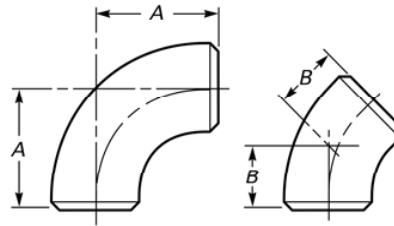


(18)

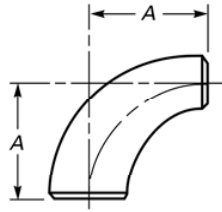
Table 5-1 Material Groupings

Group No.	Material	Standards
1	Carbon and low-alloy steels	ASTM A234/A234M and ASTM A420/A420M
2	Austenitic and duplex stainless steels	ASTM A403/A403M and ASTM A815/A815M
3	Nickel alloys	ASTM B366/B366M
4	Aluminum alloys	ASTM B361
5	Titanium alloys	ASTM B363

Table 6.1-1 Dimensions of Long Radius Elbows

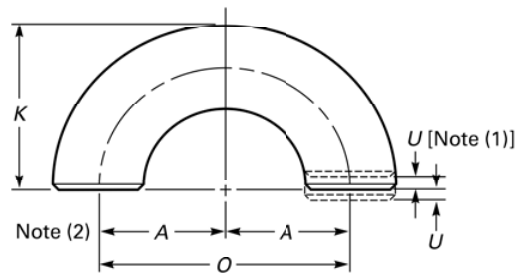
Nominal Pipe Size (NPS)	Outside Diameter at Bevel, mm (in.)	Center-to-End, mm (in.)	
		90-deg Elbows, A	45-deg Elbows, B
1/2	21.3 (0.84)	38 (1.50)	16 (0.62)
3/4	26.7 (1.05)	38 (1.50)	19 (0.75)
1	33.4 (1.32)	38 (1.50)	22 (0.88)
1 1/4	42.2 (1.66)	48 (1.88)	25 (1.00)
1 1/2	48.3 (1.90)	57 (2.25)	29 (1.12)
2	60.3 (2.38)	76 (3.00)	35 (1.38)
2 1/2	73.0 (2.88)	95 (3.75)	44 (1.75)
3	88.9 (3.50)	114 (4.50)	51 (2.00)
3 1/2	101.6 (4.00)	133 (5.25)	57 (2.25)
4	114.3 (4.50)	152 (6.00)	64 (2.50)
5	141.3 (5.56)	190 (7.50)	79 (3.12)
6	168.3 (6.62)	229 (9.00)	95 (3.75)
8	219.1 (8.62)	305 (12.00)	127 (5.00)
10	273.0 (10.75)	381 (15.00)	159 (6.25)
12	323.8 (12.75)	457 (18.00)	190 (7.50)
14	355.6 (14.00)	533 (21.00)	222 (8.75)
16	406.4 (16.00)	610 (24.00)	254 (10.00)
18	457.0 (18.00)	686 (27.00)	286 (11.25)
20	508.0 (20.00)	762 (30.00)	318 (12.50)
22	559.0 (22.00)	838 (33.00)	343 (13.50)
24	610.0 (24.00)	914 (36.00)	381 (15.00)
26	660.0 (26.00)	991 (39.00)	406 (16.00)
28	711.0 (28.00)	1 067 (42.00)	438 (17.25)
30	762.0 (30.00)	1 143 (45.00)	470 (18.50)
32	813.0 (32.00)	1 219 (48.00)	502 (19.75)
34	864.0 (34.00)	1 295 (51.00)	533 (21.00)
36	914.0 (36.00)	1 372 (54.00)	565 (22.25)
38	965.0 (38.00)	1 448 (57.00)	600 (23.62)
40	1 016.0 (40.00)	1 524 (60.00)	632 (24.88)
42	1 067.0 (42.00)	1 600 (63.00)	660 (26.00)
44	1 118.0 (44.00)	1 676 (66.00)	695 (27.38)
46	1 168.0 (46.00)	1 753 (69.00)	727 (28.62)
48	1 219.0 (48.00)	1 829 (72.00)	759 (29.88)

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Table 6.1-2 Dimensions of Long Radius Reducing Elbows

Nominal Pipe Size (NPS)	Outside Diameter at Bevel, mm (in.)		Center- to-End, A, mm (in.)	Nominal Pipe Size (NPS)	Outside Diameter at Bevel, mm (in.)		Center- to-End, A, mm (in.)
	Large End	Small End			Large End	Small End	
2 × 1½	60.3 (2.38)	48.3 (1.90)	76 (3.00)	10 × 8	273.0 (10.75)	219.1 (8.62)	381 (15.00)
2 × 1¼	60.3 (2.38)	42.2 (1.66)	76 (3.00)	10 × 6	273.0 (10.75)	168.3 (6.62)	381 (15.00)
2 × 1	60.3 (2.38)	33.4 (1.32)	76 (3.00)	10 × 5	273.0 (10.75)	141.3 (5.56)	381 (15.00)
2½ × 2	73.0 (2.88)	60.3 (2.38)	95 (3.75)	12 × 10	323.8 (12.75)	273.0 (10.75)	457 (18.00)
2½ × 1½	73.0 (2.88)	48.3 (1.90)	95 (3.75)	12 × 8	323.8 (12.75)	219.1 (8.62)	457 (18.00)
2½ × 1¼	73.0 (2.88)	42.2 (1.66)	95 (3.75)	12 × 6	323.8 (12.75)	168.3 (6.62)	457 (18.00)
3 × 2½	88.9 (3.50)	73.0 (2.88)	114 (4.50)	14 × 12	355.6 (14.00)	323.8 (12.75)	533 (21.00)
3 × 2	88.9 (3.50)	60.3 (2.38)	114 (4.50)	14 × 10	355.6 (14.00)	273.0 (10.75)	533 (21.00)
3 × 1½	88.9 (3.50)	48.3 (1.90)	114 (4.50)	14 × 8	355.6 (14.00)	219.1 (8.62)	533 (21.00)
3½ × 3	101.6 (4.00)	88.9 (3.50)	133 (5.25)	16 × 14	406.4 (16.00)	355.6 (14.00)	610 (24.00)
3½ × 2½	101.6 (4.00)	73.0 (2.88)	133 (5.25)	16 × 12	406.4 (16.00)	323.8 (12.75)	610 (24.00)
3½ × 2	101.6 (4.00)	60.3 (2.38)	133 (5.25)	16 × 10	406.4 (16.00)	273.0 (10.75)	610 (24.00)
4 × 3½	114.3 (4.50)	101.6 (4.00)	152 (6.00)	18 × 16	457.0 (18.00)	406.4 (16.00)	686 (27.00)
4 × 3	114.3 (4.50)	88.9 (3.50)	152 (6.00)	18 × 14	457.0 (18.00)	355.6 (14.00)	686 (27.00)
4 × 2½	114.3 (4.50)	73.0 (2.88)	152 (6.00)	18 × 12	457.0 (18.00)	323.8 (12.75)	686 (27.00)
4 × 2	114.3 (4.50)	60.3 (2.38)	152 (6.00)	18 × 10	457.0 (18.00)	273.0 (10.75)	686 (27.00)
5 × 4	141.3 (5.56)	114.3 (4.50)	190 (7.50)	20 × 18	508.0 (20.00)	457.0 (18.00)	762 (30.00)
5 × 3½	141.3 (5.56)	101.6 (4.00)	190 (7.50)	20 × 16	508.0 (20.00)	406.4 (16.00)	762 (30.00)
5 × 3	141.3 (5.56)	88.9 (3.50)	190 (7.50)	20 × 14	508.0 (20.00)	355.6 (14.00)	762 (30.00)
5 × 2½	141.3 (5.56)	73.0 (2.88)	190 (7.50)	20 × 12	508.0 (20.00)	323.8 (12.75)	762 (30.00)
				20 × 10	508.0 (20.00)	273.0 (10.75)	762 (30.00)
6 × 5	168.3 (6.62)	141.3 (5.56)	229 (9.00)	24 × 22	610.0 (24.00)	559.0 (22.00)	914 (36.00)
6 × 4	168.3 (6.62)	114.3 (4.50)	229 (9.00)	24 × 20	610.0 (24.00)	508.0 (20.00)	914 (36.00)
6 × 3½	168.3 (6.62)	101.6 (4.00)	229 (9.00)	24 × 18	610.0 (24.00)	457.0 (18.00)	914 (36.00)
6 × 3	168.3 (6.62)	88.9 (3.50)	229 (9.00)	24 × 16	610.0 (24.00)	406.4 (16.00)	914 (36.00)
8 × 6	219.1 (8.62)	168.3 (6.62)	305 (12.00)	24 × 14	610.0 (24.00)	355.6 (14.00)	914 (36.00)
8 × 5	219.1 (8.62)	141.3 (5.56)	305 (12.00)	24 × 12	610.0 (24.00)	323.8 (12.75)	914 (36.00)
8 × 4	219.1 (8.62)	114.3 (4.50)	305 (12.00)	...	...	...	...

