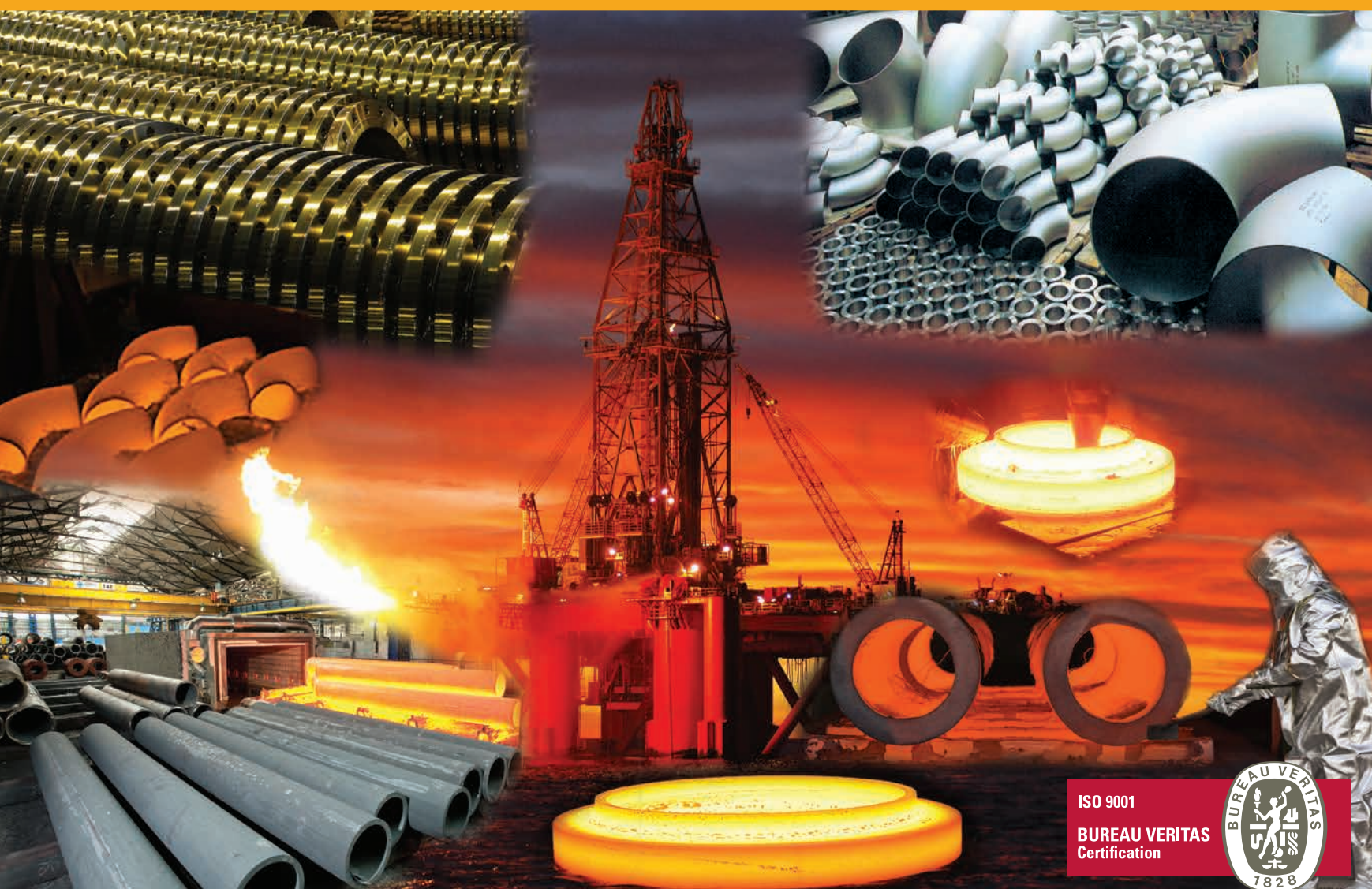




PIPELINE SUPPLIES

Product & Technical
Information

www.ozlinc.com.au



ISO 9001

BUREAU VERITAS
Certification



Company Profile / Vision and Mission

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Scope of Supply

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Company Profile

Ozlinc Industries Pty Ltd has established itself and is recognized as a primary Stockist and Trader of Piping, Piping Components, Hose & Valves within the Mining, Marine, Fire Services, Power and Oil & Gas industries throughout Australia.

Founded in 1990, the company traded under the name of Couplers Pty Ltd for its first 23 years of operation. In 2013, new business partners acquired a majority shareholding in the company enabling the business to continue its growth strategy.

In 2013, the company was renamed to "Ozlinc Industries Pty Ltd" to reflect the connection with the Australian market and its client base. The rebranding was the first stage of a long-term growth strategy encompassing the realignment of the business with its core strengths, client base and industry sectors.

Ozlinc's commitment is reflected in the ongoing investment in inventory, facilities and professional staff to meet the needs of our customer base and industry sectors. During the past few years the company has substantially increased its inventory, now equating to approximately 3000 tonne, covering in excess of five thousand individual items, that are managed in our extensive (5000sqm) warehouse operations in O'Connor Western Australia.

The company's scope of supply is continually evolving with the needs of the industries and now encompasses extensive ranges of Pipe, BW Fittings, ANSI & Plate Flanges, Valves, Screwed & Socket Weld Fittings, Hose & Hosing accessories, in a variety of grades.

Vision & Mission

Ozlinc serves the resources & manufacturing markets in Australia

Ozlinc's vision, is to be Western Australia's "first port of call" for the supply of piping and piping components.

Ozlinc's mission is the development and maintenance of a talented team, safe warehousing facilities and strategic stockholdings. Ozlinc endeavours to match our customers quality and delivery requirements with an unbeatable price.



Project Reference List

Project Name	Year	Product
Nullagine Processing Plant & Mine Expansion	2019	Carbon Steel & Stainless Steel Pipe, Flanges, Fittings, Valves & Hosing
Rio Tinto East Intercourse Island Stacker Water Supply	2019	Carbon Steel & Stainless Steel Pipe, Flanges, Fittings, Valves & Hosing Components
Burrup Ammonia Nitrate Facility Repairs & Maintenance	2019	Carbon Steel, Stainless Steel, Low Temperature & Chrome Moly Piping Materials
Alcoa MTL Pipeline Replacement	2019	Carbon Steel Seamless Pipe
Worsley Alumina Refinery & Powerhouse Maintenance	2019	Carbon Steel & Stainless Steel Pipe, Flanges, Valves, Bolts & Gaskets
Alcoa Wagerup Bioxolite Destruction Facility	2019	Carbon Steel & Stainless Steel Pipe, Flanges & Fittings
Alcoa Alumina Refinery Maintenance	2019	Carbon Steel & Stainless Steel Pipe, Flanges, Valves, Bolts & Gaskets
Kwinana Lithium Project	2019	Carbon Steel, Galvanised CS & Stainless Steel Pipe, Flanges & High Pressure Fittings
Wodgina Lithium Plant	2019	Carbon Steel & Galvanised CS Pipe, Flanges & High Pressure Fittings
Ichthys Onshore LNG Project	2019	Carbon Steel, Stainless Steel & Duplex Pipe, Flanges & Fittings
Greenbushes Lithium Plant Expansion	2019	Carbon Steel & Stainless Steel Pipe, Flanges & High Pressure Fittings
Alcoa Wagerup Bioxolite Destruction Facility	2018	Carbon Steel & Stainless Steel Pipe, Flanges & Fittings
Telfer Mine Processing Plant Maintenance Program	2018	Carbon Steel Pipe, Flanges & Fittings
Karratha Gas Plant Life Extension	2018	Offshore Valves
Shell Prelude FLNG	2018	Stainless Steel, Carbon Steel, Low Temp & Duplex High Pressure Fittings, Pipe & Flanges, Compact Flanges
Dampier Ammonia Nitrate Plant	2018	High Pressure Pipe, Flanges & Fittings, Carbon, Stainless, Chrome Moly & Impact Tested
Pinjarra Filtration Pipe Super Thickner	2018	Welded Carbon Steel Pipe
Pipeline Replacement Kwinana Residue	2018	Seamless Carbon Steel Pipe
Van Gogh Gas Offshore FPSO	2018	Low Temp Heavy Wall Fittings, Low Temp High Rated Flanges
Worsley Alumina Gas Pipeline Replacement	2018	Carbon Steel Seamless Piping, Flanges & Fittings, Carbon Steel & Stainless Steel Valves
Karara Mine Site Maintenance and Pipeline Replacement	2018	Carbon Steel Pipe, Flanges & Fittings
Cape Lambert Dust Suppression Upgrade	2018	Carbon Steel Roll Grooved Piping
Shell Prelude FLNG	2017	Carbon Steel & Stainless Steel Flanges, High Pressure Fittings
BHP Olympic Dam Cooling Towers	2017	Carbon Steel Pipe, Flanges & Fittings
Port Kembla Coal Terminal Restoration & Compliance Project	2017	Stainless Steel Pipe, Flanges, Fittings & Valves. Hose & Hose Fittings
Alcoa Wagerup Sand to Lakes Pipeline	2017	Carbon Steel Welded Pipe & Fittings
Yandi Oxbow Project	2017	Carbon Steel Large Bore Piping Materials.
Amrun Bauxite Mine Project	2017	Carbon Steel Welded Pipe
Veranus Island Gas Processing Hub Compression Expansion	2017	Low Temperature Heavy Wall Pipe & Fittings, High Pressure Flanges
Solomon Hub Filtrate Lines	2017	Carbon Steel Pipeline
Cape Lambert Power Station Upgrade	2016	Carbon Steel & Stainless Steel Pipe, Flanges, Fittings & Valves
Mt Caitlin Lithium Project	2016	Carbon Steel Seamless Pipe, High Pressure Forged Fittings
Karratha Gas Plant Maintenance Shutdown	2015	Valves, Fuel Vent Heads
Ichthys Gas Plant	2015	Stainless Steel Flanges & Fittings
Sino Iron Ore Project	2015	Carbon Steel High Pressure Fittings
Roy Hill Iron Ore Maintenance Program	2015	Carbon Steel & Stainless Steel Pipe, Flanges & Fittings.
Fire & Emergency Services Contract	2015	Extruded Rubber Suction & Delivery Hose, Hose Fittings
Dampier Supply Base	2015	Class Approved Marine Valves, Pipe and Hose

Scope of Supply

Product	Type	Sizing	Local Inventory Grade/s	Schedules & Pressure Classes	International Inventory
Pipe - Carbon Steel	Welded	50NB to 900NB	ASTM A53 Gr B API 5L Gr B API 5L X42 API 5L Gr X52 AS1163 Gr350LO	Std & XS	Low Temp & High Yield CS
Pipe - Carbon Steel	Seamless	50NB to 750NB	ASTM A53 Gr B API 5L Gr B ASTM A106 Gr B	Std, XS, S80, S160 & XXS	Low Temp, High Yield CS & CrMo
Pipe - Stainless Steel	Welded & Seamless	15NB to 600NB	ASTM A312 TP316 ASTM A312 TP316L	S10s, S40s, S80s, S160 & XXS	Stainless Steel, Duplex, Super Duplex, CuNi, Nickel Alloys & Titanium
Flanges - Forged	Weld Necks, Blinds, Slip Ons, Socket Weld & Threaded	15NB to 900NB	ASTM A105N ASTM A182 F316 ASTM A182 F316L	Class 150 to 2500lb Std, XS, S80, S160 & XXS	Stainless Steel, Duplex, Super Duplex, CuNi, Nickel Alloys & Titanium
Flanges – Plate	Slip Ons & Blinds	15NB to 900NB	Mild Steel 316SS 316LSS	Table D, E, F, H, JIS & PN	Stainless Steel, Duplex, Super Duplex, CuNi, Nickel Alloys & Titanium
Buttweld Fittings	Elbows, Tees, Reducers & Caps	15NB to 1200NB	ASTM A403 WP316 ASTM A403 WP316L	Std, XS, S80, S160 & XXS	Stainless, Low Temp, High Yield CS, CrMo, Duplex, Super Duplex, CuNi, Nickel Alloys & Titanium
High Pressure Forged Fittings, Threaded & Socket Weld	Elbows, Tees, Caps, Plugs, Nipples, Olets, Unions & Bushes	15NB to 150NB	ASTM A105N ASTM A105N Galv ASTM A182 F316 ASTM A182 F316L	3000lb, 6000lb & 9000lb	Stainless, Low Temp, High Yield CS, CrMo, Duplex, Super Duplex, CuNi, Nickel Alloys & Titanium
Low Pressure Screwed Fittings	Elbows, Tees, Caps, Plugs, Nipples, Olets, Unions & Bushes	15NB to 150NB	Black Steel Galvanised Steel Stainless 316 Stainless 316L	BSP-T BSP-P NPT	Stainless, Low Temp, High Yield CS, CrMo, Duplex, Super Duplex, CuNi, Nickel Alloys & Titanium
Valves	Ball Gate Check Globe Butterfly Knife Gates	15NB to 200NB	Carbon Steel Stainless Steel	End Connection – Flanges, Screwed & Socket Weld Pressure Rate – Up to 1600Kpa	Stainless, Low Temp, High Yield CS, CrMo, Duplex, Super Duplex, CuNi, Nickel Alloys & Titanium
Hose		6NB to 300NB	Suitable for Air, Water, Chemical, Compressed Air, Fuel & Marine Exhaust		
Hose Fittings	Camlocks Minsup Clamps Hose Tails		Bronze, Stainless Steel, Aluminum & Poly		
Tubing	Heat Exchanger Boiler Super Heater Finned	8NB to 100NB			Carbon, Low Temp, High Yield, CrMo, CuNi, Duplex, Super Duplex, Inconel, Nickel Alloys & Titanium
Engineered Products	Compact Flanges Forged Wye Pieces Swivel Flanges Misalignment Flanges Manifolds	15NB to 1200NB		Class 150 to Class 2500	Carbon, Low Temp, High Yield, CrMo, Duplex, Super Duplex, Inconel, Nickel Alloys & Titanium

