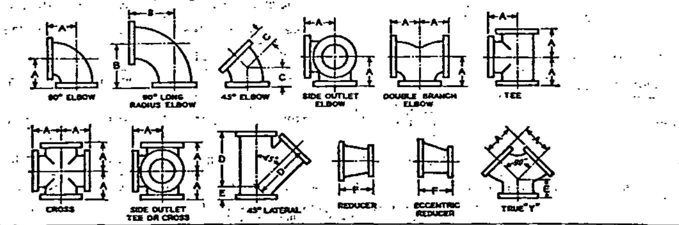
Table 9 .... Dimensions of Flanged Cast-Iron Elbows, Double Branch Elbows, Tees, Crosses, Laterals, True Y's (Straight Sizes), and Reducers (Class 125)




| Nominal Pipe Size | Inside Dia of Fittings | Center to Face 90 Deg Elbow, Tees, Crosses, True Y, and Double Branch Elbow A | Center to Face 90 Deg Long Radius Elbow B | Center to Face 45 Deg Elbow C | Center to Face Lateral D | Short Center to Face True Y and Lateral E | Face to Face Reducer F | Dia of Flange | Thickness of Flange (Min) | Wall Thickness |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 1 | 3½ | 5 | 1¾ | 5¾ | 1¾ | .... | 4¼ | 7/16 | 5/16 |
| 1¼ | 1¼ | 3¾ | 5½ | 2 | 6¼ | 1¾ | .... | 4⅝ | ½ | 5/16 |
| 1½ | 1½ | 4 | 6 | 2¼ | 7 | 2 | .... | 5 | 9/16 | 5/16 |
| 2 | 2 | 4½ | 6½ | 2½ | 8 | 2½ | 5 | 6 | ⅝ | 5/16 |
| 2½ | 2½ | 5 | 7 | 3 | 9½ | 2½ | 5½ | 7 | 11/16 | 5/16 |
| 3 | 3 | 5½ | 7¾ | 3 | 10 | 3 | 6 | 7½ | ¾ | ⅜ |
| 3½ | 3½ | 6 | 8½ | 3½ | 11½ | 3 | 6½ | 8½ | 13/16 | 7/16 |
| 4 | 4 | 6½ | 9 | 4 | 12 | 3 | 7 | 9 | 15/16 | ½ |
| 5 | 5 | 7½ | 10¼ | 4½ | 13½ | 3½ | 8 | 10 | 15/16 | ½ |
| 6 | 6 | 8 | 11½ | 5 | 14½ | 3½ | 9 | 11 | 1 | 9/16 |
| 8 | 8 | 9 | 14 | 5½ | 17½ | 4½ | 11 | 13½ | 1⅛ | ⅝ |
| 10 | 10 | 11 | 16½ | 6½ | 20½ | 5 | 12 | 16 | 1 3/16 | ¾ |
| 12 | 12 | 12 | 19 | 7½ | 24½ | 5½ | 14 | 19 | 1¼ | 13/16 |
| 14 OD | 14 | 14 | 21½ | 7½ | 27 | 6 | 16 | 21 | 1⅜ | ⅞ |
| 16 OD | 16 | 15 | 24 | 8 | 30 | 6½ | 18 | 23½ | 1 7/16 | 1 |
| 18 OD | 18 | 16½ | 26½ | 8½ | 32 | 7 | 19 | 25 | 1 9/16 | 1 1/16 |
| 20 OD | 20 | 18 | 29 | 9½ | 35 | 8 | 20 | 27½ | 1 11/16 | 1⅛ |
| 24 OD | 24 | 22 | 34 | 11 | 40½ | 9 | 24 | 32 | 1⅞ | 1¼ |
| 30 OD | 30 | 25 | 41½ | 15 | 49 | 10 | 30 | 38¾ | 2⅛ | 1 7/16 |
| 36 OD | 36 | 28* | 49 | 18 | .... | .... | 36 | 46 | 2⅜ | 1⅝ |
| 42 OD | 42 | 31* | 56½ | 21 | .... | .... | 42 | 53 | 2⅝ | 1 13/16 |
| 48 OD | 48 | 34* | 64 | 24 | .... | .... | 48 | 59½ | 2¾ | 2 |

From *American Standard for Cast Iron Pipe Flanges and Flanged Fittings*, Class 125, *ASA* B16.1-1948. All dimensions given are in inches.
* Does not apply to true Y's or double-flanged elbows.

