

SECTION 15055 - BASIC PIPING MATERIALS AND METHODS

PART 1 - GENERAL

1.1 SUBMITTALS:

- A. Refer to Division 1 and Basic Mechanical Requirements for administrative and procedural requirements for submittals.
- B. Product Data: Submit industry standards and manufacturer's technical product data, installation instructions, and dimensioned drawings for each type of pipe and pipe fitting. Submit piping schedule showing pipe or tube weight, fitting type, and joint type for each piping system.
- C. Welding Certifications: Submit reports as required for piping work.
- D. Brazing Certifications: Submit reports as required for piping work.

1.2 QUALITY ASSURANCE:

- A. Manufacturer's Qualifications: Firms regularly engaged in manufacturer of pipes and pipe fittings of types and sizes required, whose products have been in satisfactory use in similar service for not less than 5 years.
- B. Welder's Qualifications: All welders shall be qualified in accordance with ASME Boiler and Pressure Vessel Code, Section IX, Welding and Brazing Qualifications.
- C. Welding procedures and testing shall comply with the latest revisions of the applicable sections for B31, of the ANSI/ASME standard codes for pressure piping, noted as follows: B31.1 - Pressure Piping Code / B31.2 - Fuel Gas Piping Code / B31.5 - Refrigeration Piping / B31.9 - Building Service Piping Code.
- D. Before any welding is performed, the contractor shall submit to the Architect/Engineer, or his authorized, a copy of the Manufacturer's Record of Welder or Welding Operator Qualification Tests and his Welding Procedure Specification together with the Procedure Qualification Record as required by ASME Boiler and Pressure Vessel Code.
- E. Each manufacturer or contractor shall be responsible for the quality of welding done by his organization and shall repair or replace any work not in accordance with these specifications.
- F. Soldering and Brazing procedures shall conform to ANSI Standard Safety Code for Mechanical Refrigeration.

PART 2 PRODUCTS

2.1 GENERAL:

- A. Piping Materials: Provide pipe and tube of type, pressure and temperature ratings, capacities, joint type, grade, size and weight (wall thickness or Class) indicated for each service. Where type, grade or class is not indicated, provide proper selection as determined by Installer for installation requirements, and comply with governing regulations and industry standards.
- B. Pipe/Tube Fittings: Provide factory-fabricated fittings of type, materials, grade, class and pressure rating indicated for each service and pipe size. Provide sizes and types matching pipe, tube, valve or equipment connection in each case. Where not otherwise indicated,

comply with governing regulations and industry standards for selections, and with pipe manufacturer's recommendations where applicable.

2.2 STEEL PIPES AND PIPE FITTINGS:

- A. Black Steel Pipe: ASTM A 53, Grade B, type E, electric resistance welded.
- B. Galvanized Steel Pipe: ASTM A 53, Grade B.
- C. Seamless Steel Pipe: ASTM A 53, Grade B, type S or A106 high temperature.
- D. Stainless Steel Pipe: ASTM A 312; Grade TP 304 (high temperature and corrosive service, 1/8 inch thru 30 inches).
- E. Stainless Steel Sanitary Tubing: ASTM A 270; Finish No. 80, (dairy and food industry, 1 inch thru 4 inches).
- F. Steel Water Pipe: AWWA C200 for pipe 6 inches and larger.
- G. Coal Tar Protective Coatings and Linings for Steel Water Pipe: AWWA C203 for enamel and tape, hot applied.
- H. Chlorinated Rubber-Alkyd Paint System for Steel Water Pipe: AWWA C204 (exterior above-ground steel water pipe).
- I. Cement-Mortar Protective Lining and Coating for Steel Pipe: AWWA C205.
- J. Cast-Iron Flanged Fittings: ANSI/ASME B16.1, including bolting (Class 125 and 250).
- K. Cast-Iron Threaded Fittings: ANSI/ASME B16.4 (Class 125 and 250).
- L. Malleable-Iron Threaded Fittings: ANSI/ASME B16.3; plain or galvanized as indicated (Class 125 and 300).
- M. Malleable-Iron Threaded Unions: ANSI B16.39, Class 150, 250 or 300; selected by Installer for proper piping fabrication and service requirements, including style, end connections, and metal-to-metal seats (iron, bronze or brass); plain or galvanized as indicated (Class 150, 250 and 300).
- N. Threaded Pipe Plugs: ANSI/ASME B16.14.
- O. Steel Flanges/Fittings: ANSI/ASME B16.5, ASTM A234 (Fire Protection) including bolting and gasketing of the following material group, end connection and facing, except as otherwise indicated.