Scope of Supply



PIPE WELDED & SEAMLESS

Carbon, Impact Tested, High Yield, Stainless, CuNi, CrMo, Duplex, Super Duplex, Nickel Alloys & Titanium



HOSE & HOSE FITTINGS

Hose - Air, Water, Chemical, Fuel, Exhaust, Delivery & Suction.
Fittings - Camlocks, Minsups, Clamps & Hose Tails



COMPACT & ENGINEERED FLANGES

Carbon, Impact Tested, High Yield, Stainless, CuNi, CrMo, Duplex, Super Duplex, Nickel Alloys & Titanium



HIGH & LOW PRESSURE FITTINGS SCREWED & SOCKET WELD

Carbon, Impact Tested, Stainless, Mild Steel, CrMo, Duplex, Super Duplex, Nickel Alloys & Titanium



BOLTING

Carbon, Impact Tested, High Yield, Stainless, CuNi, CrMo, Duplex, Super Duplex, Nickel Alloys & Titanium



ANSI BUTTWELD FITTINGS SEAMLESS & WELDED

Carbon, Impact Tested, High Yield, Stainless, CuNi, CrMo, Duplex, Super Duplex, Nickel Alloys & Titanium



ANSI & PLATE FLANGES

Carbon, Mild Steel, Impact Tested, High Yield, Stainless, CuNi, CrMo, Duplex, Super Duplex, Nickel Alloys & Titanium

VALVES - BALL, GATE, GLOBE, CHECK & BUTTERFLY

Carbon, Impact Tested, High Yield, Stainless, CuNi, CrMo, Duplex, Super Duplex, Nickel Alloys & Titanium



Pipe, Carbon & Stainless – Dimensions and Weights

UPPER FIGURE = WT

LOWER FIGURE = KGS/MTR

INCHES	NOMINAL PIPE SIZE MM	OD MM	5S	10S	10	20	30	STD	40S	40	60	XS	80S	80	100	120	140	160	XXS
1/8	6	10.3		1.24 0.28				1.73 0.37	1.73 0.36	1.73 0.37		2.41 0.47	2.41 0.48	2.41 0.47					
1/4	8	13.7		1.65 0.51				2.24 0.63	2.24 0.64	2.24 0.63		3.02 0.80	3.02 0.82	3.02 0.80					
3/8	10	17.1		1.65 0.64				2.31 0.84	2.31 0.84	2.31 0.84		3.20 1.10	3.20 1.12	3.20 1.10					
1/2	15	21.3	1.65 0.82	2.11 1.01				2.77 1.27	2.77 1.30	2.77 1.27		3.73 1.62	3.73 1.65	3.73 1.62				4.78 1.95	7.47 2.55
3/4	20	26.7	1.65 1.04	2.11 1.31				2.87 1.69	2.87 1.71	2.87 1.69		3.91 2.20	3.91 2.24	3.91 2.20				5.56 2.90	7.82 3.64
1	25	33.4	1.65 1.33	2.77 2.13				3.38 2.50	3.38 2.55	3.38 2.50		4.55 3.24	4.55 3.29	4.55 3.24				6.35 4.24	9.09 5.45
1 1/4	32	42.2	1.65 1.68	2.77 2.76				3.56 3.39	3.56 3.46	3.56 3.39		4.85 4.47	4.85 4.56	4.85 4.47				6.35 5.61	9.70 7.77
1 1/2	40	48.3	1.65 1.95	2.77 3.17				3.68 4.05	3.68 4.13	3.68 4.05		5.08 5.41	5.08 5.51	5.08 5.41				7.14 7.25	10.15 9.56
2	50	60.3	1.65 2.44	2.77 4.01				3.91 5.44	3.91 5.54	3.91 5.44		5.54 7.48	5.54 7.63	5.54 7.48				8.74 11.11	11.07 13.44
2 1/2	65	73.0	2.11 3.77	3.05 5.36				5.16 8.63	5.16 8.81	5.16 8.63		7.01 11.41	7.01 11.64	7.01 11.41				9.53 14.92	14.02 20.39
3	80	88.9	2.11 4.60	3.05 6.59				5.49 11.29	5.49 11.52	5.49 11.29		7.62 15.27	7.62 15.59	7.62 15.27				11.13 21.35	15.24 27.68
3 1/2	90	101.6	2.11 5.29	3.05 7.55				5.74 13.57	5.74 13.84	5.74 13.57		8.08 18.63	8.08 19.01	8.08 18.63					
4	100	114.3	2.11 5.96	3.05 8.52				6.02 16.07	6.02 16.40	6.02 16.07		8.56 22.32	8.56 22.77	8.56 22.32		11.13 28.32		13.49 33.54	17.12 41.03
5	125	141.3	2.77 9.67	3.40 11.82				6.55 21.77	6.55 22.20	6.55 21.77		9.53 30.97	9.53 31.59	9.53 30.97		12.70 40.28		15.88 49.11	19.05 57.43
6	150	168.3	2.77 11.55	3.40 14.13				7.11 28.26	7.11 28.83	7.11 28.26		10.97 42.56	10.97 43.42	10.97 42.56		14.27 54.20		18.26 67.56	21.95 79.22
8	200	219.1	2.77 15.09	3.76 20.37		6.35 33.31	7.04 36.81	8.18 42.55	8.18 43.39	8.18 42.55	10.31 53.08	12.70 64.64	12.70 65.95	12.70 64.64	15.09 75.92	18.26 90.44	20.62 100.92	23.01 111.27	22.23 107.92
10	250	273.1	3.40 23.08	4.19 28.34		6.35 41.77	7.80 51.03	9.27 60.31	9.27 61.52	9.27 60.31	12.70 81.55	12.70 81.55	12.70 83.19	15.09 96.01	18.26 114.75	21.44 133.06	25.40 155.15	28.58 172.33	25.40 155.15
12	300	323.9	3.96 31.89	4.57 36.73		6.35 49.73	8.38 65.20	9.53 73.88	9.52 75.32	10.31 79.73	14.27 108.96	12.70 97.46	12.70 99.43	17.48 132.08	21.44 159.91	25.40 186.97	28.58 208.14	33.32 238.76	25.40 186.97
14	350	355.6	3.96 35.06	4.78 42.14	6.35 54.69	7.92 67.90	9.53 81.33	9.53 81.33		11.13 94.55	15.09 126.71	12.70 107.39		19.05 158.10	23.83 194.96	27.79 224.65	31.75 253.56	35.71 281.70	
16	400	406.4	4.19 42.41	4.78 48.26	6.35 62.64	7.92 77.83	9.53 93.27	9.53 93.27		12.70 123.30	16.66 160.12	12.70 123.30		21.44 203.53	26.19 245.56	30.96 286.84	36.53 333.19	40.49 365.35	
18	450	457.2	4.19 47.77	4.78 54.36	6.35 70.57	7.92 87.71	9.53 122.38	9.53 105.16		14.27 155.80	20.05 205.74	12.70 139.15		23.88 254.55	29.36 309.62	34.93 363.56	39.67 408.26	45.24 459.37	
20	500	508.0	4.78 60.46	5.54 70.00	6.35 78.55	9.53 117.15	12.70 155.12	9.53 117.15		15.09 183.42	20.62 247.83	12.70 155.12		26.19 311.17	32.54 381.53	38.10 441.49	44.45 508.11	50.01 564.81	
22	550	558.8	4.78 66.57	5.54 77.06	6.35 86.54	9.53 129.13	12.70 171.09	9.53 129.13		22.23 294.25	27.48 342.91	12.70 171.09		28.58 373.83	34.93 451.42	41.28 527.02	47.63 600.63	53.98 672.26	
24	600	609.6	5.54 84.16	6.35 96.37	6.35 94.53	9.53 141.12	12.70 209.64	9.53 141.12		17.48 255.41	24.61 355.26	12.70 187.06		30.96 442.08	38.89 547.71	46.02 640.03	52.27 720.15	59.54 808.22	
26	650	660.04			7.92 127.36	12.70 202.72		9.53 152.87				12.70 202.72	Wall Thickness = mm Weight = kg/m (plain end mass) 5 S, 10 S, 40 S, 80 S – ANSI B36.19 Formula to attain approximate mass in kilograms per metre (kg/m) for Steel Round Pipe and Tubing $M = (D-t) \times 0.02466$ Where: M = Mass to the nearest 0.01 kg/m D = Outside diameter in millimetres (To nearest 0.1mm for OD up to 406.4mm) (To nearest 1.0mm for OD 457mm and above) t = Wall thickness to nearest 0.01mm						
28	700	711.2			7.92 137.32	12.70 218.69	15.88 271.21	9.53 164.85				12.70 218.69							
30	750	762.0	6.35 120.72	7.92 150.36	7.92 147.28	12.70 234.67	15.88 292.18	9.53 176.84				12.70 234.67	EXAMPLE: Nominal Size DN300 NPS12 OD = 323.9mm W.T. = 9.53mm Step 1. 323.9 – 9.53 = 314.37 Step 2. 314.37 x 9.53 = 2995.9461 Step 3. 2995.9461 x 0.02466 = 73.88kg/m						
32	800	812.8			7.92 157.24	12.70 250.64	15.88 312.15	9.53 188.82		17.48 342.91		12.70 250.64							
34	850	863.6			7.92 167.20	12.70 266.61	15.88 332.12	9.53 200.31		17.48 364.90		12.70 266.61	EXAMPLE: Nominal Size DN300 NPS12 OD = 323.9mm W.T. = 9.53mm Step 1. 323.9 – 9.53 = 314.37 Step 2. 314.37 x 9.53 = 2995.9461 Step 3. 2995.9461 x 0.02466 = 73.88kg/m						
36	900	914.4			7.92 176.96	12.70 282.27	15.88 351.70	9.53 212.56		19.05 420.42		12.70 282.27							
38	950	965.2						9.53 224.54				12.70 298.24	EXAMPLE: Nominal Size DN300 NPS12 OD = 323.9mm W.T. = 9.53mm Step 1. 323.9 – 9.53 = 314.37 Step 2. 314.37 x 9.53 = 2995.9461 Step 3. 2995.9461 x 0.02466 = 73.88kg/m						
40	1000	1016.0						9.53 236.63				12.70 314.22							
42	1050	1066.8						9.53 248.52				12.70 330.19	EXAMPLE: Nominal Size DN300 NPS12 OD = 323.9mm W.T. = 9.53mm Step 1. 323.9 – 9.53 = 314.37 Step 2. 314.37 x 9.53 = 2995.9461 Step 3. 2995.9461 x 0.02466 = 73.88kg/m						
44	1100	1117.6						9.53 260.50				12.70 346.16							
46	1150	1168.4						9.53 272.25				12.70 351.82	EXAMPLE: Nominal Size DN300 NPS12 OD = 323.9mm W.T. = 9.53mm Step 1. 323.9 – 9.53 = 314.37 Step 2. 314.37 x 9.53 = 2995.9461 Step 3. 2995.9461 x 0.02466 = 73.88kg/m						
48	1200	1219.2						9.53 284.24				12.70 377.79							

PIPE SCHEDULE – ANSI B36.10 – METRIC

ANSI Flanges and Butt Weld Fittings - General Information

Flanges

A flange is a method of connecting pipes, valves, pumps and other equipment to form a pipe work 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.

Ring Type Joint

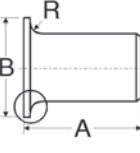
This is a method of ensuring leak proof flange connection at high pressures. A metal ring is compressed into a hexagonal groove on the face of the flange to make the seal. This jointing method can be employed on Weld Neck, Slip-on and Blind Flanges.

