

Technical Literature of Flanges

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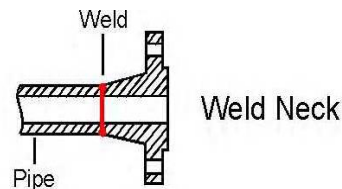
Flanges - General Information

A Flange is a method of connecting pipes, valves, pumps and other equipment to form a pipework system. It also provides easy access for cleaning, inspection or modification. Flanges are usually welded or screwed into such systems and then joined with bolts.

Flange Types

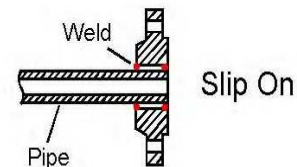
Weld Neck

This flange is circumferentially welded into the system at its neck which means that the integrity of the butt welded area can be easily examined by radiography. The bores of both pipe and flange match, which reduces turbulence and erosion inside the pipeline. The weld neck is therefore favoured in critical applications



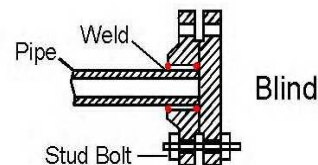
Slip-on

This flange is slipped over the pipe and then fillet welded. Slip-on flanges are easy to use in fabricated applications.



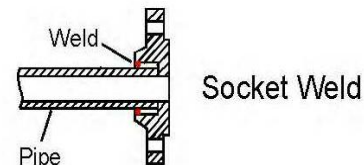
Blind

This flange is used to blank off pipelines, valves and pumps, it can also be used as an inspection cover. It is sometimes referred to as a blanking flange.



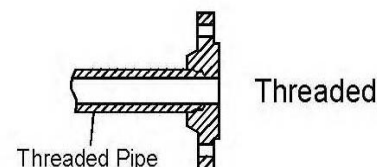
Socket Weld

This flange is counter bored to accept the pipe before being fillet welded. The bore of the pipe and flange are both the same therefore giving good flow characteristics.



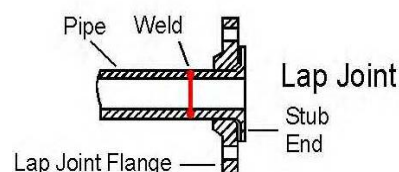
Threaded

This flange is referred to as either threaded or screwed. It is used to connect other threaded components in low pressure, non-critical applications. No welding is required.



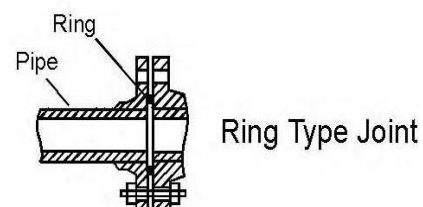
Lap Joint

These flanges are always used with either a stub end or taft which is butt welded to the pipe with the flange loose behind it. This means the stub end or taft always makes the face. The lap joint is favoured in low pressure applications because it is easily assembled and aligned. To reduce cost these flanges can be supplied without a hub and/or in treated, coated carbon steel.



Ring Type Joint

This is a method of ensuring leak proof flange connection at high pressures. A metal ring is compressed into a hexagonal groove on the face of the flange to make the seal. This jointing method can be employed on Weld Neck, Slip-on and Blind Flanges.



Flanges - General Information

Specifications

ASME B16.5 ASME B16.47 BS 4504 BS 3293 BS 10

Manufacture

Summary of materials used for flanges

	ASME/ ANSI B16.5	ASME B16.47 Series A (or MSS SP-44 ¹)	ASME B16.47 Series B (or API 605 ²)	BS 4504	BS 3293	BS 10 ³
Forging (ASTM A 182)	✓	✓	✓	✓	✓	✓
Plate (ASTM A 240) ⁴	✓			✓		✓
Bar ⁵						✓
Casting ⁶	✓			✓		✓

Notes

- 1 MSS SP-44 flanges are designated Series A flanges in ASME B16.47.
- 2 API 605 has been cancelled. API 605 flanges are designated Series B flanges in ASME B16.47.
- 3 BS 10, although obsolete, remains in use for light weight economy stainless steel flanges.
- 4 Within specification ANSI B16.5, plate can only be used to provide blind flanges.
- 5 Most small BS 10 flanges are made from bar.
- 6 Castings are not included in this manual.