Material Group: Group 1.1.
End Connections: Buttwelding.
Facings: Raised-face.
- P. Steel Pipe Flanges for Waterworks Service: AWWA C207 (water service piping only).
- Q. Corrosion-Resistant Cast Flanges/Fittings: MSS SP-51, including bolting and gasketing (threaded where pressure is not critical).

- R. Forged-Steel Socket-Welding and Threaded Fittings: ANSI B16.11, except MSS SP-79 for threaded reducer inserts; rated to match schedule of connected pipe (up to 4 inch pipe size).
 - S. Wrought-Steel Buttwelding Fittings: ANSI B16.9, except ANSI B16.28 for short-radius elbows and returns; rated to match connected pipe.
 - T. Stainless-Steel Buttwelding Fittings: MSS SP-43.
 - U. Cast-Iron Threaded Drainage Fittings: ANSI B16.12.
 - V. Forged Branch-Connection Fittings: Except as otherwise indicated, provide type as determined by Installer to comply with installation requirements.
 - W. Pipe Nipples: Fabricated from same pipe as used for connected pipe; except do not use less than Schedule 80 pipe where length remaining unthreaded is less than 1-1/2 inches, and where pipe size is less than 1-1/2 inches, and do not thread nipples full length (no close-nipples).
- 2.3 COPPER TUBE AND FITTINGS:
- A. Copper Tube: ASTM B 88; Type K or L as indicated for each service; hard-drawn temper, except as otherwise indicated.
 - B. DWV Copper Tube: ASTM B 306.
 - C. ACR Copper Tube: ASTM B 280.
 - D. Cast-Copper Solder-Joint Fittings: ANSI B16.18.
 - E. Wrought-Copper Solder-Joint Fittings: ANSI B16.22.
 - F. Cast-Copper Solder-Joint Drainage Fittings: ANSI B16.23 (drainage and vent with DWV or tube).
 - G. Wrought-Copper Solder-Joint Drainage Fittings: ANSI B16.29.
 - H. Cast-Copper Flared Tube Fittings: ANSI B16.26.
 - I. Bronze Pipe Flanges/Fittings: ANSI B16.24 (Class 150 and 300).
 - J. Copper-Tube Unions: Provide standard products recommended by manufacturer for use in service indicated.
- 2.4 BRASS PIPE AND FITTINGS:
- A. Red Brass Pipe: ASTM B 43 (boiler feed pipe, 1/8 inch thru 12 inches, regular or extra strong weight).
 - B. Cast-Bronze Threaded Fittings: ANSI B16.15, Class 125 or 250.
 - C. Cast-Bronze Threadless Fittings: ASTM B 61 or B 62, brazed joints.
- 2.5 CAST-IRON PRESSURE PIPES AND PIPE FITTINGS:
- A. Ductile-Iron Pipe: Class 52, ANSI A21.51; AWWA C151; 350 psi pressure rating.
 - B. Cement-Mortar Lining for Ductile-Iron and Pipe and Fittings for Water: ANSI A21.4; AWWA C104.
 - C. Polyethylene Encasement for Ductile Cast-Iron Piping: ANSI A21.5; AWWA C105.
 - D. Cast-Iron Fittings: ANSI/AWWA C110/A21.10.
 - E. Ductile-Iron Fittings: ANSI/AWWA C110/A21.10.
 - F. Rubber-Gasket Joints: ANSI/AWWA C111/A21.11.
- 2.6 CAST-IRON SOIL PIPES AND PIPE FITTINGS:

- A. Hubless Cast-Iron Soil Pipe: FS WW-P-401 and CISPI Standards 301 and 310. Pipe and fittings shall be marked with the collective trademark of the cast iron soil pipe institute or receive prior approval of the engineer.
 - B. Cast-Iron Hub-and-Spigot Soil Pipe: ASTM A 74. Pipe and fittings shall be marked with the collective trademark of the cast iron soil pipe institute or receive prior approval of the engineer.
 - C. Hubless Cast-Iron Soil Pipe Couplings: Neoprene gasket complying with ASTM C564, CISPI Standard 310 and stainless steel clamp holding band.
 - D. Heavy Duty Hubless Cast Iron Soil Pipe Couplings: Neoprene gasket coupling with ASTM C564. 304 stainless steel shield, minimum 0.15 inches thick, minimum 3 inches wide with 4 sealing bands up to 4 inch pipe, minimum 9 inches wide with 6 sealing bands up to 10 inch pipe.
 - 1. Basis of Design: Husky SD 4000.
 - E. Cast-Iron Hub-and-Spigot Soil Pipe Fittings: Match soil pipe units; complying with ASTM A 74.
 - F. Neoprene Compression Gaskets: ASTM C 564.
- 2.7 CONCRETE PIPES AND PIPE FITTINGS:
- A. Reinforced Concrete Pipe: ASTM C 76, Class 1, 2 or 3, with modified tongue-and-groove compression gasket joints complying with ASTM C 443.
 - B. Concrete Pipe: ASTM C 14, Class 2, unless otherwise indicated.
 - C. Fittings for Concrete Pipe: Match concrete pipe; provide units produced by same manufacturer, complying with same standards.
- 2.8 PLASTIC PIPES AND PIPE FITTINGS:
- A. Acrylonitrile-Butadiene-Styrene Sewer Pipe (ABS): ASTM D-1527, 3 inch thru 12 inch; SDR 23.5, 4 and 6 inch; SDR 35, 3 inch, 4 inch, and 6 inch; SDR 42, 8 inches, 10 inch and 12 inch.
 - B. ABS Pipe Fittings:
 - Schedule 40 Socket: ASTM D 2468.
 - Schedule 80 Socket: ASTM D 2469.
 - Schedule 80 Threaded: ASTM D 2465.
 - Solvent Cement: ASTM D 2235.
 - Solvent Cement (To Join ABS To PVC): ASTM D 3138.
 - C. Polyvinylchloride Sewer Pipe (PVC): ASTM D-2729, 2 inch thru 6 inch; ASTM D2665, 1-1/2 inches thru 8 inches.
- 2.9 DRAINAGE TILE AND PIPE, FITTINGS, AND ACCESSORIES:
- A. Clay Drain Tile: ASTM C 4, Standard Class, unless otherwise indicated; lengths as indicated.
 - B. Perforated Polyvinyl Chloride Pipe (PVC): ASTM D 2729; perforated except where standard sections of pipe are indicated.

- C. Perforated Clay Pipe: ASTM C 700; Standard Strength, unless otherwise indicated.
 - D. Fittings and Accessories for Drainage Tile and Pipe: Unless otherwise indicated, provide fittings matching and of same material as pipe units; comply with same standards, where applicable, except fittings need not be perforated where pipe is required to be perforated.
 - E. Tile Joint Accessories: Where open-joint drainage tile is indicated, provide joint accessory units as follows:
 - 1. Heavy-mesh burlap joint covers, with copper wire ties.
 - 2. Coal-tar saturated felt covers, with copper wire ties.
 - 3. Copper screen covers, 18-14 mesh, with copper wire ties.
 - 4. Corrosion-resistant metal spacer-band covers.
- 2.10 MISCELLANEOUS PIPING MATERIALS/PRODUCTS:
- A. Welding Materials: Except as otherwise indicated, provide welding materials as determined by Installer to comply with installation requirements.
 - 1. Comply with Section II, Part C, ASME Boiler and Pressure Vessel Code for welding materials.
 - B. Soldering Materials: All soldering materials shall be lead free.
 - 1. 95-5 Tin-Antimony: ASTM B 32, Grade 95TA. Melting Range 450-470 degrees F.
 - 2. Silver-Tin Alloy: Fed. Spec. QQ-S-571E, NSFC2. Melting Range 430 to 530 degrees F.
 - 3. Flux: All flux shall be lead free, water soluble, and compatible with the solder and the materials being joined. ASTM B813-93.
 - C. Brazing Materials: Except as otherwise indicated, provide brazing materials to comply with installation requirements.
 - 1. Comply with AWSA 5.8, Section II, ASME Boiler and Pressure Vessel Code for brazing filler metal materials.
 - a. Copper phosphorus -Bcup-5, 15 percent solver content, melting range 1190 to 1480 degrees F.
 - b. Silver - BAg-36, 45 percent silver, cadmium-free. Melting range 1195 to 1265 degrees F.
 - D. Gaskets for Flanged Joints: ANSI B16.21; full-faced for cast-iron flanges; raised-face for steel flanges, unless otherwise indicated.
 - E. Piping Connectors for Dissimilar Non-Pressure Pipe: Elastomeric annular ring insert, or elastomeric flexible coupling secured at each end with stainless steel clamps, sized for exact fit to pipe ends and subject to approval by plumbing code.
 - 1. Manufacturer: Subject to compliance with requirements, provide piping connectors of the following:
 - a. Husky Technologies (Husky SD 4000):

