
SECTION 22 10 05
PLUMBING PIPING**PART 1 GENERAL****1.1 SECTION INCLUDES**

- A. Pipe.
- B. Pipe Fittings.

1.2 RELATED REQUIREMENTS

- A. Section 22 00 00 - Plumbing Common Work Results; for administrative requirements
- B. Section 22 00 00 - Plumbing Common Work Results; for product requirements
- C. Section 22 00 00 - Plumbing Common Work Results; for closeout requirements
- D. Section 22 00 00 - Plumbing Common Work Results
- E. Section 07 84 00 - Firestopping.
- F. Section 08 31 00 - Access Doors and Panels.
- G. Section 09 90 00 - Painting and Coating.
- H. Section 22 05 48 - Plumbing Supports for Piping and Equipment
- I. Section 22 05 53 - Plumbing Identification for Piping and Equipment.
- J. Section 22 05 16 - Plumbing Expansion Fittings and Loops.

1.3 REFERENCE STANDARDS

- A. ASME B16.1 - Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250; The American Society of Mechanical Engineers; 2010.
- B. ASME B16.3 - Malleable Iron Threaded Fittings: Classes 150 and 300; The American Society of Mechanical Engineers; 2011.
- C. ASME B16.5 - Pipe Flanges and Flanged Fittings; The American Society of Mechanical Engineers.
- D. ASME B16.12 - Cast Iron Threaded Drainage Fittings; The American Society of Mechanical Engineers.
- E. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings; The American Society of Mechanical Engineers; 2012.
- F. ASME B16.22 - Wrought Copper and Copper Alloy Solder Joint Pressure Fittings; The American Society of Mechanical Engineers; 2013.
- G. ASME B16.23 - Cast Copper Alloy Solder Joint Drainage Fittings - DWV; The American Society of Mechanical Engineers; 2011.
- H. ASME B16.24 - Cast Copper Alloy Pipe Flanges and Flanged Fittings: Classes 150, 300, 600, 900, 1500 and 2500; 2011.
- I. ASME B16.29 - Wrought Copper and Wrought Copper Alloy Solder Joint Drainage Fittings - DWV; The American Society of Mechanical Engineers; 2012.
- J. ASME (BPV IX) - Boiler and Pressure Vessel Code, Section IX - Welding and Brazing Qualifications; The American Society of Mechanical Engineers; 2013.
- K. ASTM A47/A47M - Standard Specification for Ferritic Malleable Iron Castings; 1999 (Reapproved 2009).
- L. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2012.
- M. ASTM A74 - Standard Specification for Cast Iron Soil Pipe and Fittings; 2013a.
- N. ASTM A126 - Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings; 2014.

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- O. ASTM A181/A181M - Standard Specification for Carbon Steel Forgings, for General-Purpose Piping; 2013
 - P. ASTM A197 - Standard Specification for Cupola Malleable Iron.
 - Q. ASTM A234/A234M - Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service; 2013.
 - R. ASTM A888 - Standard Specification for Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications; 2013.
 - S. ASTM B32 - Standard Specification for Solder Metal; 2008.
 - T. ASTM B88 - Standard Specification for Seamless Copper Water Tube; 2009.
 - U. ASTM B280 - Standard Specification for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service; 2013.
 - V. ASTM B306 - Standard Specification for Copper Drainage Tube (DWV); 2013.
 - W. ASTM C564 - Standard Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings; 2012.
 - X. ASTM D1785 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120; 2012.
 - Y. ASTM D2467 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80; 2013.
 - Z. ASTM D2564 - Standard Specification for Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems; 2012.
 - AA. ASTM D2665 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Drain, Waste, and Vent Pipe and Fittings; 2012.
 - BB. ASTM D2855 - Standard Practice for Making Solvent-Cemented Joints with Poly(Vinyl Chloride) (PVC) Pipe and Fittings; 1996 (Reapproved 2010).
 - CC. ASTM D3034 - Standard Specification for Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings; 2008.
 - DD. ASTM F477 - Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe; 2010.
 - EE. AWS A5.8/A5.8M - Specification for Filler Metals for Brazing and Braze Welding; American Welding Society; 2011 and errata.
 - FF. AWWA C104/A21.4 - Cement-Mortar Lining for Ductile-Iron Pipe and Fittings.
 - GG. AWWA C110/A21.10 - American National Standard for Ductile-Iron and Gray-Iron Fittings, 3 In. Through 48 In. (75 mm Through 1200 mm), for Water and Other Liquids; American Water Works Association; 2012.
 - HH. AWWA C151/A21.51 - Ductile-Iron Pipe, Centrifugally Cast, for Water; American Water Works Association; 2009.

