

ASA B2.1. Right-hand threads are used unless otherwise ordered. To facilitate drainage, some elbows have the thread tapped at an angle to provide a pitch of the connecting pipe of 1 in. to the foot. These elbows are known to the trade as pitch elbows and are commercially available. All threaded pipe joints should be made up with a thread paste suitable for the service for which the pipe is to be used.

Screwed joints are limited by the Code for Pressure Piping to not over 3 in. nominal size for refrigerant pressure 250 psi or less, 1½ in. for refrigerant pressures above 250 psi and not over 4 in. for water and brine. Screwed-on flanges are not permitted in sizes larger than those given above. Bushings are not permitted for reductions of a single pipe size. For screwed brass or copper refrigerant pipe, extra heavy fittings are required.

Table 4 contains pertinent threading data for standard weight, extra strong and double extra strong steel, and wrought-iron pipe. The normal engagement of pipe threads is given in Table 5.

PIPE FITTINGS

Pipe is joined by butt welding one length to another, or by using fittings. Pipe fittings are made in a variety of forms such as elbows, tees, couplings, reducers, and unions, and may be screwed, flanged, or welded. The type of fitting to be used is determined by the pressure of the fluid being carried, or by the intended use of the pipe line. The materials generally used are steel, cast iron, malleable iron (heat treated cast iron), copper, brass, stainless steel, alloy steel, or bronze. The material used also depends upon the pressure and characteristics of the fluid.

Fittings are designated and sized in accordance with American Standards Association specifications and are identified by their nominal pipe sizes.

In the case of reducing tees, crosses, and Y-branches (laterals), the size of the largest run opening is given first, followed by the size of the opening at the opposite end of the run. Where the fitting is a tee or Y-branch (lateral), the size of the outlet is given last. Where the fitting is a cross, the largest side-outlet opening is the third dimension given followed by the opening opposite. The straight line sketches, Fig. 1, illustrate how the reducing fittings are designated.

Where an external thread is wanted, the word *male* follows the size of that opening; *female* indicates an internal thread.

Allowable pressures for solder-type fittings are given in American Standards B16.18—1963, *Cast Bronze Solder-Joint Pressure Fittings*, and B16.22—1963, *Wrought Copper and Bronze Solder-Joint Pressure Fittings*. Data on solders are

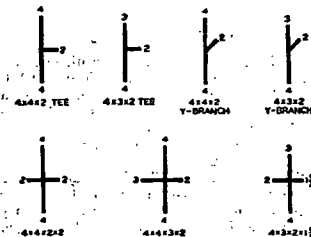


Fig. 1: Description of Tees and Laterals (ASA B16.3)

Table 4: Threading Data for Pipe

Nominal Pipe OD	Standard Weight			Extra and Double Extra Strong		
	Threads per inch ^a	Coupling Length	Coupling Length	Threads per inch	Coupling Length	Coupling Length
1/8	0.405	27	0.563	1 1/8	27	0.563
1/4	0.540	18	0.719	1 1/4	18	0.719
3/8	0.675	18	0.875	1 3/8	18	0.875
1/2	0.840	14	1.063	1 1/2	14	1.063
3/4	1.050	14	1.313	1 3/4	14	1.313
1	1.315	11 1/2	1.578	2	11 1/2	1.578
1 1/4	1.660	11 1/2	1.900	2 1/4	11 1/2	2.054
1 1/2	1.990	11 1/2	2.200	2 1/2	11 1/2	2.200
2	2.375	8	2.750	3	8	2.875
2 1/2	2.875	8	3.250	3 1/2	8	3.375
3	3.500	8	4.000	4	8	4.000
3 1/2	4.000	8	4.625	4 1/2	8	4.625
4	4.500	8	5.000	5	8	5.200
5	5.563	8	6.298	6	8	6.298
6	6.625	8	7.390	8	8	7.390
8	8.625	—	—	10	8	8.625
10	10.750	—	—	12	8	11.750
12	12.750	—	—	14	8	14.000
14	14.000	—	—	16	8	15.000
16	16.000	—	—	18	8	17.000
18	18.000	—	—	20	8	19.000
20	20.000	—	—	22	8	21.000

^a All dimensions in inches.

