



CREATIVE PIPING
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BUTT-WELD PIPE FITTINGS B16.9 & B16.28



STANDARDS

- * ANSI B16.9 & B16.28
- * ASTM A234
- * JIS B2311 - 1997



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1. GENERAL

A pipe fitting is defined as a part used in piping system to change direction of function, which is mechanically joined to the system.

Probably the simplest way to achieve this would be to bend the pipe in the direction required, but this process will stretch and thin the outer wall whilst thickening and wrinkling the inner wall. This results in flow resistance and accelerated wall erosion.

A second method sometimes used is a mitre joint, where pipes are cut to the correct angle and welded together to achieve the desired change. Whilst the cross-sectional area and wall thickness are maintained, a great deal of efficiency is lost due to friction and turbulence resulting from the severe changes in direction. For example, a single-mitre bend offers about six times the resistance of a swept elbow.

For these reasons swept fittings are preferred on most piping systems, particularly where internal pressure, flow and corrosion are of major consideration.

2. TYPES AND APPLICATIONS OF BUTTWELD FITTINGS

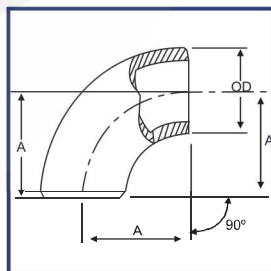
A piping system using butt weld fittings has many inherent advantages over other forms.

- Welding a fitting to the pipe means it is permanently leakproof.
- The continuous metal structure formed between pipe and fitting adds strength to the system
- Smooth inner surface and gradual directional changes reduce pressure losses and turbulence and minimise the action of corrosion and erosion
- A welded system utilises a minimum of space

90° ELBOWS

The function of a 90° elbow is to change direction of flow in a piping system.

Elbows are split into three groups which define the distance over which they change direction, expressed as a function of the distance from the centre line of one end to the opposite face. This is known as the centre to face distance and is equivalent to the radius through which the elbow is bent.



Long Radius Elbow

The most common is the long radius (L.R.) elbow where the centre to face dimension is always 1½ times the nominal pipe size of the elbow.

Short Radius Elbow

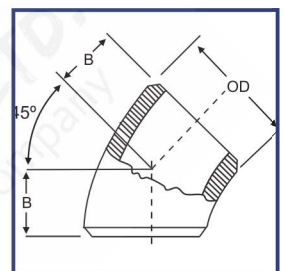
In this case the centre to face dimension is the same as the nominal pipe size of the elbow.

Extra Long Radius

This is where the centre to face dimensions is longer than the standard long radius type. The most common of these is where the centre to face dimension is three times the nominal size i.e. 3R.

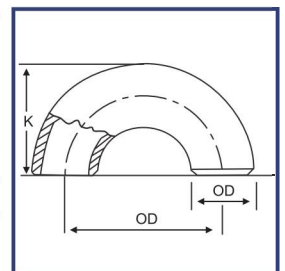
45° ELBOWS

The function of a 45° elbow is the same as a 90° elbow, but the measurement of the dimensions, however, is different to that of the 90° elbow. The radius of a 45° elbow is the same as the radius of the 90° L.R. elbow where 'R' equals 1½ D. However, the centre to face dimension is not equivalent to the radius as in 90° L.R. elbows. This is measured from each face to the point of intersection of the centre lines perpendicular to each other. This is due to the smaller degree of bend.



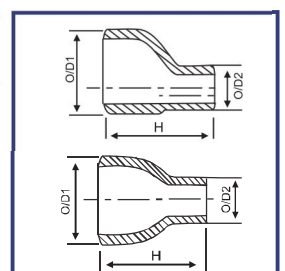
180° RETURN BENDS

The function of a 180° return bend is to change direction of flow through 180° and there are two basic types, long radius and short radius. Both types have a centre to centre dimension double the matching 90° elbows. The primary application of these fittings is in heater coils and heat exchangers, boilers etc.



ECCENTRIC AND CONCENTRIC REDUCERS

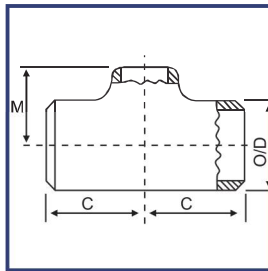
The function of both types of reducer is to reduce the line from a larger to a smaller pipe size, this obviously results in an increased flow pressure. With the eccentric reducer the smaller outlet end is off centre to the larger end enabling it to line up with one side of the inlet and not with the other.



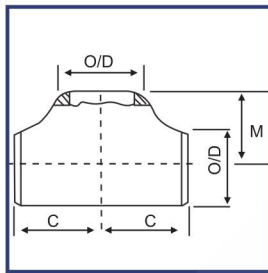
The concentric reducer is so manufactured that both inlet and outlet ends are on a common centre line. The concentric reducer is easier and less expensive to produce but does not allow quite the same versatility as the eccentric reducer. The lengths of both types are fixed by manufacturing standards.

EQUAL AND REDUCING TEES

The function of a tee is to permit flow at 90° to the main direction of flow. The main flow passes through the 'run' whilst the 90° outlet is known as the 'branch'. The equal tee is manufactured with all three outlets being the same size.

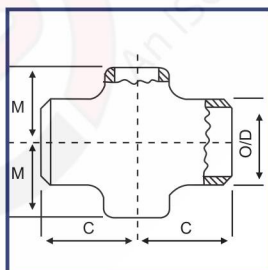
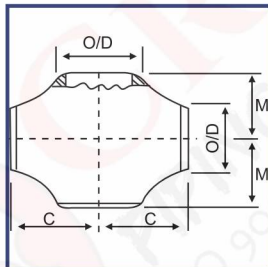


The reducing tee is manufactured with the branch outlet smaller than the run to obtain the desired flow and pressure through the system.



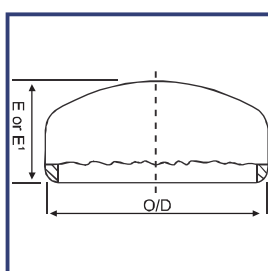
EQUAL AND REDUCING CROSSES

The function of a cross is similar to that of a tee with the exception of providing two 90° outlets opposite each other. Equal crosses have all four outlets of equal size. Reducing crosses have branches that are smaller in size to that of the run to obtain the desired flow and pressure through the system.



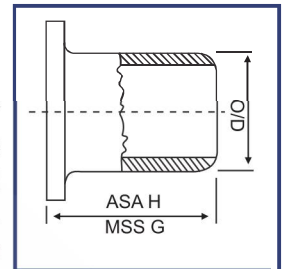
CAPS

The function of an end cap is to block off the end of a line in piping systems. This is achieved by placing the end cap over the open line and welding around the joint.



LAP JOINT STUB ENDS

A lap joint stub end and its associated slip-on flange in a piping system allows quick disconnection of the particular section involved. Stub ends are installed in pairs and mated together with two lap joint flanges. The surface of the stub end has a phonographic serrated gasket surface which prevents leakage at the joint. Using stub ends allows sections of the line to be opened for cleaning, inspection or quick replacement etc., without the need to re-weld.



There are two basic types of stub end, ANSI types A&B long barrel, and M.S.S. types short barrel. Under certain design criteria such as temperature or pressure, etc., it is not acceptable to have the joint between stub end and pipe in close proximity with the flange joint, in these applications ANSI types are used.