CARBON		Flange Material	
A105(N)	ALLOY STEEL	STAINLESS STEEL	DUPLEX/S.DUPLEX
A181	A182 F1	A182 F304/H/L	- A182 F51/UNS S31803
A266	A182 F2	A182 F310	- A182 F53/UNS S32750
A350 LF1/LF2/LF3	A182 F5/A	A182 F316/H/L	- A182 F55/UNS S32760
A694 F42	A182 F6/A	A182 F321/H	- A182 F44/UNS S31254
A694 F52	A182 F9	A182 F347/H	- A182 F49/UNS S34565
A694 F60	A182 F11	A182 F348/H	
A694 F65	A182 F12	A182 F10	
A707/3 CL.2/CL.3	A182 F22		
A707/5 CL.3	A182 F91		

What Are Butt Weld Fittings?

Butt weld fittings are a family of fittings used in connecting and creating pipe work systems whereby they are welded into the system using circumferential butt welds. They are used only in conjunction with ANSI pipe and are available in the same size range. They are used in areas where pipe work is permanent and are designed to provide good flow characteristics.

For what is each fitting used?

Fitting	Use/Notes	Fitting	Use/Notes
Long Radius Elbows: 45 and 90 Degree Elbow and 180 Degree Return Bends		Concentric Reducer	
	Enables the pipe run to be turned through 45 degree, a right angle or back on itself. Radius is 1.5 times nominal pipe size.		Used to connect two pipes of different dimensions. Designed to have good flow characteristics thus reducing erosion and corrosion.
90 Degree Short Radius Elbows and 180 Degree Return Bends		Eccentric Reducer	
	Enables the pipe run to be turned through a right angle or back on itself. Radius is 1 times nominal pipe size.		Used to connect two pipes of different dimensions. Designed to have good flow characteristics thus reducing erosion and corrosion.
Equal Tee		End Cap	
	Allows connection of a branch at right angles from main pipe run. Branch has same dimensions as main pipe run.		Used to blank off at the end of pipe work.
Reducing Tee		Stub End: Made to MSS SP43	
	Allows connection of a branch at right angles from main pipe run. Branch has smaller dimensions than main pipe run. When stating the size, the larger dimension always specifies the main pipe run, no matter which order the dimensions are quoted in.		Always used with a lap joint flange as a backing flange. Flange can be made of coated mild steel, as it does not come into contact with the product in the pipe. This is a cheap method of flanging in low-pressure, non-critical applications.

Butt Weld Fittings – Dimensions

ANSI B16.9

 B16.9
 LONG RADIUS WELDING ELBOWS, RETURN BENDS & CAPS

 B16.9
 SHORT RADIUS WELDING ELBOWS & RETURN BENDS

 NOMINAL SIZES SHOWN ARE
 ∇ DN: SI METRIC TERM ∩ NPS: ANSI TERM

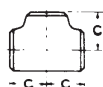
Nom. Size		PIPE OD mm	WALL THICKNESS — MILLIMETRES (mm)													A	B	K	D	V	E. Std. Wt. & Ex. Stg	Nom. Size		
∇ DN	∩ NPS		Sch. 10	Sch. 20	Sch. 30	Std. Wt.	Sch. 40	Sch. 60	X Stg.	Sch. 80	Sch. 100	Sch. 120	Sch. 140	Sch. 160	X.X. Stg.							∇ DN	∩ NPS	
15	½	21.3	-	-	-	2.77	↑ SAME AS STD. WT. ↓	-	3.73	↑ SAME AS X. STG. ↓	-	-	-	4.78	7.47	38	16	48	-	-	25.4	15	½	
20	¾	26.7	-	-	-	2.87		-	3.91		-	-	-	-	5.56	7.82	38	19	51	19	33	25.4	20	¾
25	1	33.4	-	-	-	3.38		-	4.55		-	-	-	-	6.35	9.09	38	22	56	25	41	38.1	25	1
32	1¼	42.2	-	-	-	3.56		-	4.85		-	-	-	-	6.35	9.70	48	25	70	32	52	38.1	32	1¼
40	1½	48.3	-	-	-	3.68		-	5.08		-	-	-	-	7.14	10.15	57	29	83	38	62	38.1	40	1½
50	2	60.3	-	-	-	3.91	↑ SAME AS STD. WT. ↓	-	5.54	↑ SAME AS X. STG. ↓	-	-	-	8.74	11.07	76	35	106	51	81	38.1	50	2	
65	2½	73.0	-	-	-	5.16		-	7.01		-	-	-	-	9.53	14.02	95	44	132	64	100	38.1	65	2½
80	3	88.9	-	-	-	5.49		-	7.62		-	-	-	-	11.13	15.24	114	51	159	76	121	50.8	80	3
90	3½	101.6	-	-	-	5.74		-	8.08		-	-	-	-	-	16.15	133	57	184	89	140	63.5	90	3½
100	4	114.3	-	-	-	6.02		↑ SAME AS STD. WT. ↓	-		8.56	↑ SAME AS X. STG. ↓	-	11.13	-	13.49	17.12	152	64	210	102	159	63.5	100
125	5	141.3	-	-	-	6.55	-		9.53	-	-		12.70	-	15.88	19.05	190	79	262	127	197	76.2	125	5
150	6	168.3	-	-	-	7.11	-		10.97	-	-		14.27	-	18.26	21.95	229	95	313	152	237	88.9	150	6
200	8	219.1	-	6.35	7.04	8.18	10.31		12.70	15.09	18.26		20.62	23.01	22.23	305	127	414	203	313	102	200	8	
250	10	273.1	-	6.35	7.80	9.27	12.70		12.70	15.09	18.26		21.44	25.40	28.58	25.40	381	159	518	254	390	127	250	10
300	12	323.9	-	6.35	8.38	9.53	10.31	14.27	12.70	17.48	21.44	25.40	28.58	33.32	25.40	457	190	619	305	467	152	300	12	
350	14	355.6	6.35	7.92	9.53	9.53	11.13	15.09	12.70	19.05	23.83	27.79	31.75	35.71	-	533	222	711	356	533	165	350	14	
400	16	406.4	6.35	7.92	9.53	9.53	12.70	16.66	12.70	21.44	26.19	30.96	36.53	40.49	-	610	254	813	406	610	178	400	16	
450	18	457	6.35	7.92	11.13	9.53	14.27	19.05	12.70	23.83	29.36	34.93	39.67	45.24	-	686	286	914	457	686	203	450	18	
500	20	508	6.35	9.53	12.70	9.53	15.09	20.62	12.70	26.19	32.54	38.10	44.45	50.01	-	762	318	1016	508	762	229	500	20	
600	24	610	6.35	9.53	14.27	9.53	17.48	24.61	12.70	30.96	38.89	46.02	52.37	59.54	-	914	381	1219	610	914	267	600	24	
750	30	762	7.92	12.70	15.88	9.53	-	-	12.70	-	-	-	-	-	-	1143	470	1524	762	1143	267	750	30	
900	36	914	7.92	12.70	15.88	9.53	19.05	-	12.70	-	-	-	-	-	-	1372	565	-	914	1372	267	900	36	

All dimensions are in millimetres – (mm)

STRAIGHT TEES (B16.9)

REDUCING TEES (B16.9)

CONCENTRIC & ECCENTRIC REDUCERS (B16.9)


 NOMINAL SIZES SHOWN ARE
 ∇ DN: SI METRIC TERM ∩ NPS: ANSI TERM

NOMINAL SIZE				C	M	H	NOMINAL SIZE				C	M	H	NOMINAL SIZE				C	M	H
DN ∇		NPS ⊥					DN ∇		NPS ⊥					DN ∇		NPS ⊥				
Large End	Small End	Large End	Small End				Large End	Small End	Large End	Small End				Large End	Small End	Large End	Small End			
20	20 15	¾	¾ ½	29	29	38	100	100 90 80	4	4 3½ 3	105	- 102 98	- 102 102	400	400 350 300	16	16 14 12	305	- 305 295	- 356 356
25	25 20 15	1	1 ¾ ½	38	- 38 38	50.8 50.8		65 50 40		2½ 2 1½		89 102 102	250 200 150		10 8 6		283 273 264		356 356 356	
	32		25 20 15		1¼	1 ¾ ½		48		- 48 48		50.8 50.8 50.8	125		125 100 90		5		5 4 3½	124
40	40 32 25 20 15	1½	1½ 1¼ 1 ¾ ½	57	- 57 57 57 57	- 63.5 63.5 63.5 63.5	80 65 50	3 2½ 2	111 108 105	127 127 127	300 250 200	12 10 8		321 308 298	381 381 381					
	50		50 40 32 25 20		2	2 1½ 1¼ 1 ¾	64	- 60 57 51 44	- 76.2 76.2 76.2 76.2	150	150 125 100 90 80 65	6		6 5 4 3½ 3 2½	143	- 137 130 127 124 121		- 140 140 140 140 140	500	
65		65 50 40 32 25	2½	2½ 2 1½ 1¼ 1		76		- 70 67 64 57	- 88.9 88.9 88.9 88.9		200		200 150 125 100 80	8		8 6 5 4 3	216	- 168 162 156 152 152		- 152 152 152 152
	80	80 65 50 40 32		3	3 2½ 2 1½ 1¼		86	- 83 76 73 70	- 88.9 88.9 88.9 88.9	250		250 200 150 125 100	10		10 8 6 5 4	254		- 203 194 191 184	- 178 178 178 178	750
90		90 80 65 50 40	3½		3½ 3 2½ 2 1½	95		- 92 89 83 79	- 102 102 102 102		300	300 250 200 150		12	12 10 8 6		279	- 241 229 219	- 203 203 203	
	350	350 300 250 200 150		14	14 12 10 8 6		279	- 270 257 248 238	- 330 330 330 330	900		900 750 600 500 450	36		36 30 24 20 18	673		- 635 610 584 572	- 610 610 610 610	
Note: All dimensions are in millimetres – (mm)																				

Note: All dimensions are in millimetres – (mm)

ANSI Butt Weld Fittings – Dimensional Tolerances

Cross-sectional tolerances for all butt welding fittings (ASME/ANSI B16.9)

Nominal Pipe Size (NPS)	All Fittings				Wall thickness
	OD at Bevel		ID at Bevel ±		
	in	mm	in	mm	
½ to 2½	+0.06, -0.03	+1.6, -0.8	0.03	0.8	Not less than 87.5% of nominal wall thickness.
3 to 3½	±0.6	±1.6	0.06	1.6	
4	±0.6	±1.6	0.06	1.6	
5 to 6	+0.09, -0.06	+2.4, -1.6	0.06	1.6	
8	+0.09, -0.06	+2.4, -1.6	0.06	1.6	
10	+0.16, -0.12	+4.0, -3.2	0.12	3.2	
12 to 18	+0.16, -0.12	+4.0, -3.2	0.12	3.2	
20 to 24	+0.25, -0.19	+6.4, -4.8	0.19	4.8	
26 to 30	+0.25, -0.19	+6.4, -4.8	0.19	4.8	
32 to 48	+0.25, -0.19	+6.4, -4.8	0.19	4.8	



Tolerances for Specific Fittings

Dimensional tolerances for elbows and returns (ASME/ANSI B16.9)

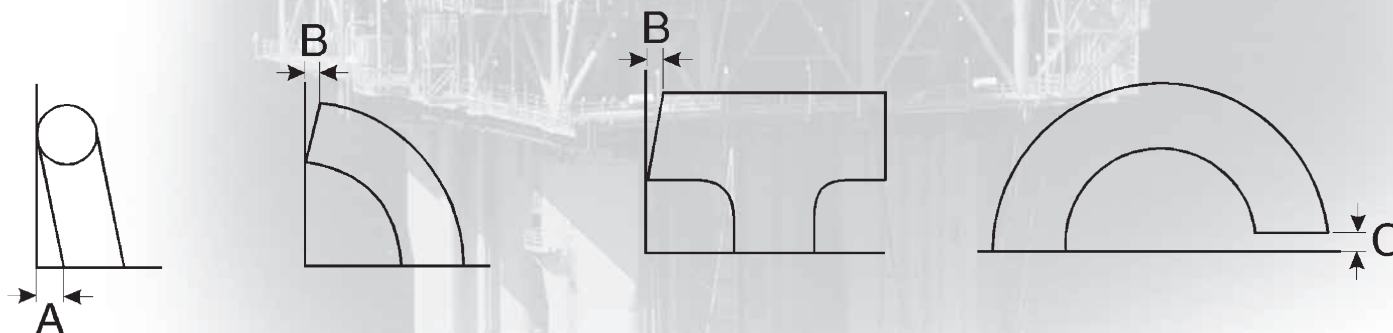
Nominal Pipe Size (NPS)	90° & 45° Long Radius Elbows 90° Short Radius Elbows and Tees		180° Returns			
	Centre-to-End Dimension ± A, B		Centre-to-Centre Dimension ± B (=2 x A)		Back-to-Face Dimension ± C	
	in	mm	in	mm	in	mm
½ to 2½	0.06	2	0.25	6	0.25	6
3 to 3½	0.06	2	0.25	6	0.25	6
4	0.06	2	0.25	6	0.25	6
5 to 6	0.06	2	0.25	6	0.25	6
8	0.06	2	0.25	6	0.25	6
10	0.09	2	0.38	10	0.25	6
12 to 18	0.09	2	0.38	10	0.25	6
20 to 24	0.09	2	0.38	10	0.25	6
26 to 30	0.12	3	–	–	–	–
32 to 48	0.19	5	–	–	–	–