1. A soldered joint is a gastight joint obtained by joining of metal parts with metallic mixtures or alloys which melt at temperatures below 1000 F and above 400 F.
2. A brazed joint is defined as a gastight joint obtained by joining metal parts with alloys which melt at temperatures higher than 1000 F but less than the melting temperature of the joined parts.

*Soldered Joints.* Consideration of the materials to be used is an important preliminary step in any job concerning the soldering of copper tube joints. The type of solder selected will depend on the service for which the tube is intended. In general, the maximum temperature and pressure of the fluid to be carried by the line are the deciding factors. A properly designed piping system will have suitable provision for expansion and contraction, although they are not the factors that determine the kind of solder to be used. If, on the other hand, the forces of contraction place high tension stresses on the joints, these stresses may well be in excess of those caused by internal pressure and may be of first importance.

Under ordinary circumstances, a properly made joint will be stronger than the tube itself, for stresses of short duration. However, at elevated temperatures when the stress is maintained over long periods of time, the solder, because it is somewhat plastic, may give when the stress is less than that which would produce a break with short-time loads. This condition is known as *creep*, and the creep strength of various types of solder varies widely.

For all service at room temperatures and for low-pressure steam (up to 15 psi), as well as for moderate pressures with temperatures up to 250 F, a good grade of 50–50 tin-lead solder is more commonly used.



For all temperatures up to 250 F, where higher strengths are required, a 95–5 tin-antimony solder should be used. This solder melts at a higher temperature then does 50–50, has less of a pasty range, and is therefore somewhat more difficult to handle, particularly for a vertical joint to be filled upward.

For copper pipe lines carrying refrigerants, the use of silver solder is recommended, either 35 or 45 percent alloys. These brazing alloys have been improved to such a degree that their ease of application and their permanence will offset the additional material cost. *Once a joint is made and tested tight, it will remain tight, while soft solder will frequently vibrate loose.*

The *fluxes* best suited to the 50–50 and 95–5 solders are in paste form and consist of a petrolatum base, impregnated with zinc and ammonium chlorides. *It should not be the function of the flux to clean the copper.* But if the joint has been cleaned, the flux will remove residues of oxide and serve to protect the surfaces from oxidation during the heating process, float out the remaining oxides ahead of the molten solder and promote wetting action of the solder.

For strong, tight, long-lasting joints, thorough cleaning of the tube surface and the inside of the cup of the fitting is of the utmost importance.

Pretinning is unnecessary, and is not recommended, because of the possibility that it may interfere with the capillary action which should draw all the solder needed for the joint.

Capillary action is dependent upon a fairly tight fit (see Fig. 3), and looseness may cause difficulties in larger sizes. This is particularly true for horizontal joints where an oversized fitting may allow the tube to rest directly on the socket resulting in a double space at the top. Such joints should be made up in a vertical position before assembly.

*Brazed Joints* may be made with brazing alloys melting at temperatures in the approximate range of 1100 F to 1500 F. These brazing materials are sometimes called hard solders, a term not universally accepted as correct.

Brazing materials may be divided into two classes; the alloys containing silver, and the copper-phosphorous alloys. The two classes have fairly wide differences in their melting and flowing characteristics, and the user should consider these factors, as well as the time required to make the joint, in selecting the brazing material. For joining copper tubes with copper or bronze capillary fittings, *any of these brazing alloys* will provide the necessary strength. The copper-phosphorous alloys are definitely preferred when joining copper to copper,

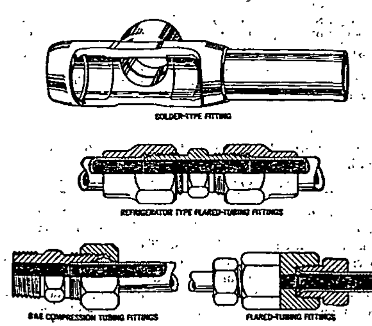
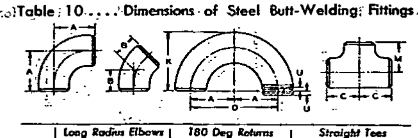