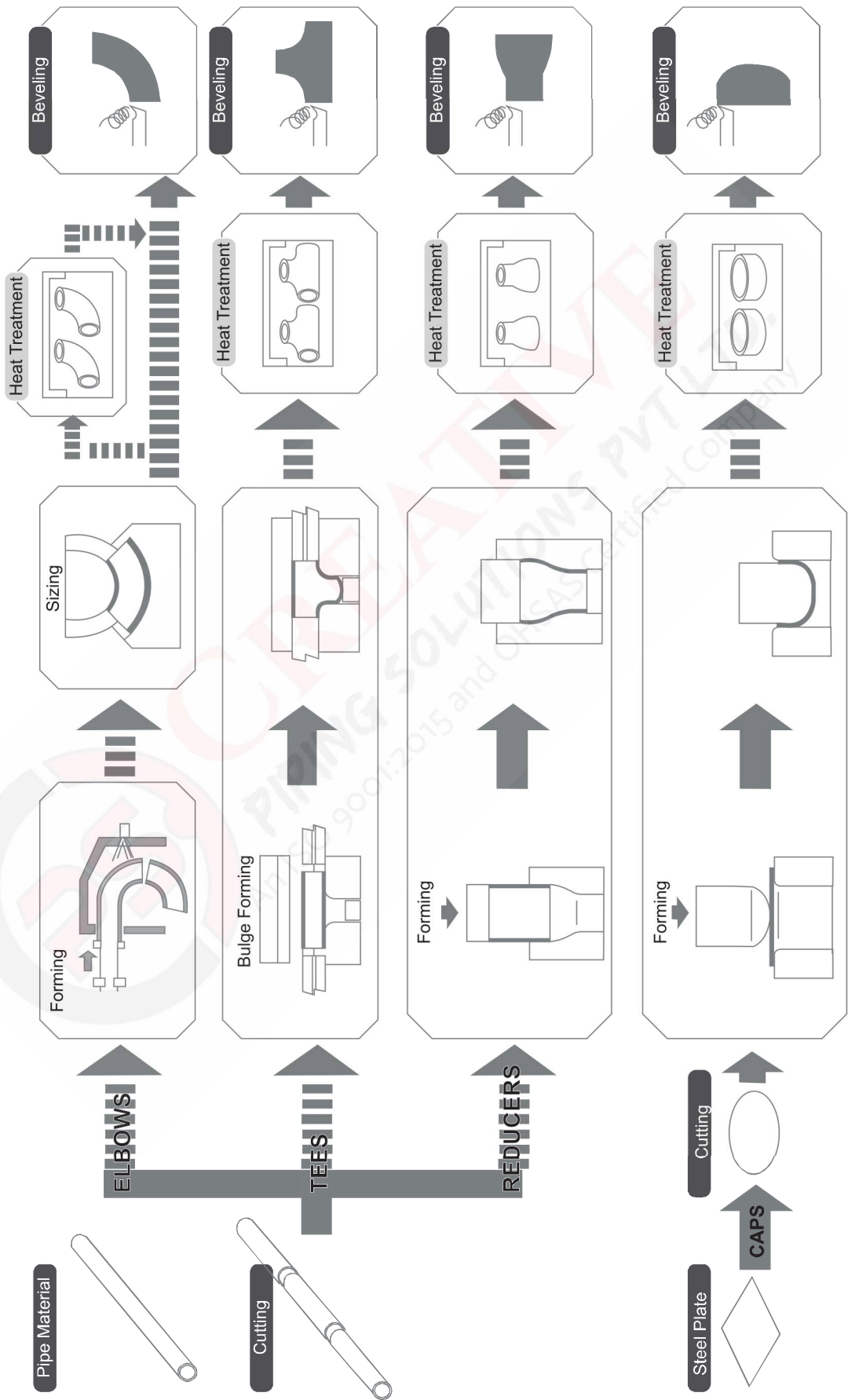
3. TYPICAL APPLICATIONS

Buttweld fittings are used in many varied applications, of which some are listed as follows:

- Cold and Hot water
- Furnace Building
- Oil and Gas plants
- Industrial gases
- Offshore exploration & platforms
- Chemical plants
- Steam generation
- Ship Building
- Food Industry



4. BUTTWELD CARBON STEEL FITTING MANUFACTURING PROCESS



5. STANDARDS (ASTM A234 WPB)

Steel butt weld fittings are manufactured from steel pipe materials in accordance with the standards and specifications listed as follows:

Applicable Standard of Steel Butt Weld Fittings

1. ASTM Standards

A234 Pipe fittings of wrought carbon steel and alloy steel for moderate and elevated temperatures.

A403 Wrought austenitic stainless steel pipe fittings.

A 420 Pipe fittings of wrought carbon steel and alloy steel for low temperature service.

2. American National Standards Institute ANSI B16,9 Factory made wrought steel butt weld fittings ANSI B16,28 Wrought steel butt weld short radius elbows and returns

3. Manufacturers Standardisation Society of the Valve and Fittings Industry Standards

MSS SP-25 Standard marking system for valves, fittings, flanges and unions.

Marking of products

1. Manufacturer's name or Trade mark
2. Material Designation
3. Rating Designation
4. Size

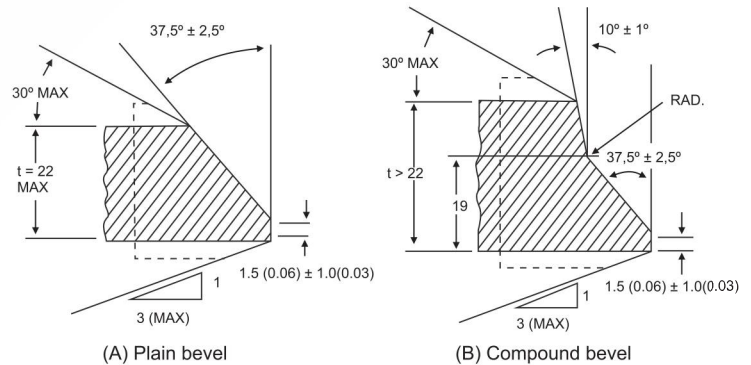
Coatings

Carbon steel and alloy steel fittings are painted with clear lacquer or black lacquer

6. WELDING END PREPARATION

Dimensions in mm

Nominal Pipe Wall Thickness (t)	End Preparation
Less than X	Cut square or slightly chamfer, at manufacturer's option
X to 22 (0.88)	Plain bevel as in Figure (a)
More than (0.88)	Compound bevel as in Figure (b)



Notes:

1. End preparations are in accordance with ANSI B 16.25
2. End preparations conforming to customer specifications will be specially manufactured on request.

Material Specification for Products

Material	Marking Symbol	ASTM Spec (Pipe)
Carbon Steel	WPA	A-106-A
Carbon Steel	WPB	A-106-B
Carbon Steel	WPC	A-106-C
Carbon Steel	WPL6	A-333-6
3 - ½ Ni steel	WPL3	A-333-3
Carbon-Mo steel	WP1	A-335-P1
1Cr - ½ Mo steel	WP12	A-335-P12
2 - ¼ -1-Mo steel	WP11	A-335-P11
5CR - ½ Mo steel	WP22	A-335-P22
9Cr - 1Mo steel	WP5	A-335-P5
18Cr - 1Mo steel	WP9	A-335-P9
18CR-8Ni Austenitic stainless steel	WP304	A-312-TP304
18Cr-12Ni-Mo Austenitic stainless steel	WP316	A-312-TP316
18Cr-8Ni-Ti Austenitic stainless steel	WP321	A-312-TP321
25Cr-20Ni Austenitic stainless steel	WP310	A-312-TP310

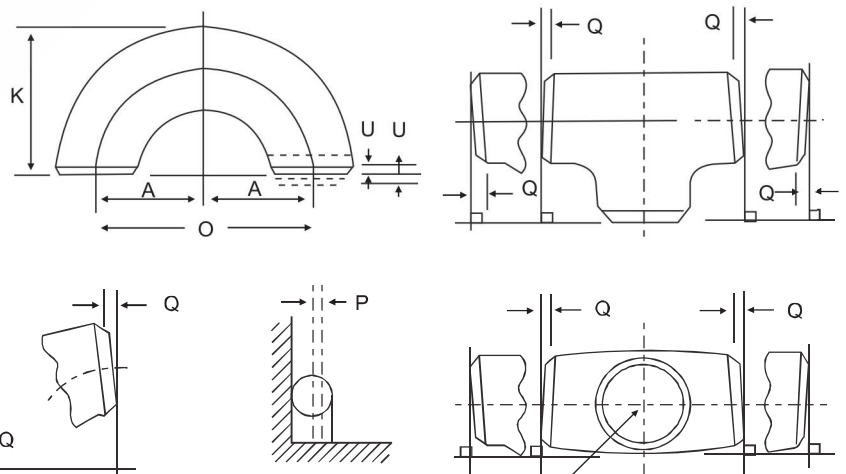
7. DIMENSIONAL TOLERANCE ANSI B16.9 & ANSI B16.28

Tolerance for the inside and outside diameters at each bevelled end, wall thicknesses and dimensions specific to each type of fitting are given by nominal pipe size by:

- * ANSI B 16.28 for short-radius elbows
- * ANSI B 16.9 for long-radius elbows, reducers, tees and caps.

