



## Engineering Fluid Solutions

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### WHAT TYPE OF PIPING TO USE AND WHERE TO USE IT

In every project, the time eventually comes when the designer must select what type of piping to use for the different plumbing systems. Many things affect this decision, including cost, value engineering and contractors wanting to use a specific type of piping for a particular system. It is the designer's main responsibility to choose the best type of pipe for each application, and to do so, the designer must know about the different piping materials available and the pros and cons of each. This article provides some fundamental information about the different types of drainage piping and the follow-up article will cover pressure piping.

#### CAST IRON SOIL PIPE

The two types of cast iron soil piping are hub and spigot and hubless (no hub). Cast iron soil piping is classified as XH (extra heavy) or SV (service or service weight) and is used for sanitary drainage, waste, vent, and storm systems. The extra heavy class generally is used underground, while the service weight class is used aboveground.

The manufactured sizes for extra heavy and service weight hub-and-spigot pipe range from 2 to 15 inches in diameter, with lengths of 5 to 10 feet. Extra heavy and service weight hubless piping ranges from 1 ½ to 15 inches in diameter, with lengths of 5 to 10 feet. Because of the different wall thicknesses between extra heavy and service weight, the piping is not interchangeable without a special adapter from the manufacturer.

Hub-and-spigot pipe and fittings are composed of a hub into which the plain end (spigot) of the piping is inserted. A rubber compression gasket in the hub seals the joint. To help make the connection, a lubricant is used, although in some areas molten lead and oakum still are used to make this seal.

Hubless cast iron piping and fittings simply do not have a hub. To join this type of piping, a hubless rubber coupling is used, which is slipped over the plain ends of the piping and tightened to seal it. The coupling comes in two types: standard and extra heavy. The difference between the two is the number of bands around the coupling.

The applicable standards for cast iron soil piping are as follows:

- ASTM A74: *Standard Specification for Cast Iron Soil Pipe and Fittings*
- ASTM A888: *Standard Specification for Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications*
- Cast Iron Soil Pipe Institute (CISPI) 301: *Standard Specification for Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste and Vent Piping Applications.*
- CISPI 310: *Specification for Coupling for Use in Connection with Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications.*
- ASTM C564: *Standard Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings.*
- ASTM C1540: *Standard Specification for Heavy-duty Shielded Couplings Joining Hubless Cast Iron Pipe and Fittings.*



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### DUCTILE IRON SEWER PIPE

Ductile iron piping manufactured for gravity sewerage comes in diameters from 3 to 64 inches. The pipe is manufactured with bell ends and is 18 to 20 feet long. It is similar to cast iron piping except that it has higher allowable pressure ratings and external load-bearing capacities and is used more underground outside the building perimeter because of its strength. The primary use of this piping is for water and sewer systems and some industrial applications.

The joining method of ductile iron piping and fittings is push-on, either mechanical or flanged. Other special joining methods are available such as restrained, ball and socket, grooved, and shouldered. The push-on method is similar to cast iron piping with the use of a rubber compression gasket.

The applicable standards for ductile iron piping are as follows:

- ANSI/AWWA C104/A21.4: *Cement Mortar Lining for Ductile Iron Pipe and Fittings for Water*
- ANSI/AWWA C105/A21.5: *Polyethylene Encasement for Ductile Iron Pipe Systems*
- ANSI/AWWA C110/A21.10: *Ductile Iron and Gray Iron Fittings for Water*
- ANSI/AWWA C111/A21.11: *Rubber Gasket Joints for Ductile Iron Pressure Pipe and Fittings*
- ANSI/AWWA C115/A21.15: *Flanged Ductile Iron Pipe with Ductile Iron or Gray Iron Threaded Flanges*
- ANSI/AWWA C116/A21.16: *Protective Fusion-bonded Epoxy Coatings for the Interior and Exterior Surfaces of Ductile Iron and Gray Iron Fittings for Water Supply Service.*
- ANSI/AWWA C150/A21.50: *Thickness Design of Ductile Iron Pipe*
- ANSI/AWWA C151/A21.51: *Ductile Iron Pipe, Centrifugally Cast*
- ANSI/AWWA C153/A21.53: *Ductile Iron Compact Fittings for Water Service*
- ANSI/AWWA C600: *Standard for the Installation of Ductile Iron Water Mains and Their Appurtenances.*
- AWWA C651: *Disinfecting Water Mains*
- ASTM A716: *Standard Specification for Ductile Iron Culvert Pipe*
- ASTM A746: *Standard Specification for Ductile Iron Gravity Sewer Pipe*

### CONCRETE PIPE

Concrete piping is manufactured from non reinforced or reinforced concrete. Nonreinforced piping is used for drainage and sewer lines and for gravity-flow water supply lines. It is available in diameters of 4 to 36 inches. Reinforced concrete piping (RCP) is used for sewage and storm drainage systems and is available in diameters from 12 to 144 inches. RCP commonly is used for drainage of parking areas and roadways.