Dimensional tolerances for reducers, caps and stub ends (ASME/ANSI B16.9)

Nominal Pipe Size (NPS)	Reducers & Lap Joint Stub Ends		Caps		Lap Joint Stub Ends			
	Overall Length ± A		Overall Length ± A		OD of Lap B		Fillet Radius of Lap B	
	in	mm	in	mm	in	mm	in	mm
½ to 2½	0.06	2	0.12	3	+0	+0, -1	+0	+0, -1
3 to 3½	0.06	2	0.12	3	+0, -0.03	+0, -1	+0, -0.03	+0, -1
4	0.06	2	0.12	3	+0, -0.03	+0, -1	+0, -0.06	+0, -2
5 to 6	0.06	2	0.25	6	+0, -0.03	+0, -1	+0, -0.06	+0, -2
8	0.06	2	0.25	6	+0, -0.03	+0, -1	+0, -0.06	+0, -2
10	0.09	2	0.25	6	+0, -0.06	+0, -2	+0, -0.06	+0, -2
12 to 18	0.09	2	0.25	6	+0, -0.06	+0, -2	+0, -0.06	+0, -2
20 to 24	0.09	2	0.25	6	+0, -0.06	+0, -2	+0, -0.06	+0, -2
26 to 30	0.19	5	0.38	10	–	–	–	–
32 to 48	0.19	5	0.38	10	–	–	–	–

Alignment Tolerances

Alignment tolerances are concerned with the way that the ends of a fitting are cut. Exaggerated distortions are shown for clarity in the diagram below.



Alignment Tolerances (ASME/ANSI B16.9)

Nominal Pipe Size (NPS)	Off Plane Tolerances, ± A		Off Angle Tolerances, ± B		Alignment of Ends, ± C	
	in	mm	in	mm	in	mm
	in	mm	in	mm	in	mm
½ to 4	0.06	2	0.03	1	0.03	1
5 to 8	0.12	4	0.06	2	0.03	1
10 to 12	0.19	5	0.09	2	0.06	2
14 to 16	0.25	6	0.09	3	0.06	2
18 to 24	0.38	10	0.12	4	0.06	2
26 to 30	0.38	10	0.19	5	–	–
32 to 42	0.50	13	0.19	5	–	–
44 to 48	0.75	19	0.19	5	–	–

Dimensional Tolerances for reducers, caps and stub ends (ASME/ANSI B16.9)

Dimensions and Tolerances – MSS SP-43

MSS SP-43 only covers butt weld fittings made for use with Schedule 5S and 10S pipe as defined in ANSI/ASME B36.19M (plus short pattern stub ends suitable for use with Schedule 40S pipe). The dimensions and tolerances defined in MSS SP-43 are substantially the same as those in ASME/ANSI specifications (½ to 24 in).

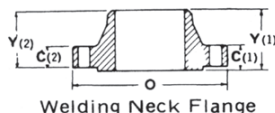
- MSS SP-43 tolerances (including alignment tolerance) are the same as for ASME/ANSI B16.9 except with regard to the outside diameter at the bevel:
- Tolerance of OD at Bevel =
± 0.03 in for NPS ½ to 4
+0.06, -0.03 in for NPS 5 to 8
+0.09, -0.03 in for NPS 10 to 18
+0.12, to -0.03 in for NPS 20 to 24

Forged Flanges – Dimensions

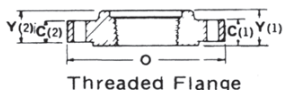
ANSI B16.5

DN 15 to 600 are to ANSI B16.5

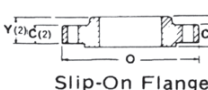
DN 750 & 900 are to BS 3293 for Slip-On & Weldneck only



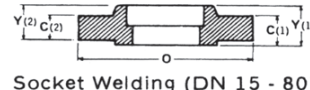
Welding Neck Flange



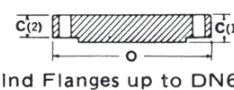
Threaded Flange



Slip-On Flange



Socket Welding (DN 15 - 80)


 Blind Flanges up to DN600
(Above DN600 see notes below ‡)

NOMINAL SIZES SHOWN ARE ∇DN: SI METRIC TERM ±NPS: ANSI TERM

Note: All dimensions are in millimetres – (mm)

Nominal Size		PN20 (CLASS 150)							PN50 (CLASS 300)							PN100 (CLASS 600)							Nominal Size	
		Dia. of Fig.	Thick-ness of Fig. Min.	Length Thru Hub		Dia. of Bolt Circle	Dia. of Bolt Holes	No. of Bolts	Dia. of Fig.	Thick-ness of Fig. Min.	Length Thru Hub		Dia. of Bolt Circle	Dia. of Bolt Holes	No. of Bolts	Dia. of Fig.	Thick-ness of Fig. Min.	Length Thru Hub		Dia. of Bolt Circle	Dia. of Bolt Holes	No. of Bolts		
				Thrd. Slip-on Soc/ Weld Y(1)†	Weld Neck Y(1)†						Thrd. Slip-on Soc/ Weld Y(1)†	Weld Neck Y(1)†						Thrd. Slip-on Soc/ Weld Y(2)†	Weld Neck Y(2)†				Thrd. Slip-on Soc/ Weld Y(2)†	Weld Neck Y(2)†
DN	NPS	0	C(1)†					0	C(1)†						0	C(2)†							DN	NPS
15	½	90	11.2	15.6	47.6	60.3	16	4	95	14.3	22.6	52.6	66.7	16	4	95	14.3	22	52	66.7	16	4	15	½
20	¾	100	12.7	15.6	52.6	69.9	16	4	115	15.9	25.6	57.6	82.6	19	4	115	15.9	25	57	82.6	19	4	20	¾
25	1	110	14.3	17.6	55.6	79.4	16	4	125	17.5	26.6	61.6	88.9	19	4	125	17.5	27	62	88.9	19	4	25	1
32	1¼	115	15.9	20.6	57.6	88.9	16	4	135	19.1	26.6	65.6	98.4	19	4	135	20.7	29	67	98.4	19	4	32	1¼
40	1½	125	17.5	22.6	61.6	98.4	16	4	155	20.7	30.6	68.6	114.3	22	4	155	22.3	32	70	114.3	22	4	40	1½
50	2	150	19.1	25.6	63.6	120.7	19	4	165	22.3	33.6	69.6	127.0	19	8	165	26.4	37	73	127.0	19	8	50	2
65	2½	180	22.3	28.6	69.6	139.7	19	4	190	25.4	38.6	76.6	149.2	22	8	190	28.6	41	79	149.2	22	8	65	2½
80	3	190	23.9	30.6	69.6	152.4	19	4	210	28.6	42.6	79.6	168.3	22	8	210	31.8	46	83	168.3	22	8	80	3
90	3½	215	23.9	31.6	71.6	177.8	19	8	230	30.2	44.6	80.6	184.2	22	8	230	35.0	49	86	184.2	25	8	90	3½
100	4	230	23.9	33.6	76.6	190.5	19	8	255	31.8	47.6	85.6	200.0	22	8	275	38.1	54	102	215.9	25	8	100	4
125	5	255	23.9	36.6	88.6	215.9	22	8	280	35.0	50.6	98.6	235.0	22	8	330	44.5	60	114	266.7	28	8	125	5
150	6	280	25.4	39.6	88.6	241.3	22	8	320	36.6	52.6	98.6	269.9	22	12	355	47.7	67	117	292.1	28	12	150	6
200	8	345	28.6	44.6	101.6	298.5	22	8	380	41.3	61.6	111.6	330.2	25	12	420	55.6	76	133	349.2	32	12	200	8
250	10	405	30.2	49.6	101.6	362.0	25	12	445	47.7	66.6	117.6	387.4	28	16	510	63.5	86	152	431.8	35	16	250	10
300	12	485	31.8	55.6	114.6	431.8	25	12	520	50.8	72.6	130.6	450.8	32	16	560	66.7	92	156	489.0	35	20	300	12
350	14	535	35.0	57.6	126.6	476.3	28	12	585	54.0	76.6	142.6	514.4	32	20	605	69.9	94	165	527.0	38	20	350	14
400	16	595	36.6	63.6	126.6	539.8	28	16	650	57.2	82.6	145.6	571.5	35	20	685	76.2	106	178	603.2	41	20	400	16
450	18	635	39.7	68.6	139.6	577.9	32	16	710	60.4	88.6	158.6	628.6	35	24	745	82.6	117	184	654.0	44	20	450	18
500	20	700	42.9	72.6	144.6	635.0	32	20	775	63.5	95.6	161.6	685.8	35	24	815	88.9	127	190	723.9	44	24	500	20
600	24	815	47.7	82.6	152.6	749.3	35	20	915	69.9	106.6	168.6	812.8	41	24	940	101.6	140	203	838.2	51	24	600	24
750	30	985	54.0	89	130.2	914.4	35	28	1092.3	92.1	209.6	209.6	996.9	47.6	28	1130.4	114.4	247.7	247.7	1022.3	54	28	750	30
900	36	1170	60.4	95.3	136.6	1085.8	41.2	32	1270.1	104.8	241.4	241.4	1168.4	53.9	32	1314.5	123.9	282.6	282.6	1193.8	67	28	900	36

Nominal Size		PN150 (CLASS 900)							PN250 (CLASS 1500)							PN420 (CLASS 2500)							Nominal Size		
		Dia. of Fig.	Thick-ness of Fig. Min.	Length Thru Hub		Dia. of Bolt Circle	Dia. of Bolt Holes	No. of Bolts	Dia. of Fig.	Thick-ness of Fig. Min.	Length Thru Hub		Dia. of Bolt Circle	Dia. of Bolt Holes	No. of Bolts	Dia. of Fig.	Thick-ness of Fig. Min.	Length Thru Hub		Dia. of Bolt Circle	Dia. of Bolt Holes	No. of Bolts			
				Thrd. Slip-on Soc/ Weld Y(2)†	Weld Neck Y(2)†						Thrd. Slip-on Soc/ Weld Y(2)†	Weld Neck Y(2)†						Thrd. Slip-on Soc/ Weld Y(2)†	Weld Neck Y(2)†			Thrd. Slip-on Soc/ Weld Y(2)†	Weld Neck Y(2)†	∇ DN	± NPS
DN	NPS	0	C(2)†						0	C(2)†						0	C(2)†							DN	NPS
15	½	USE PN250 DIMENSIONS IN THESE SIZES							120	22.5	32	60	82.6	22	4	135	30.2	40	73	88.9	22	4	15	½	
20	¾								130	25.5	35	70	88.9	22	4	140	31.8	43	79	95.2	22	4	20	¾	
25	1								150	29.0	41	73	101.6	25	4	160	35.0	48	89	108.0	25	4	25	1	
32	1¼								160	29.0	41	73	111.1	25	4	185	38.1	52	95	130.2	29	4	32	1¼	
40	1½								180	32.0	44	83	123.8	28	4	205	44.5	60	111	146.0	32	4	40	1½	
50	2								215	38.5	57	102	165.1	25	8	235	50.9	70	127	171.4	29	8	50	2	
65	2½								245	41.5	64	105	190.5	28	8	265	57.2	79	143	196.8	32	8	65	2½	
80	3	240	38.1	54	102	190.5	25	8	265	48.0		117	203.2	32	8	305	66.7		168	228.6	35	8	80	3	
100	4	290	44.5	70	114	235.0	32	8	310	54.0		124	241.3	35	8	355	76.2		190	273.0	41	8	100	4	
125	5	350	50.8	79	127	279.4	35	8	375	73.5		155	292.1	41	8	420	92.1		229	323.8	48	8	125	5	
150	6	380	55.6	86	140	317.5	32	12	395	83.0		171	317.5	38	12	485	108.0		273	368.3	54	8	150	6	
200	8	470	63.5	102	162	393.7	38	12	485	92.0		213	393.7	44	12	550	127.0		318	438.2	54	12	200	8	
250	10	545	69.9	108	184	469.9	38	16	585	108.0		254	482.6	51	12	675	165.1		419	539.8	67	12	250	10	
300	12	610	79.4	117	200	533.4	38	20	675	124.0		283	571.5	54	16	760	184.2		464	619.1	73	12	300	12	
350	14	640	85.8	130	213	558.8	41	20	750	133.5		298	635.0	60	16								350	14	
400	16	705	88.9	133	216	616.0	44	20	825	146.5		311	704.8	67	16								400	16	
450	18	785	101.6	152	229	685.8	51	20	915	162.0		327	774.7	73	16								450	18	
500	20	855	108.0	159	248	749.3	54	20	985	178.0		356	831.8	79	16								500	20	
600	24	1040	139.7	203	292	901.7	67	20	1170	203.5		406	990.6	92	16								600	24	

NOTES:

- * 1. The 1.6mm Raised Face is included in thickness C(1) and length through hub Y(1). This applies to PN20 and PN50 Pressure Ratings.
- = 2. The 6.4mm Raised Face is not included in thickness C(2) and length through hub Y(2). PN100, 150, 250 and 420 Pressure Ratings are regularly furnished with 6.4mm Raised Face which is additional to the flange thickness C(2) and Y(2).
3. Always specify bore when ordering weldneck flanges. Bore dimensions shown opposite also provide inside pipe diameters

LARGE DIAMETER FLANGES ABOVE DN 600

- ‡ For Blind Flanges refer to ASME B16.47-A (MSS SP44).
- BS 3293 covers Slip-On and Weldneck but excludes Blind Flanges.
- ASME B16.47-A (MSS SP44) covers Blind and Weldneck but excludes Slip-On Flanges.
- BS 3293 Weldneck PN20 flange thickness, C(1), is less than MSS SP44 equivalents.
- ASME B16.47-B (API - 605) Dimensions for Large Diameter Flanges vary considerably from both BS 3293 and ASME B16.47-A (MSS SP44) – Details on request.