1.4 SUBMITTALS

- A. See Section 22 00 00 - Plumbing Common Work Results; for closeout requirements
- B. Submit chart indicating the following: (22 10 05 - 001 - A)
 - 1. Service.
 - 2. Application / Fluid type.
 - 3. Pipe type.
 - 4. Pipe manufacturer.
 - 5. Pipe joints.
 - 6. Fitting manufacturer.
- C. Start-up Report: Indicate start-up results.

1. Refer to Section 22 00 00 - Plumbing Common Work Results
2. System pressure tests (22 10 05 - 002 -A)

1.5 QUALITY ASSURANCE

- A. Welder Qualifications: Certified in accordance with ASME (BPV IX).
- B. Identify pipe with marking including size, ASTM material classification, ASTM specification, potable water certification, water pressure rating.

1.6 FIELD CONDITIONS

- A. Do not install underground piping when bedding is wet or frozen. Refer to Section 31 23 17 - Trenching, Backfilling, and Compacting.

PART 2 PRODUCTS

2.1 DIELECTRIC FITTINGS

- A. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.
- B. Dielectric Unions:
 1. Standard: ASSE 1079.
 2. Revise pressure rating and temperature in "Pressure Rating" Subparagraph below to suit Project, or insert other options for specific applications.
 3. Pressure Rating: 150 psig.
 4. End Connections: Solder-joint copper alloy and threaded ferrous.
- C. Dielectric Nipples:
 1. Standard: IAPMO PS 66.
 2. Electroplated steel nipple complying with ASTM F 1545.
 3. Revise pressure rating and temperature in "Pressure Rating and Temperature" Subparagraph below to suit Project, or insert other options for specific applications.
 4. Pressure Rating and Temperature: 300 psig at 225 deg F.
 5. End Connections: Male threaded or grooved.
 6. Lining: Inert and noncorrosive, propylene.
- D. Unshielded, Nonpressure Transition Couplings:
 1. Standard: ASTM C 1173.
 2. Description: Elastomeric, sleeve-type, reducing or transition pattern. Include shear ring and corrosion-resistant-metal tension band and tightening mechanism on each end.
 3. Sleeve Materials:
 - a. For Cast-Iron Storm, soil Pipes: ASTM C 564, rubber.
 - b. For Plastic Pipes: ASTM F 477, elastomeric seal or ASTM D 5926, PVC.
 - c. For Dissimilar Pipes: ASTM D 5926, PVC or other material compatible with pipe materials being joined.
- E. Shielded, Nonpressure Transition Couplings:
 1. Standard: ASTM C 1460.
 2. Description: Elastomeric or rubber sleeve with full-length, corrosion-resistant outer shield and corrosion-resistant-metal tension band and tightening mechanism on each end.

2.2 PIPE AND PIPE FITTINGS

- A. Pipe shall conform to the materials specified herein, and shall be installed for piping systems as scheduled on drawing.

2.3 COPPER PIPE - TYPE L

- A. Design Pressure: 150 psig.
- B. Maximum Design Temperature: 200 degrees F.
- C. Sizes 2 Inches and Smaller:
 - 1. Tubing: Type L hard drawn seamless copper tube, ASTM B88.
 - 2. Joints: Solder type with 95-5 solder.
 - 3. Fittings: Wrought copper solder joint, ASME B16.22 or cast bronze solder joint, ASME B16.18.
- D. Sizes 2 1/2 Inches and Larger:
 - 1. Tubing: Type L hard drawn seamless copper tube, ASTM B88.
 - 2. Joints: Flanged and solder type with 95-5 solder.
 - 3. Fittings: Wrought copper solder joint, ASME B16.22 or cast bronze solder joint, ASME B16.18.
 - 4. Flanges: 150 lb. class cast bronze, ASME B16.24.
- E. All piping installed in medical gas piping systems shall be oxygen clean, Type L copper or ACR medical gas piping with brazed joints, in accordance with NFPA 99.