The joining of RCP when used for parking areas and roadways is made with cement plaster. The joining method for use in sanitary sewer applications for both nonreinforced and reinforced concrete pipe is rubber gaskets, but many plumbing codes permit only elastomeric gasket joints conforming to ASTM C443 for use under buildings.



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The applicable standards and specifications for concrete pipe include the following:

- ASTM C14: *Standard Specification for Non-reinforced Concrete Sewer, Storm Drain and Culvert Pipe.*
- ASTM C76: *Standard Specification for Reinforced Concrete Culvert, Storm Drain and Sewer Pipe.*
- ASTM C655: *Standard Specification for Reinforced Concrete D-Load Culvert, Storm Drain and Sewer Pipe*
- ASTM C443: *Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets.*

### **COPPER DRAINAGE PIPING**

Copper drainage piping for DWV applications is seamless copper tubing and comes in diameters from 1 ¼ to 8 inches. This type of pipe is required to be engraved with the manufacturer's name or trademark and the letters "DWV" at intervals no greater than 1 ½ feet. It also can be identified by a yellow strip with the manufacturer's name or trademark, the nation of origin, and the letters "DWV" stamped on it. Joining for drainage applications can be soldered or brazed.

The application standards and specifications for copper drainage piping are as follows:

- ASTM B306: *Standard Specification for Copper Drainage Tube (DWV)*
- ASME/ANSI B16.23: *Cast Copper Alloy Solder Joint Drainage Fittings (DWV)*
- ASME/ANSI B16.29: *Wrought Copper and Wrought Copper Alloy Solder Joint Drainage Fittings*

### **VITRIFIED CLAY PIPE**

Vitrified clay piping is made from selected clay and shale mixed with water, formed into pipe and fired at 2,000°F. Vitrification takes place at this temperature, producing an extremely hard and dense corrosion-resistant material. Because of its corrosion-resistance, this piping is used for industrial wastes in addition to domestic sewer and drainage systems. Available sizes are from 3 to 48 inches in diameter, with lengths up to 10 feet in standard and extra strength grades, as well as perforated for use for septic tank land fields and perimeter drainage. This piping is recommended for use outside buildings only and is joined with a prefabricated compression seal.

The applicable standards and specifications are as follows:

- ASTM C12: *Standard Practice for Installing Vitrified Clay Pipe Lines*
- ASTM C301: *Standard Test Methods for Vitrified Clay Pipe*
- ASTM C425: *Standard Specification for Compression Joints for Vitrified Clay Pipe and Fittings.*
- ASTM C700: *Standard Specification for Vitrified Clay Pipe, Extra Strength, Standard Strength and Perforated*
- ASTM C828: *Standard Test Method for Low-Pressure Air Test of Vitrified Clay Pipe Lines*
- ASTM C896: *Standard Terminology Relating to Clay Products*



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- ASTM C1208: *Standard Specification for Vitrified Clay Pipe and Joints for Use in Microtunneling, Sliplining, Pipe Bursting and Tunnels*
- ASTM C1091: *Standard Test Method for Hydrostatic Infiltration Testing of Vitrified Clay Pipe Lines.*

## PLASTIC PIPE

Plastic pipe is available in compositions designed for various drainage applications, including DWV, water supply, gas service, and laboratory waste and other chemical drainage systems. Fuel double-containment systems, high-purity pharmaceutical, and electronic-grade water and fire protection sprinklers systems are other applications, but as mentioned, this article covers only DWV systems.

## POLYVINYL CHLORIDE

PVC is a rigid drainage pipe that resists chemicals and corrosion. It comes in two types: Schedule 40 and Schedule 80. PVC drainage piping is used for storm drainage, sewage, laboratory and hospital wastes, and chemical lines. Schedule 40 comes in diameters from ½ inch to 30 inches, and Schedule 80 comes in diameters from 1/8 inch to 30 inches. The maximum temperature rating of PVC is 140°F. The joining method for Schedule 80 is solvent welded or threaded. Schedule 40 cannot be threaded and is available only with socket fittings.

The applicable standards and specification are as follows:

- ASTM D1785: *Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedule 40, 80 and 120.*
- ASTM D2466: *Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40*
- ASTM D2467: *Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80*
- ASTM D2564: *Standard Specification for Solvent Cement for Poly (Vinyl Chloride) (PVC) Plastic Piping Systems.*
- ASTM D2665: *Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Drain, Waste and Vent Pipe and Fittings*
- ASTM D2729: *Standard Specification for Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings*

## ACRYLONITRILE-BUTADIENE-STYRENE

ABS is used for main sewers and utility conduits and is manufactured in Schedules 40 and 80. It commonly is used for DWV plumbing (black in color), main sanitary and storm sewers, and applications in the chemical and petroleum industries. ABS is available in diameters of 1 ½, 2, 3, 4 and 6 inches.