Table 6.1-3 Dimensions of Long Radius Returns

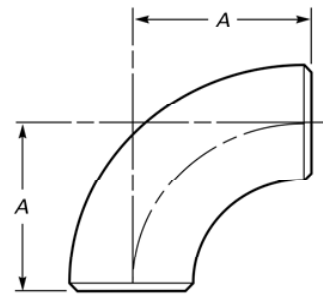


Nominal Pipe Size (NPS)	Outside Diameter at Bevel, mm (in.)	Center-to-Center, O, mm (in.)	Back-to-Face, K, mm (in.)
1/2	21.3 (0.84)	76 (3.00)	48 (1.88)
3/4	26.7 (1.05)	76 (3.00)	51 (2.00)
1	33.4 (1.32)	76 (3.00)	56 (2.19)
1 1/4	42.2 (1.66)	95 (3.75)	70 (2.75)
1 1/2	48.3 (1.90)	114 (4.50)	83 (3.25)
2	60.3 (2.38)	152 (6.00)	106 (4.19)
2 1/2	73.0 (2.88)	190 (7.50)	132 (5.19)
3	88.9 (3.50)	229 (9.00)	159 (6.25)
3 1/2	101.6 (4.00)	267 (10.50)	184 (7.25)
4	114.3 (4.50)	305 (12.00)	210 (8.25)
5	141.3 (5.56)	381 (15.00)	262 (10.31)
6	168.3 (6.62)	457 (18.00)	313 (12.31)
8	219.1 (8.62)	610 (24.00)	414 (16.31)
10	273.0 (10.75)	762 (30.00)	518 (20.38)
12	323.8 (12.75)	914 (36.00)	619 (24.38)
14	355.6 (14.00)	1 067 (42.00)	711 (28.00)
16	406.4 (16.00)	1 219 (48.00)	813 (32.00)
18	457.0 (18.00)	1 372 (54.00)	914 (36.00)
20	508.0 (20.00)	1 524 (60.00)	1 016 (40.00)
22	559.0 (22.00)	1 676 (66.00)	1 118 (44.00)
24	610.0 (24.00)	1 829 (72.00)	1 219 (48.00)

NOTES:

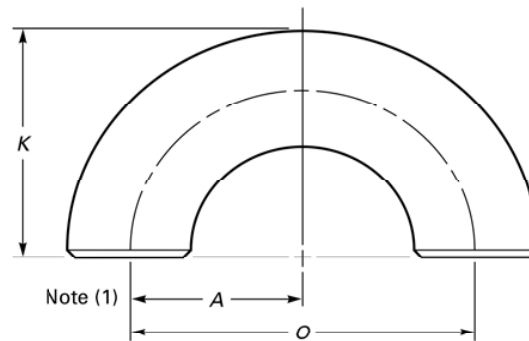
(1) See Table 11-1 for tolerance for alignment of ends *U*.(2) Dimension *A* is equal to one-half of dimension *O*.

Table 6.1-4 Dimensions of Short Radius Elbows



Nominal Pipe Size (NPS)	Outside Diameter at Bevel, mm (in.)	Center-to-End, A, mm (in.)
1	33.4 (1.32)	25 (1.00)
1 1/4	42.2 (1.66)	32 (1.25)
1 1/2	48.3 (1.90)	38 (1.50)
2	60.3 (2.38)	51 (2.00)
2 1/2	73.0 (2.88)	64 (2.50)
3	88.9 (3.50)	76 (3.00)
3 1/2	101.6 (4.00)	89 (3.50)
4	114.3 (4.50)	102 (4.00)
5	141.3 (5.56)	127 (5.00)
6	168.3 (6.62)	152 (6.00)
8	219.1 (8.62)	203 (8.00)
10	273.0 (10.75)	254 (10.00)
12	323.8 (12.75)	305 (12.00)
14	355.6 (14.00)	356 (14.00)
16	406.4 (16.00)	406 (16.00)
18	457.0 (18.00)	457 (18.00)
20	508.0 (20.00)	508 (20.00)
22	559.0 (22.00)	559 (22.00)
24	610.0 (24.00)	610 (24.00)

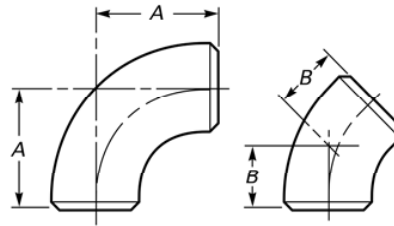
(18)

Table 6.1-5 Dimensions of Short Radius 180-deg Returns

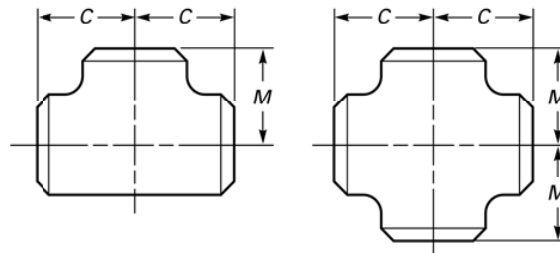
Nominal Pipe Size (NPS)	Outside Diameter at Bevel, mm (in.)	Center-to-Center, O, mm (in.)	Back-to-Face, K, mm (in.)
1	33.4 (1.32)	51 (2.00)	41 (1.62)
1 ¹ / ₄	42.2 (1.66)	64 (2.50)	52 (2.06)
1 ¹ / ₂	48.3 (1.90)	76 (3.00)	62 (2.44)
2	60.3 (2.38)	102 (4.00)	81 (3.19)
2 ¹ / ₂	73.0 (2.88)	127 (5.00)	100 (3.94)
3	88.9 (3.50)	152 (6.00)	121 (4.75)
3 ¹ / ₂	101.6 (4.00)	178 (7.00)	140 (5.50)
4	114.3 (4.50)	203 (8.00)	159 (6.25)
5	141.3 (5.56)	254 (10.00)	197 (7.75)
6	168.3 (6.62)	305 (12.00)	237 (9.31)
8	219.1 (8.62)	406 (16.00)	313 (12.31)
10	273.0 (10.75)	508 (20.00)	391 (15.38)
12	323.8 (12.75)	610 (24.00)	467 (18.38)
14	355.6 (14.00)	711 (28.00)	533 (21.00)
16	406.4 (16.00)	813 (32.00)	610 (24.00)
18	457.0 (18.00)	914 (36.00)	686 (27.00)
20	508.0 (20.00)	1 016 (40.00)	762 (30.00)
22	559.0 (22.00)	1 118 (44.00)	838 (33.00)
24	610.0 (24.00)	1 219 (48.00)	914 (36.00)

NOTE: (1) Dimension A is equal to one-half of dimension O.

(18)

Table 6.1-6 Dimensions of 3D Radius Elbows

Nominal Pipe Size (NPS)	Outside Diameter at Bevel, mm (in.)	Center-to-End, mm (in.)	
		90-deg Elbows, A	45-deg Elbows, B
3/4	26.7 (1.05)	57 (2.25)	24 (0.94)
1	33.4 (1.32)	76 (3.00)	31 (1.25)
1 1/4	42.2 (1.66)	95 (3.75)	39 (1.56)
1 1/2	48.3 (1.90)	114 (4.50)	47 (1.88)
2	60.3 (2.38)	152 (6.00)	63 (2.50)
2 1/2	73.0 (2.88)	190 (7.50)	79 (3.12)
3	88.9 (3.50)	229 (9.00)	95 (3.75)
3 1/2	101.6 (4.00)	267 (10.50)	111 (4.38)
4	114.3 (4.50)	305 (12.00)	127 (5.00)
5	141.3 (5.56)	381 (15.00)	157 (6.19)
6	168.3 (6.62)	457 (18.00)	189 (7.44)
8	219.1 (8.62)	610 (24.00)	252 (9.94)
10	273.0 (10.75)	762 (30.00)	316 (12.44)
12	323.8 (12.75)	914 (36.00)	378 (14.88)
14	355.6 (14.00)	1 067 (42.00)	441 (17.38)
16	406.4 (16.00)	1 219 (48.00)	505 (19.88)
18	457.0 (18.00)	1 372 (54.00)	568 (22.38)
20	508.0 (20.00)	1 524 (60.00)	632 (24.88)
22	559.0 (22.00)	1 676 (66.00)	694 (27.31)
24	610.0 (24.00)	1 829 (72.00)	757 (29.81)
26	660.0 (26.00)	1 981 (78.00)	821 (32.31)
28	711.0 (28.00)	2 134 (84.00)	883 (34.75)
30	762.0 (30.00)	2 286 (90.00)	946 (37.25)
32	813.0 (32.00)	2 438 (96.00)	1 010 (39.75)
34	864.0 (34.00)	2 591 (102.00)	1 073 (42.25)
36	914.0 (36.00)	2 743 (108.00)	1 135 (44.69)
38	965.0 (38.00)	2 896 (114.00)	1 200 (47.25)
40	1 016.0 (40.00)	3 048 (120.00)	1 264 (49.75)
42	1 067.0 (42.00)	3 200 (126.00)	1 326 (52.19)
44	1 118.0 (44.00)	3 353 (132.00)	1 389 (54.69)
46	1 168.0 (46.00)	3 505 (138.00)	1 453 (57.19)
48	1 219.0 (48.00)	3 658 (144.00)	1 516 (59.69)

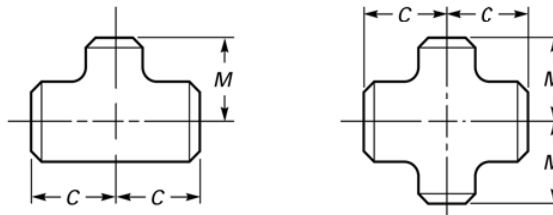
Table 6.1-7 Dimensions of Straight Tees and Crosses

