# SECTION 221000 - plumbing PIPing AND PumpS

## PART 1 - GENERAL

1.1 DESCRIPTION

A. Provide pipe, pipe fittings, piping specialties, pumps and related items required for complete piping system.

B. Related Work: The requirements of Section 220500, Common Plumbing Materials and Methods, also apply to this section.

1.2 QUALITY ASSURANCE

A. General: ASTM, and ANSI Standards are indicated. In addition, special standards are referenced where neither ASTM nor ANSI Standards are applicable.

B. Labeling: All piping shall be continuously and legibly labeled on each length as required by codes and standards and including as a minimum, country of origin, manufacturer’s identification marking, wall thickness designation, and applicable standards and approvals. Fittings shall be labeled as required by the referenced standard. Tubular fixture traps shall be stamped with manufacturer’s mark and material thickness.

C. Potable Water Valves: Potable water piping materials not limited to faucets, mixing valves, shutoff valves, or pressure reducing valves. Valves shall meet NSF Standard 61, Section 9, for drinking water faucets and shall be brass construction. Brass components which contact water within the faucet shall be from brass which contains no more than 3 percent lead by dry weight.

D. Definitions: Where piping fluid is not indicated in the following paragraphs, provide similar piping materials for similar fluids (i.e., "make-up water" = "domestic water"; "wet stand pipe" = "fire sprinkler pipe"; "drainage piping" = "sanitary/storm sewer piping").

E. Plumbing System Disinfection and Testing shall be performed by an experienced, qualified, chemical treatment agency. Mt. Hood Chemical, Chemcoa, or approved alternate.

F. Installer certification: Where piping systems include proprietary components, systems, or methods (PEX, Propress, Victaulic, etc.) the installers shall be certified by the product manufacturer for the installation of the product to ensure the validity of the factory warranty. Include installer certification documents with the product material submittals.

1.3 STORAGE AND HANDLING

A. Provide factory-applied end caps on each length of pipe and tube. Maintain end caps through shipping, storage and handling as required to prevent pipe-end damage and eliminate dirt and moisture from inside of pipe and tube. Protect flanges, valves, and fittings from moisture and dirt by inside storage and enclosure, or by packaging with durable, waterproof wrapping.

1.4 SUBMITTALS

A. Submit catalog data for each product specified.

## PART 2 - PRODUCTS

2.1 PIPING MATERIALS

A. Copper Pipe and Tube:

1. Application:

a. Domestic water

b. Priming lines

c. Condensate lines where heat traced.

2. Pipe: ASTM B88.

a. Above Ground Domestic Water: Type L hard temper copper with soldered joints.

b. Underground Domestic Water and Priming Lines: Type L soft annealed with no joints or type K hard tempered copper with silver soldered joints.

3. Fittings: Wrought copper solder-joint fittings, ANSI B16.22.

B. Cast Iron DWV Pipe:

1. Application: 1-1/2”" and larger in all non-residential areas including below and through the fire rated PT slabs.

a. Sanitary waste

b. Plumbing vent

c. Rain drain

2. Pipe: Hubless cast iron soil pipe, CISPI 301-05/ASTM A 888-05.

3. Fittings: Hubless cast iron fittings: CISPI 301-05/ASTM A 888-05.

4. Couplings:

a. Light Duty: Standard couplings meeting CISPI 310/ASTM A 1277.

b. Heavy Duty: No-hub couplings meeting ASTM C 1540, and FM 1680. ASTM C 564 neoprene gasket, type 304 SS corrugated shield and type 304 SS clamping bands. Four bands on 1-1/2” thru 4” pipe and 6 bands on 5” thru 10” pipe.

5. Manufacturers: Cast iron pipe and fittings – AB&I, Charlotte Pipe, Tyler Pipe, or approved. All pipe shall be labeled by the manufacturer.

C. Plastic Pipe – Drain, Waste, Vent (DWV):

1. Application: All residential areas.

a. Sanitary waste

b. Plumbing vent

c. Rain drain

2. Pipe:

a. Acrylonitrile-butadiene-styrene (ABS) (ASTM D3965) plastic drain, waste and vent piping (ASTM F628) and fittings (ASTM D2661) (DWV).

b. Polyvinyl chloride (PVC ) (ASTM D1784) plastic drain, waste and vent pipe (ASTM D2665 and D1785) and fittings (ASTM D2665) (DWV).

3. Fittings: Provide fittings of the type indicated, matching piping manufacture. Where not otherwise indicated, provide socket style, solvent weld fittings produced and recommended for the service indicated by the piping manufacturer.