^b Taper of threads is 1/4 in. per ft on diameter on all sizes of pipe, and in couplings of 3/4 in. and over. Couplings 3 in. and smaller are straight tapered.

^c 5.563 for copper and red brass pipe.

given in Table 6. Allowable pressures for ferrous screwed, flanged, and welding fittings according to ASA specifications are given in Table 7.

Steel welding (butt or socket type) fittings may be used for the same pressure as the pipe, provided wall thickness (or schedule number), and also the material, are the same as the pipe on which they are used.

Screwed fittings include: couplings, elbows (45° or 90°), return bends (close and open), tees, crosses, laterals (Y-

Table 5: Normal Engagement of Tight-Fit Male and Female Pipe Threads

For American Standard and API Pipe Threads

Pipe Size	Engaged Length ^a in.	Pipe Size	Engaged Length ^a in.
1/8	3/4	2 1/4	1 1/4
1/4	3/4	3	1
3/8	3/4	3 1/2	1 1/4
1/2	3/4	4	1 1/2
3/4	1 1/4	5	1 3/4
1	1 1/4	6	1 3/4
1 1/4	1 1/4	8	1 3/4
1 1/2	1 1/4	10	1 3/4
2	1 1/4	12	1 3/4

^a Dimension shown is the normal tight-fit thread engagement from the leading edge of the female thread back to the leading edge of the male thread. No allowance has been made for threading variations.

Table 6: Solder Data

Solder or Brazing Alloy	Composition	Melting Point, F		Shear Strength Under Sustained Load, psi		
		Start	Complete	At 75 F	At 150 F	At 250 F
50-50 Tin-Lead, ASTM-B32, 50A	50% Pb-50% Sn	358	414	83.4	46.6	26.6
95-5 Tin-Antimony, ASTM B32, 5A	95% Sn-5% Sb	450	465	327.0	213.5	126.7
Silver Solder ^a	45% Ag-15% Cu, 24% Cd, 16% Zn	1120	1145	8340	8340	8340
Phos. Copper ^a	95% Cu-5% P	1310	1650	8340	8340	8340

Note: A safety factor of 3.0 is included in the above figures. To determine the internal pressure corresponding to the shear strength in the above table, use the formula:

$$P = \frac{4SL}{D} \quad \text{where } P = \text{pressure, pounds per square inch} = \frac{4SL}{D}$$

where S = shear strength, pounds per square inch.

L = length of joint, inches.

D = outside diameter of tubing, inches.

^a For most joints in refrigeration piping whether shop- or field-made, either silver solder or phos. copper is used.

branches), plugs, caps, lock nuts, flanges, bushings, and reducing fittings (elbows, tees, and couplings). Reducing fittings and bushings may be eccentrically tapped to permit drainage of condensate.

Sometimes nipples are erroneously called fittings. Actually a nipple is a piece of pipe less than 12 in. long that has been threaded on both ends. Pipe 12 in. or longer is regarded as *cut pipe*. Nipples are classified as *close* or *full thread*, *shoulder*, *short*, and *long*. A close nipple is about twice the length of the pipe thread since the threads actually meet. A shoulder nipple has a shoulder between the threads and is further classified as *short* or *long*. All shoulder nipples are cut to specific lengths and sold in that manner.

As a general rule, flanged joints are used when it is expected that the line will be disassembled quite often. There are three types of joints for attaching the flange to the pipe: *screwed*, *welded*, or *lapped*. Types of contact surface will be discussed in the next section.