2.4 COPPER TUBING - TYPE L

- A. Design Pressure: 240 psig.
- B. Maximum Design Temperature: 125 degrees F.
- C. Sizes 4 Inches and Smaller:
 - 1. Tubing: Type L hard drawn seamless copper tube, ASTM B280 (ACR).
 - 2. Joints: Brazed, AWS A5.8 B Cup silver/phosphorus/copper alloy.
 - 3. Fittings: Wrought copper solder joint, ASME B16.22.

2.5 COPPER PIPE - TYPE K

- A. Design Pressure: 150 psig.
- B. Maximum Design Temperature: 150 degrees F.
- C. Sizes 2 Inches and Smaller:
 - 1. Tubing: Type K hard drawn seamless copper tube, ASTM B88.
 - 2. Joints: Solder type with 95-5 solder.
 - 3. Fittings: Wrought copper solder joint, ASME B16.22 or cast bronze solder joint, ASME B16.18.
- D. Sizes 2 1/2 Inches and 3 Inches:
 - 1. Tubing: Type K hard drawn seamless copper tube, ASTM B88.
 - 2. Joints: Flanged and solder type with 95-5 solder.
 - 3. Fittings: Wrought copper solder joint, ASME B16.22 or cast bronze solder joint, ASME B16.18.
 - 4. Flanges: 150 lb. class cast bronze, ASME B16.24.
- E. Pipes penetrating building floors on grade or building walls or pit walls below grade shall be ductile iron. Refer to Ductile Iron Pressure Pipe.

2.6 COPPER PIPE - TYPE DWV

- A. Design Pressure: Gravity.
- B. Maximum Design Temperature: 180 degrees F.
- C. Sizes 1-1/4 Inches through 4 Inches:

1. Pipe: Type DWV hard temper seamless copper drainage tube, ASTM B306.
 2. Joints: Solder. ASTM B32, Grade 50B.
 3. Fittings: Cast bronze solder joint drainage type, ASME B16.23 or wrought copper solder joint drainage type, ASME B16.29.
- D. DWV copper shall not be installed for branch drainage piping that receives waste from waterless urinals.

2.7 DUCTILE IRON PRESSURE PIPE

- A. Pipe: Ductile iron pressure water pipe, thickness Class 51 for 5 inch pipe size and smaller, thickness Class 50 for sizes 6 inches through 24 inches, 250 psi rated working pressure, in accordance with AWWA C151, tar coated outside, and cement mortar lined inside in accordance with AWWA/ANSI C104/A21.4. Full lengths of pipe shall be utilized to the greatest extent possible.
- B. Joints: Mechanical or push on joints.
- C. Fittings: Push on joint or mechanical joint type shall be cast iron or ductile iron, 250 psi pressure rating, in accordance with AWWA C110/A21.10, tar coated outside and cement mortar lined inside in accordance with AWWA C104/A21.4.
- D. Flanged type shall be cast iron or ductile iron, short body, 250 psi pressure rating, in accordance with AWWA C110/A21.10 (drilled and faced in accordance with ASME B16.1, Class 125), tar coated outside, and cement mortar lined inside in accordance with AWWA C104/A21.4.
- E. Pipe penetrating building floors on grade shall be ductile iron, thickness Class 51 for 4 inch pipe size, thickness Class 50 for 6 inches through 24 inches, 250 psi rated working pressure, in accordance with AWWA C151/A21.51, tar coated outside, and cement mortar lined inside in accordance with AWWA C104/A21.4. Pipe shall be one piece beginning at engagement of plain end with 1/4 bend below the floor and terminating six inches above floor level with a ductile iron flange.
- F. Pipe penetrating building walls or pit walls below grade shall be ductile iron, thickness Class 51 for 4 inch pipe size, thickness Class 50 for 6 inches through 24 inches, 250 psi working pressure, in accordance with AWWA C151/A21.51, tar coated outside, and cement mortar lined inside in accordance with AWWA C104/A21.4. Pipe shall terminate approximately 12 inches either side of wall with push on joint bell end or mechanical joint bell end on outside and ductile iron flange on inside.