Nominal Pipe Size (in)	Outside Diameter at Bevel (in./mm)	Inside Diameter at End (in./mm)	Wall Thickness t (%)	45° 90° Elbows and Tees Center to End A.B.C.M (in./mm)	180° Returns			Reducers Length H (in./mm)	Caps Length E (in./mm)
					Center to Center O (in./mm)	Back to Face K (in./mm)	Alignment of Ends U (in./mm)		
1/2" to 2 1/2"	+1/16 -1/32 +1.59 -0.79	±1/32 + 0.79	-12.5	+1/16 ±1.59	±1/4 ±6.35	±1/4 ±6.35	±1/32 ±0.79	±1/16 ±1.59	±1/8 ±3.17
3 to 4"	±1/16 ±1.59	+ 1/16 ±1.59	-12.5	±1/16 ±1.59	±1/4 ±6.35	±1/4 ±6.35	±1/32 ±0.79	±1/16 ±1.59	±1/8 ±3.17
5 to 8"	+1/32 -1/16 +2.38 -1.59	±1/16 ±1.59	-12.5	±1/16 +1.59	±1/4 ±6.35	±1/4 ±6.35	±1/32 ±0.79	±1/16 ±1.59	±1/4 ±6.35
10 to 18"	+5/32 -1/8 +3.96 -3.17	±1/8 ±3.17	-12.5	+2/32 ±2.38	±3/8 ±9.52	±1/4 ±6.35	±1/16 ±1.59	±3/32 ±2.38	±1/4 ±6.35
20 to 24"	+1/4 -3/16 +6.35 -4.76	±3/16 ±4.76	-12.5	±2/32 +2.38	±3/8 ±9.52	±1/4 ±6.35	±1/16 ±1.59	±3/32 ±2.38	±1/4 ±6.35

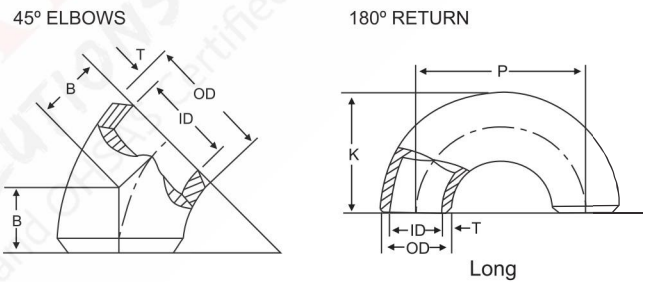
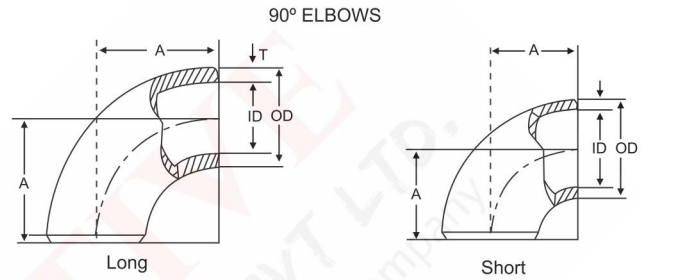
Nominal Pipe Size mm	Nominal Pipe Size inch	Angularity Tol.	
		Off Angle O in/mm	Off Plane P in/mm
15 - 100	1/2 to 4	0.03/0.76	0.06/1.52
125 - 200	5 to 8	0.06/1.52	0.12/3.05
250 - 300	10 to 12	0.09/2.29	0.19/4.83
350 - 400	14 to 16	0.09/2.29	0.25/6.35
450 - 600	18 to 24	0.12/3.05	0.38/9.65



8. MATERIALS SPECIFICATION

Grade & Marking Symbol	Carbon max.	Composition % Phosphorus max.	Sulphur max.	Silicon min.	Cr	Mo	Ni	Cu
WPB A.B.C	0.30	0.29 - 1.06	0.05	0.058	0.10	0.40	0.15	0.40

- A. Fittings made from bar or plate may have 0,35 max carbon.
- B. Fittings made from forgings may have 0,35 max carbon and 0,35 max silicon with no minimum.
- C. For each reduction of 0,01% below the specified carbon maximum, an increase of 0,06% manganese above the specified maximum will be permitted, up to a maximum of 1,35%.
- D. The sum of Copper, Nickel, Chromium and Molybdenum shall not exceed 1.0%



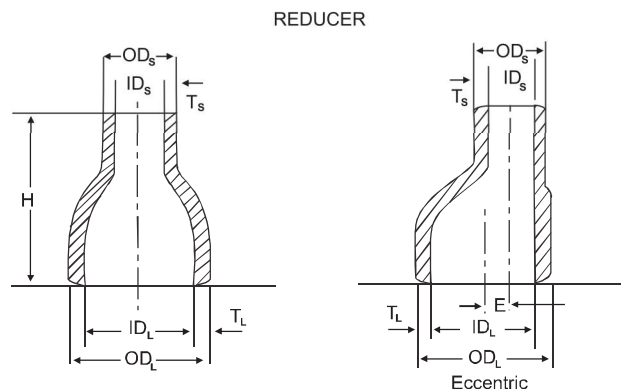
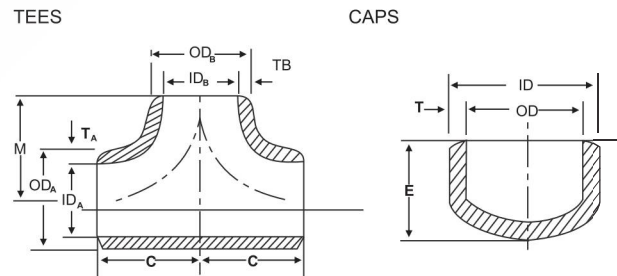
Grade Marking Symbol	Tensile Strength Range		Yield Strength (min)	
	lb/in	MPa	lb/in	MPa
WPA	60,000 to 85,000	415 to 655	35,000	240

Elongation WPA Longitudinal % Transverse %

Standard round specimen, or small proportional specimen, min % in 4 D 22 14

Rectangular specimen for wall thickness 7,94 mm and over, and for all small sizes tested in Full section: min % in 50 mm 30 20

Rectangular specimen for wall thickness less than 7,94 mm



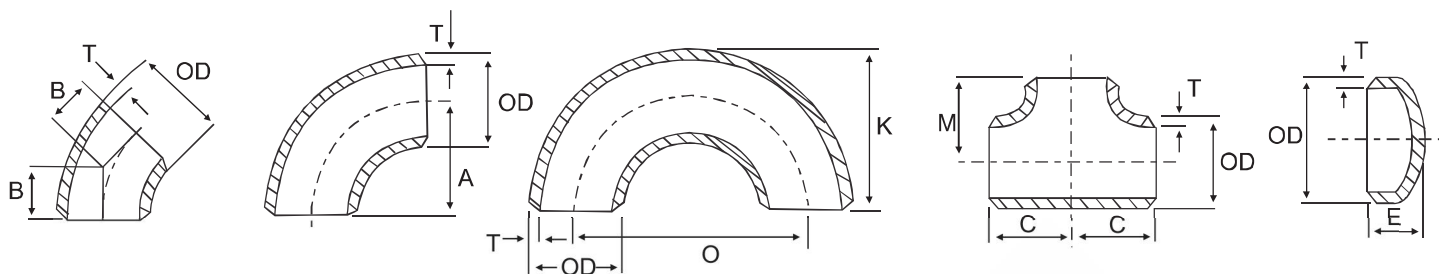
- A. WPA fitting manufactured from plate shall have a minimum elongation of 17%.
- B. For each 0,79 mm decrease in wall thickness below 7,94 mm, deduction of 1,5% longitudinal and 1,0% for transverse from the values shown above is permitted.



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Dimensions ANSI B16.9 & ANSI B16.28