Raised Face Diam.	NOMINAL SIZE		O.D. of PIPE mm	APPROXIMATE WELDING NECK FLANGE BORES - mm														
	Alt. Press Ratings-mm	∇ DN		Ⅰ NPS	SCH. 10	SCH. 20	SCH. 30	STD. WT.	SCH. 40	SCH. 60	EXT. STG.	SCH. 80	SCH. 100	SCH. 120	SCH. 140	SCH. 160	X.X. STG.	
35	15	½	21.3				15.8	↑ SAME AS STD. WT. ↓		13.9	↑ SAME AS EXT. STG. ↓				11.8	6.4		
43	20	¾	26.7				20.9			18.9						15.5	11.0	
51	25	1	33.4				26.6			24.3						20.7	15.2	
64	32	1½	42.2				35.1			32.5						29.5	22.8	
73	40	1½	48.3				40.9			38.1						34.0	27.9	
92	50	2	60.3				52.5			49.2						42.9	38.2	
105	65	2½	73.0				62.7			59.0						54.0	45.0	
127	80	3	88.9				77.9			73.7						66.7	58.4	
140	90	3½	101.6				90.1			85.4								
157	100	4	114.3				102.3			97.2							87.3	80.1
186	125	5	141.3				128.2		122.3				92.1	115.9	109.6	103.2		
216	150	6	168.3				154.1		146.3				139.7	188.9	177.8	131.8	124.4	
270	200	8	219.1				202.7		193.7				182.6	247.7	230.2	173.1	174.6	
324	250	10	273.1		206.4	205.0	254.5		247.7	247.7	242.9	236.5	230.2	222.3	215.9	222.3		
381	300	12	323.9		311.1	307.1	304.8	303.2	295.3	298.5	288.9	281.0	273.1	266.7	257.2	273.1		
413	350	14	355.6	342.9	339.8	336.6	336.6	333.3	325.4	330.2	317.5	307.9	300.0	292.1	284.2			
470	400	16	406.4	393.7	390.6	387.4	387.4	381.0	373.1	381.0	363.5	354.0	344.5	333.3	325.4			
533	450	18	457.0	444.5	441.4	434.9	438.2	428.7	419.1	431.8	409.5	398.5	387.4	377.9	366.7			
584	500	20	508.0	495.3	489.0	482.6	482.6	477.8	466.8	482.6	455.6	442.9	431.8	419.1	408.0			
692	600	24	610.0	596.9	590.6	581.1	590.6	574.6	560.4	584.2	547.7	531.8	517.6	504.9	490.5			
857	750	30	762.0	746.2	736.6	730.2	743.0			736.6								
1022	900	36	914.0	898.6	889.0	882.6	882.6	876.3		889.0								

Forged Flanges – Dimensional Tolerances

ANSI B16.5

The tolerances listed below are always observed in the flange production and are to be understood as maximum limits, since the manufacture, effected by modern and properly equipped machines, usually ranges between more narrow limits. Said tolerances, unless otherwise specified, and those approved by American Standard ANSI B16.5.

DIMENSIONS IN INCHES

THREADED, SOCKET-WELDING SLIP-ON, LAP JOINT AND BLIND FLANGES

OUTSIDE DIAMETER	When O.D. is 5" or less	+0.09", -0.03"
	When O.D. is 6" and above	+ 0.16", -0.03"
INSIDE DIAMETER	Threaded	To Standard Gauge Limits
	Socket-welding Slip-on and Lap Joint Sizes 10" and smaller	+0.03", -0"
	Sizes 12" to 18"	+ 0.06", -0"
	Sizes 20" and above	+0.12", -0.06"
DIAMETER OF COUNTERBORE	Threaded Sizes 10" and below	+0.03", -0"
	Threaded Sizes 12" and above	+0.06", -0"
	Socket Weld 3" and below	± 0.10"
DIAMETER OF CONTACT FACE	1/16" Raised Face	± 0.03"
	1/4" Raised Face Tongue and Groove or Male and Female	± 0.02"
DRILLING	Bolt Circle	± 0.06"
	Bolt Hole Spacing	± 0.016"
	Concentricity of Bolt Circle and Facing 2 1/2" and below	0.03"
	Concentricity of Bolt Circle and Facing 3" and above	0.06"
LENGTH THRU HUB	Sizes 18" and smaller	+ 0.12", -0.03"
	Sizes 20" and larger	+ 0.19", -0.06"
THICKNESS	Sizes 18" and smaller	+ 0.12", -0"
	Sizes 20" and larger	+ 0.19", -0"

WELDING NECK FLANGES

OUTSIDE DIAMETER	When O.D. is 5" or less	+0.09", -0.03"
	When O.D. is 6" and above	+ 0.16", -0.03"
INSIDE DIAMETER	Sizes 10" and smaller	± 0.03"
	Sizes 12" through 18"	± 0.06"
	Sizes 20" and larger	+ 0.12", -0.06"
DIAMETER OF CONTACT FACE	1/16" Raised Face	± 0.03"
	1/4" Raised Face	± 0.02"
	Tongue and Groove or Male and Female	± 0.02"
DRILLING	Bolt Circle	± 0.06"
	Bolt Hole Spacing	± 0.03"
	Concentricity of Bolt Circle and Facing 2 1/2" and below	0.03"
	Concentricity of Bolt Circle and Facing 3" and above	0.06"
LENGTH THRU HUB	Sizes 4" and smaller	± 0.06"
	Sizes 5" to 10"	+0.06", -0.12"
	Sizes 12" and above	+ 0.12", -0.18"
THICKNESS	Sizes 12" and smaller	+ 0.12", -0"
	Sizes 12" and larger	+ 0.19", -0"

Forged Flanges – Dimensions

ASME B16.47-A (MSS SP44)

LARGE DIAMETER FLANGES SPECIFICATIONS ASME B16.47-A (MSS-SP44)

RATING	NOMINAL PIPE SIZE mm	OD FLANGE O	FLANGE THICKNESS WELD NECK QA	FLANGE THICKNESS BLIND QB	OVERALL HEIGHT YY	HUB DIAMETER X	PCD P	NUMBER HOLES N	HOLE DIAMETER HD	RF DIAMETER R	RTJ DIAMETER K	RING PITCH DIAMETER RP	DEPTH GROOVE E	WIDTH GROOVE F	RING NUMBER RN
150	650	870	68.4	68.4	121	676	806.4	24	35.0	749					
	700	925	71.4	71.4	126	727	863.6	28	35.0	800					
	750	985	74.7	74.7	137	781	914.4	28	35.0	857					
	800	1060	81.0	81.0	145	832	977.9	28	41.1	914					
	850	1110	82.6	82.6	150	883	1028.7	32	41.1	965					
	900	1170	90.5	90.5	158	933	1085.8	32	41.1	1022					
	950	1240	87.4	87.4	158	991	1149.4	32	41.1	1073					
300	1000	1290	90.5	90.5	164	1041	1200.2	36	41.1	1124					
	650	970	79.3	84.1	185	721	876.3	28	44.4	749	810	749.3	12.7	19.8	93
	700	1035	85.8	90.5	197	775	939.8	28	44.4	800	861	800.1	12.7	19.8	94
	750	1090	92.1	95.3	210	827	997.0	28	47.7	857	917	857.2	12.7	19.8	95
	800	1150	98.6	100.1	223	881	1054.1	28	50.8	914	984	914.4	14.2	23.0	96
	850	1205	101.7	104.8	232	937	1104.9	28	50.8	965	1035	965.2	14.2	23.0	97
	900	1270	104.8	111.2	242	991	1168.4	32	53.8	1022	1092	1022.3	14.2	23.0	98
600	950	1170	108.0	108.0	181	994	1092.2	32	41.1	1029					
	1000	1240	114.4	114.4	194	1048	1155.7	32	44.4	1086					
	650	1015	108.0	125.5	222	748	914.4	28	50.8	749	810	749.3	12.7	19.8	93
	700	1075	111.2	131.8	235	803	965.2	28	53.9	800	861	800.1	12.7	19.8	94
	750	1130	114.3	139.7	248	862	1022.4	28	53.9	857	917	857.2	12.7	19.8	95
	800	1195	117.5	147.7	260	918	1079.5	28	60.3	914	984	914.4	14.2	23.0	96
	850	1245	120.7	154.0	270	973	1130.3	28	60.3	965	1035	965.2	14.2	23.0	97
900	900	1315	123.9	162.0	283	1032	1193.8	28	66.6	1022	1092	1022.3	14.2	23.0	98
	950	1270	152.4	155.0	254	1022	1162.0	28	60.3	1054					
	1000	1320	158.8	162.0	264	1073	1212.8	32	60.3	1111					
	650	1085	139.7	160.4	286	775	952.5	20	73.0	749	832	749.3	17.4	30.1	100
	700	1170	142.9	171.5	298	832	1022.4	20	79.3	800	889	800.1	17.4	33.3	101
	750	1230	149.3	182.6	311	889	1085.8	20	79.3	857	946	857.2	17.4	33.3	102
	800	1315	158.8	193.7	330	946	1155.7	20	85.7	914	1003	914.4	17.4	33.3	103
900	850	1395	165.1	204.8	349	1006	1225.6	20	92.0	965	1067	965.2	20.6	36.5	104
	900	1460	171.5	214.4	362	1064	1289.0	20	92.0	1022	1129	1022.3	20.6	36.5	105
	950	1460	190.5	215.9	352	1073	1289.0	20	92.0	1099					
	1000	1510	196.9	223.9	364	1127	1339.8	24	92.0	1162					

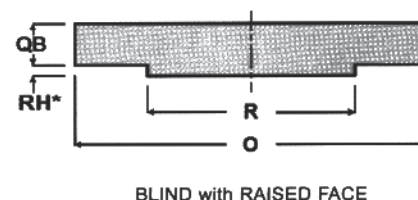
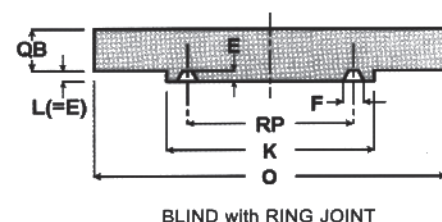
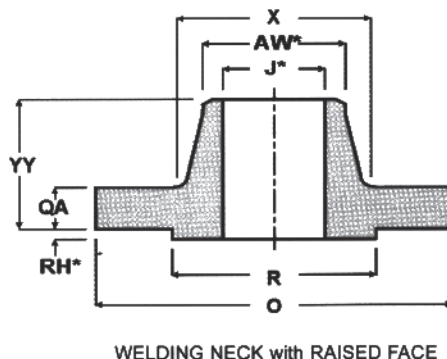
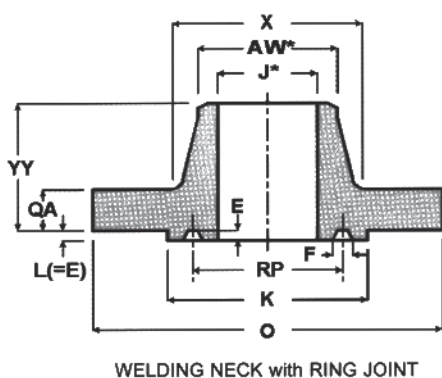
*RH SIZE: 150 & 300 RATING 1.6mm INCLUDED IN QA, QB AND YY DIMENSION.
600 & 900 RATING 6.4mm NOT INCLUDED IN QA, QB AND YY DIMENSION.

