

Internal Use Only

Installation Standard For COPPER PLUMBING TUBE, PIPE, AND FITTINGS

IAPMO IS 3-2006

1.0 SCOPE

1.1 Installation and material of copper tube, pipe and fittings in drainage, vent, and water systems shall comply with this standard and the current edition of the Uniform Plumbing Code [UPC]TM, published by the International Association of Plumbing and Mechanical Officials (IAPMO).

Note: The following sections of the Uniform Plumbing Code shall apply.

- 103.5.3 Testing of systems
- 301.1 Minimum standards
- 310.0 Workmanship
- 311.0 Prohibited fittings and practices
- 313.0 Protection of piping materials and structures
- 314.0 Hangers and supports
- 316.1 Types of joints
- 316.2 Special joints
- 316.4 Prohibited joints and connections
- 317.0 Increasers and reducers
- 604.0 Materials
- 604.1 Water piping
- 604.2 Water piping
- 604.3 Marking of tubing
- 604.4 Flexible water connectors
- 604.7 Restriction of used piping
- 606.1.1 Flared joints
- 606.2.1 Use of joints, copper water tube
- 608.0 Relief valve drain
- 609.0 Installation, inspection, testing
- 610.0 Size of potable piping
- 701.1.4 Drainage and vent piping
- 704.4.1 Closet flanges
- 705.3.3 Ground joint, flared or ferrule connections
- 707.1 Cleanouts
- 701.0 Materials, drainage piping
- 811.1 Chemical or industrial waste piping
- 903.0 Materials, vent piping
- 903.2 Use of copper tubing
- 1101.3 Materials, rain water piping

1105.1 Materials, roof drains

Table 14-1 Standards

ASME B 16.18	Cast Copper Alloy Solder-Joint Pressure Fittings
ASME B 16.22	Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings
ASME B 16.23	Cast Bronze Solder-Joint Drainage Fittings - DWV
ASME B 16.29	Wrought Copper and Copper Alloy Solder-Joint Drainage Fittings
ASME B 16.50	Wrought Copper and Copper Alloy Braze-Joint Pressure Fittings
ASTM B 32	Solder Metal
ASTM B 42	Seamless Copper Pipe, Standard Sizes
ASTM B 75	Seamless Copper Tubes
ASTM B 88	Seamless Copper Water Tube
ASTM B 302	Threadless Copper Pipe, Standard Sizes
ASTM B 306	Copper Drainage Tube (DWV)
ASTM B 813	Liquid and Paste Fluxes for Soldering Applications of Copper and Copper Alloy Tube
ASTM B 828	Standard Practice for Making Capillary Joints by Soldering of Copper and Copper Alloy Tube and Fittings
Appendix A	Chart A-4 Friction loss per 100 ft. (30.5 m)

2.0 PRODUCT REQUIREMENTS

2.1 Minimum Standards

2.1.1 Materials. Materials shall comply with the appropriate standard in Table 14-1 of the UPC. [UPC 301.1]

Note: The nominal or standard size of copper plumbing tube is always 0.125 inch (3.175 mm) or one-eighth (1/8) inch (3.175 mm) smaller than the actual outside diameter dimension of the tube. For example, 3 inch (76 mm) nominal size

copper plumbing tube measures 3-1/8 inch (79 mm) O.D., 1/2 inch (12.7 mm) nominal size copper plumbing tube measures 5/8 inch (15.9 mm) O.D., etc.

2.1.2 Markings. Markings shall be visible for inspection. Products that are covered by this standard shall be identified in accordance with the standard found in Table 14-1. [UPC 301.1]

2.1.3 Tube and Threadless Pipe.

Water tube (Types K, L, M), drainage tube (Type DWV), and threadless pipe (TP), shall bear the following incised marking at not over 18 inch (457 mm) intervals:

(a) Manufacturer's name or trademark;
and

(b) Tube type

2.1.4 Pipe (Copper and Copper Alloy)

Pipe shall bear the following incised marking at not over 18 inch (457 mm) intervals:

(a) Manufacturer's name or trademark;
and

(b) Pipe type.

2.1.5 Fittings

Fittings shall bear the following markings:

(a) Manufacturer's name or trademark;
and

(b) "DWV" on drainage fittings.

2.2 Type of Joints

2.2.1 General Information

Copper tube and fittings may be joined in a number of ways, depending on the purpose of the system. Soldering and brazing with capillary fittings are the methods used most.

The American Welding Society (AWS) defines soldering as a joining process which takes place below 840°F (449°C) and brazing as a similar process which occurs above 840°F (449°C) but below the melting point of the base metals. In actual practice for copper systems, most soldering is done at temperatures from about 350°F (177°C) to 550°F (288°C), while most brazing is done at temperatures ranging from 1100°F (593°C) to 1500°F (816°C). The choice between soldering or brazing will generally depend on operating conditions. Solder joints are generally used where the service temperature does not exceed 250°F (121°C), while brazed joints are used where greater tensile strength is

required to resist vibration, or pressure or temperature cycling, or where system temperatures are as high as 350°F (177°C). Although brazed joints offer higher joint strength in general, the annealing of the tube and fitting which results from the higher heat used in the brazing process can cause the rated pressure of the system to be less than that of a soldered joint. This fact should also be considered in choosing which joining process to use.