Nominal Pipe Size (NPS)	Outside Diameter at Bevel, mm (in.)	Center-to-End, mm (in.)	
		Run, C	Outlet, M [Notes (1) and (2)]
1/2	21.3 (0.84)	25 (1.00)	25 (1.00)
3/4	26.7 (1.05)	29 (1.12)	29 (1.12)
1	33.4 (1.32)	38 (1.50)	38 (1.50)
1 1/4	42.2 (1.66)	48 (1.88)	48 (1.88)
1 1/2	48.3 (1.90)	57 (2.25)	57 (2.25)
2	60.3 (2.38)	64 (2.50)	64 (2.50)
2 1/2	73.0 (2.88)	76 (3.00)	76 (3.00)
3	88.9 (3.50)	86 (3.38)	86 (3.38)
3 1/2	101.6 (4.00)	95 (3.75)	95 (3.75)
4	114.3 (4.50)	105 (4.12)	105 (4.12)
5	141.3 (5.56)	124 (4.88)	124 (4.88)
6	168.3 (6.62)	143 (5.62)	143 (5.62)
8	219.1 (8.62)	178 (7.00)	178 (7.00)
10	273.0 (10.75)	216 (8.50)	216 (8.50)
12	323.8 (12.75)	254 (10.00)	254 (10.00)
14	355.6 (14.00)	279 (11.00)	279 (11.00)
16	406.4 (16.00)	305 (12.00)	305 (12.00)
18	457.0 (18.00)	343 (13.50)	343 (13.50)
20	508.0 (20.00)	381 (15.00)	381 (15.00)
22	559.0 (22.00)	419 (16.50)	419 (16.50)
24	610.0 (24.00)	432 (17.00)	432 (17.00)
26	660.0 (26.00)	495 (19.50)	495 (19.50)
28	711.0 (28.00)	521 (20.50)	521 (20.50)
30	762.0 (30.00)	559 (22.00)	559 (22.00)
32	813.0 (32.00)	597 (23.50)	597 (23.50)
34	864.0 (34.00)	635 (25.00)	635 (25.00)
36	914.0 (36.00)	673 (26.50)	673 (26.50)
38	965.0 (38.00)	711 (28.00)	711 (28.00)
40	1 016.0 (40.00)	749 (29.50)	749 (29.50)
42	1 067.0 (42.00)	762 (30.00)	711 (28.00)
44	1 118.0 (44.00)	813 (32.00)	762 (30.00)
46	1 168.0 (46.00)	851 (33.50)	800 (31.50)
48	1 219.0 (48.00)	889 (35.00)	838 (33.00)

NOTES:

- (1) Outlet dimension *M* for NPS 26 and larger is recommended but not required.
 (2) Dimensions applicable to crosses NPS 24 and smaller.

Table 6.1-8 Dimensions of Reducing Outlet Tees and Reducing Outlet Crosses



Nominal Pipe Size (NPS)	Outside Diameter at Bevel, mm (in.)		Center-to-End, mm (in.)	
	Run	Outlet	Run, C	Outlet, M [Note (1)]
$\frac{1}{2} \times \frac{1}{2} \times \frac{3}{8}$	21.3 (0.84)	17.3 (0.68)	25 (1.00)	25 (1.00)
$\frac{1}{2} \times \frac{1}{2} \times \frac{1}{4}$	21.3 (0.84)	13.7 (0.54)	25 (1.00)	25 (1.00)
$\frac{3}{4} \times \frac{3}{4} \times \frac{1}{2}$	26.7 (1.05)	21.3 (0.84)	29 (1.12)	29 (1.12)
$\frac{3}{4} \times \frac{3}{4} \times \frac{3}{8}$	26.7 (1.05)	17.3 (0.68)	29 (1.12)	29 (1.12)
$1 \times 1 \times \frac{3}{4}$	33.4 (1.32)	26.7 (1.05)	38 (1.50)	38 (1.50)
$1 \times 1 \times \frac{1}{2}$	33.4 (1.32)	21.3 (0.84)	38 (1.50)	38 (1.50)
$1\frac{1}{4} \times 1\frac{1}{4} \times 1$	42.2 (1.66)	33.4 (1.32)	48 (1.88)	48 (1.88)
$1\frac{1}{4} \times 1\frac{1}{4} \times \frac{3}{4}$	42.2 (1.66)	26.7 (1.05)	48 (1.88)	48 (1.88)
$1\frac{1}{4} \times 1\frac{1}{4} \times \frac{1}{2}$	42.2 (1.66)	21.3 (0.84)	48 (1.88)	48 (1.88)
$1\frac{1}{2} \times 1\frac{1}{2} \times 1\frac{1}{4}$	48.3 (1.90)	42.2 (1.66)	57 (2.25)	57 (2.25)
$1\frac{1}{2} \times 1\frac{1}{2} \times 1$	48.3 (1.90)	33.4 (1.32)	57 (2.25)	57 (2.25)
$1\frac{1}{2} \times 1\frac{1}{2} \times \frac{3}{4}$	48.3 (1.90)	26.7 (1.05)	57 (2.25)	57 (2.25)
$1\frac{1}{2} \times 1\frac{1}{2} \times \frac{1}{2}$	48.3 (1.90)	21.3 (0.84)	57 (2.25)	57 (2.25)
$2 \times 2 \times 1\frac{1}{2}$	60.3 (2.38)	48.3 (1.90)	64 (2.50)	60 (2.38)
$2 \times 2 \times 1\frac{1}{4}$	60.3 (2.38)	42.2 (1.66)	64 (2.50)	57 (2.25)
$2 \times 2 \times 1$	60.3 (2.38)	33.4 (1.32)	64 (2.50)	51 (2.00)
$2 \times 2 \times \frac{3}{4}$	60.3 (2.38)	26.7 (1.05)	64 (2.50)	44 (1.75)
$2\frac{1}{2} \times 2\frac{1}{2} \times 2$	73.0 (2.88)	60.3 (2.38)	76 (3.00)	70 (2.75)
$2\frac{1}{2} \times 2\frac{1}{2} \times 1\frac{1}{2}$	73.0 (2.88)	48.3 (1.90)	76 (3.00)	67 (2.62)
$2\frac{1}{2} \times 2\frac{1}{2} \times 1\frac{1}{4}$	73.0 (2.88)	42.2 (1.66)	76 (3.00)	64 (2.50)
$2\frac{1}{2} \times 2\frac{1}{2} \times 1$	73.0 (2.88)	33.4 (1.32)	76 (3.00)	57 (2.25)
$3 \times 3 \times 2\frac{1}{2}$	88.9 (3.50)	73.0 (2.88)	86 (3.38)	83 (3.25)
$3 \times 3 \times 2$	88.9 (3.50)	60.3 (2.38)	86 (3.38)	76 (3.00)
$3 \times 3 \times 1\frac{1}{2}$	88.9 (3.50)	48.3 (1.90)	86 (3.38)	73 (2.88)
$3 \times 3 \times 1\frac{1}{4}$	88.9 (3.50)	42.2 (1.66)	86 (3.38)	70 (2.75)
$3\frac{1}{2} \times 3\frac{1}{2} \times 3$	101.6 (4.00)	88.9 (3.50)	95 (3.75)	92 (3.62)
$3\frac{1}{2} \times 3\frac{1}{2} \times 2\frac{1}{2}$	101.6 (4.00)	73.0 (2.88)	95 (3.75)	89 (3.50)
$3\frac{1}{2} \times 3\frac{1}{2} \times 2$	101.6 (4.00)	60.3 (2.38)	95 (3.75)	83 (3.25)
$3\frac{1}{2} \times 3\frac{1}{2} \times 1\frac{1}{2}$	101.6 (4.00)	48.3 (1.90)	95 (3.75)	79 (3.12)
$4 \times 4 \times 3\frac{1}{2}$	114.3 (4.50)	101.6 (4.00)	105 (4.12)	102 (4.00)
$4 \times 4 \times 3$	114.3 (4.50)	88.9 (3.50)	105 (4.12)	98 (3.88)
$4 \times 4 \times 2\frac{1}{2}$	114.3 (4.50)	73.0 (2.88)	105 (4.12)	95 (3.75)
$4 \times 4 \times 2$	114.3 (4.50)	60.3 (2.38)	105 (4.12)	89 (3.50)
$4 \times 4 \times 1\frac{1}{2}$	114.3 (4.50)	48.3 (1.90)	105 (4.12)	86 (3.38)

Table 6.1-8 Dimensions of Reducing Outlet Tees and Reducing Outlet Crosses (Cont'd)