2.8 GALVANIZED STEEL PIPE - SCHEDULE 40

- A. Design Pressure: 125 psig.
- B. Sizes 4 Inches and Smaller:
 1. Pipe: Schedule 40 galvanized steel, threaded and coupled, ASTM A53.
 2. Joints: Threaded or mechanically coupled grooved joint.
 3. Fittings: Galvanized cast iron threaded drainage type, ASME B16.12 or Schedule 40 galvanized steel mechanically coupled grooved joint.
- C. Sizes 5 Inches and Larger:
 1. Pipe: Schedule 40 galvanized steel, threaded and coupled or beveled as required.
 2. Joints: Horizontal; threaded or mechanically coupled grooved joint. Vertical; butt welded.
 3. Fittings: Schedule 40 seamless steel, threaded or mechanically coupled grooved joint.
 4. Fittings: 150 lb (S) 300 lb (WOG) galvanized malleable iron, banded, ASTM A197, ASME B16.3 or flanged 125 lb (S) 175 lb (WOG) galvanized cast iron, ASTM A126, ASME B16.1.
- D. Special Installation Requirements:

1. Where galvanizing has been burned off from welding, clean surfaces and paint with one coat of rust inhibiting metal primer. When dry paint with one coat of oil base aluminum enamel.
2. Where standard weight seamless steel butt weld fittings are used, clean surfaces and paint with one coat of rust inhibiting metal primer. When dry paint with one coat of oil base aluminum enamel.
3. All pipe with mechanically coupled grooved joints shall maintain a maximum 1/4 inch per foot slope.

2.9 GALVANIZED STEEL PIPE - SCHEDULE 40

- A. Maximum Design Pressure: 150 psig.
- B. Maximum Design Temperature: 200 degrees F.
- C. All Pipe Sizes:
 1. Pipe: Schedule 40 galvanized steel, ASTM A53 Type F, furnace butt or continuous welded.
 2. Joints: Threaded or flanged.
 3. Flanges: Malleable iron, ASTM A47 Grade 32510, adapter flange or 125 lb (S) 175 lb (WOG), galvanized cast iron, threaded, ASTM A126 Grade B, ASME B16.1. All bolting to be galvanized or cadmium plated.

2.10 BLACK STEEL PIPE - SCHEDULE 40

- A. Design Pressure: 150 psig.
- B. Maximum Design Temperature: 350 degrees F.
- C. Sizes 2-1/2 Inches and Smaller:
 1. Pipe: Schedule 40 black steel, threaded and coupled, ASTM A53.
 2. Joints: Threaded. (Exception: All gas piping installed outdoors or in steel conduits; all gas conduit and conduit vent pipe; all black steel pipe installations below ground; shall be continuous butt weld joints. ASME B31.2)
 3. Fittings: 150 lb (S) 300 lb (WOG) black malleable iron.
 4. Unions: 250 lb (S) 500 lb (WOG) black malleable iron, ground joint with brass seat.
 5. Mechanically coupled grooved joint.
- D. Sizes 2-1/2 Inches and Larger:
 1. Pipe: Schedule 40 black steel, beveled ends, ASTM A53.
 2. Joints: Butt welded and flanged.
 3. Fittings: Schedule 40 seamless steel, butt weld type, ASTM A234.
 4. Flanges: 150 lb forged steel, welding neck or slip on, ASTM A181 Class 60.
 5. Mechanically coupled grooved joint.
- E. All piping installed below ground shall have factory applied coal tar coating. Below ground joints shall have a field applied coal tar coating.

2.11 SEAMLESS BLACK STEEL PIPE - SCHEDULE 40

- A. Design Pressure: 250 psig.
- B. Maximum Design Temperature: 400 degrees F.
- C. Sizes 2 Inches and Smaller:
 1. Pipe: Schedule 40 seamless, black steel, threaded and coupled ASTM A53, Grade B.
 2. Joints: Threaded. (Exception: All joints in piping installed below ground shall be welded.)
 3. Fittings: 250 lb (S) - 400 lb (WOG) black malleable iron, ASME B16.3.

- 4. Unions: 250 lb (S) - 500 lb (WOG) black malleable iron, ground joint with brass seat.
- D. Sizes 2-1/2 Inches and Larger:
 - 1. Pipe: Schedule 40, seamless black steel, beveled ends, ASTM A53 Grade B.
 - 2. Joints: Butt welded and flanged.
 - 3. Fittings: Schedule 40 seamless steel, butt weld type, ASTM A234.
 - 4. Flanges: 300 lb forged steel, welding neck or slip-on, ASTM A181, Class 60, ASME B16.5.
- E. All piping installed below ground shall have factory applied coal tar coating. Below ground joints shall have a field applied coal tar coating.