Nominal Pipe Size Ins/mm	Outside Dia	Long radius				Short radius			Equal Tees C&M	Caps E	Nominal Pipe Size Inch/mm
		45° Elbows B	90° Elbows A	180° Returns		90° Elbows A	180° Returns				
				K	O		K	O			
½	0.840	0.63	1.50	1.88	3.00			1.000	1.00	½	
15	21.3	15.88	38.10	47.80	76.20			25.400	25.40	15	
¾	1.050	0.44	1.13	2.00	3.00			1.125	1.00	¾	
20	26.7	11	28.5	50.8	76.2			28.6	25.4	20	
1	1.315	0.875	1.500	2.188	3.000	1.000	1.620	2.000	1.500	1.500	1
25	33.4	22	38	55	76	25.5	41.1	50.8	38.1	38.1	25
1¼	1.660	1.000	1.875	2.750	3.750	1.250	2.060	2.500	1.875	1.500	1¼
32	42.4	25	47.5	69	95	32	52.3	63.5	47.6	38.1	32
1½	1.900	1.125	2.250	3.250	4.500	1.500	2.438	3.000	2.250	1.500	1½
40	48.3	29	57	82	114	38	62	76	57.2	38.1	40
2	2.375	1.375	3.000	4.188	6.000	2.000	3.188	4.000	2.500	1.500	2
50	60.3	35	76	106	152	51	81	102	63.5	38.1	50
2½	2.875	1.750	3.750	5.188	7.500	2.500	3.938	5.000	3.000	1.500	2½
65	73	45	95	133	190	63.5	100	127	76.2	38.1	65
3	3.500	2.000	4.500	6.250	9.000	3.000	4.750	6.000	3.375	2.000	3
80	88.9	51	114.5	159	229	76	121	152	85.7	50.8	80
3½	4.000	2.250	5.250	7.250	10.500	3.500	5.500	7.000	3.750	2.500	3½
90	101.6	57	133.5	184	267	89	140	178	95.3	63.5	90
4	4.500	2.500	6.000	8.250	12.000	4.000	6.250	8.000	4.125	2.500	4
100	114.3	64	152.5	210	305	101.5	159	2.3	105	63.5	100
5	5.563	3.125	7.500	10.313	15.000	5.000	7.750	10.000	4.875	3.000	5
125	141.3	79	190.5	260	381	127	197	254	124	76.2	125
6	6.625	3.750	9.000	12.313	18.000	6.000	9.313	12.000	5.625	3.500	6
150	168.3	95	228.5	313	457	152.5	237	305	143	88.9	150
8	8.625	5.000	12.000	16.310	24.000	8.000	12.310	16.000	7.000	4.000	8
200	219.1	127	305	415	610	203	312	406	178	102	200
10	10.750	6.250	15.000	20.380	30.000	10.000	15.380	20.000	8.500	5.000	10
250	273	159	381	517.7	762	254	390.7	508	216	127	250
12	12.750	7.500	18.000	24.380	36.000	12.000	18.380	24.000	10.000	6.000	12
300	323.9	191	457	619.3	914.4	305	466.9	609.6	254	152	300
14	14.000	8.750	21.000	28.000	42.000	14.000	21.000	28.000	11.000	6.500	14
350	355.6	222	533	711.2	1066.8	355	533.4	711.2	279	165	350
16	16.000	10.000	24.000	32.000	48.000	16.000	24.000	32.000	12.000	7.000	16
400	406.4	254	610	812.8	1219.2	406	609.6	812.8	305	178	400
18	18.000	11.250	27.000	36.000	54.000	18.000	27.000	36.000	13.500	8.000	18
450	457.0	286.0	686.0	914.4	1377.6	457.0	685.8	914.4	343.0	203.0	450
20	20.000	12.500	30.000	40.000	60.000	20.000	30.000	40.000	15.000	9.000	20
500	508	318	762	1016	1524	508	762	1016	381	229	500
24	24.000	15.000	36.000	48.000	72.000	24.000	36.000	48.000	17.000	10.500	24
600	609.6	381	914	1219.2	1828.8	610	914.4	1219.2	432	267	600

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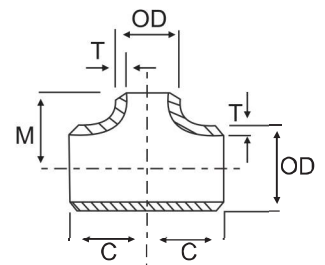
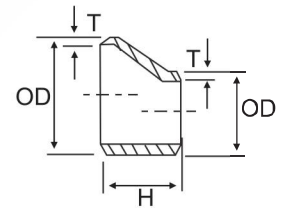
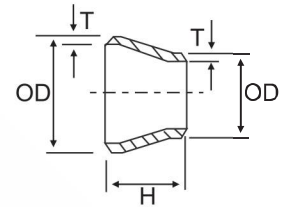
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Dimensions ANSI B16.9 & ANSI B16.28

UNIT: INCH/mm

Nominal Pipe Size Inches/mm	Reducers Height H	Reducers Tees Centre to End	
		Run C	Branch M
¾ x ½	1.500	1.125	1.125
20 x 15	38.1	28.6	28.6
1 x ¾	2.000	1.500	1.500
25 x 20	50.8	38.1	38.1
1 x ½	2.000	1.500	1.500
25 x 15	50.8	38.1	38.1
1¼ x 1	2.000	1.875	1.875
32 x 25	50.8	47.6	47.6
1¼ x ¾	2.000	1.875	1.875
32 x 20	50.8	47.6	47.6
1¼ x ½	2.000	1.875	1.875
32 x 15	50.8	47.6	47.6
1½ x 1¼	2.500	2.250	2.250
40 x 32	63.5	57.2	57.2
1½ x 1	2.500	2.250	2.250
40 x 25	63.5	57.2	57.2
1½ x ¾	2.500	2.250	2.250
40 x 20	63.5	57.2	57.2
1½ x ½	2.500	2.250	2.250
40 x 15	63.5	57.2	57.2
2 x 1½	3.000	2.500	2.375
50 x 40	76.2	63.5	60.3
2 x 1¼	3.000	2.500	2.250
50 x 32	76.2	63.5	57.2
2 x 1	3.000	2.500	2.000
50 x 25	76.2	63.5	50.8
2 x ¾	3.000	2.500	1.752
50 x 20	76.2	63.5	44.5
2½ x 2	3.500	3.000	2.750
65 x 50	88.9	76.2	69.9
2½ x 1½	3.500	3.000	2.625
65 x 40	88.9	76.2	66.7
2½ x 1¼	3.500	3.000	2.500
65 x 32	88.9	76.2	63.5
2½ x 1	3.500	3.000	2.250
65 x 25	88.9	76.2	57.2
3 x 2½	3.500	3.375	3.250
80 x 65	88.9	85.7	82.6
3 x 2	3.500	3.375	3.000
80 x 50	88.9	85.7	76.2
3 x 1½	3.500	3.375	2.875
80 x 40	88.9	85.7	73.0
3 x 1¼	3.500	3.375	2.752
80 x 32	88.9	85.7	69.9
3 x 1	3.500	3.375	2.626
80 x 25	88.9	85.7	66.7
3½ x 3	4.000	3.752	3.626
90 x 80	101.6	95.3	92.1
3½ x 2½	4.000	3.752	3.500
90 x 65	101.6	95.3	88.9
3½ x 2	4.000	3.752	3.252
90 x 50	101.6	95.3	82.6
3½ x 1½	4.000	3.752	3.126
90 x 40	101.6	95.3	79.4
4 x 3	4.000	4.126	3.875
100 x 80	101.6	104.8	98.4
4 x 2½	4.000	4.126	3.750
100 x 65	101.6	104.8	95.3
4 x 2	4.000	4.126	3.500
100 x 50	101.6	104.8	88.9
4 x 1½	4.000	4.126	3.374
100 x 40	101.6	104.8	85.4
5 x 4	5.000	4.874	4.626
125 x 100	127.0	123.8	117.5
5 x 3	5.000	4.874	4.374
125 x 80	127.0	123.8	111.1
5 x 2½	5.000	4.874	4.252
125 x 65	127.0	123.8	108.0
5 x 2	5.000	4.874	4.126
125 x 50	127.0	123.8	104.8

Nominal Pipe Size Inches/mm	Reducers Height H	Reducers Tees Centre to End	
		Run C	Branch M
6 x 5	5.500	5.626	5.374
150 x 125	139.7	142.9	136.5
6 x 4	5.500	5.626	5.122
150 x 100	139.7	142.9	130.1
6 x 3	5.500	5.626	4.874
150 x 80	139.7	142.9	123.8
6 x 2½	5.500	5.626	4.752
150 x 65	139.7	142.9	120.7
6 x 2	5.500	5.626	4.625
150 x 50	139.7	142.9	117.5
8 x 6	6.000	7.000	6.625
200 x 150	152	178	168
8 x 5	6.000	7.000	6.375
200 x 125	152	178	162
8 x 4	6.000	7.000	6.125
200 x 100	152	178	155
8 x 3	6.000	7.000	6.000
200 x 80	152	178	152
10 x 8	7.000	8.500	8.000
250 x 200	178	216	203
10 x 6	7.000	8.500	7.625
250 x 150	178	216	194
10 x 5	7.000	8.500	7.500
250 x 125	178	216	191
10 x 2	7.000	8.500	7.250
50 x 100	178	216	184
12 x 10	8.000	10.000	9.500
300 x 250	2.0	254	241
12 x 8	8.000	10.000	9.000
300 x 200	203	254	229
12 x 6	8.000	10.000	8.625
300 x 150	203	254	219
12 x 5	8.000	10.000	8.500
300 x 125	203	254	213.6
14 x 12	13.000	11.000	10.625
350 x 300	330	279	270
14 x 10	13.000	11.000	10.125
350 x 250	330	279	257
14 x 8	13.000	11.000	9.75
350 x 200	330	279.4	247.6
14 x 6	13.000	11.000	9.38
350 x 150	330	279.4	238.3
16 x 14	14.000	12.000	12.000
400 x 350	356	305	305
16 x 12	14.000	12.000	11.625
400 x 300	356	305	295
16 x 10	14.000	12.000	11.125
400 x 250	356	305	283
16 x 8	14.000	12.000	10.75
400 x 200	356	304.8	273
18 x 16	15	13.5	13
450 x 400	381	342.9	330.2
18 x 14	15	13.5	13
450 x 350	381	342.9	330.2
18 x 12	15	13.5	12.62
450 x 300	381	342.9	320.5
18 x 10	15	13.5	12.12
450 x 250	381	342.9	307.8
20 x 18	20	15	14.5
500 x 450	508	381	368.3
20 x 16	20	15	14
500 x 400	508	381	355.6
20 x 14	20	15	14
500 x 350	508	381	355.6
20 x 12	20	15	13.62
500 x 300	508	381	345.9
24 x 20	20	17	17
600 x 500	508	431.8	431.8
24 x 18	20	17	17
600 x 450	508	431.8	431.8
24 x 16	20	17	16.5
600 x 400	508	431.8	419.1
24 x 14	20	17	16
600 x 350	508	431.8	406.4