- F. Pipe Thread Sealant Material: Except as otherwise indicated, provide all pipe threads with the sealant material as recommended by the manufacturer for the service.
 - 1. Manufacturer: Subject to compliance with requirements, provide piping thread sealant material of the following:
 - a. The Rectorseal Corporation

PART 3 EXECUTION

3.1 EXAMINATION:

- A. Verify all dimensions by field measurements. Verify that all water distribution piping may be installed in accordance with pertinent codes and regulations, and original design, and the referenced standards.
- B. Examine rough-in requirements for plumbing fixtures and other equipment having water connections to verify actual locations of piping connections prior to installation.
- C. Do not proceed until unsatisfactory conditions have been corrected.

3.2 PIPING INSTALLATION:

- A. General: Install pipes and pipe fittings in accordance with recognized industry practices which will achieve permanently-leakproof piping systems, capable of performing each indicated service without piping failure. Install each run with minimum joints and couplings, but with adequate and accessible unions for disassembly and maintenance/replacement of valves and equipment. Reduce sizes (where indicated) by use of reducing fittings. Align piping accurately at connections, within 1/16 inch misalignment tolerance.
 - 1. Comply with ANSI B31 Code for Pressure Piping.
 - 2. Electrical Equipment Spaces: Do not run piping through transformer vaults and other electrical or electronic equipment spaces and enclosures. Only piping serving this type of equipment space shall be allowed.
 - 3. Locations and Arrangements: Drawings (plans, schematics, and diagrams) indicate the general location and arrangement of piping systems. Locations and arrangements of piping take into consideration pipe sizing and friction loss, expansion, pump sizing, and other design considerations. So far as practical, install piping as indicated.
 - 4. Use fittings for all changes in direction and all branch connections.
 - 5. Install piping at right angles or parallel to building walls. Diagonal runs are not permitted, unless expressly indicated.
 - 6. Conceal all pipe installations in walls, pipe chases, utility spaces, above ceilings, below grade or floors, unless indicated to be exposed to view.
 - 7. Install piping tight to slabs, beams, joists, columns, walls, and other permanent elements of the building. Provide space to permit insulation applications, with 1 inch clearance outside the insulation. Allow sufficient space above removable ceiling panels to allow for panel removal.

8. Locate groups of pipes parallel to each other, spaced to permit applying insulation and servicing of valves.
 9. Install drains in pressure pipe systems at all low points in mains, risers, and branch lines consisting of a tee fitting, ¾ inch ball valve, and short ¾ inch threaded end nipple and cap with chain.
 10. Install piping free of sags or bends and with ample space between piping to permit proper insulation applications.
 11. Fire and Smoke Wall Penetrations: Where pipes pass through fire and smoke rated walls, partitions, ceilings, and floors, maintain the fire and smoke rated integrity. Refer to Division 15, Section 15120 and 15050 for materials.
 12. Exterior Wall Penetrations: Seal pipe penetrations through exterior walls using sleeves and mechanical sleeve seals (See Section 15120). Pipe sleeves smaller than 6 inch shall be steel; pipe sleeves 6 inches and larger shall be sheet metal.
 13. Anchor piping to ensure proper direction of expansion and contraction.
 14. Coordinate foundation and all other structural penetrations with structural engineer.
- B. Hydronic Piping:
1. Make reductions in hydronic pipe sizes using eccentric reducer fitting installed with the level side up.
 2. Install hydronic piping branch connections to mains using Tee fittings in main with take-off out the bottom of the main, except for up-feed risers which shall have take-off out the top of the main line. Install all hydronic piping level with manual air vent at all high points in direction of flow.
 3. Install hydronic piping level except for gravity flow systems such as condenser water and condensate drain piping.
- C. Sanitary Waste and Vent; Roof Drain and Storm Drain Piping:
1. Install plumbing drainage piping with 1/4 inch per foot (2 percent) downward slope in direction of drain for piping 3 inches and smaller, and 1/8 inch per foot (1 percent) for piping 4 inch and larger. Install cast iron pipe in accordance with the Cast Iron Soil Pipe Institute Handbook.
 2. Install 1 inch thick extruded polystyrene over underground drainage piping that is above frost line and not under building. Provide width to extend minimum of 12 inches beyond each side of pipe. Install directly over pipe, centered on pipe center line.
 3. Make changes in direction for drainage and vent piping using appropriate 45 degree wyes, half-wyes, or long sweep quarter, sixth, eighth, or sixteenth bends. **SANITARY CROSSES OR SHORT QUARTER BENDS SHALL NOT BE USED IN DRAIN PIPING.**
 4. Provide thrust restraints (bracing to structure or rodded joints) at branches and changes in direction for cast iron pipe 5 inches and larger suspended within the building.
 5. Where cast iron piping is suspended in excess of 18 inches on single rod hangers, sway bracing shall be provided to prevent shear at the joints.