- **Materials.** Most standards specify the material from which the flange is produced. The purchaser should specify the exact requirements.
- **Flange Sizes.** All sizes and grades compatible to standard pipe ranges and wall thicknesses (pressure ratings) are available. The table below provides a summary.
- **Flange Face.** There are various face configurations for flanges. Typically: flat face, raised face, tongue and groove, ring joint.
- **Face Finish.** The finish on the face of a flange is measured as an Arithmetical Average Roughness Height (AARH). The finish is determined by the standard used. For example, ANSI B16.5 specifies face finishes within a range 125AARH - 500AARH (3.2 Ra to 12.5 Ra). Other finishes are available on request, for example 1.6 Ra max, 1.6/3.2 Ra, 3.2/6.3 Ra or 6.3/12.5 Ra. The range 3.2/6.3 Ra is most common.

Summary of flange sizes specified by common standards

Flange Type	Specifications				
	ASME/ANSI B16.5	ASME B16.47 Series A (or MSS SP-44 ¹)	ASME B16.47 Series B (or API 605 ²)	BS 4504 (ISO 7005-1)	BS 3293
	Nominal Pipe Sizes				
	< NPS 26	≥NPS 26	≥NPS 26	DN 10 to DN 4000	≥ NPS 26
	Nominal Pressure (Class)				
	Class (lb)	Class (lb)	Class (lb)	PN (bar)	Class (lb)
Weld Neck	150-2500	150-900	75-900	2.5-40	150-600
Slip-on	150-1500	-	-	2.5-40	150-600
Blind	150-2500	300-900	300-900	2.5-40	-
Lap Joint	150-2500	-	-	6-40 ³	-
Socket Weld	150-1500	-	-	N/A	-
Threaded	150-2500	-	-	6-40	-
Flat/Raised Facings	As above	As above	As above	As above	As above
Ring Joint Facings	150-2500	300-900	300-900	2.5-40	300-600
Other Facings	150-2500 ³	-	-	2.5-40	-

Notes

- 1 MSS SP-44 flanges are designated Series A flanges in ASME B16.47. It also covers flanges in the range NPS 12 to 24, these being equivalent to ASME/ANSI B16.5 flanges in the same range (except for the addition of NPS 22 in MSS SP-44).
- 2 API 605 has been cancelled. API 605 flanges are designated Series B flanges in ASME B16.47. Ranges quoted are based on ASME B16.47 Series B.
- 3 Dimensions not covered in this summary.

ASME/ANSI B16.5-1996 and B16.47-1996

American national standards ASME/ANSI B16.5 and B16.47 together cover pipe flanges up to NPS 60 (NPS 48 is the largest detailed in this summary). ASME/ANSI B16.47 covers two series of flanges, Series A which is equivalent to MSS SP-44 (the 1996 Edition of MSS SP-44 complies with B16.47 tolerances), and Series B which is equivalent to API 605 (API 605 is now cancelled).

Dimensions and Tolerances

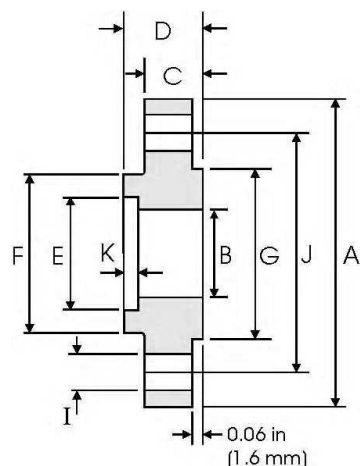
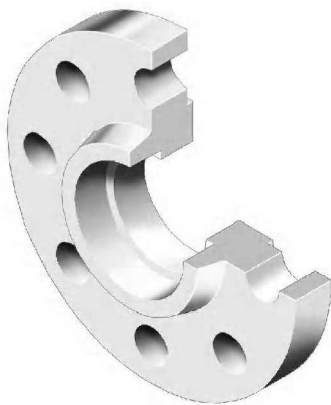
Tolerances on flange dimensions (ASME/ANSI B16.5 and B16.47, and MSS SP-44)