Nominal Pipe Size (NPS)	Outside Diameter at Bevel, mm (in.)		Center-to-End, mm (in.)	
	Run	Outlet	Run, <i>C</i>	Outlet, <i>M</i> [Note (1)]
5 × 5 × 4	141.3 (5.56)	114.3 (4.50)	124 (4.88)	117 (4.62)
5 × 5 × 3½	141.3 (5.56)	101.6 (4.00)	124 (4.00)	114 (4.50)
5 × 5 × 3	141.3 (5.56)	88.9 (3.50)	124 (4.88)	111 (4.38)
5 × 5 × 2½	141.3 (5.56)	73.0 (2.88)	124 (4.88)	108 (4.25)
5 × 5 × 2	141.3 (5.56)	60.3 (2.38)	124 (4.88)	105 (4.12)
6 × 6 × 5	168.3 (6.62)	141.3 (5.56)	143 (5.62)	137 (5.38)
6 × 6 × 4	168.3 (6.62)	114.3 (4.50)	143 (5.62)	130 (5.12)
6 × 6 × 3½	168.3 (6.62)	101.6 (4.00)	143 (5.62)	127 (5.00)
6 × 6 × 3	168.3 (6.62)	88.9 (3.50)	143 (5.62)	124 (4.88)
6 × 6 × 2½	168.3 (6.62)	73.0 (2.88)	143 (5.62)	121 (4.75)
8 × 8 × 6	219.1 (8.62)	168.3 (6.62)	178 (7.00)	168 (6.62)
8 × 8 × 5	219.1 (8.62)	141.3 (5.56)	178 (7.00)	162 (6.38)
8 × 8 × 4	219.1 (8.62)	114.3 (4.50)	178 (7.00)	156 (6.12)
8 × 8 × 3½	219.1 (8.62)	101.6 (4.00)	178 (7.00)	152 (6.00)
10 × 10 × 8	273.0 (10.75)	219.1 (8.62)	216 (8.50)	203 (8.00)
10 × 10 × 6	273.0 (10.75)	168.3 (6.62)	216 (8.50)	194 (7.62)
10 × 10 × 5	273.0 (10.75)	141.3 (5.56)	216 (8.50)	191 (7.50)
10 × 10 × 4	273.0 (10.75)	114.3 (4.50)	216 (8.50)	184 (7.25)
12 × 12 × 10	323.8 (12.75)	273.0 (10.75)	254 (10.00)	241 (9.50)
12 × 12 × 8	323.8 (12.75)	219.1 (8.62)	254 (10.00)	229 (9.00)
12 × 12 × 6	323.8 (12.75)	168.3 (6.62)	254 (10.00)	219 (8.62)
12 × 12 × 5	323.8 (12.75)	141.3 (5.56)	254 (10.00)	216 (8.50)
14 × 14 × 12	355.6 (14.00)	323.8 (12.75)	279 (11.00)	270 (10.62)
14 × 14 × 10	355.6 (14.00)	273.0 (10.75)	279 (11.00)	257 (10.12)
14 × 14 × 8	355.6 (14.00)	219.1 (8.62)	279 (11.00)	248 (9.75)
14 × 14 × 6	355.6 (14.00)	168.3 (6.62)	279 (11.00)	238 (9.38)
16 × 16 × 14	406.4 (16.00)	355.6 (14.00)	305 (12.00)	305 (12.00)
16 × 16 × 12	406.4 (16.00)	323.8 (12.75)	305 (12.00)	295 (11.62)
16 × 16 × 10	406.4 (16.00)	273.0 (10.75)	305 (12.00)	283 (11.12)
16 × 16 × 8	406.4 (16.00)	219.1 (8.62)	305 (12.00)	273 (10.75)
16 × 16 × 6	406.4 (16.00)	168.3 (6.62)	305 (12.00)	264 (10.38)
18 × 18 × 16	457 (18.00)	406.4 (16.00)	343 (13.50)	330 (13.00)
18 × 18 × 14	457 (18.00)	355.6 (14.00)	343 (13.50)	330 (13.00)
18 × 18 × 12	457 (18.00)	323.8 (12.75)	343 (13.50)	321 (12.62)
18 × 18 × 10	457 (18.00)	273.0 (10.75)	343 (13.50)	308 (12.12)
18 × 18 × 8	457 (18.00)	219.1 (8.62)	343 (13.50)	298 (11.75)
20 × 20 × 18	508 (20.00)	457.0 (18.00)	381 (15.00)	368 (14.50)
20 × 20 × 16	508 (20.00)	406.4 (16.00)	381 (15.00)	356 (14.00)
20 × 20 × 14	508 (20.00)	355.6 (14.00)	381 (15.00)	356 (14.00)

Table 6.1-8 Dimensions of Reducing Outlet Tees and Reducing Outlet Crosses (Cont'd)

Nominal Pipe Size (NPS)	Outside Diameter at Bevel, mm (in.)		Center-to-End, mm (in.)	
	Run	Outlet	Run, <i>C</i>	Outlet, <i>M</i> [Note (1)]
20 × 20 × 12	508 (20.00)	323.8 (12.75)	381 (15.00)	346 (13.62)
20 × 20 × 10	508 (20.00)	273.0 (10.75)	381 (15.00)	333 (13.12)
20 × 20 × 8	508 (20.00)	219.1 (8.62)	381 (15.00)	324 (12.75)
22 × 22 × 20	559 (22.00)	508.0 (20.00)	419 (16.50)	406 (16.00)
22 × 22 × 18	559 (22.00)	457.0 (18.00)	419 (16.50)	394 (15.50)
22 × 22 × 16	559 (22.00)	406.4 (16.00)	419 (16.50)	381 (15.00)
22 × 22 × 14	559 (22.00)	355.6 (14.00)	419 (16.50)	381 (15.00)
22 × 22 × 12	559 (22.00)	323.8 (12.75)	419 (16.50)	371 (14.62)
22 × 22 × 10	559 (22.00)	273.0 (10.75)	419 (16.50)	359 (14.12)
24 × 24 × 22	610 (24.00)	559.0 (22.00)	432 (17.00)	432 (17.00)
24 × 24 × 20	610 (24.00)	508.0 (20.00)	432 (17.00)	432 (17.00)
24 × 24 × 18	610 (24.00)	457.0 (18.00)	432 (17.00)	419 (16.50)
24 × 24 × 16	610 (24.00)	406.4 (16.00)	432 (17.00)	406 (16.00)
24 × 24 × 14	610 (24.00)	355.6 (14.00)	432 (17.00)	406 (16.00)
24 × 24 × 12	610 (24.00)	323.8 (12.75)	432 (17.00)	397 (15.62)
24 × 24 × 10	610 (24.00)	273.0 (10.75)	432 (17.00)	384 (15.12)
26 × 26 × 24	660 (26.00)	610.0 (24.00)	495 (19.50)	483 (19.00)
26 × 26 × 22	660 (26.00)	559.0 (22.00)	495 (19.50)	470 (18.50)
26 × 26 × 20	660 (26.00)	508.0 (20.00)	495 (19.50)	457 (18.00)
26 × 26 × 18	660 (26.00)	457.0 (18.00)	495 (19.50)	444 (17.50)
26 × 26 × 16	660 (26.00)	406.4 (16.00)	495 (19.50)	432 (17.00)
26 × 26 × 14	660 (26.00)	355.6 (14.00)	495 (19.50)	432 (17.00)
26 × 26 × 12	660 (26.00)	323.8 (12.75)	495 (19.50)	422 (16.62)
28 × 28 × 26	711 (28.00)	660.0 (26.00)	521 (20.50)	521 (20.50)
28 × 28 × 24	711 (28.00)	610.0 (24.00)	521 (20.50)	508 (20.00)
28 × 28 × 22	711 (28.00)	559.0 (22.00)	521 (20.50)	495 (19.50)
28 × 28 × 20	711 (28.00)	508.0 (20.00)	521 (20.50)	483 (19.00)
28 × 28 × 18	711 (28.00)	457.0 (18.00)	521 (20.50)	470 (18.50)
28 × 28 × 16	711 (28.00)	406.4 (16.00)	521 (20.50)	457 (18.00)
28 × 28 × 14	711 (28.00)	355.6 (14.00)	521 (20.50)	457 (18.00)
28 × 28 × 12	711 (28.00)	323.8 (12.75)	521 (20.50)	448 (17.62)
30 × 30 × 28	762 (30.00)	711.0 (28.00)	559 (22.00)	546 (21.50)
30 × 30 × 26	762 (30.00)	660.0 (26.00)	559 (22.00)	546 (21.50)
30 × 30 × 24	762 (30.00)	610.0 (24.00)	559 (22.00)	533 (21.00)
30 × 30 × 22	762 (30.00)	559.0 (22.00)	559 (22.00)	521 (20.50)
30 × 30 × 20	762 (30.00)	508.0 (20.00)	559 (22.00)	508 (20.00)
30 × 30 × 18	762 (30.00)	457.0 (18.00)	559 (22.00)	495 (19.50)
30 × 30 × 16	762 (30.00)	406.4 (16.00)	559 (22.00)	483 (19.00)
30 × 30 × 14	762 (30.00)	355.6 (14.00)	559 (22.00)	483 (19.00)

Table 6.1-8 Dimensions of Reducing Outlet Tees and Reducing Outlet Crosses (Cont'd)

Nominal Pipe Size (NPS)	Outside Diameter at Bevel, mm (in.)		Center-to-End, mm (in.)	
	Run	Outlet	Run, <i>C</i>	Outlet, <i>M</i> [Note (1)]
30 × 30 × 12	762 (30.00)	323.8 (12.75)	559 (22.00)	473 (18.62)
30 × 30 × 10	762 (30.00)	273.0 (10.75)	559 (22.00)	460 (18.12)
32 × 32 × 30	813 (32.00)	762.0 (30.00)	597 (23.50)	584 (23.00)
32 × 32 × 28	813 (32.00)	711.0 (28.00)	597 (23.50)	572 (22.5)
32 × 32 × 26	813 (32.00)	660.0 (26.00)	597 (23.50)	572 (22.50)
32 × 32 × 24	813 (32.00)	610.0 (24.00)	597 (23.50)	559 (22.00)
32 × 32 × 22	813 (32.00)	559.0 (22.00)	597 (23.50)	546 (21.50)
32 × 32 × 20	813 (32.00)	508.0 (20.00)	597 (23.50)	533 (21.00)
32 × 32 × 18	813 (32.00)	457.0 (18.00)	597 (23.50)	521 (20.50)
32 × 32 × 16	813 (32.00)	406.4 (16.00)	597 (23.50)	508 (20.00)
32 × 32 × 14	813 (32.00)	355.6 (14.00)	597 (23.50)	508 (20.00)
34 × 34 × 32	864 (34.00)	813.0 (32.00)	635 (25.00)	622 (24.50)
34 × 34 × 30	864 (34.00)	762.0 (30.00)	635 (25.00)	610 (24.00)
34 × 34 × 28	864 (34.00)	711.0 (28.00)	635 (25.00)	597 (23.50)
34 × 34 × 26	864 (34.00)	660.0 (26.00)	635 (25.00)	597 (23.50)
34 × 34 × 24	864 (34.00)	610.0 (24.00)	635 (25.00)	584 (23.00)
34 × 34 × 22	864 (34.00)	559.0 (22.00)	635 (25.00)	572 (22.50)
34 × 34 × 20	864 (34.00)	508.0 (20.00)	635 (25.00)	559 (22.00)
34 × 34 × 18	864 (34.00)	457.0 (18.00)	635 (25.00)	546 (21.50)
34 × 34 × 16	864 (34.00)	406.4 (16.00)	635 (25.00)	533 (21.00)
36 × 36 × 34	914 (36.00)	864.0 (34.00)	673 (26.50)	660 (26.00)
36 × 36 × 32	914 (36.00)	813.0 (32.00)	673 (26.50)	648 (25.50)
36 × 36 × 30	914 (36.00)	762.0 (30.00)	673 (26.50)	635 (25.00)
36 × 36 × 28	914 (36.00)	711.0 (28.00)	673 (26.50)	622 (24.50)
36 × 36 × 26	914 (36.00)	660.0 (26.00)	673 (26.50)	622 (24.50)
36 × 36 × 24	914 (36.00)	610.0 (24.00)	673 (26.50)	610 (24.00)
36 × 36 × 22	914 (36.00)	559.0 (22.00)	673 (26.50)	597 (23.50)
36 × 36 × 20	914 (36.00)	508.0 (20.00)	673 (26.50)	584 (23.00)
36 × 36 × 18	914 (36.00)	457.0 (18.00)	673 (26.50)	572 (22.50)
36 × 36 × 16	914 (36.00)	406.4 (16.00)	673 (26.50)	559 (22.00)
38 × 38 × 36	965 (38.00)	914.0 (36.00)	711 (28.00)	711 (28.00)
38 × 38 × 34	965 (38.00)	864.0 (34.00)	711 (28.00)	698 (27.50)
38 × 38 × 32	965 (38.00)	813.0 (32.00)	711 (28.00)	686 (27.00)
38 × 38 × 30	965 (38.00)	762.0 (30.00)	711 (28.00)	673 (26.50)
38 × 38 × 28	965 (38.00)	711.0 (28.00)	711 (28.00)	648 (25.50)
38 × 38 × 26	965 (38.00)	660.0 (26.00)	711 (28.00)	648 (25.50)
38 × 38 × 24	965 (38.00)	610.0 (24.00)	711 (28.00)	635 (25.00)
38 × 38 × 22	965 (38.00)	559.0 (22.00)	711 (28.00)	622 (24.50)
38 × 38 × 20	965 (38.00)	508.0 (20.00)	711 (28.00)	610 (24.00)
38 × 38 × 18	965 (38.00)	457.0 (18.00)	711 (28.00)	597 (23.50)