6. Install underground drain piping to conform with the plumbing code, and in accordance with the Cast Iron Soil Pipe Institute Engineering Manual.
7. Lay piping beginning at low point of system, true to grades and alignment indicated, with unbroken continuity of invert.
8. Place bell ends or groove ends of piping facing upstream.
9. Install gaskets in accordance with manufacturer's recommendations for use of lubricants, cements, and other special installation requirements.
10. Install sub-surface drain piping according to requirements of the soils engineers requirements when required and connect to storm sewer / sump pump.
11. Grade trench bottoms to provide a smooth, firm, and stable foundation, free from rock, throughout the length of the pipe.
12. Remove unstable, soft, and unsuitable materials at the surface upon which pipes shall be laid, and backfill with clean sand or pea gravel to indicated invert elevation.
13. Shape bottom of trench to fit the bottom 1/4 of the circumference of pipe. Fill unevenness with tamped sand. At each pipe joint dig bell holes to relieve the bell of the pipe of all loads, and to ensure continuous bearing of the pipe barrel on the foundation.

D. Refrigerant Piping:

1. General: Install refrigerant piping in accordance with ASHRAE Standard 15 - "The Safety Code for Mechanical Refrigeration."
2. Install piping in as short and direct arrangement as possible to minimize pressure drop.
3. Install piping for minimum number of joints using as few elbows and other fittings as possible.
4. Arrange piping to allow normal inspection and servicing of compressor and other equipment. Install valves and specialties in accessible locations to allow for servicing and inspection.
5. Provide adequate clearance between pipe and adjacent walls and hanger, or between pipes for insulation installation. Use sleeves through floors, walls, or ceilings, sized to permit installation of full thickness insulation.
6. Insulate suction lines. Liquid line are not required to be insulated, except where they are installed adjacent and clamped to suction lines, where both liquid and suction lines shall be insulated as a unit.
 - a. Do not install insulation until system testing has been completed and all leaks have been eliminated.
7. Install branch tie-in lines to parallel compressors equal length, and pipe identically and symmetrically.
8. Install copper tubing in rigid or flexible conduit in locations where copper tubing will be exposed to mechanical injury.

9. Slope refrigerant piping as follows:
 - a. Install horizontal hot gas discharge piping with 1/2 inch per 10 feet downward slope away from the compressor.
 - b. Install horizontal suction lines with 1/2 inch per 10 feet downward slope to the compressor, with no long traps or dead ends which may cause oil to separate from the suction gas and return to the compressor in damaging slugs.
 - c. Install traps and double risers where indicated, and where required to entrain oil in vertical runs.
 - d. Liquid lines may be install level.
 - E. Condensate Drain Piping:
 1. Condensate drain piping from air conditioning unit coil condensate drain pan shall be of the sizes shown on the drawings.
 - F. Plastic Pipe:
 1. All plastic piping installed below grade shall meet ASTM D2321-89 requirements.
- 3.3 PIPING SYSTEM JOINTS:
- A. General: Provide joints of type indicated in each piping system.
 - B. Thread pipe in accordance with ANSI B2.1; 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 not more than 3 threads exposed.
 - C. Braze copper tube-and-fitting joints in accordance with ASME B31.
 - D. Solder copper tube-and-fitting joints with silver solder or 95-5 tin-antimony. 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 manner which will draw solder full depth and circumference of joint. Wipe excess solder from joint before it hardens.
 - E. Weld pipe joints in accordance with ASME Code for Pressure Piping, B31. Provide weld-o-let fittings for two pipe sizes less than main pipe size.
 - F. Weld pipe joints in accordance with recognized industry practice and as follows:
 1. Weld pipe joints only when ambient temperature is above 0 degrees F (-18 degrees C) where possible.
 2. Bevel pipe ends at a 37.5 degrees angle where possible, smooth rough cuts, and clean to remove slag, metal particles and dirt.
 3. Use pipe clamps or tack-weld joints with 1 inch long welds; 4 welds for pipe sizes to 10 inches, 8 welds for pipe sizes 12 inch to 20 inch.