Dimension	Range	Tolerance	
		in	mm
General and Blind Flanges (For blind flange dimensions see page 8-23 for B16.5, page 8-46 for B16.47 Series A / MSS SP-44 and page 8-51 for B16.47 Series B / API 605):			
G (raised face diameter)	≤ NPS 24	±0.03	±0.76
	≥ NPS 26, with 0.06 in raised face	±0.08	± 2.03
	≥ NPS 26, with 0.25 in raised face	±0.04	± 1.02
I (bolt hole diameter)	All	No tolerance in B16.5 or B16.47	
J (bolt circle diameter)	All	±0.06	±1.52
Centre to centre of adjacent bolt holes	All	±0.03	±0.76
Eccentricity of bolt circle and machined facing diameters	≤ NPS 2½	±0.03	±0.76
	≥ NPS 3	±0.06	±1.52
Weld Neck Flanges ¹ (For dimensions see page 8-10 for B16.5, page 8-46 for B16.47 Series A / MSS SP-44 and page 8-51 for B16.47 Series B / API 605):			
D (overall length)	≤ NPS 4	+0.06	+1.52
	NPS 5 to 10	+0.06, -0.12	+1.52, -3.05
	NPS 12 to 24	+0.12, -0.18	+3.05, -4.57
	≥ NPS 26	±0.19	±4.83
Thickness of hub	All	> 87.5% of pipe nominal wall thickness	
Slip on (see page 8-17), Lap Joint (see page 8-32 for dimensions) and Socket Welding (see page 8-30 for dimensions) Flanges:			
B (inside diameter, or bore)	≤ NPS 10	+0.03, -0.0	+0.76, -0.0
	≥ NPS 12	+0.06, -0.0	+1.52, -0.0
Threaded Flanges (see page 8-40 for dimensions):			
B (counterbore) (Not applicable for Class 150 lb)	≤ NPS 10	+0.03, -0.0	+0.76, -0.0
	≥ NPS 12	+0.06, -0.0	+1.52, -0.0
Ring Joint Facing (See page 6 for dimensions; see page 9 for tolerances)			



Note

¹ See page 5 for weld neck welding end dimension and tolerance data.



Socket Welding Flanges - ANSI B16.5



Class 150 lb

Pipe	Flange							Hub	Raised Face	Drilling Data			Weight
Nominal Pipe Size		A	B	C	D	E	K	F	G	H	I	J	
	Outside Diameter	Overall Diameter	Inside Diameter	Flange Thickness min	Overall Length	Socket Diameter	Depth of Socket	Hub Diameter	Face Diameter	No. of Holes	Bolt Hole Diameter	Diameter of Circle of Holes	kg/ piece
	in mm	in mm	in mm	in mm	in mm	in mm	in mm	in mm	in mm		in mm	in mm	
1/2	0.840 21.30	3.500 88.90	0.620 15.70	0.440 11.20	0.620 15.70	0.880 22.40	0.380 9.600	1.190 30.20	1.380 35.10	4	0.620 15.70	2.380 60.45	0.42
3/4	1.050 26.70	3.880 98.60	0.820 20.80	0.500 12.70	0.620 15.70	1.090 27.70	0.440 11.10	1.500 38.10	1.690 42.90	4	0.620 15.70	2.750 69.85	0.59
1	1.315 33.40	4.250 108.0	1.050 26.70	0.560 14.20	0.690 17.50	1.360 34.50	0.500 12.70	1.940 49.30	2.000 50.80	4	0.620 15.70	3.120 79.25	0.81
1 1/4	1.660 42.20	4.620 117.3	1.380 35.10	0.620 15.70	0.810 20.60	1.700 43.20	0.560 14.20	2.310 58.70	2.500 63.50	4	0.620 15.70	3.500 88.90	1.07
1 1/2	1.900 48.30	5.000 127.0	1.610 40.90	0.690 17.50	0.880 22.30	1.950 49.50	0.620 15.70	2.560 65.00	2.880 73.15	4	0.620 15.70	3.880 98.60	1.36
2	2.375 60.30	6.000 152.4	2.070 52.60	0.750 19.10	1.000 25.40	2.440 62.00	0.690 17.50	3.060 77.70	3.620 91.90	4	0.750 19.10	4.750 120.7	2.10
2 1/2	2.875 73.00	7.000 177.8	2.470 62.70	0.880 22.40	1.120 28.40	2.940 74.70	0.750 19.00	3.560 90.40	4.120 104.6	4	0.750 19.10	5.500 139.7	3.33
3	3.500 88.90	7.500 190.5	3.070 78.00	0.940 23.90	1.190 30.20	3.570 90.70	0.810 20.60	4.250 108.0	5.000 127.0	4	0.750 19.10	6.000 152.4	3.90