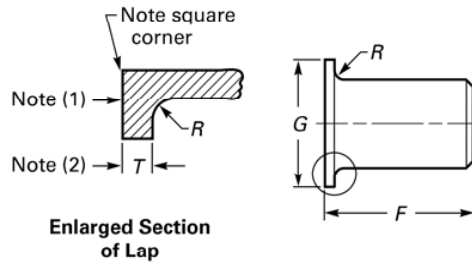
Table 6.1-8 Dimensions of Reducing Outlet Tees and Reducing Outlet Crosses (Cont'd)

Nominal Pipe Size (NPS)	Outside Diameter at Bevel, mm (in.)		Center-to-End, mm (in.)	
	Run	Outlet	Run, <i>C</i>	Outlet, <i>M</i> [Note (1)]
40 × 40 × 38	1 016 (40.00)	965.0 (38.00)	749 (29.50)	749 (29.50)
40 × 40 × 36	1 016 (40.00)	914.0 (36.00)	749 (29.50)	737 (29.00)
40 × 40 × 34	1 016 (40.00)	864.0 (34.00)	749 (29.50)	724 (28.50)
40 × 40 × 32	1 016 (40.00)	813.0 (32.00)	749 (29.50)	711 (28.00)
40 × 40 × 30	1 016 (40.00)	762.0 (30.00)	749 (29.50)	698 (27.50)
40 × 40 × 28	1 016 (40.00)	711.0 (28.00)	749 (29.50)	673 (26.50)
40 × 40 × 26	1 016 (40.00)	660.0 (26.00)	749 (29.50)	673 (26.50)
40 × 40 × 24	1 016 (40.00)	610.0 (24.00)	749 (29.50)	660 (26.00)
40 × 40 × 22	1 016 (40.00)	559.0 (22.00)	749 (29.50)	648 (25.50)
40 × 40 × 20	1 016 (40.00)	508.0 (20.00)	749 (29.50)	635 (25.00)
40 × 40 × 18	1 016 (40.00)	457.0 (18.00)	749 (29.50)	622 (24.50)
42 × 42 × 40	1 067 (42.00)	1 016.0 (40.00)	762 (30.00)	711 (28.00)
42 × 42 × 38	1 067 (42.00)	965.0 (38.00)	762 (30.00)	711 (28.00)
42 × 42 × 36	1 067 (42.00)	914.0 (36.00)	762 (30.00)	711 (28.00)
42 × 42 × 34	1 067 (42.00)	864.0 (34.00)	762 (30.00)	711 (28.00)
42 × 42 × 32	1 067 (42.00)	813.0 (32.00)	762 (30.00)	711 (28.00)
42 × 42 × 30	1 067 (42.00)	762.0 (30.00)	762 (30.00)	711 (28.00)
42 × 42 × 28	1 067 (42.00)	711.0 (28.00)	762 (30.00)	698 (27.50)
42 × 42 × 26	1 067 (42.00)	660.0 (26.00)	762 (30.00)	698 (27.50)
42 × 42 × 24	1 067 (42.00)	610.0 (24.00)	762 (30.00)	660 (26.00)
42 × 42 × 22	1 067 (42.00)	559.0 (22.00)	762 (30.00)	660 (26.00)
42 × 42 × 20	1 067 (42.00)	508.0 (20.00)	762 (30.00)	660 (26.00)
42 × 42 × 18	1 067 (42.00)	457.0 (18.00)	762 (30.00)	648 (25.50)
42 × 42 × 16	1 067 (42.00)	406.4 (16.00)	762 (30.00)	635 (25.00)
44 × 44 × 42	1 118 (44.00)	1 067.0 (42.00)	813 (32.00)	762 (30.00)
44 × 44 × 40	1 118 (44.00)	1 016.0 (40.00)	813 (32.00)	749 (29.50)
44 × 44 × 38	1 118 (44.00)	965.0 (38.00)	813 (32.00)	737 (29.00)
44 × 44 × 36	1 118 (44.00)	914.0 (36.00)	813 (32.00)	724 (28.50)
44 × 44 × 34	1 118 (44.00)	864.0 (34.00)	813 (32.00)	724 (28.50)
44 × 44 × 32	1 118 (44.00)	813.0 (32.00)	813 (32.00)	711 (28.00)
44 × 44 × 30	1 118 (44.00)	762.0 (30.00)	813 (32.00)	711 (28.00)
44 × 44 × 28	1 118 (44.00)	711.0 (28.00)	813 (32.00)	698 (27.50)
44 × 44 × 26	1 118 (44.00)	660.0 (26.00)	813 (32.00)	698 (27.50)
44 × 44 × 24	1 118 (44.00)	610.0 (24.00)	813 (32.00)	698 (27.50)
44 × 44 × 22	1 118 (44.00)	559.0 (22.00)	813 (32.00)	686 (27.00)
44 × 44 × 20	1 118 (44.00)	508.0 (20.00)	813 (32.00)	686 (27.00)
46 × 46 × 44	1 168 (46.00)	1 118.0 (44.00)	851 (33.50)	800 (31.50)
46 × 46 × 42	1 168 (46.00)	1 067.0 (42.00)	851 (33.50)	787 (31.00)
46 × 46 × 40	1 168 (46.00)	1 016.0 (40.00)	851 (33.50)	775 (30.50)
46 × 46 × 38	1 168 (46.00)	965.0 (38.00)	851 (33.50)	762 (30.00)

Table 6.1-8 Dimensions of Reducing Outlet Tees and Reducing Outlet Crosses (Cont'd)

Nominal Pipe Size (NPS)	Outside Diameter at Bevel, mm (in.)		Center-to-End, mm (in.)	
	Run	Outlet	Run, <i>C</i>	Outlet, <i>M</i> [Note (1)]
46 × 46 × 36	1 168 (46.00)	914.0 (36.00)	851 (33.50)	762 (30.00)
46 × 46 × 34	1 168 (46.00)	864.0 (34.00)	851 (33.50)	749 (29.50)
46 × 46 × 32	1 168 (46.00)	813.0 (32.00)	851 (33.50)	749 (29.50)
46 × 46 × 30	1 168 (46.00)	762.0 (30.00)	851 (33.50)	737 (29.00)
46 × 46 × 28	1 168 (46.00)	711.0 (28.00)	851 (33.50)	737 (29.00)
46 × 46 × 26	1 168 (46.00)	660.0 (26.00)	851 (33.50)	737 (29.00)
46 × 46 × 24	1 168 (46.00)	610.0 (24.00)	851 (33.50)	724 (28.50)
46 × 46 × 22	1 168 (46.00)	559.0 (22.00)	851 (33.50)	724 (28.50)
48 × 48 × 46	1 219 (48.00)	1 168.0 (46.00)	889 (35.00)	838 (33.00)
48 × 48 × 44	1 219 (48.00)	1 118.0 (44.00)	889 (35.00)	838 (33.00)
48 × 48 × 42	1 219 (48.00)	1 067.0 (42.00)	889 (35.00)	813 (32.00)
48 × 48 × 40	1 219 (48.00)	1 016.0 (40.00)	889 (35.00)	813 (32.00)
48 × 48 × 38	1 219 (48.00)	965.0 (38.00)	889 (35.00)	813 (32.00)
48 × 48 × 36	1 219 (48.00)	914.0 (36.00)	889 (35.00)	787 (31.00)
48 × 48 × 34	1 219 (48.00)	864.0 (34.00)	889 (35.00)	787 (31.00)
48 × 48 × 32	1 219 (48.00)	813.0 (32.00)	889 (35.00)	787 (31.00)
48 × 48 × 30	1 219 (48.00)	762.0 (30.00)	889 (35.00)	762 (30.00)
48 × 48 × 28	1 219 (48.00)	711.0 (28.00)	889 (35.00)	762 (30.00)
48 × 48 × 26	1 219 (48.00)	660.0 (26.00)	889 (35.00)	762 (30.00)
48 × 48 × 24	1 219 (48.00)	610.0 (24.00)	889 (35.00)	737 (29.00)
48 × 48 × 22	1 219 (48.00)	559.0 (22.00)	889 (35.00)	737 (29.00)

NOTE: (1) Outlet dimension *M* for run sizes NPS 14 and larger is recommended but not required.

