wall Bench - CS – Deck Mounted

Chicago 928-VB water faucet

vii. G1 Gas Outlet - Wall Bench – Deck Mounted
Chicago No. 980 WS-909C single gas outlet
Chicago No. 981 WS-909C double gas outlet

viii. V1 Vacuum Outlet - Wall Bench – Deck Mounted
Chicago No. 980 WS-907 single vacuum outlet
Chicago No. 981 WS-907 double vacuum outlet.

ix. A1 Compressed Air Outlet - Wall Bench – Deck Mounted
Chicago No. 980 WS-907 single compressed air outlet
Chicago No. 981 WS-907 double compressed air outlet

x. N1 Nitrogen Outlet - Wall Bench – Deck Mounted
Chicago No. 980 WS -937 single nitrogen outlet
Chicago No. 981 WS -937 double nitrogen outlet

xi. RO - Reverse Osmosis Faucet – Deck Mounted
Orion GNF30-STD or GNF30-VB deionized deck mounted water faucet.

xii. Provide Chicago Quick Connects where required.

c.

5. Source Equipment

a. Vacuum Pumps

i. Provide complete factory-assembled and pre-tested laboratory / medical / dental medical vacuum pump system consisting of oil less rotary vane, screw or claw vacuum pumps by Medaes, Beacon Medical or approved equal and in compliance with NFPA 99.

ii. Sihi vacuum pumps shall be considered for laboratories using chemicals in the vacuum system.

b. Air Compressor System

i. Provide complete factory-assembled and pre-tested laboratory / medical air compressor system in compliance with NFPA 99. System shall consist of oil-less compressors, motors, control panel, receiving tank, air dryers, duplex filter assembly cabinet, pressure regulating valves, and dewpoint/carbon monoxide monitor. System shall be Beacon Medaes MedPlus, Beacon Medical, Squire Cogswell or approved equal.

ii. Compressors shall be oil-less rotary scroll, oil-less reciprocating, oil-free rotary tooth.

c. pH Adjustment System

i. The laboratory waste pH Neutralization System shall be supplied as a complete, integrated process system by a single supplier, skid mounted, preassembled and pre-tested prior to delivery to the site. The system shall be delivered as a complete skid with all inter connecting piping, signal wiring, and power wiring installed and tested prior to delivery. The system shall be manufactured by PPM or Practical Applications, Inc.

ii. The laboratory waste pH Neutralization system shall be a two-stage system with two continuous, stirred tank reactors in series. Each tank stage shall have bi-directional pH control and have equal treatment capacity in order to provide full redundancy. Laboratory waste shall flow into the first tank from the laboratory drain system. After mixing and treatment, the wastewater shall flow into the second tank for additional treatment as necessary and then be discharged to the sewer. The pH of the final treated effluent wastewater shall be monitored independently and shall be recorded on a circular chart recorder. The flow rate and total cumulative flow of the final treated effluent shall be monitored and shall be recorded on the same circular chart recorder. The system shall be provided with a minimum of three (3) 3/8" sampling spigots installed on the effluent discharge. Spigots shall be located so that they are accessible from the floor.

d. Reverse Osmosis Deionized Water System

i. Water Purification Equipment

1. The system shall be factory wired. All skids shall have local disconnects at pumps and devices requiring starters for 460 VAC power. 110 VAC or 24 V signals from the central monitoring and control panel located on the distribution pump skid shall signal local stagers, starters, and VFDs. This Contractor shall be responsible for all required interconnecting wiring and piping between the skids.

   System shall consist of, but not limited to, the following major components as required to provide the level of water quality specified. The specification is provided with references to Arion. The panel is to be wired to provide a single point connection for service from Section 260530. The contract shall include all components as required to provide a completely operational system as outlined by these documents and verified by the vendors detailed P, & I, D drawings.

2. Minimum Performance requirements: The system shall generate water equal to the following, measured at the effluent of the distribution skid outlet:

    a. Silicate (SiO2): ≤ 0.1 mg/l

    b. Resistivity: greater than 16.0 Megohm-cm

    c. Bacteria Content: less than 1000 CFU/ml

3. Complete documentation shall be provided with the pure water equipment. Documentation shall include but not limited to the following:

4. Detailed P&ID Drawing

    a. Valves tag numbers

    b. Instruments tag numbers

    c. Alarms

    d. Pipe sizing and material of construction

    e. Skid limitations

    f. Plan of component layout

    g. Written sequence of operation

5. Mechanical Assemblies of all Skids

    a. Dimensions

    b. Major components highlighted

    c. Bill of materials

6. Control Panel Layout

    a. Lights, switches and instrument plaques

    b. Back panel layout

7. Manufacture Catalog Data Sheets

    a. Major components

8. Testing

    a. Hydrostatic of all equipment

    b. Control panel checkout

9. System shall be a fully recirculated piping system.

e. RO Reject System

1. Considerations should be to collect and re-use rejected water.

2. General Description

    a. To transfer reject the water that has been stored, a _____ GPM duplex pump skid is to be provided. The pump skid shall be shipped completely pre-piped. One VFD (with pressure transmitter and PID loop control) per each pump shall be provided, and include a disconnect in its own dedicated NEMA 12 enclosure to allow servicing of either pump without interrupting service flow. Deliver _____ psig at final skid discharge. The pump skid shall be built with flanged inlet and outlet connections to mate directly to adjoining tanks and other supplied equipment. One pump shall operate as a backup. Provisions shall be made to alternate the back-up pump on a time basis, in accordance with manufacturer's recommendations for best performance and longest life.

    b. Pump quantity ..... Two (2)
    Pump type..... Multistage centrifugal
    Design flow ..... _____ GPM (per pump)
    Design pressure ..... _____ PSI (regulated, per pump)
    Manufacturer..... Grundfos _____ or Approved Equal
    Materials of construction ..316L stainless steel (wetted surfaces)
    Horsepower ..... _____ HP
    Phases ..... 3 phase
    Voltage ..... 460 VAC
    Components..... 316 stainless steel

3. Skid, Valves and Piping
    Frame ..... Carbon steel
    Paint ..... Epoxy, polyurethane, or powder coated
    Valves (≥ 2”)..... Butterfly (EPDM/316SS internals)
    Valves (< 2”)..... Ball, PVC
    Piping ..... SCH 80 PVC, solvent welded

ii. Reject Transfer Bladder Tank and Instruments

1. Bladder Tank

a. A five gallon bladder tank shall be provided. The purpose of the tank is to allow the VFDs to go into automatic shutdown mode to save energy when no water is called for.

2. Instrumentation
Pressure indicators (1).....316SS, 2.5" face, liquid filled, 1-160 psig
Sample valves .....(1) PVC ball

f. Animal Watering System

i. The Contractor shall be responsible for a complete and functional animal watering system (AWS). The system shall include all circuitry (conduit, cable, wire, boxes, etc.) for control wiring required. All wiring material shall comply with the AWS vendor requirements and shall be coordinated with all other trades. The Animal Watering System shall be by Edstrom.

ii. Any system installed shall have the capability to connect to HMS Infrastructure

1. Example is Edstrom Watchdog System. A computer-based data management, monitoring and control system specifically designed for laboratory animal facilities. The multi-tasking operating system allows simultaneous data collection, room task scheduling, alarm notification and report generation. The modular system design allows for addition of devices and sensors to meet the changing needs of the facility.

2. Animal Watering System Controller (AWSC)
Collect and process all data from sensors, provide user interface to view status, troubleshoot, set-up and activate control components. Store data in the event of communication loss with Watchdog server.

3. System Communications and Cabling
Applicable cabling required for specified communications to interconnect components of modular design system.

iii. Chlori-Flush Station (Model CFS-305)

1. General

a. The Chlori-Flush Station shall be a panel assembled self-contained unit designed for wall mounting. It will provide chlorinated water at an operating pressure of approximately 17

psi for flushing and sanitizing mobile rack manifolds. Both models are UL LISTED

iv. Recoil Hose Flush Station

1. The recoil hose flush station is to be a panel assembled, self-contained unit designed for wall-mounting. It shall provide a method to internally flush up to (6) detachable recoil hoses at one time.

v. Portable Sanitizer

1. The portable sanitizer shall be a self-contained system capable of delivering a pre-mixed sanitizing solution into the room distribution piping via an injection point.

vi. Pressure Reducing Stations

1. The Pressure Reducing Station is a panel assembly to provide animal drinking water at a normal operating pressure of 3-4 +/-1/2 psi with a minimum flow of one gallon per minute.

vii. Stainless Steel Room Distribution System

1. The stainless steel room distribution system is a water delivery piping system designed specifically for an animal automated drinking water system. The system operates normally at a low pressure of 3-5 psi, but is subjected to flushing pressures up to 50 psi.

    a. This specification applies to the receiving, handling, storage, and installation of stainless steel tubing and fittings for an animal drinking water system.

    b. Furnish all materials in accordance with this specification and manufacture in accordance with applicable codes and standards.

    c. ANSI/ASTM Standard A450 stainless steel tubing.

    d. Purchase the complete piping system from a single manufacturer. Factory cut and fabricate tubing to system designed lengths, electropolish and passivate and then cap and/or seal in a bag and suitably box for shipping protection. Individually bag each fitting and suitably box for shipping protection.

e. Inspect shipping cartons upon delivery for damage and material cleanliness. Report promptly to the manufacturer any damaged material.

f. Handle tubing to avoid bending or damage. Keep materials clean and free from grease and oil. Store all tubing and fittings in their original package until ready to use.

g. Store all system material in an area segregated from other construction material. Choose a location inside a building protected from any corrosive atmosphere. Limit access to protect against physical damage, loss and contamination.