*WN BORE J: TO BE SPECIFIED BY PURCHASER.

*AW DIAMETER OF NECK: TO MATCH PIPE OD.

*All dimensions are in millimetres (mm)

*For tolerance please refer to ASME B16.47



Forged Flanges – Dimensions

ASME B16.47-B (API 605)

LARGE DIAMETER FLANGES SPECIFICATIONS ASME B16.47-B (API-605)

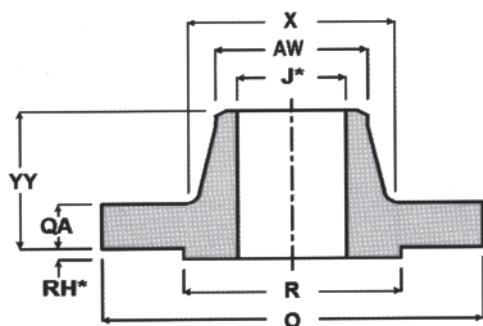
RATING	NOMINAL PIPE SIZE mm	OD FLANGE O	FLANGE THICKNESS WELD NECK QA	FLANGE THICKNESS BLIND QB	OVERALL HEIGHT YY	RF DIAMETER R	HUB DIAMETER X	NECK DIAMETER AW	PCD P	NO. OF BOLT HOLES N	HOLE DIAMETER HD
150	650	785	41.4	44.6	89	711	684	661.9	744.5	36	22.3
	700	835	44.6	47.8	96	762	735	712.7	795.3	40	22.3
	750	885	44.6	50.9	100	813	787	763.5	846.1	44	22.3
	800	940	46.2	54.1	108	864	840	814.3	900.1	48	22.3
	850	1005	49.3	57.3	111	921	892	865.1	957.3	40	25.4
	900	1055	52.5	58.9	118	972	945	915.9	1009.6	44	25.4
	950	1125	54.1	63.6	124	1022	997	968.2	1070.0	40	28.5
	1000	1175	55.7	66.8	129	1080	1049	1019.0	1120.8	44	28.5
	1050	1225	58.9	68.4	134	1130	1102	1069.8	1171.6	48	28.5
	1100	1275	60.5	71.6	137	1181	1153	1120.6	1222.4	52	28.5
	1150	1340	62.0	74.6	145	1235	1205	1171.4	1284.3	40	31.7
	1200	1390	65.2	77.9	150	1289	1257	1222.2	1335.1	44	31.7
300	650	865	89.0	89.0	145	737	702	665.2	803.3	32	34.9
	700	920	89.0	89.0	150	787	756	716.0	857.2	36	34.9
	750	990	93.7	93.6	158	845	813	768.4	920.8	36	38.1
	800	1055	103.2	103.2	169	902	864	819.2	977.9	32	41.2
	850	1110	103.2	103.2	173	953	918	870.0	1031.9	36	41.2
	900	1170	103.2	103.2	181	1010	965	920.8	1089.0	32	44.4
	950	1220	111.2	111.2	193	1060	1016	971.6	1139.8	36	44.4
	1000	1275	115.9	115.9	199	1114	1067	1022.4	1190.6	40	44.4
	1050	1335	119.1	119.1	205	1168	1118	1074.7	1244.6	36	47.6
	1100	1385	127.1	127.1	215	1219	1173	1125.5	1295.4	40	47.6
	1150	1460	128.6	130.1	223	1270	1229	1176.3	1365.2	36	50.8
	1200	1510	128.6	134.9	224	1327	1278	1227.1	1416.0	40	50.8
600	650	890	111.2	111.3	181	727	698	660.4	806.4	28	44.4
	700	950	115.9	115.9	190	784	752	711.2	863.6	28	47.6
	750	1020	125.5	127.0	205	841	806	762.0	927.1	28	50.8
	800	1085	130.2	134.9	216	895	860	812.8	984.2	28	53.9
	850	1160	141.3	144.2	233	953	914	863.6	1054.1	24	60.3
	900	1215	146.1	150.9	243	1010	968	914.4	1104.9	28	60.3
900	650	1020	135.0	154.0	259	762	743	660.4	901.7	20	66.6
	700	1105	147.7	166.7	276	819	797	711.2	971.6	20	73.0
	750	1180	155.6	176.1	289	876	851	762.0	1035.0	20	79.3
	800	1240	160.4	186.0	303	927	908	812.8	1092.2	20	79.3
	850	1315	171.5	195.0	319	991	962	863.6	1155.7	20	85.7
	900	1345	173.1	201.7	325	1029	1016	914.4	1200.2	24	79.3

*RH SIZE: 150 & 300 RATING 1.6mm INCLUDED IN QA, QB AND YY DIMENSION.
600 & 900 RATING 6.4mm NOT INCLUDED IN QA, QB AND YY DIMENSION.

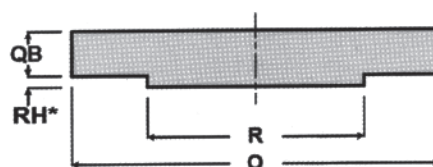
*WN BORE J: TO BE SPECIFIED BY PURCHASER.

*All dimensions are in millimetres (mm)

*For tolerance please refer to ASME B16.47



WELDING NECK



BLIND

LARGE DIAMETER FLANGES SPECIFICATIONS BS 3293

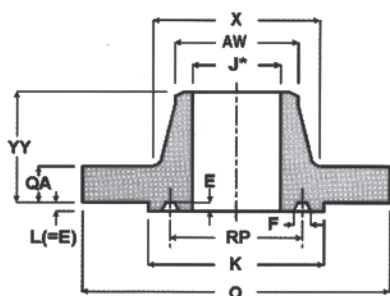
RATING	NOMINAL PIPE SIZE mm	OD FLANGE O	FLANGE THICKNESS QA	OVERALL HEIGHT YY	OVERALL HEIGHT YS	SLIP ON BORE SB	HUB DIAMETER X	NECK DIAMETER AW	PCD P	NUMBER HOLES N	HOLE DIAMETER HD	RF DIAMETER R	RTJ RJ DIAMETER K	RING PITCH DIAMETER RP	DEPTH GROOVE E	WIDTH GROOVE F	RING NUMBER RN	LENGTH OF STUD BOLTS	
																		RF	RTJ
150	650	870.0	50.9	127.1	85.8	666.7	724.0	660.5	806.4	24	34.9	743.0						170	
	700	927.2	52.4	128.6	87.3	717.5	781.1	711.3	863.6	28	34.9	793.8						180	
	750	984.3	53.9	130.2	89.0	768.3	831.9	762.1	914.4	28	34.9	857.3						180	
	800	1060.5	57.2	133.4	92.1	819.1	889.1	812.9	977.9	28	41.2	908.1						200	
	850	1111.3	58.8	135.0	93.7	869.9	939.9	863.7	1028.7	32	41.2	958.9						205	
	900	1168.5	60.4	136.6	95.3	920.7	997.0	914.5	1085.8	32	41.2	1022.4						205	
	950	1238.3	60.4	136.6	95.3	971.5	1060.5	965.3	1149.3	32	41.2	1073.2						205	
	1000	1289.1	63.6	139.8	98.5	1022.3	1111.3	1016.1	1200.1	36	41.2	1124.0						210	
	1050	1346.3	66.7	142.9	101.7	1073.1	1168.5	1066.9	1257.3	36	41.2	1193.9						215	
	1100	1403.4	66.7	142.9	101.7	1123.9	1219.3	1117.7	1314.4	40	41.2	1244.7						215	
	1150	1454.2	68.3	144.5	103.2	1174.7	1270.1	1168.5	1365.2	40	41.2	1295.5						225	
	1200	1511.4	69.9	146.1	104.8	1225.5	1327.2	1219.3	1422.4	44	41.2	1359.0						225	
300	650	971.6	79.4	184.2		666.7	720.8	666.8	876.3	28.0	44.4	749.4	809.6	749.3	12.7	19.8	93	250	280
	700	1035.1	85.8	196.9		717.5	774.8	717.6	939.8	28.0	44.4	800.2	860.4	800.1	12.7	19.8	94	260	295
	750	1092.3	92.1	209.6		768.3	825.5	768.4	996.9	28.0	47.6	857.3	917.5	857.2	12.7	19.8	95	280	315
	800	1149.4	98.5	222.3		819.1	881.1	819.2	1054.1	28.0	50.8	914.5	984.2	914.4	14.2	23.0	96	300	330
	850	1206.6	101.7	231.8		871.5	936.7	871.6	1104.9	28.0	50.8	965.3	1035.0	965.2	14.2	23.0	97	305	340
	900	1270.1	104.8	241.4		922.3	990.7	922.4	1168.4	32.0	53.9	1022.4	1092.2	1022.3	14.2	23.0	98	320	350
600	650	1016.1	107.9	222.3		666.7	747.7	671.5	914.4	28	50.8	749.4	809.6	749.3	12.7	19.8	93	330	365
	700	1073.2	111.2	235.0		717.5	803.3	724.0	965.2	28	53.9	800.2	860.4	800.1	12.7	19.8	94	345	375
	750	1130.4	114.4	247.7		768.3	862.1	774.8	1022.3	28	53.9	857.3	917.5	857.2	12.7	19.8	95	350	380
	800	1193.9	117.5	260.4		819.1	917.6	825.6	1079.5	28	60.3	914.5	984.2	914.4	14.2	23.0	96	370	410
	850	1244.7	120.7	269.9		869.9	973.2	877.9	1130.3	28	60.3	965.3	1035.0	965.2	14.2	23.0	97	375	415
	900	1314.5	123.9	282.6		920.7	1031.9	928.7	1193.8	28	66.6	1022.4	1092.2	1022.3	14.2	23.0	98	395	435

*RH SIZE: 150 & 300 RATING 1.6mm INCLUDED IN QA, YY AND YS DIMENSION.
600 & 900 RATING 6.4mm NOT INCLUDED IN QA AND YY DIMENSION.

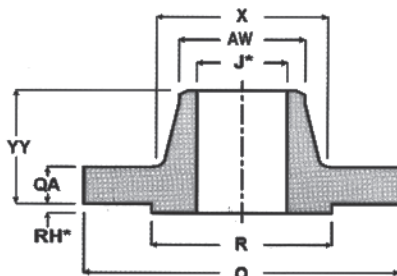
*WN BORE J: TO BE SPECIFIED BY PURCHASER.

*All dimensions are in millimetres (mm)

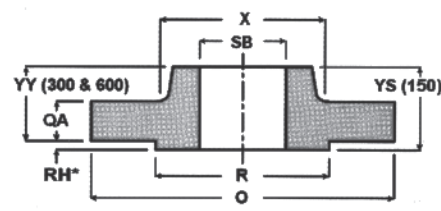
*For tolerance please refer to BS3293



WELDING NECK with RING JOINT



WELDING NECK



SLIP-ON

Compact Flanges

The Compact Flange System® is a fully proven alternative to the conventional flanged connection used throughout the oil, gas, petrochemical and power generation industries. Produced in a comprehensive range of sizes and materials, they offer versatility, compactness, weight saving and cost effectiveness in connecting piping system.

Standard pressure classes, sizes and flange types

A full range of compact flanges – equivalent to or with higher rating than ASME flanges are readily available.

The Compact Flange covers the usual range of nominal pipe size from ½" to 42". It is also available, as standard, in sizes from 26" to 42" for Class 1500, from 14" to 24" for Class 2500 and from ½" to 20" for Class 4500.

The Compact Flange is available as standard, with the following flange types: weld neck flange, blind flange, swivel flange, integral (equipment) flange, rigid interface and line blanks. Orifice flanges, restriction orifices and drip rings are also available on request.

The integral (valve) flange neck outside diameter fulfils the minimum wall thickness requirements given in ASME B16.34, Table 3 with the inside diameter given in ASME B167.34, Table A1.

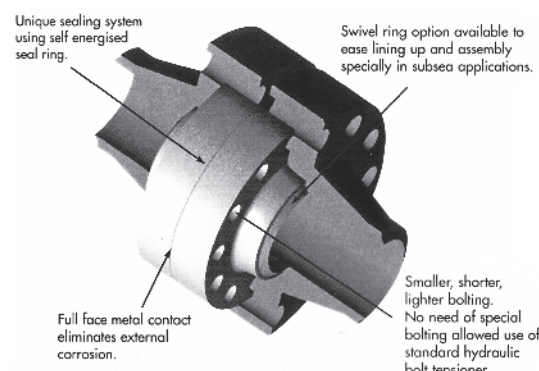
Access is made for torque tool with standard sockets in order to allow for valve-to-valve make up.

The envelope for CL600 to CL1500 up to 24" and CL2500 up to 12" is within the ANSI flange envelope. This means that standard flange castings "former" can be used without any modification. Major valve manufactures covering ball, gate, globe, choke and plug valves, have confirmed that they can use the integral compact flange on their valves.