4. Build up welds with stringer-bead pass, followed by hot pass, followed by cover or filler pass. Eliminate valleys at center and edges of each weld. Weld by procedures which will ensure elimination of unsound or unfused metal, cracks, oxidation, blow-holes and non-metallic inclusions.
 5. Do not weld-out piping system imperfections by tack-welding procedures; refabricate to comply with requirements.
- G. Weld pipe joints of steel water pipe in accordance with AWWA C206.
- H. Flanged Joints: Match flanges within piping system, and at connections with valves and equipment. Clean flange faces and install gaskets. Tighten bolts to provide uniform compression of gaskets.
- I. Hubless Cast-Iron Joints: Comply with coupling manufacturer's installation instructions. Use pre-set torque wrench set to 80 in-lbs on heavy duty couplings.
- J. Clay Pipe Joints: Comply with ASTM C 12.
- K. Concrete Pipe Joints: Except as otherwise indicated, comply with applicable provisions of "Concrete Pipe Field Manual" by the American Concrete Pipe Assn.
- L. Corrugated Metal Pipe Joints: Comply with manufacturer's instructions and recommendations.
- M. Open Drain-Tile Joints: Except as otherwise indicated, provide 1/4 inch open joint, with top 2/3 of annular space covered by joint accessory material.
- 3.4 PIPING APPLICATION:
- A. Domestic Hot and Cold Water - Inside Building:
1. Above Grade Inside Building:
 - a. 6 inches and Smaller: Type L / K, hard drawn copper tube with wrought copper or bronze fittings, 95-5 tin-antimony / silver tin alloy soldered joints.
 2. Below Grade Inside and Outside Building:
 - a. 2-1/2 inches and Smaller: Type K, soft copper or Type K annealed copper tube with wrought copper fittings, silver tin alloy solder joints.
 - b. Larger than 2-1/2 inches: Ductile iron, tar coated outside, cement mortar lined inside. Full lengths of pipe shall be utilized to the greatest extent possible. Fittings for ductile iron pipe shall be 350 psi pressure, tar coated outside and cement lined inside. Rubber gasket joints.
- B. Sanitary Drainage and Vents - Inside Building:
1. Above Grade: Service weight cast iron, no-hub type with neoprene gaskets; service weight cast iron, hub and spigot type with neoprene gaskets; or DWV copper with wrought copper or cast brass fittings.

2. Below Grade: Sizes 2 inch to 20 inch, service weight cast iron, hub and spigot type only with neoprene compression gaskets; or sizes 12 inches and larger ductile cast iron with neoprene gasket joints.
 - a. Provide husky series 4000 couplings for waste pipe above critical spaces including:
 - 1) Food Service
 - 2) Electrical Rooms
 - 3) Communication Rooms
- C. Sanitary Sewer - Beyond 5 feet Outside Building: Extra strength vitrified clay pipe hub and spigot type with resilient gasket joints or type ASTM D2665 SDR-35 PVC Sewer Pipe; sizes 12" and larger ductile cast iron with neoprene gaskets; or service weight cast iron, hub and spigot type with neoprene gaskets.
- D. Roof Drainage - Inside Building:
 1. Above Grade:
 - a. 30 foot head or less: Service weight cast iron, hub and spigot type or no-hub Husky Series 4000 (or equivalent); or galvanized steel with galvanized cast iron drainage fittings and threaded joints.
 - b. Over 30 foot head: Schedule 40 galvanized steel pipe with galvanized cast iron drainage fittings and threaded joints; or schedule 40 grooved galvanized steel pipe joined with rigid couplings and gaskets designed for water service, molded of materials conforming to ASTM D-2000; or ductile iron, thickness 52 or ANSI/AWWA C150/A21.50-81, 350 psi pressure rating. Full lengths of pipe shall be utilized to greatest extent possible.
 2. Below Grade: Sizes 2 inch to 20 inch, service weight cast iron, hub and spigot type or sizes 12 inches and larger ductile cast iron with neoprene gasket joints.
- E. Storm Sewer - Beyond 5 feet Outside Building: Extra strength vitrified clay pipe; hub and spigot type or ASTM D3034 SDR-35 PVC sewer pipe, sizes 12 inches and larger ductile cast iron with neoprene gasket joints; or service weight cast iron, hub and spigot type with neoprene gaskets.
- F. Accessible Gas Piping:
 1. Above Grade:
 - a. Exposed Location:
 - 1) 2 Inches and Smaller: Schedule 40, black steel pipe, beveled ends, with 150 lb. malleable iron fittings and threaded joints.
 - 2) Over 2 Inches: Schedule 40 black steel with butt weld fittings and welded joints.
 - b. Inaccessible Location:
 - 1) All sizes: Schedule 40 black steel pipe, beveled ends, with socket weld fittings same thickness as pipe; welded joints.