Table 6.1-9 Dimensions of Lap Joint Stub Ends

Nominal Pipe Size (NPS)	Outside Diameter of Barrel, mm (in.)		Long Pattern Length, F , mm (in.)	Short Pattern Length, F , mm (in.)	Radius of Fillet, R , mm (in.)	Diameter of Lap, G , mm (in.)
	Max.	Min.	[Notes (3), (4)]	[Notes (3), (4)]	[Note (5)]	[Note (6)]
$\frac{1}{2}$	22.8 (0.896)	20.5 (0.809)	76 (3.00)	51 (2.00)	3 (0.12)	35 (1.38)
$\frac{3}{4}$	28.1 (1.106)	25.9 (1.019)	76 (3.00)	51 (2.00)	3 (0.12)	43 (1.69)
1	35.0 (1.376)	32.6 (1.284)	102 (4.00)	51 (2.00)	3 (0.12)	51 (2.00)
$1\frac{1}{4}$	43.6 (1.716)	41.4 (1.629)	102 (4.00)	51 (2.00)	5 (0.19)	64 (2.50)
$1\frac{1}{2}$	49.9 (1.965)	47.5 (1.869)	102 (4.00)	51 (2.00)	6 (0.25)	73 (2.88)
2	62.4 (2.456)	59.5 (2.344)	152 (6.00)	64 (2.50)	8 (0.31)	92 (3.62)
$2\frac{1}{2}$	75.3 (2.966)	72.2 (2.844)	152 (6.00)	64 (2.50)	8 (0.31)	105 (4.12)
3	91.3 (3.596)	88.1 (3.469)	152 (6.00)	64 (2.50)	10 (0.38)	127 (5.00)
$3\frac{1}{2}$	104.0 (4.096)	100.8 (3.969)	152 (6.00)	76 (3.00)	10 (0.38)	140 (5.50)
4	116.7 (4.593)	113.5 (4.469)	152 (6.00)	76 (3.00)	11 (0.44)	157 (6.19)
5	144.3 (5.683)	140.5 (5.532)	203 (8.00)	76 (3.00)	11 (0.44)	186 (7.31)
6	171.3 (6.743)	167.5 (6.594)	203 (8.00)	89 (3.50)	13 (0.50)	216 (8.50)
8	222.1 (8.743)	218.3 (8.594)	203 (8.00)	102 (4.00)	13 (0.50)	270 (10.62)
10	277.2 (10.913)	272.3 (10.719)	254 (10.00)	127 (5.00)	13 (0.50)	324 (12.75)
12	328.0 (12.913)	323.1 (12.719)	254 (10.00)	152 (6.00)	13 (0.50)	381 (15.00)
14	359.9 (14.170)	354.8 (13.969)	305 (12.00)	152 (6.00)	13 (0.50)	413 (16.25)
16	411.0 (16.180)	405.6 (15.969)	305 (12.00)	152 (6.00)	13 (0.50)	470 (18.50)
18	462.0 (18.190)	456.0 (17.969)	305 (12.00)	152 (6.00)	13 (0.50)	533 (21.00)
20	514.0 (20.240)	507.0 (19.969)	305 (12.00)	152 (6.00)	13 (0.50)	584 (23.00)
22	565.0 (22.240)	558.0 (21.969)	305 (12.00)	152 (6.00)	13 (0.50)	641 (25.25)
24	616.0 (24.240)	609.0 (23.969)	305 (12.00)	152 (6.00)	13 (0.50)	692 (27.25)

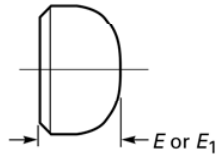
GENERAL NOTES:

- (a) See Table 11-1 for tolerances.
- (b) Service conditions and joint construction often dictate stub end length requirements. Therefore, the purchaser must specify long or short pattern fitting when ordering.

NOTES:

- (1) Gasket face finish shall be in accordance with ASME B16.5 for raised-face flanges.
- (2) The lap thickness, T , shall not be less than nominal pipe wall thickness. See Table 11-1 for tolerance.
- (3) When short pattern stub ends are used with larger flanges in Classes 300 and 600, with most sizes in Classes 900 and higher, and when long pattern stub ends are used with larger flanges in Classes 1500 and 2500, it may be necessary to increase the length of the stub ends in order to avoid covering the weld with the flange. Such increases in length shall be a matter of agreement between the manufacturer and purchaser.
- (4) When special facings such as tongue and groove or male and female are employed, additional lap thickness must be provided and such additional thickness shall be in addition to (not included in) the basic length, F .
- (5) These dimensions conform to the radius established for lap joint flanges in ASME B16.5.
- (6) This dimension conforms to standard machined facings shown in ASME B16.5. The back face of the lap shall be machined to conform to the surface on which it sits. Where ring joint facings are to be applied, use dimension K as given in ASME B16.5.

Table 6.1-10 Dimensions of Caps



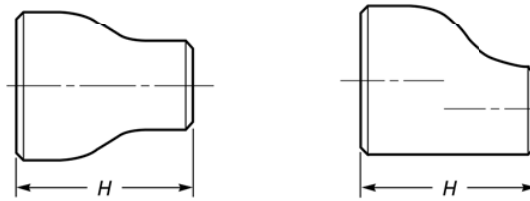
Nominal Pipe Size (NPS)	Outside Diameter at Bevel, mm (in.)	Length, E , mm (in.) [Note (1)]	Limiting Wall Thickness for Length, E , mm (in.)	Length, E_1 , mm (in.) [Note (2)]
$\frac{1}{2}$	21.3 (0.84)	25 (1.00)	4.57 (0.18)	25 (1.00)
$\frac{3}{4}$	26.7 (1.05)	25 (1.00)	3.81 (0.15)	25 (1.00)
1	33.4 (1.32)	38 (1.50)	4.57 (0.18)	38 (1.50)
$1\frac{1}{4}$	42.2 (1.66)	38 (1.50)	4.83 (0.19)	38 (1.50)
$1\frac{1}{2}$	48.3 (1.90)	38 (1.50)	5.08 (0.20)	38 (1.50)
2	60.3 (2.38)	38 (1.50)	5.59 (0.22)	44 (1.75)
$2\frac{1}{2}$	73.0 (2.88)	38 (1.50)	7.11 (0.28)	51 (2.00)
3	88.9 (3.50)	51 (2.00)	7.62 (0.30)	64 (2.50)
$3\frac{1}{2}$	101.6 (4.00)	64 (2.50)	8.13 (0.32)	76 (3.00)
4	114.3 (4.50)	64 (2.50)	8.64 (0.34)	76 (3.00)
5	141.3 (5.56)	76 (3.00)	9.65 (0.38)	89 (3.50)
6	168.3 (6.62)	89 (3.50)	10.92 (0.43)	102 (4.00)
8	219.1 (8.62)	102 (4.00)	12.70 (0.50)	127 (5.00)
10	273.0 (10.75)	127 (5.00)	12.70 (0.50)	152 (6.00)
12	323.8 (12.75)	152 (6.00)	12.70 (0.50)	178 (7.00)
14	355.6 (14.00)	165 (6.50)	12.70 (0.50)	191 (7.50)
16	406.4 (16.00)	178 (7.00)	12.70 (0.50)	203 (8.00)
18	457.0 (18.00)	203 (8.00)	12.70 (0.50)	229 (9.00)
20	508.0 (20.00)	229 (9.00)	12.70 (0.50)	254 (10.00)
22	559.0 (22.00)	254 (10.00)	12.70 (0.50)	254 (10.00)
24	610.0 (24.00)	267 (10.50)	12.70 (0.50)	305 (12.00)
26	660.0 (26.00)	267 (10.50)	...	...
28	711.0 (28.00)	267 (10.50)	...	...
30	762.0 (30.00)	267 (10.50)	...	...
32	813.0 (32.00)	267 (10.50)	...	...
34	864.0 (34.00)	267 (10.50)	...	...
36	914.0 (36.00)	267 (10.50)	...	...
38	965.0 (38.00)	305 (12.00)	...	...
40	1 016.0 (40.00)	305 (12.00)	...	...
42	1 067.0 (42.00)	305 (12.00)	...	...
44	1 118.0 (44.00)	343 (13.50)	...	...
46	1 168.0 (46.00)	343 (13.50)	...	...
48	1 219.0 (48.00)	343 (13.50)	...	...

GENERAL NOTE: The shape of these caps shall be ellipsoidal and shall conform to the requirements given in the ASME Boiler and Pressure Vessel Code.

NOTES:

- (1) Length E applies for thickness not exceeding that given in column "Limiting Wall Thickness for Length, E ."
- (2) Length E_1 applies for thickness greater than that given in column "Limiting Wall Thickness for Length, E " for NPS 24 and smaller. For NPS 26 and larger, length E_1 shall be by agreement between the manufacturer and purchaser.