Materials

Compact Flanges are available from standard forging with seal ring in compatible high strength material. The table below lists the more common material combinations:

All seal rings are coated to provide lubrication during make-up. A polymer based coating (PTFE) is used up to 250°C, and molybdenum disulphide (MoS2) coating is used up to 350°C. Silver plating is available for liquid oxygen service.



FLANGE	SEAL RING	BOLTING
ASTM A105 ASTM A350 LF2 ASTM A694 F52 ASTM A694 F60 ASTM A694 F65 AISI 4130 (UNS 41400)	AISI 41 40	ASTM A193 B7 ASTM A193 B16 ASTM A320 L7 ASTM A320 L43
ASTM 182 F316 ASTM 182 F44 (6Mo)ASTM A182 F51 ASTM 182 F49 ASTM 182 F51 (Duplex) ASTM 182 F53/F55 (Super Duplex)	ASTM A564 630 (17-4PH) ASTM A182 F53/F55 INCONEL 625 INCOLOY 825	
OVERLAY ON SEALING AREA, CONTACT SURFACE AND BORE IF REQUIRED.		

Applications

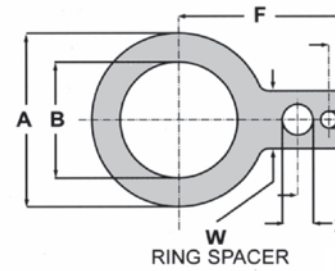
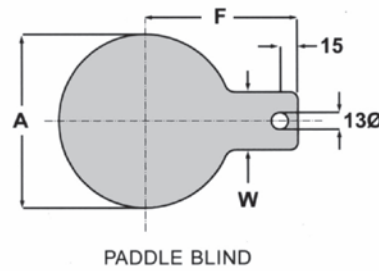
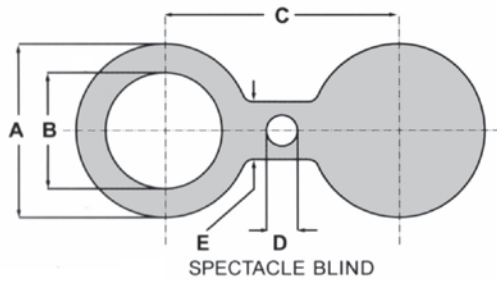
The compact flange can be used in many applications throughout a variety of different industries. The many features and benefits of the sealing integrity have gained acceptance in a variety of service conditions. The following is a partial list existing and/or potential service applications.

General – High-pressure, high temperature, hard to hold gas streams, vibrating or pulsating conditions and corrosive service.

Oil and Gas production – Subsea and onshore pipeline transmission/distribution, flow lines, risers, manifolds, well heads, injection systems, end fittings.

Spectacle & Paddle Blinds and Ring Spacers – Dimensions

Specification: ANSI B16.48



3.2 – 6.3 Ra FINISH BOTH SIDES T = THICKNESS

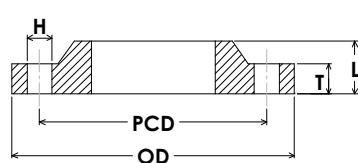
*NOTE: (1) Dimensions based on sizes designed to suit ANSI B16.5 Flanges.
(2) All dimensions are in mm

NOMINAL BORE mm	ANSI 150								ANSI 300							
	A	B	C	D	E	W	F	T	A	B	C	D	E	W	F	T
25	64.0	27	80	15.8	38	38	145.0	3.0	70	27	90	19.0	38	38	150.0	6.4
40	83.0	48	100	15.8	38	38	155.0	6.4	92	48	115	22.2	38	38	170.0	6.4
50	102.0	61	120	19.0	51	51	165.0	6.4	108	61	125	19.0	51	51	173.0	9.7
80	133.0	89	150	19.0	64	64	175.0	6.4	146	89	170	22.2	64	64	195.0	9.7
100	172.0	114	190	19.0	64	64	205.0	9.7	178	114	200	22.2	64	64	215.0	12.7
150	219.0	168	240	22.2	76	76	230.0	12.7	248	168	270	22.2	76	76	250.0	15.7
200	276.0	219	300	22.2	76	76	260.0	12.7	305	219	330	25.4	76	76	280.0	22.4
250	337.0	273	360	25.4	102	102	295.0	15.7	359	273	385	28.5	102	102	312.0	25.4
300	406.0	324	430	25.4	102	102	330.0	19.1	419	324	450	31.7	102	102	350.0	28.4
350	448.0	356	475	28.5	108	108	360.0	19.1	483	356	515	31.7	108	108	383.0	31.8
400	511.0	406	540	28.5	108	108	390.0	22.4	536	406	570	34.9	108	108	415.0	31.8
450	546.0	457	580	31.7	114	114	410.0	25.4	594	457	630	34.9	114	114	445.0	41.1
500	603.0	508	635	31.7	121	121	440.0	28.4	651	508	685	34.9	121	121	447.0	44.5
600	714.0	610	750	34.9	140	140	500.0	31.8	772	610	810	41.2	140	140	547.0	50.8

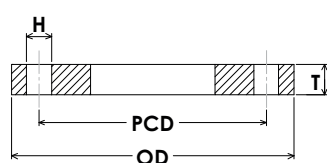
NOMINAL BORE mm	ANSI 600								ANSI 900							
	A	B	C	D	E	W	F	T	A	B	C	D	E	W	F	T
25	70	27	90	19.0	57	57	150.0	6.4	76	27	100	25.4	57	57	164.0	6.4
40	92	43	115	22.2	67	67	170.0	9.7	95	43	125	28.5	67	67	179.0	9.7
50	108	55	125	19.0	57	57	173.0	9.7	140	55	165	25.4	57	57	198.0	12.7
80	146	83	170	22.2	67	67	195.0	12.7	165	83	190	25.4	67	67	210.0	15.7
100	191	108	215	25.4	76	76	225.0	15.7	203	108	235	31.7	76	76	235.0	19.1
150	264	162	290	28.5	86	86	267.0	22.4	286	162	320	31.7	86	86	280.0	25.4
200	318	212	350	31.7	95	95	300.0	28.4	356	212	395	38.1	95	95	325.0	35.1
250	397	265	430	34.9	105	105	345.0	35.1	432	265	470	38.1	105	105	363.0	41.1
300	454	315	490	34.97	105	105	370.0	41.1	495	315	535	38.1	105	105	395.0	47.8
350	489	346	525	38.1	114	114	393.0	44.5	518	346	560	41.2	114	114	410.0	53.8
400	562	397	605	41.2	124	124	432.0	50.8	572	397	615	44.4	124	124	443.0	60.5
450	610	448	655	44.4	133	133	463.0	53.8	635	448	685	50.8	133	133	485.0	66.5
500	679	497	725	44.4	133	133	500.0	63.5	696	497	750	53.9	133	133	520.0	73.2
600	787	597	840	50.8	152	152	560.0	73.2	835	597	900	66.6	152	152	615.0	88.9

Plate Flanges – Dimensions

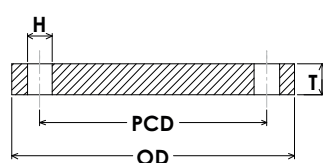
AS 2129



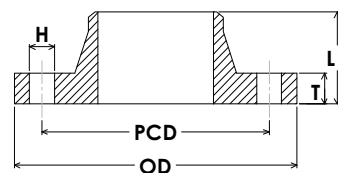
BOSSSED



SLIP ON



BLIND



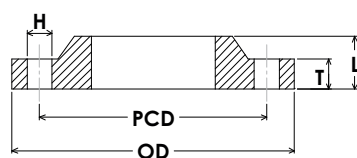
WELD NECK

TABLE D				LENGTH THROUGH HUB		DRILLING DATA		
NOMINAL PIPE SIZE		FLANGE OUTSIDE DIAMETER	THICKNESS OF FLANGE (Refer Note.1)	BOSSSED SOW	WELD NECK	PITCH CIRCLE DIAMETER	BOLT HOLE DIAMETER	NUMBER OF BOLT HOLES
MM	INCH	OD	T	L	L1	PCD	H	#
15	1/2	95	5	15	27	67	14	4
20	3/4	100	5	16	27	73	14	4
25	1	115	5	16	27	83	14	4
32	1 1/4	120	6	17	31	87	14	4
40	1 1/2	135	6	19	35	98	14	4
50	2	150	8	21	37	114	18	4
65	2 1/2	165	8	24	40	127	18	4
80	3	185	10	26	45	146	18	4
90	3 1/2	205	10	27	45	165	18	4
100	4	215	10	29	51	178	18	4
125	5	255	13	32	57	210	18	8
150	6	280	13	32	61	235	18	8
200	8	335	13	35	64	292	18	8
250	10	405	16	43	80	356	22	8
300	12	455	19	48	89	406	22	12
350	14	525	22		95	470	26	12
400	16	580	22			521	26	12
450	18	640	25			584	26	12
500	20	705	29			641	26	16
550	22	760	29			699	30	16
600	24	825	32			756	30	16
700	28	910	35			845	30	20
750	30	995	41			927	33	20
800	32	1060	41			984	36	20
850	34	1090	44			1016	36	20
900	36	1175	48			1092	36	24
1000	40	1255	51			1175	36	24
1050	42	1335	54			1251	36	28
1200	48	1490	60			1410	36	32

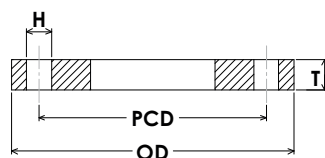
NOTES: (1) Plate Flanges less than 12mm thickness may suffer unacceptable distortion after welding.
 (2) Bore sizes to suit ASME B 36.10 pipe unless otherwise specified.
 (3) Flanges are generally supplied flat faced.
 (4) All dimensions are in millimetres (mm)

TABLE E				LENGTH THROUGH HUB		DRILLING DATA		
NOMINAL PIPE SIZE		FLANGE OUTSIDE DIAMETER	THICKNESS OF FLANGE (Refer Note.1)	BOSSSED SOW	WELD NECK	PITCH CIRCLE DIAMETER	BOLT HOLE DIAMETER	NUMBER OF BOLT HOLES
MM	INCH	OD	T	L	L1	PCD	H	#
15	1/2	95	6	16	28	67	14	4
20	3/4	100	6	17	28	73	14	4
25	1	115	7	18	29	83	14	4
32	1 1/4	120	8	19	33	87	14	4
40	1 1/2	135	9	22	38	98	14	4
50	2	150	10	23	39	114	18	4
65	2 1/2	165	10	26	42	127	18	4
80	3	185	11	27	46	146	18	4
90	3 1/2	205	12	29	47	165	18	8
100	4	215	13	32	54	178	18	8
125	5	255	14	33	58	210	18	8
150	6	280	17	36	65	235	22	8
200	8	335	19	41	70	292	22	8
250	10	405	22	49	86	356	22	12
300	12	455	25	54	95	406	26	12
350	14	525	29		102	470	26	12
400	16	580	32			521	26	12
450	18	640	35			584	26	16
500	20	705	38			641	26	16
550	22	760	44			699	30	16
600	24	825	48			756	33	16
700	28	910	51			845	33	20
750	30	995	54			927	36	20
800	32	1060	54			984	36	20
850	34	1090	57			1016	36	20
900	36	1175	64			1092	36	24
1000	40	1255	67			1175	39	24
1050	42	1335	70			1251	39	28
1200	48	1490	79			1410	39	32

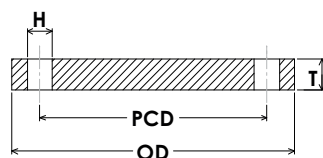
NOTES: (1) Plate Flanges less than 12mm thickness may suffer unacceptable distortion after welding.
 (2) Bore sizes to suit ASME B 36.10 pipe unless otherwise specified.
 (3) Flanges are generally supplied flat faced.
 (4) All dimensions are in millimetres (mm)