2.12 SEAMLESS BLACK STEEL PIPE - SCHEDULE 80

- A. Design Pressure: 300 psig.
- B. Maximum Design Temperature: 400 degrees F.
- C. Sizes 1-1/4 Inches and Smaller:
 - 1. Pipe: Schedule 80, seamless, black steel, ASTM A53 Grade B.
 - 2. Joints: Threaded. (Exception: All joints in piping installed below ground shall be welded.)
 - 3. Fittings: 250 lb. (S) - 400 lb. (WOG), black malleable iron, ASME B16.3.
 - 4. Unions: 250 lb. (S) - 500 lb. (WOG) black malleable iron, ground joint with brass seat.
- D. Sizes 1-1/2 Inches through 12 Inches:
 - 1. Pipe: Schedule 80, seamless, black steel, ASTM A53, Grade B.
 - 2. Joints: Butt welded and flanged.
 - 3. Fittings: Schedule 80, seamless steel, butt weld type, ASTM A234.
 - 4. Flanges: 150 lb. forged steel, welding neck or slip on, ASTM A181, Class 60, ASME B16.5. Welding neck type shall have bore to match pipe.

2.13 CAST IRON PIPE - SERVICE WEIGHT

- A. Design Pressure: Gravity.
- B. Maximum Design Temperature: 180 degrees F.
- C. All Pipe Sizes:
 - 1. Pipe & Fittings: Service weight cast iron soil pipe, tar coated inside and outside, ASTM A74, A888.
 - 2. Joints: Below ground; push on. Above ground; no hub.
 - 3. Adapters: Transitions from cast iron soil pipe to another pipe material shall be made with Fernco Joint Sealer Company PVC Donuts adapters, or approved equal.

2.14 CORRUGATED STEEL PIPE

- A. Design Pressure: Gravity.
- B. Pipe: Corrugated steel pipe shall conform to Pennsylvania Department of Transportation Form 408 76.
- C. Class I for round pipe, Class II for pipe arch.
- D. Pipe sizes 12 inches and smaller shall be fully asphalt coated. Pipe sizes 12 inches and larger, and pipe arches shall be fully asphalt coated with paved invert type C.
- E. Joints: Connection bands shall be plain galvanized. Joints in pipe sizes 36 inches and larger shall be hand troweled.
- F. Perforated corrugated steel pipe shall be 16 gage with no asphalt coating and no paved invert. Joints shall be plain galvanized.
- G. Storage: Asphalt coated pipe shall be stored in locations protected from sunlight.

2.15 PVC PIPE - SCHEDULE 40

- A. Design Pressure: Gravity.
- B. Maximum Design Temperature: 150 degrees F. at continuous flow.
- C. All Pipe Sizes:
 - 1. Schedule 40, polyvinyl chloride (PVC), ASTM D2665 with NSF seal.
 - 2. Fittings: Schedule 40, polyvinyl chloride, DWV pattern, ASTM D2665 with NSF seal.
- D. Sizes: 2 Inches and Smaller:
 - 1. Joints: Socket or factory threaded solvent cement ASTM D2564.
- E. Sizes: 2-1/2 Inches or Larger:
 - 1. Joints: Socket or flanged solvent cement ASTM D2564.

2.16 PVC PIPE - SCHEDULE 80

- A. Design Pressure: 125 psig.
- B. Maximum Design Temperature: 80 degrees F.
- C. Sizes 8 Inches and Smaller:
 - 1. Pipe: Schedule 80, Class 1120, type 1, normal impact, polyvinyl chloride (PVC) ASTM D1785 with NSF seal.
 - 2. Fittings: Schedule 80 polyvinylchloride ASTM D2467 with NSF seal. Socket, factory threaded or flanged solvent cement.

2.17 PVC SEWER PIPE

- A. Design Pressure: Gravity.
- B. Maximum Design Temperature: 180 degrees F.
- C. Sizes 12 Inches and Smaller:
 - 1. Pipe & Fittings: Polyvinyl chloride (PVC) sewer pipe and fittings ASTM D3034.
 - 2. Joints: Solvent cement joints, ASTM D2855 with solvent cement, ASTM D2564 push on type with elastomeric joint ASTM F477.

PART 3 EXECUTION

3.1 INTERFACE WITH WORK OF OTHER SECTIONS

- A. Confirm framing and support members.
- B. Confirm rough-in and framing of walls and partitions with supports for equipment and accessories.