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The applicable standards and specification for ABS are as follows:

- ASTM D1527: *Standard Specification for Acrylonitrile-Butadiene-Styrene (ABS) Plastic Pipe, Schedules 40 and 80*
- ASTM D2235: *Standard Specification for Solvent Cement for Acrylonitrile-Butadiene-Styrene (ABS) Plastic Pipe and Fittings*
- ASTM D2661: *Standard Specification for Acrylonitrile-Butadiene-Styrene (ABS) Schedule 40 Plastic Drain, Waste and Vent Pipe and Fittings*
- ASTM D2680: *Standard Specification for Acrylonitrile-Butadiene-Styrene (ABS) and Poly (Vinyl Chloride) (PVC) Composite Sewer Piping*
- ASTM D2751: *Standard Specification for Acrylonitrile-Butadiene-Styrene (ABS) Sewer Pipe and Fittings*
- ASTM F628: *Standard Specification for Acrylonitrile-Butadiene-Styrene (ABS) Schedule 40 Plastic Drain, Waste and Vent Pipe with a Cellular Core*

## POLYPROPYLENE

PP is used for DWV systems such as chemical, special waste, and acid waste, both underground and aboveground. The piping is available in Schedule 40, Schedule 80, and flame retardant (FR) for above-ground installations. Polypropylene piping for acid waste comes with either mechanical joints in diameters of 1 ½, 2, 3, 4 and 6 inches or heated fused in diameters of 1 ½, 2, 3, 4, 6, 8, 10, 12, 14, 16, and 18 inches. PP piping also is used for industrial liquids, salt water disposal, and corrosive waste systems in sizes from ½ inch to 24 inches.

All types of PP piping comes in lengths of 10 and 20 feet.

Polypropylene also is manufactured as a double-containment piping system used in DWV acid waste market. Double-containment PP piping comes in two different types: non-flame (NFPP) for underground use and flame-retardant (FRPP) for above-ground applications. While not necessary, a leak-detection system is recommended to be installed in this type of system.

The application standards and specifications for PP piping are as follows:

- ASTM F1412: *Standard Specification for Polyolefin Pipe and Fittings for Corrosive Waste Drainage Systems.*
- ASTM F1055: *Standard Specification for Electrofusion Type Polyethylene Fittings for Outside Diameter Controlled Polyethylene Pipe and Tubing.*
- ASTM F1056: *Standard Specification for Socket Fusion Tools for Use in Socket Fusion Joining Polyethylene Pipe of Tubing and Fittings*
- ASTM F1290: *Standard Practice for Electrofusion Joining Polyolefin Pipe and Fittings.*





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### GLASS PIPE

Glass pipe is made of low-expansion borosilicate glass with a low alkali content. Mostly used for chemical waste drainage and venting, it also has been used for purified water. Glass piping can be installed aboveground with padded or coated hangers and buried with Styrofoam blocking around the piping. It is a fragile material, and care should be taken during installation. Sizes are available in 1 ½ to 6 inches, with lengths from 5 to 10 feet.

Glass pipe will not burn, but with enough heat it will melt, which is why it is a popular material for use above ceilings in return air plenums for HVAC systems. Joining of glass piping is made using a compression-type coupling consisting of 300 series stainless steel outer bands, electrometric compression liners, and sealing members of chemically inert tetrafluoroethylene (TFE).

### DURIRON PIPING

Duriron is a silicon iron used for corrosion resistance, and for many years this type of pipe and fittings has provided a durable means for draining corrosive waste. Like cast iron it is made with bell and spigot ends and fittings manufactured in diameters from 2 to 15 inches. It also is manufactured with a mechanical joint and fittings in sizes from 1 ½ to 1 inches.

The joining of bell and spigot is made using virgin lead and a special acid-resistant caulking yarn. The caulking yarn is packed into the bell of the duriron joint, and a small amount of lead is poured over the yarn to fill the hub. The mechanical joint is an easy assembly through the use of a two-bolt mechanical coupling. A calibrated ratchet is necessary to complete the joint.

The applicable standards and specifications for duriron piping are as follows:

- ASTM A518/A518M: *Standard Specification for Corrosion-resistant High-silicon Iron Castings*
- ASTM A861: *Standard Specification for High-silicon Iron Pipe and Fittings*

When designing plumbing systems for an existing facility, the plumbing designer may need to match the existing material, but the existing material may not be commonly used or manufactured any longer. In those cases, the plumbing designer must use good engineering practices and specify a pipe material that best fits the application and meets applicable codes.

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