2. Room Distribution Piping and Fittings
Distributes water from a pressure reducing station in to and around each animal room and to flush drain points. Pressure rating is 200 psi minimum. Use piping/fitting design to allow mechanical dismantling for repair or replacement of individual components. Soldered, brazed or adhesive bonded joints are not permitted. Electropolish externally and passivate all water contact surfaces to attain a uniform oxide inactive surface film.

   a. Stainless steel welded tubing

      i. .50" OD x .035" wall

      ii. 316 L grade

   b. Electropolish/passivation process

      i. Electropolish in 135□F solution of 65% phosphoric - 35% sulfuric acid

      ii. Passivate in 105□F solution of 20% nitric - 80% water

      iii. Final rinse with 125□F Reverse Osmosis water to remove all chemical residues

      iv. Electropolish and passivate after all fabrication and welding

   c. Coupling, elbow, tee fittings

      i. Clean Fitting or equivalent sanitary type

      ii. 316 L grade stainless steel

iii. ID: .43" to exactly match tubing ID

iv. Electropolish both internally and externally and passivate in accordance with 2.1.2 to a finish of 32 RA or better on all water contact surfaces

v. Joint Seal

1. High grade FDA approved silicone

2. Seal edge width: .05"

3. ID: .43" for flush internal joint

vi. Ferrule: 316 Stainless Steel

vii. Retainer hex nut: 303 stainless steel

viii. Bottle Filling Station Model BFS-675

1. The Bottle Filling Station is a complete system for automatically filling a case of animal drinking water bottles with treated or untreated water. The bottle filling station accurately mixes a base treating solution into animal drinking water for chlorination, acidification or medication and dispenses the treated water through a manifold and nozzles into a case of water bottles. The station is designed with easy access to solution tank for refilling. Solution metering pump is positioned low on the frame for positive pump priming. Reservoir tank with cone bottom can be located on either side, back or remote to the fill table. Fill Station sides are removable for conveyor feed.

6. Piping, Fittings and Joints

a. Polypropylene Piping

i. RODI Water System

1. Piping shall be SDR11 Beta Series wall thickness conforming to ASTM-2837 with butt fusion joints rated for 150 psi at 68°F as manufactured by Asahi or Orion.

2. If alternate manufacturer is submitted, it shall be the Contractor's responsibility to verify pipe sizes, pressure losses and velocities within the system. The Contractor will be required to submit his design prior to installation for review and approval.

ii. Above Ground Laboratory Waste and Vent (Smaller than 3")

1. Schedule 40 fire retardant, ASTM D4101, mechanical joint system as manufactured by Orion, IPEX / Enfield, G.F. Fuseal or Asahi.

iii. Above Ground Laboratory Waste and Vent (3" and Larger)

1. Schedule 40 flame retardant ASTM D4101, mechanical system as manufactured by Orion, IPEX / Enfield, G.F. Fuseal or Asahi.

iv. Lab Waste Ejector Discharge

1. SDR 11 flame-retardant copolymer polypropylene rated to 150 psi at 68□F conforming to ASTM D4101. Fittings shall be plain end, pressure pattern drainage type. Joints shall be socket fused conforming to ASTM D2657, George Fischer, Orion Asahi.

2. Contractor shall submit all lab waste discharge piping components to the Massachusetts Plumbing Board for approval per 248 CMR Section 10.13 Massachusetts Plumbing Code. Documentation submitted to the MA Plumbing Board shall indicate chemical compatibility.

v. Below Ground Laboratory Waste and Vent

1. Schedule 40, ASTM D4101, electrofusion or socket fusion system as manufactured by George Fischer, Orion, IPEX / Enfield or Asahi.

b. Durion Piping

i. Laboratory Waste and Vent at all glasswashers, autoclaves ad cage washers – provide 10' section of piping.

1. Piping shall be high silica content Durion or approved equal. Joints shall be made with stainless steel compression mechanical joints or hub and spigot with lead and acid resistant packing.

c. Laboratory and Specialty Gas Pipe and Fittings

i. Use for Compressed Air, Helium, Argon, Carbon Dioxide and Nitrogen

1. All piping shall be seamless copper tubing, Type L hard temper, ASTM Designation B88 for assembly with braze joint fittings.

