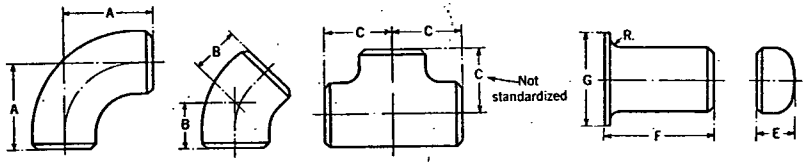
Fusion welding, commonly used in erection of piping, is defined as the process of joining metal parts in the molten, or molten and vapor states, without the application of mechanical pressure or blows. Fusion welding embraces gas welding and electric arc welding, both of which are commonly used to produce acceptable welds.

Welding application requires the same basic knowledge of design as do the other types of assembly, but in addition, requires a generous knowledge of the sciences involved, particularly as to welding qualities of

TABLE 10. AMERICAN STANDARD DIMENSIONS FOR BUTT-WELDING ELBOWS, TEES, CAPS, AND LAPPED-JOINT STUB ENDS, *A.S.A.* B16.9-1940



Nominal Pipe Size	Outside Diameter	Center-to-End			Caps *Eb-c*	Lapped-Joint Stub Ends		
		90-Deg Elbows *A*	45-Deg Elbows *B*	Of Run Tee *Ca*		Length *Fb*	Radius of Fillet *R*	Diam. of Lap *Gd*
1	1.315	1½	⅞	1½	1½	4	⅛	2
1¼	1.660	1⅞	1	1⅞	1½	4	3/16	2½
1½	1.900	2¼	1⅛	2¼	1½	4	¼	2⅞
2	2.375	3	1⅜	2½	1½	6	5/16	3⅝
2½	2.875	3¾	1¾	3	1½	6	5/16	4⅛
3	3.500	4½	2	3⅜	2	6	⅜	5
3½	4.000	5¼	2¼	3¾	2½	6	⅜	5½
4	4.500	6	2½	4⅛	2½	6	7/16	6 3/16
5	5.563	7½	3⅛	4⅞	3	8	7/16	7 5/16
6	6.625	9	3¾	5⅝	3½	8	½	8½
8	8.625	12	5	7	4	8	½	10⅝
10	10.750	15	6¼	8½	5	10	½	12¾
12	12.750	18	7½	10	6	10	½	15

All dimensions given in inches.

*The dimensions of welding tees cover those which have side outlets from one size less than half the size of the run-way opening of the tees to full size.

bDimensions *E* and *F* are applicable only to these fittings in schedules up to and including Schedule 80, *A.S.A.* Standard B36.10-1939.

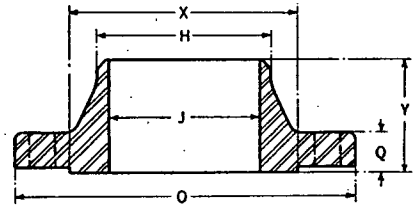
cThe shape of these caps shall be ellipsoidal and shall conform to the requirements of the *A.S.M.E.* Boiler Construction Code.

dThis dimension is for standard machined facings in accordance with American Standard for Steel Pipe Flanges and Flanged Fittings (*A.S.A.* B16e-1939). The back face of the lap shall be machined to conform to the surface of the flange on which it seats. Where ring joint facings are to be applied, use dimension *K* as given in *A.S.A.* B16e-1939.

metal, their reaction to extremely high temperatures, and the ability to determine and use only the best quality welding rods. This requirement applies equally to employer and employee with the employer accepting all of the responsibility. Thus the employer should select his welding mechanics with good judgment, provide them with first-class equipment and tools, arrange for their training and use of acceptable workmanship standards, and at regular intervals subject their work to prescribed tests. Industry will not accept the employment of mechanics of undetermined

ability nor on the basis of past experience. Neither does industry accept the statement that a weld is only as good as the workman who makes it. The control Codes now in process of adoption will be the law governing the use of the welding process. These Codes prohibit individual practices contrary to their specified procedure and rules of control, and this is

TABLE 11. AMERICAN STANDARD DIMENSIONS OF STEEL WELDING NECK FLANGES FOR STEAM SERVICE PRESSURE RATING OF 150 LB PER SQ IN. (GAGE) AT A TEMPERATURE OF 500 F, AND 100 LB PER SQ IN. (GAGE) AT 750 F, *A.S.A.* B16e-1939



Nominal Pipe Size	Diameter of Flange	Thickness of Flg.a Min.	Diameter of Hub	Hub Diam. Beginning of Chamferb-c	Length Thru Hubb	Inside Diam. of Pipe Schedule 40c	Diam. of Bolt Circle	No. of Bolts	Size of Bolts
	O	*Q*	*X*	*H*	*Y*	*J*			
½	3½	7/16	1 3/16	0.84	1⅞	0.62*	2⅜	4	½
¾	3⅞	½	1½	1.05	2 1/16	0.82*	2¾	4	½
1	4¼	9/16	1 15/16	1.32	2 3/16	1.05*	3⅛	4	½
1¼	4⅝	⅝	2 5/16	1.66	2¼	1.38*	3½	4	½
1½	5	11/16	2 9/16	1.90	2 7/16	1.61*	3⅞	4	½
2	6	¾	3 1/16	2.38	2½	2.07*	4¾	4	⅝
2½	7	⅞	3 9/16	2.88	2¾	2.47*	5½	4	⅝
3	7½	15/16	4¼	3.50	2¾	3.07*	6	4	⅝
3½	8½	15/16	4 13/16	4.00	2 13/16	3.55*	7	8	⅝
4	9	15/16	5 5/16	4.50	3	4.03*	7½	8	⅝
5	10	15/16	6 7/16	5.56	3½	5.05*	8½	8	¾
6	11	1	7 9/16	6.63	3½	6.07*	9½	8	¾
8	13½	1⅛	9 11/16	8.63	4	7.98*	11¾	8	¾
10	16	1 3/16	12	10.75	4	10.02*	14¼	12	⅞
12	19	1¼	14⅜	12.75	4½	.....	17	12	⅞
14 O.D.	21	1⅜	15¾	14.00	5	To Be	18¾	12	1
16 O.D.	23½	1 7/16	18	16.00	5	Specified	21¼	16	1
18 O.D.	25	1 9/16	19⅞	18.00	5½	by	22¾	16	1⅛
20 O.D.	27½	1 11/16	22	20.00	5 11/16	Purchaser	25	20	1⅛
24 O.D.	32	1⅞	26⅛	24.00	6		29½	20	1¼

All dimensions given in inches.

*A raised face of 1/16 in. is included in *thickness of flange minimum* and in *length through hub.*

bThe outside surface of the welding end of the hub shall be straight or tapered at not more than 6 deg.

cDimensions *H* and *J* correspond to the outside and inside diameters of pipe as given in *A.S.A.* B36.10-1939, Schedule 40.

*These diameters are identical with the diameters of what was formerly designated as *Standard Weight Pipe* of the corresponding sizes.

predicated upon the sound requirement that the employer must assume full responsibility for the deposited weld.

It is advisable that this management responsibility be included in all welding specifications and that authoritative standards of workmanship also be specified. The standards of workmanship for this industry are as