2. Below Grade: Schedule 40 seamless black steel with 150 lb. forged steel fittings and welded joints. Provide machine applied, coated and wrapped pipe in accordance with local code and utility company requirements. Provide cathodic protection as called for on the drawings.
- G. Heating Water, Chilled Water and Condenser Water Piping:
1. 2 Inches and Smaller:
 - a. Schedule 40, black steel with 125 lb. cast iron or 150 lb. malleable iron threaded fittings.

OR

Type L / K copper, hard drawn copper wrought copper or bronze fittings, silver - tin alloy solder joints.
 2. 2-1/2 Inches and Larger:
 - a. Schedule 40, seamless or ERW (std. weight 12 inches and over) black steel with flanged or welded joints.
 - b. Fittings: Standard weight / Extra strong, seamless steel, butt weld type.
 - c. Flanges: 150 lb. 300 lb. forged steel slip-on or welding neck type.
 - d. Bolting: Regular square head machine bolts with heavy hexagonal nuts.
 - e. Gaskets: Thickness, material and type suitable for fluid to be handled, and design temperature and pressures.
 3. Buried Piping:
 - a. Provide pre-insulated, pre-fabricated piping. Refer to Section 15070 / 15080.
- H. Equipment Drains and Overflows:
1. Type "M" or "DWV" copper.
- I. Sub-Surface Drain Pipe:
1. ASTM D3034 SDR-35 Polyvinylchloride (PVC) perforated sewer pipe.
- OR
2. BS corrugated, perforated polyethylene under drain pipe.
- J. Refrigerant Piping:
1. Type "L" ACR copper, cleaned, dehydrated and capped at the factory. Wrought copper fittings with brazed joints.
- K. Sump Pump Discharge:

1. Schedule 40, galvanized steel with 125 lb. cast iron or 150 lb. malleable iron galvanized threaded fittings.
 2. Type L, seamless, hard drawn copper tube with ANSI/ASME B16.22 wrought copper or bronze solder-joint pressure fittings.
- L. Diesel Generator Exhaust:
1. Schedule 40 (std. weight 12 inches and over), black steel with all welded joints.
- M. Fuel Oil Piping:
1. Refer to Section 15483 - Fuel Oil Systems.
- 3.5 PIPING TESTS:
- A. General: Provide temporary equipment for testing, including pump and gauges. Test piping system before insulation is installed wherever feasible, and remove control devices before testing. Test each section of each piping system independently but do not use piping system valves to isolate sections where test pressure exceeds valve pressure rating. Fill each section with water and pressurize for indicated pressure and time.
 - B. Test all piping systems as specified. Correct leaks by remaking joints. Remove equipment not able to withstand test procedure during test.
 - C. Work to be installed shall remain uncovered until the required tests have been completed.
 - D. Piping which is to be concealed shall be tested before being permanently enclosed.
 - E. As soon as work has been completed, conduct preliminary tests to ascertain compliance with specified requirements. Make repairs or replacements as required.
 - F. Give a minimum of twenty-four hours notice to Engineer of dates when acceptance test will be conducted. Conduct tests as specified for each system in presence of representative of owner, agency having jurisdiction or his representative. Submit three (3) copies of successful tests to the Engineer for his review. Report shall state system tested and date of successful test.
 - G. Contractor shall obtain certificates of approval, acceptance and compliance with regulations of agencies having jurisdiction. Work shall not be considered complete until such certificates have been delivered by the Engineer to the Owner.
 - H. All costs involved in these tests shall be borne by Contractor.
 - I. System Tests
 1. Hydrostatic Test: The test shall be accomplished by hand pumping the system to the specified water pressure, and maintaining that pressure until the entire system has been inspected for leaks, but in no case for a time period of less than four hours.
 - a. Domestic water systems: 100 psig or 150 percent of system pressure, whichever is greater.
 - b. Heating water: 100 psig or 150 percent of operating pressure, whichever is greater.
 - c. Chilled water: 100 psig or 150 percent of system pressure, whichever is greater.