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Standards ANSI B16.9 & ANSI B16.28

9. WALL THICKNESSES (SEAMLESS PIPES)

UNIT: INCH/mm

Nominal Pipe Size Inches/mm	Outside Diameter	Wall Thickness						
		SGP JIS	STD	S40	XS	S80	S160	XXS
½ (15)	21.3	2.8	2.77	2.77	3.73	3.73	4.75	7.47
¾ (20)	26.7	2.8	2.87	2.87	3.91	3.91	5.54	7.82
1 (25)	33.4	3.2	3.38	3.38	4.55	4.55	6.35	9.09
1¼ (32)	42.2	3.5	3.56	3.56	4.85	4.85	6.35	9.70
1½ (40)	48.3	3.5	3.68	3.68	5.08	5.08	7.14	10.15
2 (50)	60.3	3.8	3.91	3.91	5.54	5.54	8.71	11.07
2½ (65)	73.0	4.2	5.16	5.16	7.01	7.01	9.52	14.02
3 (80)	88.9	4.2	5.49	5.49	7.62	7.62	11.12	15.24
3½ (90)	101.6	4.2	5.74	5.74	8.08	8.08		
4 (100)	114.3	4.5	6.02	6.02	8.56	8.56	13.48	17.12
5 (125)	141.3	4.5	6.55	6.55	9.53	9.53	15.88	19.05
6 (150)	168.3	5.0	7.11	7.11	10.97	10.97	18.24	21.95
8 (250)	*219.1 (216.3)	5.8	8.18	8.18	12.70	12.70	23.01	22.23
10 (250)	*273.1 (267.4)	6.6	9.27	9.27	12.70	15.06	28.57	25.40
12 (300)	*323.9 (318.5)	6.9	9.53	10.31	12.70	17.45	33.32	25.40
14 (350)	355.6	7.9	9.53	11.12	12.70	19.05	35.71	
16 (400)	406.4	7.9	9.53	12.70	12.70	21.41	40.49	
18 (450)	457.2	7.9	9.53	14.27	12.70	23.80	45.24	
20 (500)	508.0	7.9	9.53	15.06	12.70	26.19	50.01	
24 (600)	609.6	7.9	9.53	17.45	12.70	30.94	59.54	

10. APPROXIMATE WEIGHTS

UNIT: kg/pc

Nominal Pipe Size inch/mm	L/R Elbows						S/R Elbows				Tees		Concentric Reducers		Eccentric Reducers		Caps	
	45°		90°		180°		90°		180°		STD	XH	STD	XH	STD	XH	STD	XH
	STD	XH	STD	XH	STD	XH	STD	XH	STD	XH	STD	XH	STD	XH	STD	XH	STD	XH
½ (15)	0.06	0.08	0.10	0.12	0.20	0.24					0.10	0.16					0.06	0.10
¾ (20)	0.10	0.13	0.18	0.23	0.36	0.46					0.16	0.22	0.09	0.16	0.09	0.16	0.07	0.12
1 (25)	0.13	0.17	0.20	0.26	0.40	0.52	0.10	0.13	0.21	0.26	0.36	0.47	0.14	0.19	0.14	0.19	0.15	0.19
1¼ (32)	0.18	0.24	0.26	0.34	0.52	0.68	0.17	0.23	0.35	0.46	0.52	0.66	0.18	0.24	0.18	0.24	0.22	0.28
1½ (40)	0.25	0.34	0.45	0.60	0.90	1.12	0.25	0.33	0.49	0.66	0.80	1.19	0.28	0.32	0.28	0.32	0.24	0.30
2 (50)	0.42	0.58	0.78	1.09	1.56	2.19	0.43	0.59	0.86	1.19	1.00	1.38	0.41	0.55	0.41	0.55	0.32	0.37
2½ (65)	0.73	0.98	1.30	1.73	2.70	3.58	0.91	1.19	1.82	2.38	1.85	2.30	0.76	0.94	0.76	0.94	0.50	0.55
3 (80)	1.12	1.53	2.00	2.77	4.08	5.54	1.36	1.83	2.71	3.65	2.70	3.40	1.00	1.25	1.00	1.25	0.73	0.90
3½ (90)	1.62	2.25	2.82	3.91	5.65	7.82	1.88	2.61	2.77	5.21	3.55	4.89	1.36	1.77	1.36	1.77	1.00	1.40
4 (100)	2.20	3.15	4.00	5.71	8.20	11.42	2.56	3.58	5.11	7.15	4.40	6.15	1.60	2.14	1.60	2.14	1.20	1.68
5 (125)	3.54	5.13	6.75	9.73	13.50	19.46	4.32	6.09	8.64	12.20	6.54	9.30	2.55	3.62	2.55	3.62	1.92	2.72
6 (150)	6.40	9.70	10.25	16.66	22.00	33.32	6.63	10.00	13.30	20.00	9.58	14.50	3.80	5.56	3.80	5.56	3.20	4.20
8 (200)	11.10	16.96	21.10	32.16	42.20	64.62	13.40	20.30	26.80	40.70	19.00	28.92	6.60	8.80	6.60	8.80	5.14	7.60
10 (250)	17.70	28.10	35.40	56.20	70.80	112.40	24.80	32.90	49.60	65.80	30.40	48.32	10.20	14.00	10.20	14.00	8.80	12.20
12 (300)	28.10	46.40	56.20	92.70	112.40	185.40	35.76	46.79	71.52	93.58	47.20	77.92	15.40	19.80	15.40	19.80	13.40	16.60
14 (350)	35.91	49.50	70.04	98.89	114.1	197.8	45.80	60.24	91.60	120.5	74.60	98.70	29.52	37.70	29.52	37.70	16.80	21.50
16 (400)	47.04	65.05	91.87	129.80	183.74	259.60	60.18	78.92	120.36	157.84	90.30	121.10	33.50	46.30	33.50	46.30	20.00	25.60
18 (450)	59.74	82.6	116.4	165	232.8	330.00	76.20	100.1	152.40	200.2	117.10	152.00	40.82	53.84	40.82	53.84	25.20	34.20
20 (500)	73.92	102.18	144.20	204.60	288.40	409.20	93.42	124.27	186.84	248.54	148.20	201.60	60.91	79.28	60.91	79.28	32.50	41.00
24 (600)	107.10	147.86	208.06	294.80	416.17	589.60	136.10	179.88	272.20	359.76	218.50	289.80	74.10	97.75	74.10	97.75	45.70	58.30

FITTINGS SPECIFICATION

*ASTM A234 for moderate and elevated temperature service

*ASTM A420 for low temperature service

*The min. Value of elongation is depended on wall thickness over

5/16 inch

Fittings Spec	Chemical Composition					Physical Properties		
	C max %	Mn %	P max %	S max %	Si %	Tensile Strength PS	Yield Point min PSI	Elongation min A% in 2" test
ASTM A234 grade WPB	0.30	0.29 ~ 1.06	0.050	0.058	0.10 min	60.000~85.000	35.000	30.00
ASTM A420 grade WPL6	0.30	0.29 ~ 1.06	0.025	0.025	0.10 min	60.000~85.000	35.000	30.00

* Dimensions to BS1965 for SGP JIS B2311 - 1977)

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Standards JIS BS 2311 - 1997