Fig. 2 .... Copper or Brass Tube Fittings

Table 10 .... Dimensions of Steel Butt-Welding Fittings



| Nominal Pipe Size | Long Radius Elbows: Outside Diameter at Bevel | Long Radius Elbows: Center-to-End 90-Deg Elbows A | Long Radius Elbows: Center-to-End 45-Deg Elbows B | 180 Deg Returns: Outside Diameter at Bevel | 180 Deg Returns: Center-to-Center O | 180 Deg Returns: Back to Face K | Straight Tees: Outside Diameter at Bevel | Straight Tees: Center-to-End Run C | Straight Tees: Center-to-End Outlet M |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 1.315 | 1½ | ⅞ | 1.315 | 3 | 2 3/16 | 1.315 | 1½ | 1½ |
| 1¼ | 1.660 | 1⅞ | 1 | 1.660 | 3¾ | 2¾ | 1.660 | 1⅞ | 1⅞ |
| 1½ | 1.900 | 2¼ | 1⅛ | 1.900 | 4½ | 3¼ | 1.900 | 2¼ | 2¼ |
| 2 | 2.375 | 3 | 1⅜ | 2.375 | 6 | 4 3/16 | 2.375 | 2½ | 2½ |
| 2½ | 2.875 | 3¾ | 1¾ | 2.875 | 7½ | 5 3/16 | 2.875 | 3 | 3 |
| 3 | 3.500 | 4½ | 2 | 3.500 | 9 | 6¼ | 3.500 | 3⅜ | 3⅜ |
| 3½ | 4.000 | 5¼ | 2¼ | 4.000 | 10½ | 7¼ | 4.000 | 3¾ | 3¾ |
| 4 | 4.500 | 6 | 2½ | 4.500 | 12 | 8¼ | 4.500 | 4⅛ | 4⅛ |
| 5 | 5.563 | 7½ | 3⅛ | 5.563 | 15 | 10 5/16 | 5.563 | 4⅞ | 4⅞ |
| 6 | 6.625 | 9 | 3¾ | 6.625 | 18 | 12 5/16 | 6.625 | 5⅝ | 5⅝ |
| 8 | 8.625 | 12 | 5 | 8.625 | 24 | 16 5/16 | 8.625 | 7 | 7 |
| 10 | 10.750 | 15 | 6¼ | 10.750 | 30 | 20⅜ | 10.750 | 8½ | 8½ |
| 12 | 12.750 | 18 | 7½ | 12.750 | 36 | 24⅜ | 12.750 | 10 | 10 |
| 14 | 14.000 | 21 | 8¾ | 14.000 | 42 | 28 | 14.000 | 11 | |
| 16 | 16.000 | 24 | 10 | 16.000 | 48 | 32 | 16.000 | 12 | Not standard |
| 18 | 18.000 | 27 | 11¼ | 18.000 | 54 | 36 | 18.000 | 13½ | |
| 20 | 20.000 | 30 | 12½ | 20.000 | 60 | 40 | 20.000 | 15 | |
| 24 | 24.000 | 36 | 15 | 24.000 | 72 | 48 | 24.000 | 17 | |

From *American Standard for Steel Butt-Welding Fittings*, *ASA* B16.9-1958. All dimensions are in inches. Dimension A is equal to ½ of dimension O.

while the alloys containing silver should be used for joining copper with bronze or steel.

With brazed joints, as well, the strength does not vary much with the different brazing materials, but depends to a large extent upon the maintenance of the proper clearance between the outside of the tube and the socket of the fitting.

*The* ASA *B9.1 Code reads as follows, under paragraph 9.3.5.*

"Sweat joints on copper tubing used in refrigerating systems containing Group 2 or Group 3 refrigerants shall be brazed joints. Soldered joints shall not be used in such refrigerating systems."

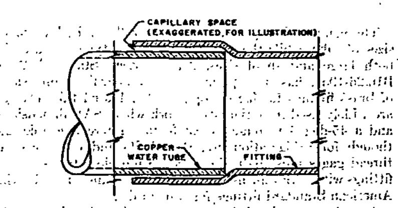



Fig. 3 .... Capillary Space in Soldered Joints