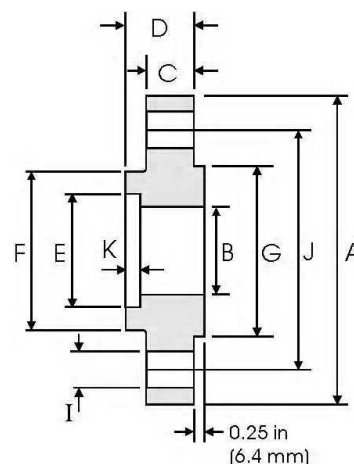
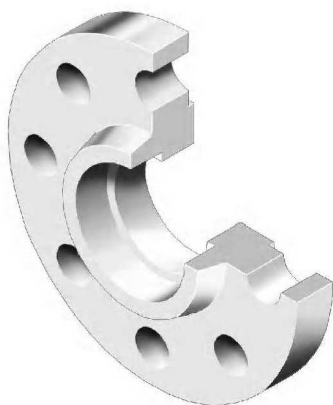
Class 300 lb

Pipe	Flange							Hub	Raised Face	Drilling Data			Weight
Nominal Pipe Size		A	B	C	D	E	K	F	G	H	I	J	
	Outside Diameter	Overall Diameter	Inside Diameter	Flange Thickness min	Overall Length	Socket Diameter	Depth of Socket	Hub Diameter	Face Diameter	No. of Holes	Bolt Hole Diameter	Diameter of Circle of Holes	kg/ piece
	in mm	in mm	in mm	in mm	in mm	in mm	in mm	in mm	in mm		in mm	in mm	
1/2	0.840 21.30	3.750 95.20	0.620 15.70	0.560 14.20	0.880 22.30	0.880 22.40	0.380 9.600	1.500 38.10	1.380 35.10	4	0.620 15.70	2.620 66.55	0.66
3/4	1.050 26.70	4.620 117.3	0.820 20.80	0.620 15.70	1.000 25.40	1.090 27.70	0.440 11.10	1.880 47.70	1.690 42.90	4	0.750 19.10	3.250 82.50	1.15
1	1.315 33.40	4.880 123.9	1.050 26.70	0.690 17.50	1.060 26.90	1.360 34.50	0.500 12.70	2.120 53.80	2.000 50.80	4	0.750 19.10	3.500 88.90	1.40
1 1/4	1.660 42.20	5.250 133.3	1.380 35.10	0.750 19.00	1.060 26.90	1.700 43.20	0.560 14.20	2.500 63.50	2.500 63.50	4	0.750 19.10	3.880 98.60	1.75
1 1/2	1.900 48.30	6.120 155.4	1.610 40.90	0.810 20.60	1.190 30.20	1.950 49.50	0.620 15.70	2.750 69.85	2.880 73.15	4	0.880 22.30	4.500 114.3	2.55
2	2.375 60.30	6.500 165.1	2.070 52.60	0.880 22.30	1.310 33.20	2.440 62.00	0.690 17.50	3.310 84.00	3.620 91.90	8	0.750 19.10	5.000 127.0	2.93
2 1/2	2.875 73.00	7.500 190.5	2.470 62.70	1.000 25.40	1.500 38.10	2.940 74.70	0.750 19.00	3.940 100.0	4.120 104.6	8	0.880 22.30	5.880 149.3	4.40
3	3.500 88.90	8.250 209.5	3.070 78.00	1.120 28.40	1.690 42.90	3.570 90.70	0.810 20.60	4.620 117.3	5.000 127.0	8	0.880 22.30	6.620 168.1	5.92


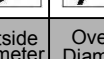
Notes

- Dimension B corresponds to the pipe inside diameter. Values quoted assume 40S/Standard wall thickness.
- Weights are based on manufacturer's data and are approximate.
- For ring joint facings see page 6. For tolerances see page 4.