Tables 8 to 13 give data on various types of ferrous fittings. Refrigerant flanged fittings and flanges were standardized in 1948. These may be expected, during the next few years, to supersede manufacturers' standards which differ somewhat, among themselves but conform more or less closely to the standard. The Code for Pressure Piping provides that facing of refrigerant flanges shall be of the retained gasket type (male and female, tongue-and-groove, or ring). All manufacturers' standards specify the tongue-and-groove type. It is necessary to match flanges to be sure they come from the same manufacturer.

Table 7: ASA Specifications and Pressures for Screwed and Flanged Fittings

Type of Fitting	Specification	Saturated Steam Pressure, Psi ^a
Cast Iron—Flanged.....	B16.1	125
Cast Iron—Flanged.....	B16b	250
Cast Iron—Flanged.....	B16b1	800
Cast Iron—Flanged (refrigeration).....	B16.16	300
Cast Iron—Screwed.....	B16.4	125 and 150
Malleable Iron—Screwed.....	B16.3	150
Malleable Iron—Screwed.....	B16.19	300
Brass or Bronze—Screwed.....	B16.15	125
Brass or Bronze—Screwed.....	B16.17	250
Steel—Flanged.....	B16.5	2500

^a Pressure may reduce with increasing size. This pressure is the maximum allowed in this specification for saturated steam. Higher pressures may be allowed with lower temperatures.

turer and to be sure that one of the pair is tongued and one grooved, and this frequently leads to annoying delays and extra joints in lines. It also requires the carrying of larger inventories in plants or shops using equipment from several manufacturers.

Fittings for copper tubing are available in soldered, flared, or compression types (see Fig. 2). Fittings for copper pipe of IPS dimensions are available in screwed or soldered types. Tables 14 and 15 give data for solder-type fittings for copper tube and pipe.

Sweat Joints are divided into two categories, according to the ASA B9.1 code. These are as follows:

Table 8: Dimensions of Screwed Cast-Iron 90° and 45-Deg Elbows, Tees, and Crosses (Class 125)

Nominal Pipe Size	Center to End, Elbows, Tees, and Crosses	Center to End, 45-Deg Elbows	Length of Thread, Min	Width of Band, Min	Inside Diameter of Fitting		Metal Thickness	Outside Diameter of Band, Min
					Max	Min		
1/8	0.81	0.73	0.32	0.38	0.584	0.540	0.110	0.93
1/4	0.95	0.80	0.36	0.44	0.719	0.675	0.120	1.12
3/8	1.12	0.88	0.43	0.50	0.897	0.840	0.130	1.34
1/2	1.31	0.98	0.50	0.58	1.107	1.050	0.155	1.63
3/4	1.50	1.12	0.58	0.62	1.355	1.315	0.170	1.95
1	1.75	1.29	0.69	0.75	1.730	1.650	0.185	2.39
1 1/4	1.94	1.43	0.70	0.75	1.970	1.900	0.200	2.68
1 1/2	2.25	1.68	0.75	0.84	2.445	2.375	0.220	3.28
2	2.70	1.95	0.92	0.94	2.978	2.875	0.240	3.88
2 1/2	3.08	2.17	0.93	1.00	3.500	3.500	0.250	4.62
3	3.42	2.39	1.03	1.08	4.100	4.000	0.280	5.20
4	3.79	2.61	1.08	1.12	4.600	4.500	0.310	5.79
5	4.50	3.05	1.18	1.18	5.663	5.563	0.380	7.05
6	5.13	3.48	1.28	1.28	6.725	6.625	0.430	8.28
8	6.56	4.28	1.47	1.47	8.725	8.625	0.550	10.63
10	8.08	5.16	1.68	1.68	10.850	10.750	0.690	13.12
12	9.50	5.97	1.88	1.88	12.850	12.750	0.800	15.47

From American Standard Dimensions of Cast-Iron Soldered Fittings, Class 125, ASA B16.4-1949. All dimensions given in inches.

^a This applies to elbows and tee only.