11. STANDARDS (JIS B2311) Japanese Industrial Standard DIMENSIONS : JIS B 2311:1997

Nominal Diameter		Outside Diameter	FSGP		LG		STD		XS	
A	B		Inside Diameter	Thickness	Inside Diameter	Thickness	Inside Diameter	Thickness	Inside Diameter	Thickness
15	½	21.7	16.1	2.8	-	-	-	-	-	-
20	¾	27.2	21.6	2.8	-	-	-	-	-	-
25	1	34.0	27.6	3.2	-	-	-	-	-	-
32	1¼	42.7	35.7	3.5	-	-	-	-	-	-
40	1½	48.6	41.6	3.5	-	-	-	-	-	-
50	2	60.5	52.9	3.8	-	-	-	-	-	-
65	2½	76.3	67.9	4.2	-	-	-	-	-	-
80	3	89.1	80.7	4.2	-	-	-	-	-	-
90	3½	101.6	93.2	4.2	-	-	-	-	-	-
100	4	114.3	105.3	4.5	-	-	-	-	-	-
125	5	139.8	130.8	4.5	-	-	-	-	-	-
150	6	165.2	155.2	5.0	155.2	5	-	-	-	-
*200	8	216.3 (219.1)	204.7	5.8	204.7	5.8	-	-	-	-
*250	10	267.4 (273.0)	254.2	6.6	254.2	6.6	-	-	-	-
*300	12	318.5 (323.8)	304.7	6.9	304.7	6.9	-	-	-	-
350	14	355.6	339.8	7.9	339.8	7.9	-	-	-	-
400	16	406.4	390.6	7.9	390.6	7.9	-	-	-	-
450	18	457.2	441.4	7.9	441.4	7.9	-	-	-	-
500	20	508.0	492.2	7.9	492.2	7.9	489.0	9.5	-	-
550	22	558.8	-	-	543.0	7.9	539.8	9.5	533.4	12.7
600	24	609.6	-	-	593.8	7.9	590.6	9.5	584.2	12.7
650	26	660.4	-	-	644.6	7.9	641.4	9.5	635.0	12.7
700	28	711.2	-	-	695.4	7.9	692.2	9.5	685.8	12.7
750	30	762.0	-	-	746.2	7.9	743.0	9.5	736.6	12.7
800	32	812.8	-	-	797.0	7.9	793.8	9.5	787.4	12.7
850	34	863.6	-	-	847.8	7.9	844.6	9.5	838.2	12.7
900	36	914.4	-	-	898.6	7.9	895.4	9.5	889.0	12.7
950	38	965.2	-	-	949.4	7.9	946.2	9.5	939.8	12.7
1000	40	1016.0	-	-	1000.2	7.9	997.0	9.5	990.6	12.7
1050	42	1066.8	-	-	-	-	1047.8	9.5	1041.4	12.7
1100	44	1117.6	-	-	-	-	1098.6	9.5	1092.2	12.7
1150	46	1168.4	-	-	-	-	1149.4	9.5	1143.0	12.7
1200	48	1219.2	-	-	-	-	1200.2	9.5	1193.8	12.7

* Dimensions to BS 1965 on 200, 250 & 300 NB, Apply to South Africa Product



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Dimensions JIS BS 2311 - 1997

45° & 90° ELBOWS FSGP/LG

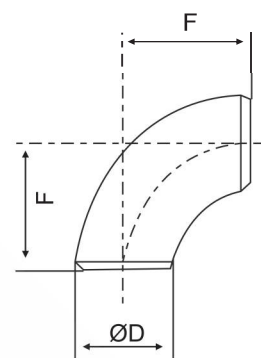
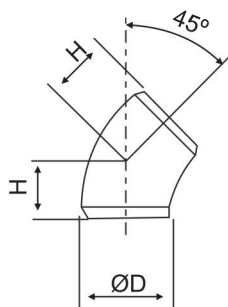


TABLE A

JIS B2311-1997

Nominal Diameter		Outside Diameter	Dimension from the center line to the end face			Approx Weight(kg)		
			45° Elbows H	90° Elbows F		45° Elbows	90° Elbows	
A	B	D	Long	Long	Short	Long	Long	Short
15	½	21.7	15.8	38.1	-	0.04	0.08	-
20	¾	27.2	15.8	38.1	-	0.05	10.00	-
25	1	34.0	15.8	38.1	25.4	0.07	0.15	0.10
32	1¼	42.7	19.7	47.6	31.8	0.13	0.25	0.17
40	1½	48.6	23.7	57.2	38.1	0.18	0.35	0.23
50	2	60.5	31.6	76.2	50.8	0.32	0.63	0.42
65	2½	76.3	39.5	95.3	63.5	0.56	1.12	0.75
80	3	89.1	47.3	114.3	76.2	0.79	1.58	1.05
90	3½	101.6	55.3	133.4	88.9	1.06	2.11	1.41
100	4	114.3	63.1	152.4	101.6	1.46	2.91	1.94
125	5	139.8	78.9	190.5	127.0	2.25	4.49	2.99
150	6	165.2	94.7	228.6	152.4	3.55	7.09	4.73
200	8	216.3	126.3	304.8	203.2	7.20	14.40	9.60
*200	8	219.1	157.8	304.8	254.0	12.70	25.40	16.93
250	10	267.4	157.8	381.0	254.0	12.70	25.40	16.93
*250	12	273.0	189.4	381.0	304.8	19.05	38.10	25.40
300	12	318.5	189.4	457.3	304.8	19.05	38.10	25.40
*300	14	323.8	220.9	457.2	355.6	28.35	56.70	37.80
350	14	355.6	220.9	533.4	355.6	28.35	56.70	37.80
400	16	406.4	252.5	609.6	406.4	37.15	74.30	49.53
450	18	457.2	284.1	685.8	457.2	47.10	94.20	62.79
500	20	508.0	315.6	762.0	508.0	59.00	117.00	78.00
550	22	558.8	347.2	838.2	558.8	71.00	141.00	94.00
600	24	609.6	378.7	914.4	609.6	84.00	168.00	112.00

* Dimensions to BS 1965

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Dimensions JIS BS 2311 - 1997

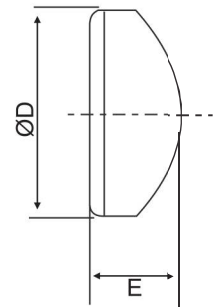
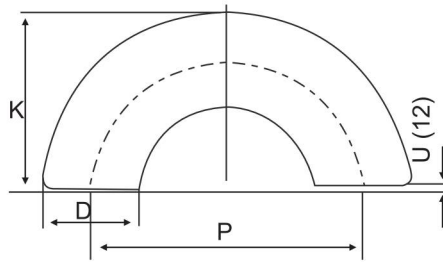


TABLE B

JIS B2311-1997

Nominal Diameter		Outside Diameter D	Centerline dimension P		Dimension from the back to the end face K			Approx Weight(kg)		
			180° Elbows P		180° Elbows K		Caps E	180° Elbows K		Caps E
A	B		Long	Short	Long	Short		Long	Short	E
15	½	21.7	76.2	-	49.0	-	25.4	0.2	-	0.1
20	¾	27.2	76.2	-	51.7	-	25.4	0.2	-	0.1
25	1	34.0	76.2	50.8	55.1	42.4	38.1	0.3	0.2	0.1
32	1¼	42.7	95.2	63.6	69.0	53.2	38.1	0.5	0.3	0.1
40	1½	48.6	114.4	76.2	81.5	62.4	38.1	0.7	0.5	0.2
50	2	60.5	152.4	101.6	106.5	81.1	38.1	1.3	0.9	0.2
65	2½	76.3	190.6	127.0	133.5	101.7	38.1	2.2	1.5	0.3
80	3	89.1	228.6	152.4	158.9	120.8	50.8	3.2	2.1	0.5
90	3½	101.6	266.8	177.8	184.2	139.7	63.5	4.2	2.8	0.7
100	4	114.3	304.8	203.2	209.6	158.8	63.5	5.8	3.9	0.9
125	5	139.8	381.0	254.0	260.4	196.9	76.2	9.0	6.0	1.3
150	6	165.2	457.2	304.8	311.2	235.0	88.9	14.2	9.5	2.1
* 200	8	216.3	609.6	406.4	413.0	311.4	101.6	28.8	19.2	3.6
* 250	10	267.4	762.0	508.0	514.7	387.7	127.0	50.8	33.9	6.5
* 300	12	323.8	914.4	609.6	616.5	464.1	152.4	76.2	50.8	9.7
350	14	355.6	1066.8	711.2	711.2	533.4	165.1	113.4	75.6	13.3
400	16	406.4	1219.2	812.8	812.8	609.6	177.8	148.6	99.1	16.7
450	18	457.2	-	-	-	-	203.2	-	-	21.5
500	20	508.0	-	-	-	-	228.6	-	-	27.0

* Dimensions to BS 1965

GENERAL NOTE: For wall thickness see Table 9

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Dimensions JIS BS 2311 - 1997