Socket Welding Flanges - ANSI B16.5



Class 600 lb

Pipe		Flange						Hub	Raised Face	Drilling Data			Weight
Nominal Pipe Size		A	B	C	D	E	K	F	G	H	I	J	
	Outside Diameter	Overall Diameter	Inside Diameter	Flange Thickness min	Overall Length	Socket Diameter	Depth of Socket	Hub Diameter	Face Diameter	No. of Holes	Bolt Hole Diameter	Diameter of Circle of Holes	kg/ piece
	in mm	in mm	in mm	in mm	in mm	in mm	in mm	in mm	in mm				
1/2	0.840	3.750	To be specified by the Purchaser	0.560	0.880	0.880	0.380	1.500	1.380	4	0.620	2.620	0.76
	21.30	95.20		14.20	22.30	22.40	9.600	38.10	35.10		15.70	66.55	
3/4	1.050	4.620		0.620	1.000	1.090	0.440	1.880	1.690	4	0.750	3.250	1.29
	26.70	117.3		15.70	25.40	27.70	11.10	47.70	42.90		19.10	82.50	
1	1.315	4.880		0.690	1.060	1.360	0.500	2.120	2.000	4	0.750	3.500	1.55
	33.40	123.9		17.50	26.90	34.50	12.70	53.80	50.80		19.10	88.90	
1 1/4	1.660	5.250		0.810	1.120	1.700	0.560	2.500	2.500	4	0.750	3.880	2.06
	42.20	133.3		20.60	28.40	43.20	14.20	63.50	63.50		19.10	98.60	
1 1/2	1.900	6.120		0.880	1.250	1.950	0.620	2.750	2.880	4	0.880	4.500	3.00
	48.30	155.4		22.30	31.75	49.50	15.70	69.85	73.15		22.30	114.3	
2	2.375	6.500	1.000	1.440	2.440	0.690	3.310	3.620	8	0.750	5.000	3.67	
	60.30	165.1	25.40	36.60	62.00	17.50	84.00	91.90		19.10	127.0		
2 1/2	2.875	7.500	1.120	1.620	2.940	0.750	3.940	4.120	8	0.880	5.880	5.35	
	73.00	190.5	28.40	41.10	74.70	19.00	100.0	104.6		22.30	149.3		
3	3.500	8.250	1.250	1.810	3.570	0.810	4.620	5.000	8	0.880	6.620	7.06	
	88.90	209.5	31.75	46.00	90.70	20.60	117.3	127.0		22.30	168.1		

Class 1500 lb

Pipe		Flange						Hub	Raised Face	Drilling Data			Weight
Nominal Pipe Size		A	B	C	D	E	K	F	G	H	I	J	
	Outside Diameter	Overall Diameter	Inside Diameter	Flange Thickness min	Overall Length	Socket Diameter	Depth of Socket	Hub Diameter	Face Diameter	No. of Holes	Bolt Hole Diameter	Diameter of Circle of Holes	kg/ piece
	in mm	in mm	in mm	in mm	in mm	in mm	in mm	in mm	in mm		in mm	in mm	
1/2	0.840 21.30	4.750 120.6	To be specified by the Purchaser	0.880 22.30	1.250 31.70	0.880 22.40	0.380 9.600	1.500 38.10	1.380 35.10	4	0.880 22.30	3.250 82.50	1.80
3/4	1.050 26.70	5.120 130.0		1.000 25.40	1.380 35.00	1.090 27.70	0.440 11.10	1.750 44.40	1.690 42.90	4	0.880 22.30	3.500 88.90	2.41
1	1.315 33.40	5.880 149.3		1.120 28.40	1.620 41.10	1.360 34.50	0.500 12.70	2.060 52.30	2.000 50.80	4	1.000 25.40	4.000 101.6	3.55
1 1/4	1.660 42.20	6.250 158.7		1.120 28.40	1.620 41.10	1.700 43.20	0.560 14.20	2.500 63.50	2.500 63.50	4	1.000 25.40	4.380 111.2	4.02
1 1/2	1.900 48.30	7.000 177.8		1.250 31.75	1.750 44.50	1.950 49.50	0.620 15.70	2.750 69.85	2.880 73.15	4	1.120 28.40	4.880 123.9	5.45
2	2.375 60.30	8.500 215.9		1.500 38.10	2.250 57.15	2.440 62.00	0.690 17.50	4.120 104.6	3.620 91.90	8	1.000 25.40	6.500 165.1	10.2
2 1/2	2.875 73.00	9.620 244.3		1.620 41.10	2.500 63.50	2.940 74.70	0.750 19.00	4.880 123.9	4.120 104.6	8	1.120 28.40	7.500 190.5	13.9

Notes

- Class 400 socket weld flanges may be provided in NPS 1/2 to 2 1/2 using Class 600 dimensions
- Dimension B corresponds to the pipe inside diameter. Values quoted assume 40S/Standard wall thickness.
- Weights are based on manufacturer's data and are approximate.
- For ring joint facings see page 6. For tolerances see page 4.