2. Fittings for connecting copper tubing shall be standard weight, wrought copper, brass or bronze type. Fittings for copper tubing shall be wrought copper fittings, deep socket, designed expressly for brazing at temperature greater than 1000□F or may be brass or bronze.

3. Brazing Alloy: For assembling braze-joint fittings shall be Aircoils 45 or other silver brazing alloy of equivalent melting point and physical properties and shall conform to ANSI/AWS A5.8.

4. All pipe shall be prewashed expressly for oxygen use and delivered washed and capped. Piping shall be installed with a constant nitrogen purge.

d. Copper Tubing and Fittings

i. Vacuum Piping, Compressed Air Intake and Vacuum Exhaust

1. Tubing to be Type L hard temper with wrought copper fittings conforming to ASTM B88 and ASME B16.22. All joints shall be soldered with ASME AWS/A5.8 lead free solder.

7. Valves

a. RODI Water Valves (Polypropylene)

i. Diaphragm Valves: 1/2" to 2", polypropylene, allowable working pressure of 150 psi at 68°F water, spigot ends, EPDM diaphragm, position indicator, George Fischer Type 315PP, Asahi or Orion.

ii. Diaphragm Valves: 2-1/2” and larger, polypropylene, allowable working pressure of 150 psi at 68F water, flanged ends, ANSI Class 150, EPDM diaphragm, position indicator, George Fischer Type 317PP, Asahi or Orion.

b. Nitrogen Shutoff Valves (Stainless Steel Systems)

i. 1/16” to 3/4” shall be all stainless steel with extended stems and CTFE seat, swage or compatible style ends equal to Whitey Series 40. 1” to 2” shall be swage or compatible style ends equal to Whitey Series 60.

c. Specialty Gas Shutoff Valves (Compressed Air, Vacuum, Helium, Argon Vacuum, Carbon Dioxide and Nitrogen)

i. Ball valves shall be three piece bronze or brass body with chrome plated bronze or brass ball, Teflon seats and stem seal, full port designed with extension ends for brazing.

ii. All valves except for vacuum shall be prepared for oxygen service. Valves to be rated for 400 psi and activated by 90 degree turn to full-on to full-off position, Watts B-6801or Apollo.

d. RODI Pressure Regulator

i. Pressure regulator shall be polypropylene with NPT threads. The valve shall be one piece body housing containing the inlet port, outlet port, valve seat and pressure orifice. The regulator shall have a piston with a fabric reinforced EPDM rolling diaphragm sensing the downstream pressure and providing for maximum sensitivity and control accuracy. The shaft connecting the piston and the valve seat assembly shall have a double U-cup seal for safety. The valve shall be as manufactured by Plast-O-Matic or George Fischer or equivalent to.

e. RODI Backpressure Regulator

i. Backpressure regulator shall be polypropylene with NPT threads. The valve shall be of the inline porting design with a solid diaphragm backed by an elastomeric supporting diaphragm. The pressure adjusting bolt and lock nut shall be plastic. The valve shall have fail-dry safety design with a vented chamber between the Teflon diaphragm and the secondary U-cup seal. The valve shall be 100% individually factory tested and shall be as manufactured by Plast-O-Matic or George Fischer or equivalent to.

f. Compressed Air Pressure Regulating Valve

i. High capacity diaphragm operated regulator with zinc body, aluminum spring cage, adjustment mechanism capable of maintaining a constant outlet pressure with wide variation in flow similar to Watts Model R-119.

## 22 General installation requirements for sealing penetrations of plumbing equipment

**Penetrations**: Whether pre-existing or created for new mechanical, electrical, plumbing or ventilation purposes, each penetration – **whether or not required by code** - should be sealed by an appropriate method that not only preserves the fire / smoke rating of the penetrated structure but also sustainably prevents the entry and passage of insect and rodent pests. Escutcheon plates are acceptable only if the penetration behind is first sealed. Weep holes in the building's exterior façade shall be protected by an insect- and rodent-resistant device or product that will permit flow of air and water. To exclude rodent and insect pests, penetrations in masonry may be packed with cement or grout. If firestopping compounds are used in masonry, wall board or other partitions, the openings might first be tightly packed, as practical, with non-oxidizing metal meshes such as stainless steel mesh pads (e.g. 'Xcluder' brand blocks or fabric) or copper mesh (e.g. 'Stuf-Fit' brand). Guidance on such product application is available from the Harvard University EH&S Senior Environmental Public Health Officer and from the pest control vendor.