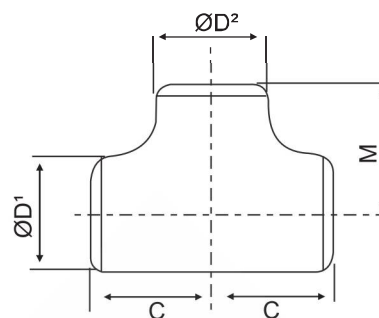


TABLE C

JIS B2311-1997

Nominal Diameter		Outside Diameter		Dimension from the centerline to the end face		Approx Weight (kg)
A	A	D1	D2	C	M	
15	½	21.7	21.7	25.4	25.4	0.12
20	¾	27.2	27.2	28.6	28.6	0.17
25	1	34.0	34.0	38.1	38.1	0.32
32	1¼	42.7	42.7	47.6	47.6	0.56
40	1½	48.6	48.6	57.2	57.2	0.78
50	2	60.5	60.5	63.5	63.5	1.16
65	2½	76.3	76.3	76.2	76.2	1.94
80	3	89.1	89.1	85.7	85.7	2.55
90	3½	101.6	101.6	95.3	95.3	3.23
100	4	114.3	114.3	104.8	104.8	4.27
125	5	139.8	139.8	123.8	123.8	6.17
150	6	165.2	165.2	142.9	142.9	9.32
200	8	216.3	216.3	177.8	177.8	17.50
* 200	8	219.1	219.1	177.8	177.8	17.50
250	10	267.4	267.4	215.9	215.9	29.70
* 250	10	273.1	273.1	215.9	215.9	29.70
300	12	318.5	318.5	254.0	254.0	32.00
* 300	12	323.8	323.8	254.0	254.0	32.00
350	14	355.6	355.6	279.4	279.4	44.70
400	16	406.4	406.4	304.8	304.8	55.20
450	18	457.2	457.2	342.9	342.9	70.00
500	20	508.0	508.0	381.0	381.0	86.60
550	22	558.8	558.8	419.1	419.1	106.00
600	24	609.6	609.6	431.8	431.8	116.00

Remarks: The dimension M of 350 A(14B) or over in nominal diameter may be altered to smaller than that as given in the table above, subject to the agreement between the parties concerned with deliver

GENERAL NOTE: For wall thickness see Table 9

* Dimensions to BS 1965

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Dimensions JIS BS 2311 - 1997

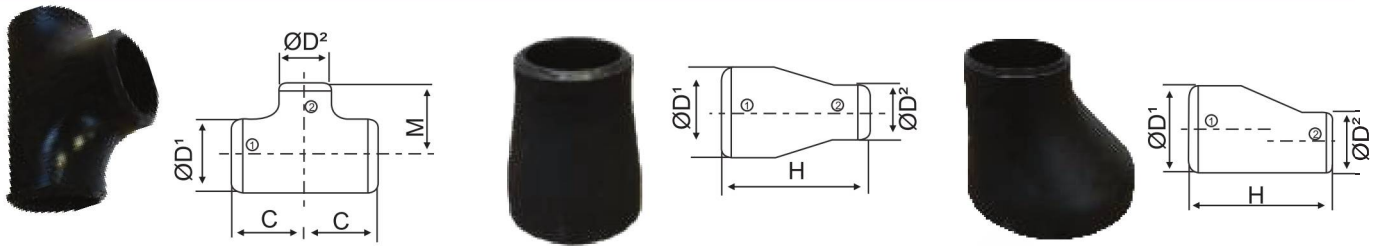


TABLE D

JIS B2311-1997

Nominal Diameter		Outside Diameter		Overall Length H	Dimension from the Centerline to the end face		Approx Weight (kg)	
A	B	D1	D2		C	M	Tees	Reducers
20x15	¾x½	27.2	21.7	38.1	28.6	28.6	0.16	0.06
25x20	1x¾	34.0	27.2	50.8	38.1	38.1	0.30	0.11
25x15	1x½	34.0	21.7	50.8	38.1	38.1	0.29	0.10
32x25	1¼x1	42.7	34.0	50.8	47.6	47.6	0.53	0.15
32x20	1¼x¾	42.7	27.2	50.8	47.6	47.6	0.50	0.14
32x15	1¼x½	42.7	21.7	50.8	47.6	47.6	0.49	0.13
40x32	1½x1¼	48.6	42.7	63.5	57.2	57.2	0.76	0.23
40x25	1½x1	48.6	34.0	63.5	57.2	57.2	0.72	0.21
40x20	1½x¾	48.6	27.2	63.5	57.2	57.2	0.68	0.19
40x15	1½x½	48.6	21.7	63.5	57.2	57.2	0.67	0.18
50x40	2x1½	60.5	48.6	76.2	63.5	60.3	1.08	0.36
50x32	2x1¼	60.5	42.7	76.2	63.5	57.2	1.04	0.34
50x25	2x1	60.5	34.0	76.2	63.5	50.8	0.99	0.32
50x20	2x¾	60.5	27.2	76.2	63.5	44.5	0.95	0.29
65x50	2½x2	76.3	60.5	88.9	76.2	69.9	1.78	0.59
65x40	2½x1½	76.3	48.6	88.9	76.2	66.7	1.70	0.54
65x32	2½x1¼	76.3	42.7	88.9	76.2	63.5	1.67	0.52
65x25	2½x1	76.3	34.0	88.9	76.2	57.2	1.61	0.48
80x65	3x2½	89.1	76.3	88.9	85.7	82.6	2.44	0.73
80x50	3x2	89.1	60.5	88.9	85.7	76.2	2.28	0.66
80x40	3x1½	89.1	48.6	88.9	85.7	73.0	2.21	0.61
80x32	3x1¼	89.1	42.7	88.9	85.7	69.9	2.17	0.59
90x80	3½x3	101.6	89.1	101.6	95.3	92.1	3.12	0.96
90x65	3½x2½	101.6	76.3	101.6	95.3	88.9	3.01	0.90
90x50	3½x2	101.6	60.5	101.6	95.3	82.6	2.85	0.83
90x40	3½x1½	101.6	48.6	101.6	95.3	79.4	2.77	0.77
90x32	3½x1¼	101.8	42.7	101.6	-	-	-	0.74
100x90	4x3½	114.3	101.6	101.6	104.8	101.6	4.09	1.17
100x80	4x3	114.3	89.1	101.6	104.8	98.4	3.98	1.10
100x65	4x2½	114.3	76.3	101.6	104.8	95.3	3.87	1.04
100x50	4x2	114.3	60.5	101.6	104.8	88.9	3.71	0.97
100x40	4x1½	114.3	48.6	101.6	104.8	85.7	3.63	0.91
125x100	5x4	139.8	114.3	127.0	123.8	117.5	5.86	1.74
125x90	5x3½	139.8	101.6	127.0	123.8	114.3	5.68	1.65
125x80	5x3	139.8	89.1	127.0	123.8	111.1	5.56	1.58
125x65	5x2½	139.8	76.3	127.0	123.8	108.0	5.45	1.50
125x50	5x2	139.8	60.5	127.0	123.8	104.8	5.32	1.41
150x125	6x5	165.2	139.8	139.7	142.9	136.5	8.80	2.55
150x100	6x4	165.2	114.3	139.7	142.9	130.2	8.49	2.36
150x90	6x3½	165.2	101.6	139.7	142.9	127.0	8.31	2.27
150x80	6x3	165.2	89.1	139.7	142.9	123.8	8.19	2.18
150x65	6x2½	165.2	76.3	139.7	142.9	120.7	8.08	2.09

* Dimensions to BS 1965

GENERAL NOTE: For wall thickness see Table 9

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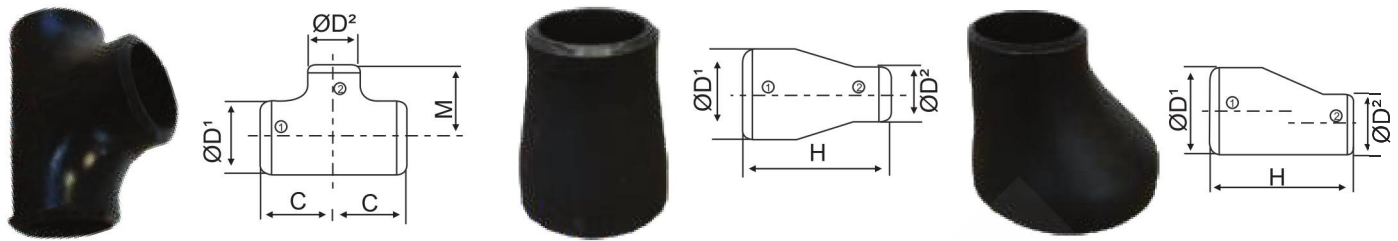


TABLE D (Cont.)