D. Plastic Pipe:

1. Application: Where approved by Code.

a. Domestic water, underground

b. Water heater & Washer pan drain

c. Condensate drains, non-heat traced.

2. Pipe:

a. Polyvinyl Chloride and Chlorinated Polyvinyl Chloride Plastic Pipe for Water Service: SDR-PR pipe, ASTM D2241; Schedules 40, 80 and 120, ASTM D1785.

3. Fittings: Provide fittings of the type indicated, matching piping manufacturer. Where not otherwise indicated, provide socket style, solvent weld fittings produced and recommended by the piping manufacturer for the service indicated.

E. Plastic Pipe:

1. Application: Allowed within residential units only. Not permitted in corridors, dwelling unit risers or at penetrations of rated walls.

a. Domestic water, 1” and smaller.

2. Pipe:

a. Cross-linked polyethylene (PEX) tubing for Water Service: ASTM F877; SDR 9. NSF-pw and NSF 61.

3. Fittings: Provide fittings of the type indicated, matching piping manufacturer. Where not otherwise indicated, provide fittings produced and recommended by the piping manufacturer for the service indicated.

2.2 MISCELLANEOUS PIPING MATERIALS

A. Soldering and Brazing Materials: Provide soldering materials as determined by the installer to comply with installation requirements.

1. Tin-Antimony Solder: ASTM B32, Grade 95TA.

2. Lead-Free Solder: ASTM B32, Grade HB. Harris "Bridgit" approved.

3. Silver Solder: ASTM B32, Grade 96.5TS.

1. Flux: Water soluble paste flux.
2. Brazing filler rod: BCuP rod to suit conditions.

B. Strainers: "Y-pattern," iron or bronze body rated for pressures indicated with blow-off connection and 20 mesh stainless steel screen.

C. Tracer Wire: 14 gauge, single strand, copper wire with blue insulation for water, green for sanitary and storm sewers, and yellow for gas. 3M "DBY" direct bury splice kit required at all splices.

D. Pipe Sleeves: For installation in cast in place concrete floor systems. UL 1479 listed with ratings for fire, smoke, and water intrusion. Cast in place pipe sleeve with external waterstop collar and interior pipe seal and intumescent collar. Holdrite “Hydroflame”.

2.3 PIPING specialties

A. Cleanouts: PVC bodies with nickel bronze adjustable top where located in finished or concrete floors.

B. Floor Drains: PVC construction with anchor flange and stainless steel or nickel bronze top, and other options as indicated by model number. Cast iron drains and tops for heavy duty drains (Including all trash rooms).

C. Roof drains: Cast iron body and dome with flashing clamp, sump receiver, and underdeck clamp. Drain configuration to match roofing system. Overflow drains with 2” high water dam.

D. Roof drain outlet nozzle: Polished nickel bronze nozzle with trim ring and threaded or socket pipe connection.

E. Priming Valves: Smith 2699, Josam 88250, Wade W8800T, Zurn Z1022, Watts MS810 or equivalent Precision Plumbing, Mifab. Locate in closets, under counters or in walls behind access panels as specified in Section 220500. Use copper specified previously for all underground priming lines.

F. Traps: Except chrome plated fixture traps. Recessed drainage pattern for threaded pipe and same grade as pipe for plastic pipe; with cleanout plugs in trap body in all above grade locations.

G. Pressure Reducing Valve: Single seat type with renewable stainless steel seat and valve. Size and capacity as shown on Drawings. Bronze bodies with screwed connections on valves 2-1/2” and smaller and flanged steel bodies on valves 3” and larger. Install each PRV with strainer on inlet or internal strainer. Leslie, Watts, Cash-Acme, Zurn-Wilkins, or approved substitute.

H. Backflow Preventer: Where indicated on the Drawings, install a double check backflow preventer complete with shutoff valves, two separate check valves, and test cocks. USC Foundation for Cross Connection Control, State Health Officials, and serving utility approved. Bronze bodies on units 2” and smaller, and cast iron bodies with bronze trim on units 2-1/2” and larger.

I. Backflow Preventer: Where indicated on the Drawings and all buildings with roof gardens, water features or living walls, install a reduced pressure backflow preventer complete with strainer on inlet**,** shutoff valves, two separate check valves, differential relief valve with drain funnel, and test cocks. USC Foundation for Cross Connection Control, State Health Officials, and serving utility approved. Bronze bodies on units 2” and smaller, cast iron bodies with bronze trim on units 2-1/2” and larger, and stainless steel construction for carbonated beverage service.