3.2 INSTALLATION

- A. Perform work in accordance with the following:
 - 1. Federal, State and Local Codes.
 - 2. Manufacturer recommendations.
 - 3. Welding Materials and Procedures: Conform to ASME (BPV IX) and applicable state labor regulations.
 - 4. Install copper tubing according to CDA's "Copper Tube Handbook."
 - a. Install encasement on piping according to ASTM A674 or AWWA C105/A21.5.
 - 5. Install ductile-iron piping under building slab with restrained joints according to AWWA C600 and AWWA M41.
 - a. Install encasement on piping according to ASTM A674 or AWWA C105/A21.5.
 - b. Install buried piping inside building between wall and floor penetrations and connection to piping outside building with restrained joints. Anchor pipe to wall or floor. Install thrust-

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- block supports at vertical and horizontal offsets.
 - c. Install encasement on piping according to ASTM A674 or AWWA C105/A21.5.
 - 6. Install cast-iron Storm, soil piping according to CISPI's "Cast Iron Storm, soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Storm, soil Pipe and Fittings."
 - a. Install encasement on underground piping according to ASTM A674 or AWWA C105/A21.5.
 - B. Install components having pressure rating equal to or greater than system operating pressure.
 - C. Piping Installation:
 - 1. Contractor shall carefully follow the Drawings in laying out and installing his work and he shall not deviate therefrom, except for structural or interior finish interferences, and then only upon Architect's approval.
 - 2. Install piping in concealed interior and exterior locations, except in equipment rooms and service areas.
 - 3. Install piping free of sags and bends.
 - 4. All pipe shall be cut to exact measurement, and installed without springing or forcing. Particular care shall be taken to avoid creating, even temporarily, undue loads, forces or strains on valves, equipment or building elements with piping connections or piping supports.
 - 5. Install exposed interior and exterior piping at right angles or parallel to building walls. Diagonal runs are prohibited, except where indicated.
 - 6. Run pipe lines straight and true, parallel to building lines with a minimum use of offsets and couplings. Use full and double lengths of pipe wherever possible.
 - 7. Changes in direction shall be made only with pipe bends or fittings. Changes in size shall be made with fittings only. All fittings shall be of the long radius type, unless otherwise specified.
 - 8. Slope piping and arrange systems to drain at low points.
 - 9. Install piping tight to slabs, beams, joists, columns, walls, and other building elements. Allow sufficient space above removable ceiling panels to allow for ceiling panel removal.
 - 10. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.
 - 11. Install fittings for changes in direction and branch connections.
 - 12. Install piping to permit valve servicing.
 - 13. Install piping to allow application of insulation plus 1-inch (25mm) clearance around insulation.
 - D. Pipe Fitting Installation:
 - 1. Unless otherwise indicated, branch take offs shall be from top of mains or headers at either a 45 degree or 90 degree angle from the horizontal plane for air and gas lines, and from top, bottom or side for liquids.
 - 2. Install couplings according to manufacturer's printed instructions.
 - 3. When installing more than one piping system material, ensure system components are compatible and joined to ensure the integrity of the system. Provide necessary joining fittings. Ensure flanges, union, and couplings for servicing are consistently provided.
 - 4. Pipe joints connecting dissimilar metals shall be insulating, dielectric connections. Copper tubing shall be protected from electrolysis at contact points with ferrous metals, including temporary methods of support, by use of insulating, non-conductive spacers such as rubber, fiberglass or an approved equal. Pipe hangers for bare copper tubing shall be copper plated.
 - 5. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.
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6. Install nipples, unions, special fittings, and valves with pressure ratings the same as or higher than the system pressure rating used in applications below unless otherwise indicated.
 7. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
 8. Provide flanges or unions at all final connections to equipment, traps and valves to facilitate dismantling.
 9. Unless otherwise indicated, install all piping to pumps and other equipment at line size with reduction in size being made only at inlet to pump or equipment connection.
 10. Install unions in copper tubing at final connection to each piece of equipment, machine, and specialty.
- E. Locate groups of pipes parallel to each other, spaced to permit valve servicing.
- F. Gravity Drainage System Installation:
1. Make changes in direction for gravity drainage systems, Storm drainage, sanitary, soil and waste drainage and vent piping using appropriate branches, bends, and long-sweep bends. Sanitary tees and short-sweep 1/4 bends may be used on vertical stacks if change in direction of flow is from horizontal to vertical. Use long-turn, double Y-branch and 1/8-bend fittings if two fixtures are installed back to back or side by side with common drain pipe. Straight tees, elbows, and crosses may be used on vent lines. Do not change direction of flow more than 90 degrees.
 2. Changes in direction on drainage pipe systems shall be made with wye fittings, combination wye and eighth bends, or one eighth bends. Offset in soil or waste pipes will not be permitted where avoidable. Offsets shall be made with 45 degree bends or similar fittings.
 3. Use proper size of standard increasers and reducers if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.
 4. Lay buried building drainage piping beginning at low point of each system. Install true to grades and alignment indicated, with unbroken continuity of invert.
- G. Install storm drainage, soil and waste drainage and vent piping at the following minimum slopes unless otherwise indicated:
1. Building Sanitary Drain: 2 percent downward in direction of flow for piping NPS 3 and smaller; 1 percent downward in direction of flow for piping NPS 4 and larger.
 2. Horizontal Sanitary Drainage Piping: 2 percent downward in direction of flow.
 3. Vent Piping: 1 percent down toward vertical fixture vent or toward vent stack.
- H. All pipe and fittings shall be carefully inspected for defects in workmanship prior to installation. Any item found unsuitable, cracked, or otherwise defective shall be rejected and removed from the jobsite. All pipe and fittings shall have factory applied markings, stampings, or nameplates with sufficient data for identification to determine their conformance with specified requirements.
- I. Plastic piping shall be installed in strict accordance with pipe manufacturer's recommendations and in accordance with the recommendations of the referenced standards. Protect piping from damage by adjacent sharp surfaces with rubber or plastic grommets or sleeves.
- J. Plastic piping installed underground shall be encased in sand for a minimum of 6" sand.
- K. During construction all openings in piping shall be kept closed except when actual work is being performed on that item. Closures shall be plugs, caps, blind flanges, or other items specifically intended for this purpose. Exercise all necessary care to prevent foreign objects from entering material.
- L. Prepare pipe, fittings, supports, and accessories for finish painting. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to
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welding. Refer to Section 09 90 00 - Painting.