Nominal Diameter		Outside Diameter		Overall Length H	Dimension from the Centerline to the end face		Approx Weight (kg)	
A	B	D1	D2		C	M	Tees	Reducers
* 200x150	8x6	219.1	165.2	152.4	177.8	168.3	16.20	4.17
* 200x125	8x5	219.1	139.8	152.4	177.8	161.9	15.70	3.87
* 200x100	8x4	219.1	114.3	152.4	177.8	155.6	15.40	3.67
* 200 x 90	8x3½	219.1	101.6	152.4	177.8	152.4	15.2	3.56
* 250x200	10x8	273.0	219.1	177.8	215.9	203.2	27.8	6.87
* 250x150	10x6	273.0	165.2	177.8	215.9	193.7	26.6	6.32
* 250x125	10x5	273.0	139.8	177.8	215.9	190.5	26.1	6.06
* 250x100	10x4	273.0	114.3	177.8	215.9	184.2	25.8	5.80
* 300x250	12x10	323.8	273.0	203.2	254.0	241.3	41.5	9.97
* 300x200	12x8	323.8	219.1	203.2	254.0	228.6	39.6	9.29
* 300x150	12x6	323.8	165.2	203.2	254.0	219.1	38.3	8.69
* 300x125	12x5	323.8	139.8	203.2	254.0	215.9	37.9	8.39
* 350x300	14x12	355.6	323.8	330.2	279.4	269.9	42.7	21.2
* 350x250	14x10	355.6	273.0	330.2	279.4	257.2	41.2	19.7
350x200	14x8	355.6	219.1	330.2	279.4	247.7	40.0	18.3
350x150	14x6	355.6	165.2	330.2	279.4	238.1	39.0	16.9
400x350	16x14	406.4	355.6	355.6	304.8	304.8	54.2	25.9
400x300	16x12	406.4	318.5	355.6	304.8	295.3	52.2	24.7
* 400x250	16x10	406.4	273.0	355.6	304.8	282.6	50.7	23.2
* 400x200	16x8	406.4	219.1	355.6	304.8	273.1	49.4	21.7
400x150	16x6	406.4	165.2	-	304.8	263.5	48.5	-
450x400	18x16	457.2	406.4	381.0	342.9	330.2	67.9	31.5
450x350	18x14	457.2	355.6	381.0	342.9	330.2	66.9	29.8
* 450x300	18x12	457.2	323.8	381.0	342.9	320.7	64.9	28.6
* 450x250	18x10	457.2	273.0	381.0	342.9	308.0	63.4	27.1
500x450	20x18	508.0	457.2	508.0	381.0	368.3	84.2	47.0
500x400	20x16	508.0	406.4	508.0	381.0	355.6	82.1	44.7
500x350	20x14	508.0	355.6	508.0	381.0	355.6	81.1	42.4
* 500x300	20x12	508.0	323.8	508.0	381.0	346.1	79.1	40.8
* 500x250	20x10	508.0	273.0	-	381.0	333.4	77.6	-
* 500x200	20x8	508.0	219.1	-	381.0	323.9	76.3	-
550x500	22x20	558.8	508.0	508.0	419.1	406.4	103.0	52.0
550x450	22x18	558.8	457.2	508.0	419.1	393.7	101.0	49.7
550x400	22x16	558.8	406.4	508.0	419.1	381.0	98.9	47.5
550x350	22x14	558.8	355.6	508.0	-	-	-	45.3
600x550	24x22	609.6	558.8	508.0	431.8	431.8	115.0	57.1
600x500	24x20	609.6	508.0	508.0	431.8	431.8	114.0	54.8
600x450	24x18	609.6	457.2	508.0	431.8	419.1	111.0	52.6
600x400	24x16	609.6	406.4	508.0	-	-	-	50.4

* Dimensions to BS 1965

GENERAL NOTE: For wall thickness see Table 9

12. DIMENSIONAL TOLERANCES AND PERMISSIBLE VALUES

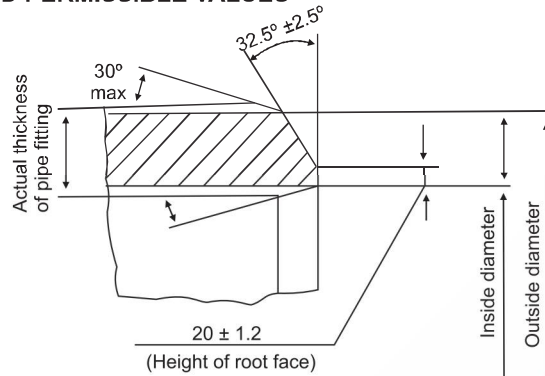


Fig.2 Shape and dimensions of bevel end

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Item	Types of pipe fittings	Nominal diameter							
		A	15-65	80-100	125-200	250-450	500-600	650-750	800-1200
		B	1/2-2 1/2	3-4	5-8	10-18	20-24	26-30	32-48
		Tolerance							
Outside diameter at end	All types of pipe fittings	± 2.0	± 2.5	± 3.5	+5.0 -4.5		+6.4 -4.8		
Inside diameter at end face		± 2.0	± 2.5	± 3.5	± 4.5		± 4.8		
Thickness		+not specified -15%							
Bevel angle		See Fig. 2							
Height of root face		See Fig. 2							
Dimension from centerline to end face (H F)	45° Elbows 90° Elbows	± 2.0		± 3.2				± 4.8	
Centerline dimension (P)	180° Elbows	± 6.4		± 9.5		-			
Dimension from back to end face (K)		± 6.4				-			
Alignment of end faces (U) (max.)		1.6		3.2		-			
Overall length (H)	Reducers	± 2.0		± 3.2				± 4.8	
Dimension from centerline to end face (C M)	Tees	± 2.0		± 3.2				± 4.8	
Dimension from back to end face (E)	Caps	± 3.2		± 6.4				-	
Outer peripheral length at end	All types of pipe fittings	-						± 0.5%	

TOLERANCES ON ALIGNMENT OF PIPE FITTINGS

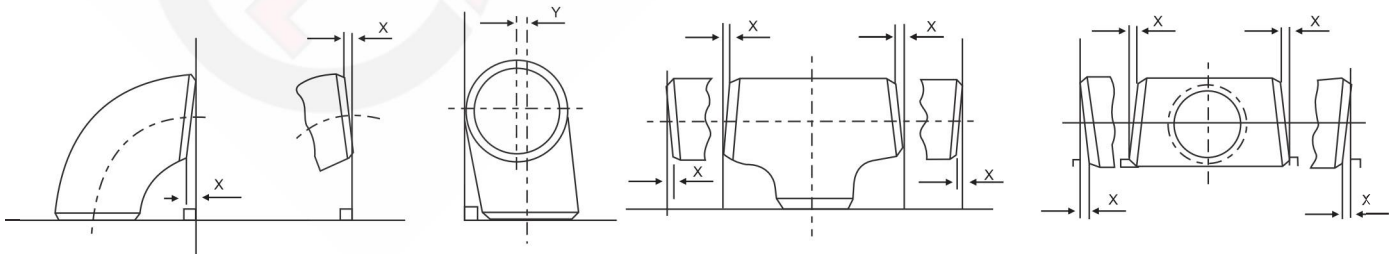


TABLE 15

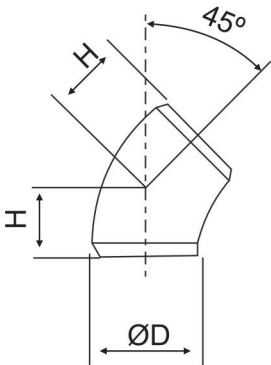
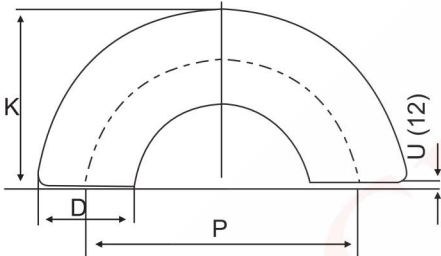
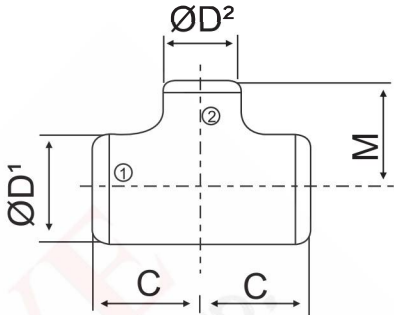
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Item	Types of pipe fittings	Nominal diameter								
		A	15-100	125-200	250-300	350-400	450-600	650-750	800-1050	1100-1200
		B	1/2-4	5-8	10-12	14-16	18-24	26-30	32-42	44-48
		Tolerance								
Off angle (X)	Elbows, reducers, tees	0.8	1.6	2.4		3.2	4.8			
Off plane (Y)	Elbows, tees	1.6	3.2	4.8	6.4	9.5		12.7	19.1	

- Remarks:
- For the dimensional tolerances for H of reducers and M of reducing tees, the tolerances specified for the larger diameter side shall apply.
 - For the galvanized part of white pipe fittings, the above-mentioned tolerances shall be applicable before galvanizing

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