Mechanical joints are used frequently for some underground connections, for joints where the use of heat is impractical and for joints that may have to be disconnected from time to time. [UPC 316.1]

2.2.2 Fittings for Soldered, Brazed, and Mechanical Joints

Cast fittings are available in all standard tube sizes and in a wide variety of types to cover needs for plumbing. They can be either soldered or brazed, although brazing cast fittings requires care. Wrought copper pressure fittings are also available over a wide range of sizes and types. These, too, can be joined by either soldering or brazing and wrought fittings are preferred where brazing is the joining method. Otherwise, the choice between cast and wrought fittings is largely a matter of the user's preference and availability. According to the American Welding Society, the strength of a brazed joint will meet or exceed that of the tube and fitting being joined when the joint overlap and the depth of the filler metal penetration is a minimum of three times the thickness of the thinner base metals (tube or fitting) and a well-developed fillet (cap) is present. The strength of a brazed copper tube joint does not vary much with different filler metals but depends on maintaining the proper clearance between the outside of the tube and the socket (cup) of the fitting. Copper tube and solder-type pressure fittings are accurately made for each other, and the tolerances permitted for each assure the capillary space will be within the limits necessary for a joint of satisfactory strength. However, the depths of the socket are considerable deeper than the three times required by AWS. There are standards available for the manufacture of fittings made specifically for brazing, these include ASME B 16.50

and MSS SP 73. When fittings are made to these standards, they cannot be soldered. They must be brazed.

2.2.2.1 Mechanical Joints

Flared-tube fittings provide metal-to-metal contact similar to ground joint unions; both can be easily taken apart and reassembled. Grooved end mechanical fittings are also available in sizes 2-inches to 6-inches. Mechanical joint fittings are especially useful where residual water cannot be removed from the tube and soldering is difficult. Mechanical joints may be required where a fire hazard exists and the use of a torch to make soldered or brazed joints is not allowed. Also, soldering under wet conditions can be very difficult and mechanical joints may be preferred under such circumstances. [UPC 316.0]

2.2.3 Solders

Most solders referenced in ASTM B 32 can be used to join copper tube and fittings in potable water systems.

Note: *Users of the Uniform Plumbing Code are reminded that provisions of the Federal Safe Drinking Water Act of 1986 (SDWA), which all must obey, forbid the use of solder which contains in excess of 0.2% of lead, in potable water systems. The provisions of the act are incorporated in all ordinances, statutes, state and municipal regulations by reference and by operation of law. [UPC 316.0]*

The selection of a solder depends on the operating pressure and temperature of the system. Consideration should also be given to the stresses on the joint caused by thermal expansion and contraction. However, stresses due to temperature changes should not be significant in two commonly encountered cases: when tube lengths are short, or when expansion loops are used in long tube runs.

Solder is generally used in wire form, but paste-type solders are also available. These are finely granulated solders in suspension in a paste flux. These solder/flux pastes must meet the requirements of ASTM B 813. When using paste-type solders, observe these four rules:

1. Wire solder must be applied in addition to the paste to fill the voids and assist in displacing the flux, otherwise the surfaces may be well

"tinned" and yet there may not be a good joint with a continuous bond. Use the same type of solder (e.g., 50-50 or 95-5) as that used in the paste.

2. The paste mixture must be thoroughly stirred if it has been standing in the can for more than a very short time, as the solder has a tendency to settle rapidly to the bottom.
3. The flux cannot be depended on to clean the tube. Cleaning should be done manually as is recommended for any other flux and solder.
4. Remove any excess flux.

Solders are available that contain small amounts of silver or other additives to impart special properties. Such solders may require special fluxes. The manufacturer's recommendations should be consulted regarding proper procedures and fluxes for such solders and about the expected properties.

2.2.4

Soldering Flux

The functions of the soldering flux are to remove residual traces of oxides, to promote wetting and to protect the surfaces to be soldered from oxidation during heating. The flux should be applied to clean surfaces and only enough should be used to lightly coat the areas to be joined.

An oxide film may reform quickly on copper after it has been cleaned. Therefore, the flux should be applied as soon as possible after cleaning.

CAUTION

Careless workmanship, especially during flux applications, can result in corrosion of the tube long after the system has been installed. If excessive flux is used, the residue inside the tube can cause corrosion. In an extreme case, such residual flux can actually lead to perforation through the tube wall causing leakage. To guard against this danger, it is important (1) to choose a flux that is manufactured to ASTM B 813, and (2) to use only the minimum amount actually needed to make the joint.

2.3

Solder Joints