- M. Underground pressure piping shall be provided with concrete anchors and thrust blocks at ends of runs and changes in direction.
- N. Pipe Joints:
1. No-hub Coupling: Heavy duty coupling.
 - a. AISI 304 stainless steel bi-directional corrugated shield.
 - b. AISI 304 stainless steel clamps and screw housing.
 - c. Gasket shall conform to ASTM C564.
 2. Mechanically Coupled Grooved Joints: Mechanical coupling connections shall consist of malleable iron housing clamps, steel bolts, and nuts, and sealing gasket designed, such that internal pressure tends to increase the tightness of the seal.
 - a. The entire installation, including pipe grooving, shall be accomplished in accordance with manufacturer's published instructions.
 - b. Final tightening of bolts shall be with a torque wrench to insure equal tension in all bolts.
 3. Mechanical Joints: Gasket material shall be neoprene. Stainless steel bolts shall be used.
 - a. Final tightening of bolts shall be with a torque wrench to insure equal tension in all bolts.
 4. Push On Joints, Pressure Pipe: Joints shall be single gasket type. The bell shall have cast or machined gasket socket recesses, a tapered annular opening and flared socket design to provide deflections up to maximum of 5 degrees. Plain spigot ends shall be suitably beveled to permit easy entry into bell, centering in gasket and compression of gasket.
 - a. The joint shall be liquidtight under all pressure ranges from vacuum up to 350 psig.
 - b. Lubricant:
 - 1) Provide a thin coat on each spigot end.
 - 2) Non toxic and shall impart no taste or odor to conveyed liquid.
 - 3) Shall have no deleterious effect on the rubber gasket.
 - 4) The lubricant shall be of such consistency, that it can be easily applied to the pipe in hot and cold weather and shall adhere to either wet or dry pipe.
 - c. Place hub ends of piping upstream.
 - d. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements.
 - e. Maintain swab in piping and pull past each joint as completed.
 5. Push On Joints, Soil Pipe: Joint shall be one piece double seal compression type gasket made specifically for joining cast iron soil pipe.
 - a. The gasket shall be neoprene material, permitting joint to flex as much as 5 degrees without loss of seal.
 - b. Gasket shall be extra heavy conforming to ASTM C564 and shall be shielded with a stainless steel shroud covering the entire length of the gasket.
 - c. Place hub ends of piping upstream. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements. Maintain swab in piping and pull past each joint as completed.
 6. Solder Joints: 95 percent tin and 5 percent antimony (95-5) solder conforming to ASTM B32 Solder Metal, Grade 95TA.
 - a. Cut copper tubing so ends are perfectly square and remove all burrs inside and outside.