Table 6.1-11 Dimensions of Reducers



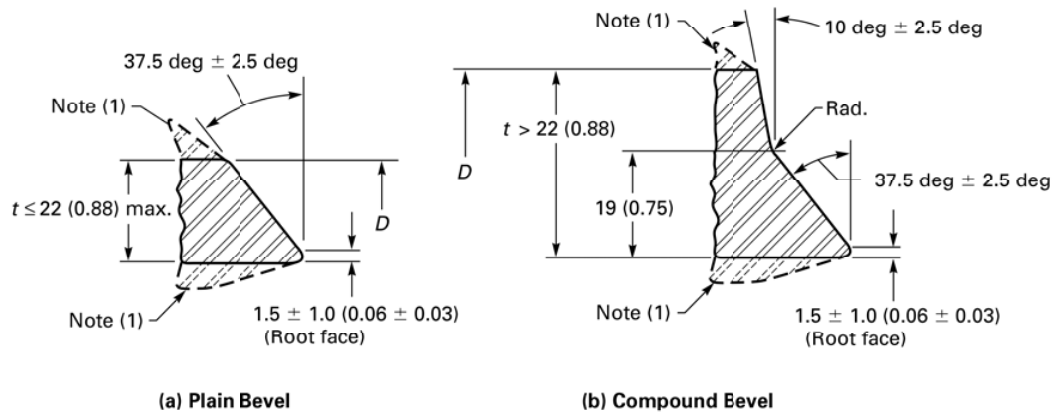
Nominal Pipe Size (NPS)	Outside Diameter at Bevel, mm (in.)		End-to-End, H, mm (in.)	Nominal Pipe Size (NPS)	Outside Diameter at Bevel, mm (in.)		End-to-End, H, mm (in.)
	Large End	Small End			Large End	Small End	
$\frac{3}{4} \times \frac{1}{2}$	26.7 (1.05)	21.3 (0.84)	38 (1.50)	5×4	141.3 (5.56)	114.3 (4.50)	127 (5.00)
$\frac{3}{4} \times \frac{3}{8}$	26.7 (1.05)	17.3 (0.68)	38 (1.50)	$5 \times 3\frac{1}{2}$	141.3 (5.56)	101.6 (4.00)	127 (5.00)
$1 \times \frac{3}{4}$	33.4 (1.32)	26.7 (1.05)	51 (2.00)	5×3	141.3 (5.56)	88.9 (3.50)	127 (5.00)
$1 \times \frac{1}{2}$	33.4 (1.32)	21.3 (0.84)	51 (2.00)	$5 \times 2\frac{1}{2}$	141.3 (5.56)	73.0 (2.88)	127 (5.00)
$1\frac{1}{4} \times 1$	42.2 (1.66)	33.4 (1.32)	51 (2.00)	5×2	141.3 (5.56)	60.3 (2.38)	127 (5.00)
$1\frac{1}{4} \times \frac{3}{4}$	42.2 (1.66)	26.7 (1.05)	51 (2.00)	6×5	168.3 (6.62)	141.3 (5.56)	140 (5.50)
$1\frac{1}{4} \times \frac{1}{2}$	42.2 (1.66)	21.3 (0.84)	51 (2.00)	6×4	168.3 (6.62)	114.3 (4.50)	140 (5.50)
$1\frac{1}{2} \times 1\frac{1}{4}$	48.3 (1.90)	42.2 (1.66)	64 (2.50)	$6 \times 3\frac{1}{2}$	168.3 (6.62)	101.6 (4.00)	140 (5.50)
$1\frac{1}{2} \times 1$	48.3 (1.90)	33.4 (1.32)	64 (2.50)	6×3	168.3 (6.62)	88.9 (3.50)	140 (5.50)
$1\frac{1}{2} \times \frac{3}{4}$	48.3 (1.90)	26.7 (1.05)	64 (2.50)	$6 \times 2\frac{1}{2}$	168.3 (6.62)	73.0 (2.88)	140 (5.50)
$1\frac{1}{2} \times \frac{1}{2}$	48.3 (1.90)	21.3 (0.84)	64 (2.50)	8×6	219.1 (8.62)	168.3 (6.62)	152 (6.00)
$2 \times 1\frac{1}{2}$	60.3 (2.38)	48.3 (1.90)	76 (3.00)	8×5	219.1 (8.62)	141.3 (5.56)	152 (6.00)
$2 \times 1\frac{1}{4}$	60.3 (2.38)	42.2 (1.66)	76 (3.00)	8×4	219.1 (8.62)	114.3 (4.50)	152 (6.00)
2×1	60.3 (2.38)	33.4 (1.32)	76 (3.00)	$8 \times 3\frac{1}{2}$	219.1 (8.62)	101.6 (4.00)	152 (6.00)
$2 \times \frac{3}{4}$	60.3 (2.38)	26.7 (1.05)	76 (3.00)	10×8	273.0 (10.75)	219.1 (8.62)	178 (7.00)
$2\frac{1}{2} \times 2$	73.0 (2.88)	60.3 (2.38)	89 (3.50)	10×6	273.0 (10.75)	168.3 (6.62)	178 (7.00)
$2\frac{1}{2} \times 1\frac{1}{2}$	73.0 (2.88)	48.3 (1.90)	89 (3.50)	10×5	273.0 (10.75)	141.3 (5.56)	178 (7.00)
$2\frac{1}{2} \times 1\frac{1}{4}$	73.0 (2.88)	42.2 (1.66)	89 (3.50)	10×4	273.0 (10.75)	114.3 (4.50)	178 (7.00)
$2\frac{1}{2} \times 1$	73.0 (2.88)	33.4 (1.32)	89 (3.50)	12×10	323.8 (12.75)	273.0 (10.75)	203 (8.00)
$3 \times 2\frac{1}{2}$	88.9 (3.50)	73.0 (2.88)	89 (3.50)	12×8	323.8 (12.75)	219.1 (8.62)	203 (8.00)
3×2	88.9 (3.50)	60.3 (2.38)	89 (3.50)	12×6	323.8 (12.75)	168.3 (6.62)	203 (8.00)
$3 \times 1\frac{1}{2}$	88.9 (3.50)	48.3 (1.90)	89 (3.50)	12×5	323.8 (12.75)	141.3 (5.56)	203 (8.00)
$3 \times 1\frac{1}{4}$	88.9 (3.50)	42.2 (1.66)	89 (3.50)	14×12	355.6 (14.00)	323.8 (12.75)	330 (13.00)
$3\frac{1}{2} \times 3$	101.6 (4.00)	88.9 (3.50)	102 (4.00)	14×10	355.6 (14.00)	273.0 (10.75)	330 (13.00)
$3\frac{1}{2} \times 2\frac{1}{2}$	101.6 (4.00)	73.0 (2.88)	102 (4.00)	14×8	355.6 (14.00)	219.1 (8.62)	330 (13.00)
$3\frac{1}{2} \times 2$	101.6 (4.00)	60.3 (2.38)	102 (4.00)	14×6	355.6 (14.00)	168.3 (6.62)	330 (13.00)
$3\frac{1}{2} \times 1\frac{1}{2}$	101.6 (4.00)	48.3 (1.90)	102 (4.00)	16×14	406.4 (16.00)	355.6 (14.00)	356 (14.00)
$3\frac{1}{2} \times 1\frac{1}{4}$	101.6 (4.00)	42.2 (1.66)	102 (4.00)	16×12	406.4 (16.00)	323.8 (12.75)	356 (14.00)
$4 \times 3\frac{1}{2}$	114.3 (4.50)	101.6 (4.00)	102 (4.00)	16×10	406.4 (16.00)	273.0 (10.75)	356 (14.00)
4×3	114.3 (4.50)	88.9 (3.50)	102 (4.00)	16×8	406.4 (16.00)	219.1 (8.62)	356 (14.00)
$4 \times 2\frac{1}{2}$	114.3 (4.50)	73.0 (2.88)	102 (4.00)	18×16	457 (18.00)	406.4 (16.00)	381 (15.00)
4×2	114.3 (4.50)	60.3 (2.38)	102 (4.00)	18×14	457 (18.00)	355.6 (14.00)	381 (15.00)
$4 \times 1\frac{1}{2}$	114.3 (4.50)	48.3 (1.90)	102 (4.00)				

Table 6.1-11 Dimensions of Reducers (Cont'd)