M. Pipe Sleeves: For installation in cast in place concrete floor systems. UL 1479 listed with ratings for fire, smoke, and water intrusion. Cast in place pipe sleeve with external waterstop collar and interior pipe seal and intumescent collar. Holdrite “Hydroflame”.

N. Master Mixing Valve: All brass or bronze body with stainless steel parts, thermostatic master control element to fail safe upon cold water or control element failure meeting ASSE 1017. Provide with external union angle check stops, strainers, volume control, shutoff valves, dial thermometer. Valve location, arrangement and capacity as shown on plans. Leonard, Lawler, Powers, Acorn, Bradley, Symmons, or approved substitute. See section 3 for factory start-up procedures.

T. Domestic Water Balancing Valve: Balancing fitting with differential pressure taps, brass or bronze body and trim. B&G “Circuit Setter” or equivalent Taco, Armstrong, Thrush, Wheatley, Flow Design or approved substitute. At contractor’s option, balancing valves 3” and larger may be butterfly style, Jenkins No. 222 EL or approved substitute as specified in Section 221000.

2.4 BACKFILL MATERIALS

A. Subbase Materials: A graded mixture of gravel, sand, crushed stone or crushed slag.

B. Finely-Graded Subbase Material: Well graded sand, gravel, crushed stone or crushed slag, with 100% passing a 3/8" sieve.

C. Backfill Material: Soil material suitable for compacting to the required densities, and complying with AASHTO designation M145, Group A-1, A-2-4, A-2-5. or A‑3.

B. Elevator Sump Pump: Submersible, 100 gpm at 15 ft. head, 1-horsepower sump pump with integral float switch. Myers, Paco, Hydronix, Zoeller, Viking, Liberty, or approved.

## PART 3 - EXECUTION

3.1 UTILITY SERVICE

A. Plumbing Utility Connections: Complete installation. Contact local serving utilities to determine conditions involved and make or arrange to have connection made at proper time and pay all costs involved.

B. Sanitary and Storm Sewers: Connect to or arrange for connection to sanitary and storm sewers as shown on the Drawings and as required by the serving utility. Verify depth, size and location prior to installation of the new sewer systems.

C. Water Service: Connect to or arrange for connection to water service as shown on the drawings. Verify serving utility requirements prior to beginning any installation. Verify water main size, depth, pressure and location prior to starting work.

D. Fire Service: Connect to or arrange for connection to fire water service as shown on the drawings. Contact local serving utilities to determine conditions involved and make or arrange to have connection made at proper time and pay all costs involved.

3.2 PIPE INSTALLATION

A. Comply with the following applicable HUD standards:

1. HUD UM 76 CPVC & PB Hot and Cold Water Distributing Pipe.

2. HUD UM 78 PE, ABS, PVC, & PB Plastic Piping for Domestic Water.

3. HUD UM 79a ABS & PVC Plastic Pipe and Fittings for Drain, Waste, and Vent.

B. General: Install pipe, tube and fittings in accordance with recognized industry practices and plumbing code standards. Install each run accurately aligned with a minimum of joints and couplings, but with adequate and accessible unions and flanges for disassembly, maintenance and/or replacement of valves and equipment. Reduce sizes (where indicated) by use of reducing fittings.

C. Piping Runs: Route piping close to and parallel with walls, overhead construction, columns and other structural and permanent-enclosure elements of the building. Install piping plumb and level except where pitched for drainage. If not otherwise indicated, run piping in the shortest route which does not obstruct usable space or block access for servicing the building or equipment and avoid diagonal runs. Wherever possible in finished and occupied spaces, conceal piping from view. Do not encase horizontal runs in solid (concrete or CMU) partitions.

D. Tracer Wire: Install tracer wire as close to underground non-metallic water, sanitary and storm sewers and gas pipe in the trench as possible. Tracer wire shall be accessible at grade via all services, valve and meter boxes, curb cocks, cleanouts at the building, manholes (inside the cover near the top), etc. Locate all points on the record as-installed drawings. Splice into utility tracer system where available. Comply with code requirements.

3.3 PIPING JOINTS

A. General: Provide joints of the type indicated in each piping system, and where piping and joint as manufactured form a system, utilize only that manufacturer's material.

B. Threaded Piping: Thread pipe in accordance with ASME B1.20.1; cut threads full and clean using sharp dies. Ream threaded ends to remove burrs and restore full inside diameter. Apply pipe joint compound or pipe joint tape (Teflon) where recommended by pipe/fitting manufacturer, on male threads at each joint and tighten joint to leave no more than three threads exposed.