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- b. Thoroughly clean sockets of fittings and ends of tubing to remove all oxide, dirt, and grease just prior to soldering.
 - c. Apply non-acid type flux evenly, but sparingly, over all surfaces to be joined. Heat joints uniformly to proper soldering temperature so solder will flow to all mated surfaces.
 - d. Wipe excess solder, leaving a uniform fillet around cup of fitting.
 - 7. Brazed Joints: Make up joints with silver alloy brazing filler metal.
 - a. Cut copper tubing so ends are perfectly square and remove all burrs inside and outside.
 - b. Thoroughly clean sockets of fittings and ends of tubing to remove all oxide, dirt, and grease just prior to brazing.
 - c. Apply non corrosive flux of the type recommended by filler alloy manufacturer evenly, but sparingly, over all surfaces to be joined. Heat joints uniformly to proper brazing temperatures using oxygen acetylene torch with tip size as recommended by fitting manufacturer.
 - d. Wipe and brush joint clean after allow has set.
 - 8. Welded Joints: Shall be in accordance with Section IX, ASME Boiler & Pressure Vessel Code, unless mandatory local codes take precedence.
 - a. Ends of pipe and fittings to be joined by butt welding shall be beveled, cleaned to bare metal and internal diameters aligned before tack welding.
 - 9. Threaded Joints: Pipe screw threads shall conform to National Standard Piping Threads. Ream pipe ends and remove all burrs and chips formed in cutting and threading. Protect plated pipe and brass valve bodies from wrench marks when making up joint.
 - 10. Flanged Joints: Bolting for services up to 500 degrees Fahrenheit, Grade B with square head bolts and heavy hexagonal nuts.
 - a. Steel pipe flanges shall conform to ASME B16.5, Steel Pipe Flanges and Flanged Fittings.
 - b. Cast iron pipe flanges shall conform to ASME B16.1, Cast Iron Flanges and Flanged Fittings.
 - c. Steel flanges shall be raised face except when bolted to flat cast iron flange.
 - d. Gaskets for flat face flanges shall form to requirements for Group I Gaskets in ASME B16.5. Unless otherwise specified, gaskets shall be 3/32 inch thick.
 - e. Set flange bolts beyond finger tightness with an indicating torque wrench to insure equal tension in all bolts. Tighten bolts such that those 180 degrees apart or directly opposite are torqued in sequence.
 - 11. Solvent Cement Joints: Socket joints in PVC, ABS, etc., pipe shall be made by using a manufacturer's recommended solvent cement suitable for respective pipe (CPVC, PVC, ABS, Schedule 40, Schedule 80) and conforming to ASTM D2564.
 - a. Follow manufacturer's instructions for handling and cementing procedures.
 - b. Wipe off excess cement fillet around socket.
 - c. Do not move pipe while cement is setting.
 - 12. Factory Threaded Solvent Cement Joints: Factory threaded solvent cement joints for plastic pressure piping systems shall be made in accordance with manufacturer's recommendations. The threads should be lubricated with a non hardening pipe dope or wrapped with Teflon tape.
 - O. Specialty Pipe Fitting Installation:
 - 1. Transition Couplings:
 - a. Install transition couplings at joints of piping with small differences in OD's.
 - b. In Drainage Piping: Unshielded, non pressure transition couplings.
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- c. In Aboveground Force Main Piping: Fitting-type transition couplings.
- d. In Underground Force Main Piping:
 - 1) NPS 1-1/2 and Smaller: Fitting-type transition couplings.
 - 2) NPS 2 and Larger: Pressure transition couplings.
- 2. Dielectric Fittings:
 - a. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.
 - b. Dielectric Fittings for NPS 2 and Smaller: Use dielectric nipples.
 - c. Dielectric Fittings for NPS 2-1/2 and larger: Use dielectric flanges.

3.3 TESTING

- A. Test piping according to system requirements. Refer to 22 00 00 - Plumbing Common Work Results
- B. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

END OF SECTION 22 10 05