Nominal Pipe Size (NPS)	Outside Diameter at Bevel, mm (in.)		End-to-End, H, mm (in.)	Nominal Pipe Size (NPS)	Outside Diameter at Bevel, mm (in.)		End-to-End, H, mm (in.)
	Large End	Small End			Large End	Small End	
18 × 12	457 (18.00)	323.8 (12.75)	381 (15.00)				
18 × 10	457 (18.00)	273.0 (10.75)	381 (15.00)	36 × 34	914 (36.00)	864 (34.00)	610 (24.00)
				36 × 32	914 (36.00)	813 (32.00)	610 (24.00)
20 × 18	508 (20.00)	457.0 (18.00)	508 (20.00)	36 × 30	914 (36.00)	762 (30.00)	610 (24.00)
20 × 16	508 (20.00)	406.4 (16.00)	508 (20.00)	36 × 26	914 (36.00)	660 (26.00)	610 (24.00)
20 × 14	508 (20.00)	355.6 (14.00)	508 (20.00)	36 × 24	914 (36.00)	610 (24.00)	610 (24.00)
20 × 12	508 (20.00)	323.8 (12.75)	508 (20.00)				
				38 × 36	965 (38.00)	914 (36.00)	610 (24.00)
22 × 20	559 (22.00)	508.0 (20.00)	508 (20.00)	38 × 34	965 (38.00)	864 (34.00)	610 (24.00)
22 × 18	559 (22.00)	457.0 (18.00)	508 (20.00)	38 × 32	965 (38.00)	813 (32.00)	610 (24.00)
22 × 16	559 (22.00)	406.4 (16.00)	508 (20.00)	38 × 30	965 (38.00)	762 (30.00)	610 (24.00)
22 × 14	559 (22.00)	355.4 (14.00)	508 (20.00)	38 × 28	965 (38.00)	711 (28.00)	610 (24.00)
				38 × 26	965 (38.00)	660 (26.00)	610 (24.00)
24 × 22	610 (24.00)	559.0 (22.00)	508 (20.00)				
24 × 20	610 (24.00)	508.0 (20.00)	508 (20.00)	40 × 38	1 016 (40.00)	965 (38.00)	610 (24.00)
24 × 18	610 (24.00)	457.0 (18.00)	508 (20.00)	40 × 36	1 016 (40.00)	914 (36.00)	610 (24.00)
24 × 16	610 (24.00)	406.4 (16.00)	508 (20.00)	40 × 34	1 016 (40.00)	864 (34.00)	610 (24.00)
				40 × 32	1 016 (40.00)	813 (32.00)	610 (24.00)
26 × 24	660 (26.00)	610.0 (24.00)	610 (24.00)	40 × 30	1 016 (40.00)	762 (30.00)	610 (24.00)
26 × 22	660 (26.00)	559.0 (22.00)	610 (24.00)				
26 × 20	660 (26.00)	508.0 (20.00)	610 (24.00)	42 × 40	1 067 (42.00)	1 016 (40.00)	610 (24.00)
26 × 18	660 (26.00)	457.0 (18.00)	610 (24.00)	42 × 38	1 067 (42.00)	965 (38.00)	610 (24.00)
				42 × 36	1 067 (42.00)	914 (36.00)	610 (24.00)
28 × 26	711 (28.00)	660.0 (26.00)	610 (24.00)	42 × 34	1 067 (42.00)	864 (34.00)	610 (24.00)
28 × 24	711 (28.00)	610.0 (24.00)	610 (24.00)	42 × 32	1 067 (42.00)	813 (32.00)	610 (24.00)
28 × 20	711 (28.00)	508.0 (20.00)	610 (24.00)	42 × 30	1 067 (42.00)	762 (30.00)	610 (24.00)
28 × 18	711 (28.00)	457.0 (18.00)	610 (24.00)				
				44 × 42	1 118 (44.00)	1 067 (42.00)	610 (24.00)
30 × 28	762 (30.00)	711.0 (28.00)	610 (24.00)	44 × 40	1 118 (44.00)	1 016 (40.00)	610 (24.00)
30 × 26	762 (30.00)	660.0 (26.00)	610 (24.00)	44 × 38	1 118 (44.00)	965 (38.00)	610 (24.00)
30 × 24	762 (30.00)	610.0 (24.00)	610 (24.00)	44 × 36	1 118 (44.00)	914 (36.00)	610 (24.00)
30 × 20	762 (30.00)	508.0 (20.00)	610 (24.00)				
				46 × 44	1 168 (46.00)	1 118 (44.00)	711 (28.00)
32 × 30	813 (32.00)	762.0 (30.00)	610 (24.00)	46 × 42	1 168 (46.00)	1 067 (42.00)	711 (28.00)
32 × 28	813 (32.00)	711.0 (28.00)	610 (24.00)	46 × 40	1 168 (46.00)	1 016 (40.00)	711 (28.00)
32 × 26	813 (32.00)	660.0 (26.00)	610 (24.00)	46 × 38	1 168 (46.00)	965 (38.00)	711 (28.00)
32 × 24	813 (32.00)	610.0 (24.00)	610 (24.00)				
				48 × 46	1 219 (48.00)	1 168 (46.00)	711 (28.00)
34 × 32	864 (34.00)	813.0 (32.00)	610 (24.00)	48 × 44	1 219 (48.00)	1 118 (44.00)	711 (28.00)
34 × 30	864 (34.00)	762.0 (30.00)	610 (24.00)	48 × 42	1 219 (48.00)	1 067 (42.00)	711 (28.00)
34 × 26	864 (34.00)	660.0 (26.00)	610 (24.00)	48 × 40	1 219 (48.00)	1 016 (40.00)	711 (28.00)
34 × 24	864 (34.00)	610.0 (24.00)	610 (24.00)				

GENERAL NOTE: Although the figure illustrates a bell-shaped reducer, the use of a conical reducer is not prohibited.

(18)

Table 8-1 Welding Bevels and Root Face

Nominal Wall Thickness, t , mm (in.)	End Preparation
Less than x [Note (2)]	Cut square or slightly chamfer, at manufacturer's option (not illustrated)
x to 22 (0.88), inclusive [Note (2)]	Plain bevel as in illustration (a) above
More than 22 (0.88)	Compound bevel as in illustration (b) above

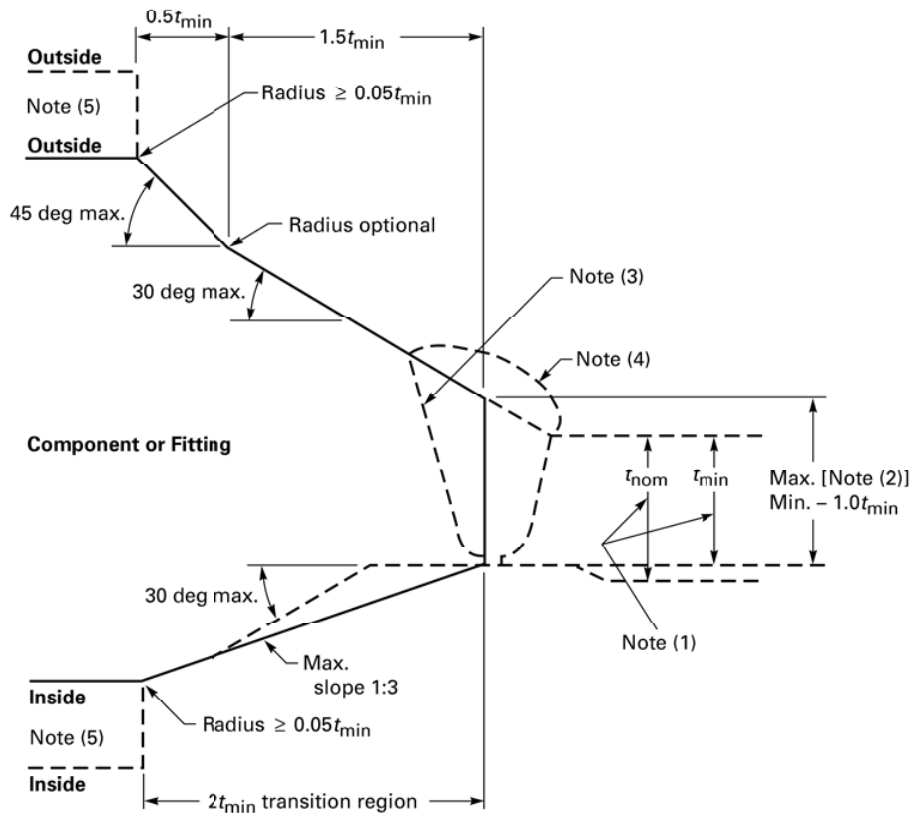
GENERAL NOTE: In the illustrations, dimensions in parentheses are in inches; other dimensions are in millimeters.

NOTES:

(1) See section 8 and Figure 8-1 for transition contours.

(2) $x = 5 \text{ mm (0.19 in.)}$ for carbon steel or ferritic alloy steel and 3 mm (0.12 in.) for austenitic steel or nonferrous alloys.

(18)

Figure 8-1 Maximum Envelope for Welding End Transitions**NOTES:**

(1) The value of t_{min} is whichever of the following is applicable:

(a) the minimum ordered wall thickness of the pipe, to include pipe that is purchased to a nominal wall thickness with an undertolerance other than 12.5%

(b) 0.875 times the nominal wall thickness of pipe ordered to a pipe schedule wall thickness that has an undertolerance of 12.5%

(2) The maximum thickness at the end of the component is as follows:

(a) the greater of $[t_{min} + 4 \text{ mm (0.16 in.)}]$ or $1.15t_{min}$ when ordered on a minimum wall basis

(b) the greater of $[t_{min} + 4 \text{ mm (0.16 in.)}]$ or $1.10t_{nom}$ when ordered on a nominal wall basis

(3) Weld bevel shown is for illustration only.

(4) The weld reinforcement permitted by applicable code may lie outside the maximum envelope.

(5) Where transitions using maximum slope do not intersect the inside or outside surfaces within the transition region, as shown by the phantom outline, maximum slopes shall be used. Alternatively, radii lying within the envelope may be used.

Table 9.2.1-1 Testing Coverage

Type of Fitting Tested [Note (1)]	Qualifies the Following If the Same Design Thickness Is Used
Short radius elbow [Note (2)]	Short radius, long radius, reducing long radius, or 3D radius elbow
Long radius elbow [Note (2)]	Long radius, reducing long radius, or 3D radius elbow
3D radius elbow [Note (2)]	3D radius elbow
Straight tee	Straight or reducing tees of any reduction
Reducing tee	Reducing tees with the same or more reduction in outlet size
Straight cross	Straight or reducing crosses of any reduction
Reducing cross	Reducing crosses with the same or more reduction in outlet size
Cap	Caps of the same configuration
Eccentric reducer [Note (3)]	Eccentric or concentric reducers with the same or lesser included transition angle
Concentric reducer [Note (3)]	Concentric reducers with the same or lesser included transition angle [Note (4)]
Lap joint stub ends	Lap joint stub ends are exempt from proof

NOTES:

- (1) Paragraph 9.4 applies to as-tested and qualified fittings.
- (2) A test of any angle elbow covered in Tables 6.1-1 through 6.1-6 will qualify any other angle. A factory-made segment elbow that has a proof test on a geometrically similar 45-deg or 90-deg elbow need not be tested separately.
- (3) Straight conical (no tangent) and bell-shaped reducers are considered different design configurations and require separate testing.
- (4) "Transition angle" is defined as the angle of the conical section and is calculated as the $[\arctan(\text{difference of diameters}/\text{twice the length})]$ for concentric reducers or $[\arctan(\text{difference of diameters}/\text{length})]$ for eccentric reducers.

Table 9.3.1-1 Test Factor, f , Determination

Number of Tests Performed, or Number of Geometrically Similar Fittings Tested	Test Factor, f
One	1.10
Two	1.05
Three or more	1.0