C. Solder Copper Tube and Fitting Joints: In accordance ANSI B 828 with recognized industry practice. Cut tube ends squarely, ream to full inside diameter, and clean outside of tube ends and inside of fittings. Apply solder flux to joint areas of both tubes and fittings. Insert tube full depth into fitting, and solder in a manner which will draw solder full depth and circumference of joint. Wipe excess solder from joint before it hardens. "T-Drill" field formed tees with brazed joints may be utilized where the main is at least two pipe sizes larger than the branch.

D. Plastic Pipe/Tube Joints: Comply with manufacturer's instructions and recommendations, and with applicable industry standards:

1. Heat Joining of Thermoplastic Pipe: ASTM D-2657.

2. Making Solvent-Cemented Joints: ASTM D-2865 and ASTM F-402.

E. Insulating (Dielectric) Fittings: Comply with manufacturer's instructions for installing unions or fittings. Install in a manner which will prevent galvanic action and stop corrosion where the "joining of ferrous and non-ferrous piping" is indicated.

F. Changes in Direction: Use fittings for all changes in direction. Run lines parallel with building surfaces.

G. Line Grades:

1. Drainage Lines: Run at maximum possible grade and in no case less than 1/8" per foot within building.

2. Vents: Pitch for drainage 1/4" per 10'.

3. Water: Pitch to low points and install hose bib drains. 3' minimum depth of ground cover for all lines outside building unless otherwise noted.

H. Unions and Flanges: At all equipment to permit dismantling and elsewhere as consistent with good installation practice.

I. Expansion: Provide loops, swing joints, anchors, runouts and spring pieces to prevent damage to piping or equipment.

3.4 CLEANOUTS

A. Where required by code, at each change of sewer direction 45 degrees or greater and more than 10’ long, at end of each branch or main and spaced not greater than 100’ apart, as required by code and/or as shown on Drawings.

3.5 MISCELLANEOUS PIPING EQUIPMENT

A. Floor, Wall and Ceiling Plates: Chrome plated pressed steel or brass screw locked split plates on all pipe penetrations in finished spaces.

B. Strainers: Install in a manner to permit access for cleaning and screen removal and with blow-off valve.

C. Sleeves: At all cast in place penetrations of concrete or masonry construction. PVC, 24 gauge galvanized steel or Schedule 40 galvanized steel pipe. Use steel pipe sleeves through beams, footings, girders or columns and for all penetrations of walls or floors below grade. Where floor finish is ceramic tile, terrazzo, or similar material extend standard steel pipe sleeves 1-1/2" above finished floor. Fabricate sleeves 1" diameter larger than pipe or insulation. PVC and sheet metal sleeves at non-structural penetrations only.

D. Sleeve Caulking: Caulk below grade pipe with rubber link seal. Grout above grade pipe with cement mortar or approved waterproof mastic. Install UL sealing caulk, putty and/or system at all penetrations of fire rated walls, floors and ceiling.

E. Trap Priming: Traps serving floor drains, floor sinks, catch basins, and similar fixtures shall be primed in accordance with Code requirements.

F. Heat Trace: Apply freeze protection heat trace to traps exposed to outdoor temperatures.

G. Domestic Hot Water Mixing Valves: Install in accordance with manufacturers installation instructions and piping diagrams.

3.6 EXCAVATING

A. General: Do not excavate for mechanical work until the work is ready to proceed without delay, to minimize the total time lapse from excavation to completion of backfilling. Comply with all applicable Federal and state safety regulations and local erosion control requirements.

B. Width: Excavate for piping with 6" to 9" clearance on both sides of pipe, except where otherwise shown or required for proper installation of pipe joints, fittings, valves and other work. Excavate for other work to provide minimum practical but adequate working clearances.

C. Depth for Direct Support: For work to be supported directly on undisturbed soil, do not excavate beyond indicated depths, and hand-excavate the bottom cut to accurate elevations. Support the following work on undisturbed soil at the bottom of the excavations:

1. Piping of 5" and less pipe/tube size.

2. Cast-in-place concrete.

D. Depth for Exterior Piping: Excavate for exterior water-bearing piping (water and drainage) so that the top of piping will not be less than 2**'** vertical distance below finished grade.

E. Depth for Unsatisfactory Soil Conditions: Where unsatisfactory soil condition at the bottom of excavation exists, excavate additional depth as directed to reach satisfactory soil-bearing condition. Backfill with subbase material, compacted as directed, to indicated excavation depth.