- d. Condenser water: 100 psig or 150 percent of system pressure, whichever is greater.
2. Compressed Air or Nitrogen Test: Compressed air tests may be substituted for hydrostatic tests only when ambient conditions or existing building conditions prohibit safe use of hydrostatic testing and must be reviewed by the Engineer prior to any testing. For tests of this type, the piping system shall be subjected to the gas pressure indicated for that specific system. The piping capped or plugged and water-pumped with oil free air, or a nitrogen bottle shall be introduced into the entire system to the pressure specified. The system shall maintain that pressure for the duration of a soapy water test of each joint.
3. Waste, Drain and Vent Piping: All waste and vent piping, including building drain, roof drain and building sewer, shall be subjected to a water test. All openings in the piping system shall be tightly closed, except the highest opening, and the system filled with water to the point of overflow. The water shall be kept in the system, or in the portion under test, for at least 15 minutes before inspection starts; the system shall then be tight to all points. No section shall be tested with less than a ten foot head of water. Roof drain shall be closed at the lowest point and filled with water to the point of overflow.
4. Sump Pump Discharge: With water in sump and pump running at full capacity, check for leaks until satisfied that system is tight.
5. Test all refrigerant piping systems with nitrogen at 300 psig pressure on high side of system, and at 150 psig pressure on low side of system. Maintain pressure without loss for a time period of not less than 4 hours. After test has been completed, the piping shall be evacuated by means of a vacuum pump for a period of not less than 24 hours or until system has been completely evacuated.
6. Repair piping systems sections which fail required piping test, by disassembly and re-installation, using new materials to extent required to overcome leakage. Do not use chemicals, stop-leak compounds, mastics, or other temporary repair methods.
7. Drain test water from piping systems after testing and repair work has been completed.

3.6 UNDERGROUND PIPE INSTALLATION:

- A. Clean fittings, nipples and other field joints thoroughly before coating.
- B. Protect gray and ductile cast iron pipe installed below grade with polyethylene encasement applied in strict accordance with ANSI/AWWA C105/A21.5.
- C. Install ductile iron pipe below grade as prescribed by AWWA C600.
- D. Provide concrete thrust block and 3/4 inch steel threaded tie bar at each direction change on underground pressure pipe. Imbed tie bar in thrust block and connect to upstream fitting. Paint tie bar with two coats of bitumastic #50 paint.
- E. Bury all outside water piping minimum 5 feet-0 inches [] below grade to top of pipe.

3.7 ADJUSTING AND CLEANING:

- A. General: Clean exterior surfaces of installed piping systems of superfluous materials, and prepare for application of specified coatings (if any). Flush out piping systems with clean

water before proceeding with required tests. Inspect each run of each system for completion of joints, supports and accessory items.

1. Inspect pressure piping in accordance with procedures of ASME B31.
 - B. Disinfect all potable water mains and water service piping in accordance with local and health department requirements. Submit test results report.
 - C. Clean and flush hydronic piping systems. Remove, clean, and replace strainer screens. After cleaning and flushing hydronic piping system, but before balancing, remove disposable fine mesh strainers in pump suction diffusers.
 - D. Chemical Treatment: Provide hydronic systems with a water analysis prepared by the chemical treatment supplier to determine the type and level of chemicals required for prevention of scale and corrosion. Perform initial treatment after completion of system testing.
- 3.8 COMMISSIONING:
- A. Fill system and perform initial chemical treatment.
 - B. Check expansion tanks to determine that they are not air bound and that the system is completely full of water.
 - C. Before operating the system perform these steps:
 1. Open valves to full open position. Close coil bypass valves.
 2. Remove and clean strainers.
 3. Check pump for proper rotation and proper wiring.
 4. Set automatic fill valves for required system pressure.
 5. Check air vents at high points of systems and determine if all are installed and operating freely (automatic type) or to bleed air completely (manual type).
 6. Set temperature controls so all coils are calling for full flow.
 7. Check operation of automatic bypass valve.
 8. Check and set operating temperature of boilers, chillers, and cooling towers to design requirements.
 9. Lubricate motors and bearings.

END OF SECTION 15055