F. Excavated Materials: Store excavated material (temporarily) near the excavation, in a manner which will not interfere with or damage the excavation or other work. Do not store under trees (within the drip line). Retain excavated material which complies with the requirements for backfill material. Dispose of excavated material which is either in excess of quantity needed for backfilling or does not comply with requirements for backfill material.

3.7 BACKFILLING

A. Do not backfill until installed mechanical work has been tested and accepted wherever testing is indicated. Install drainage fill where indicated, and tamp to a uniform firm density. Backfill with finely-graded subbase material to 6" above wrapped, coated and plastic piping. Condition backfill material by either drying or adding water uniformly, to whatever extent may be necessary to facilitate compaction to the required densities. Do not backfill with frozen materials.

3.8 CLEANING

A. General: Clean all dirt and construction dust and debris from all mechanical piping systems and leave in a new condition. Touch up paint where necessary. Removed labels and tags from plumbing fixtures and trim.

B Disinfection of Domestic Water Piping System:

1. Piping system disinfection shall be performed by an approved agency. The following procedure may be modified upon their recommendation and Engineers approval.

2. Prior to starting work, verify system is complete and clean.

3. Open all drains and fixtures valves in the building starting with the valve nearest the water service line and permit the water to run clear for 10 minutes to eliminate grease, cuttings, flux, and foreign matter.

4. Inject disinfectant at beginning of water system to be disinfected. Introduce free chlorine in liquid form, throughout system to obtain concentration required by local Public Health Department regulations or 50 to 80 mg/L residual.

5. Bleed water from all potable water outlets to ensure distribution and test for disinfectant residual at minimum 15 percent of outlets.

6. Maintain disinfectant in system for 24 hours.

7. If final disinfectant residual tests less than 25 mg/L, repeat treatment.

8. Flush disinfectant from system until residual is equal to that of incoming water or 1.0 mg/L.

9. Take samples no sooner than 24 hours after flushing, from 10 percent of outlets and from water entry, and analyze in accordance with AWWA C601. If any sample fails the analysis, repeat the procedure.

10. Include a copy of the bacteriological analysis in the Operating and Maintenance manuals.

C. Sanitary and Storm Drainage System:

1. Remove construction debris from cleanouts, drains, strainers, baskets, traps, etc., and leave same accessible and operable. Place plugs in the end of uncompleted piping at the end of the day or whenever work stops.

2. Before final acceptance of completed sewer system, flush and clean the entire system with water. Trap and remove solid material obtained from flushing and cleaning from the new system. Do not allow debris to enter the existing sewer system.

3.9 TEST

A. General:

1. Minimum duration of two hours or longer, as directed for all tests. Furnish report of test observation signed by qualified inspector. Make all tests before applying insulation, backfilling, or otherwise concealing piping or connecting fixtures or equipment. Where part of the system must be tested to avoid concealment before the entire system is complete, test that portion separately, same as for entire system.

2. Provide all necessary temporary equipment for testing, including pump and gauges. Remove control devices before testing and do not use piping system valves to isolate sections where test pressure exceeds valve pressure rating. Fill each section with water and pressurize for the indicated pressure and time.

3. Observe each test section for leakage at end of test period. Test fails if leakage is observed or if pressure drop exceeds 5% of test pressure.

B. Repair

1. Repair piping system sections which fail the required piping test by disassembly and re-installation, using new materials to the extent required to overcome leakage. Do not use chemical stop-leak compounds, solder, mastics, or other temporary repair methods.

2. Drain test water from piping systems after testing and repair work has been completed.

C. Sewer: Furnish all facilities and personnel for conducting the test. Test in accordance with the requirements of the State Plumbing Inspector and local authorities.

D. Plumbing Waste and Vent Piping: Hydrostatic test by filling to highest point, but not less than 10' water column on major horizontal portion.

E. Water Piping: Hydrostatic pressure of 100 psig without loss for four hours.

3.10 SUPERVISION AND START-UP

A. Adjust flush valves, pressure reducing valves, mixing valves, water heater thermostats, and similar equipment.

B. Master mixing valve start-up procedure: Provide a factory authorized representative to review the installation of the mixing valve and verify that the adjustment has been completed by an authorized agent of the manufacture. Provide documentation in the O&M documents showing adjustment has been completed per manufacture instructions. Record supply and return temperatures. Work shall be completed prior to substantial completion.

END OF SECTION 221000