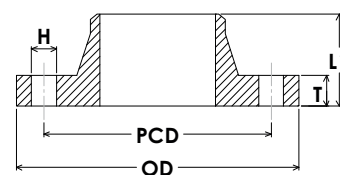
BOSSSED



SLIP ON



BLIND



WELD NECK

TABLE F				LENGTH THROUGH HUB		DRILLING DATA		
NOMINAL PIPE SIZE		FLANGE OUTSIDE DIAMETER	THICKNESS OF FLANGE (Refer Note.1)	BOSSSED SOW	WELD NECK	PITCH CIRCLE DIAMETER	BOLT HOLE DIAMETER	NUMBER OF BOLT HOLES
MM	INCH	OD	T	L	L1	PCD	H	#
15	1/2	95	10	20	32	67	14	4
20	3/4	100	10	21	32	73	14	4
25	1	120	10	21	39	87	18	4
32	1 1/4	135	13	24	48	98	18	4
40	1 1/2	140	13	26	48	105	18	4
50	2	165	16	29	51	127	18	4
65	2 1/2	185	16	32	54	146	18	8
80	3	205	16	32	60	165	18	8
90	3 1/2	215	19	36	63	178	18	8
100	4	230	19	38	70	191	18	8
125	5	280	22	41	79	235	22	8
150	6	305	22	41	79	260	22	12
200	8	370	25	47	92	324	22	12
250	10	430	29	56	102	381	26	12
300	12	490	32	61	111	438	26	16
350	14	550	35			495	30	16
400	16	610	41			552	30	20
450	18	675	44			610	33	20
500	20	735	51			673	33	24
550	22	785	54			724	33	24
600	24	850	57			781	36	24
700	28	935	60			857	36	24
750	30	1015	67			940	36	28
800	32	1060	68			984	36	28
850	34	1090	70			1016	36	32
900	36	1185	76			1105	39	32
1000	40	1275	83			1194	39	36
1050	42	1355	86			1270	39	36
1200	48	1530	95			1441	42	40

NOTES: (1) Plate Flanges less than 12mm thickness may suffer unacceptable distortion after welding.
 (2) Bore sizes to suit ASME B 36.10 pipe unless otherwise specified.
 (3) Flanges are generally supplied flat faced.
 (4) All dimensions are in millimetres (mm)

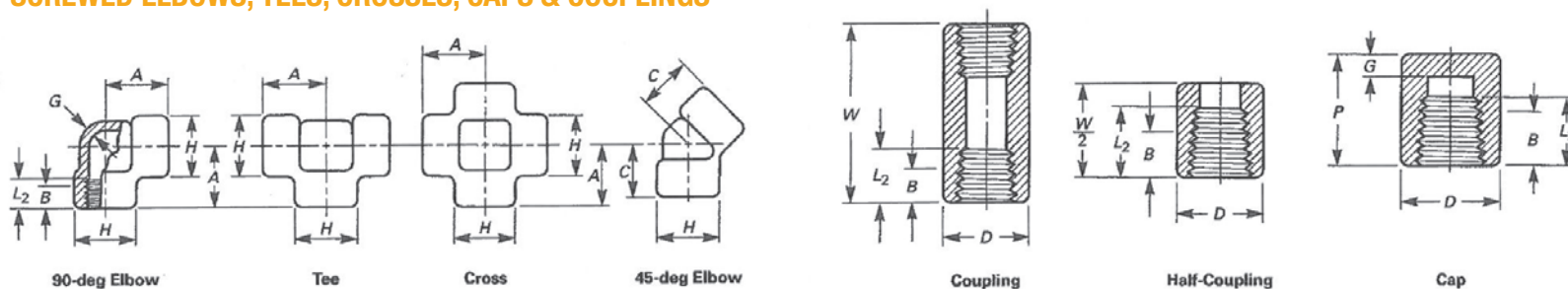
TABLE H				LENGTH THROUGH HUB		DRILLING DATA		
NOMINAL PIPE SIZE		FLANGE OUTSIDE DIAMETER	THICKNESS OF FLANGE	BOSSSED SOW	WELD NECK	PITCH CIRCLE DIAMETER	BOLT HOLE DIAMETER	NUMBER OF BOLT HOLES
MM	INCH	OD	T	L	L1	PCD	H	#
15	1/2	115	13	23	42	83	18	4
20	3/4	115	13	24	42	83	18	4
25	1	120	14	25	43	87	18	4
32	1 1/4	135	17	28	52	98	18	4
40	1 1/2	140	17	30	52	105	18	4
50	2	165	19	32	54	127	18	4
65	2 1/2	185	19	35	57	146	18	8
80	3	205	22	38	66	165	18	8
90	3 1/2	215	22	39	66	178	18	8
100	4	230	25	44	76	191	18	8
125	5	280	29	48	86	235	22	8
150	6	305	29	48	86	260	22	12
200	8	370	32	54	99	324	22	12
250	10	430	35	62	108	381	26	12
300	12	490	41	70	120	438	26	16
350	14	550	48			495	30	16
400	16	610	54			552	30	20
450	18	675	60			610	33	20
500	20	735	67			673	33	24
550	22	785	70			724	33	24
600	24	850	76			781	36	24

NOTES: (1) Plate Flanges less than 12mm thickness may suffer unacceptable distortion after welding.
 (2) Bore sizes to suit ASME B 36.10 pipe unless otherwise specified.
 (3) Flanges are generally supplied flat faced.
 (4) All dimensions are in millimetres (mm)

Forged High Pressure Fittings – Dimensions

B16.11 / BS3799 / MSS SP-83

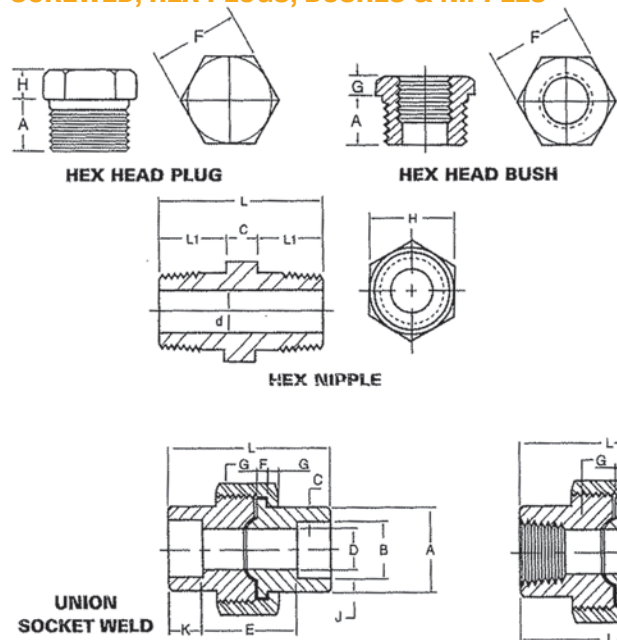
SCREWED ELBOWS, TEES, CROSSES, CAPS & COUPLINGS



SCREWED NPT ELBOW, TEE, CROSS, CAP & COUPLING B16.11 Dimensions in mm

SIZE	CENTER TO END 90 ELBOW, TEE AND CROSS A		CENTER TO END 45 ELBOW C		OUTSIDE DIAMETER OF BAND H		MINIMUM WALL THICKNESS G		THREAD LENGTH MINIMUM		END TO END W	END TO END W ₂	END TO END CAPS P		OUTSIDE DIAMETER COUPLING, CAP D		END THICKNESS MIN CAP G	
	CLASS		CLASS		CLASS		CLASS				3000 & 6000	3000 & 6000	CLASS		CLASS		CLASS	
	3000	6000	3000	6000	3000	6000	3000	6000	B	L2			3000	6000	3000	6000	3000	6000
6	21	25	17	19	22	25	3.18	6.35	6.4	6.7	32	16	19	22	16	22	4.8	6.4
8	25	28	19	22	25	33	3.30	6.60	8.1	10.2	35	17	25	27	19	25	4.8	6.4
10	28	33	22	25	33	38	3.51	6.98	9.1	10.4	48	24	32	27	22	32	4.8	6.4
15	33	38	25	28	38	46	4.09	8.15	10.9	13.6	48	24	32	33	28	38	6.4	7.9
20	38	44	28	33	46	56	4.32	8.53	12.7	13.9	51	25	37	38	35	44	6.4	7.9
25	44	51	33	35	56	62	4.98	9.93	14.7	17.3	60	30	41	43	44	57	9.7	11.2
32	51	60	35	43	62	75	5.28	10.59	17.0	18.0	67	33	44	46	57	64	9.7	11.2
40	60	64	43	44	75	84	5.56	11.07	17.8	18.4	79	39	44	48	64	76	11.2	12.7
50	64	83	44	52	84	102	7.14	12.09	19.0	19.2	86	43	48	51	76	92	12.7	15.7
65	83	95	52	64	102	121	7.65	15.29	23.6	28.9	92	46	60	64	92	108	15.7	19.0
80	95	106	64	79	121	146	8.84	16.64	25.9	30.5	108	54	65	68	108	127	19.0	22.4
100	114	114	79	79	152	152	11.18	18.67	27.7	33.0	121	60	68	75	140	159	22.4	28.4

SCREWED, HEX PLUGS, BUSHES & NIPPLES



SCREWED, NPT HEX PLUGS, BUSHES & NIPPLES B16.11 & BS3799 Dimensions mm

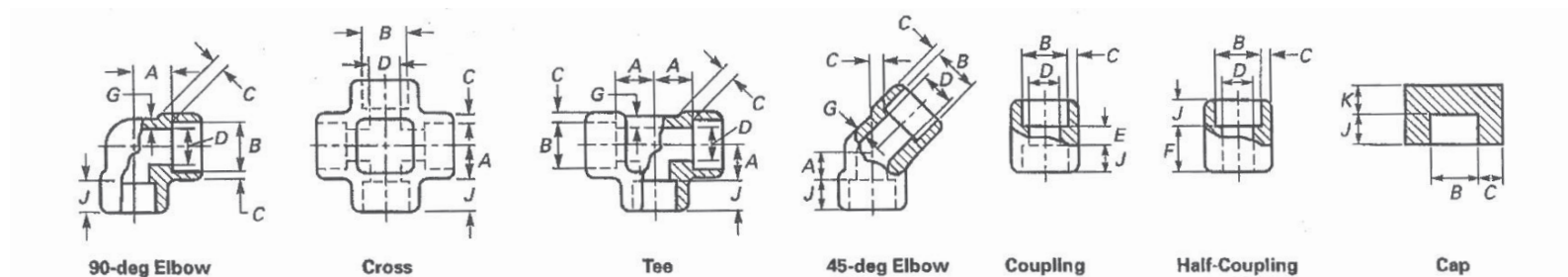
SIZE	MIN LENGTH	PLUGS & BUSHES			HEX NIPPLES (BS 3799)					
		WIDTH FLATS F	HEX HEIGHT		C	L1	L	D (3000lb)	D (6000lb)	H
			BUSH	PLUG						
6	10	11.11		6	6	10	26	5	2	11
8	11	15.88	3	6	6	15	36	8	6	15
10	13	17.46	4	8	8	16	40	11	8	18
15	14	22.23	5	8	8	20	48	14	11	22
20	16	26.99	6	10	10	21	52	19	13	27
25	19	34.93	6	10	10	25	60	24	17	35
32	21	44.45	7	14	-	-	-	-	-	-
40	21	50.80	8	16	16	26	68	38	30	50
50	22	63.50	9	18	17	27	71	49	39	62
65	27	76.20	10	19	-	-	-	-	-	-
80	28	88.90	10	21	-	-	-	-	-	-
100	32	117.48	13	25	-	-	-	-	-	-

NOTE: Hex head bushes of one size reduction should not be used in services wherein they might be subject to harmful loads and forces other than internal pressures.

UNIONS TO MSS SP-83 Dimensions mm

SIZE	COMMON DIMENSIONS				SOCKET WELD DIMENSIONS						SCREWED DIMENSIONS		
	MALE FLANGE F MIN	NUT G MIN	BEARING J MIN	LENGTH L	END A MIN	BORE B MAX	WALL C MIN	BORE D MAX/MIN	LAY LTH E MAX	SOCKET K MIN	END A MIN	WALL C MIN	BORE D MAX/MIN
6	3.17	3.17	1.24	41.40	21.80	11.18	3.17	7.59 / 6.07	22.40	9.65	14.73	2.41	8.43 / 6.43
8	3.17	3.17	1.24	41.40	21.80	14.60	3.30	10.01 / 8.48	22.40	9.65	19.05	3.02	11.12 / 9.45
10	3.43	3.43	1.37	46.00	25.90	18.03	3.50	13.28 / 11.76	26.90	9.65	22.86	3.20	14.27 / 13.51
15	3.68	3.68	1.50	49.00	31.20	22.25	4.09	16.56 / 15.04	26.90	9.65	27.68	3.73	17.85 / 17.07
20	4.06	4.06	1.68	56.90	37.10	27.55	4.27	21.69 / 20.17	31.80	12.70	33.53	3.91	23.01 / 21.39
25	4.57	4.44	1.85	62.00	45.50	34.30	4.95	27.40 / 25.88	34.30	12.70	41.40	4.55	28.98 / 27.74
32	5.33	5.21	2.13	71.10	54.90	45.05	5.28	35.81 / 34.29	40.60	12.70	50.55	4.85	37.69 / 35.36
40	5.84	5.59	2.31	76.45	61.50	49.15	5.54	41.65 / 40.13	42.20	12.70	57.15	5.08	43.54 / 41.20
50	6.60	6.35	2.69	86.10	75.20	61.62	6.05	53.26 / 51.74	45.50	15.75	70.10	5.54	55.58 / 52.12
65	7.49	7.11	3.07	102.40	91.70	74.45	7.65	64.24 / 61.19	61.70	15.75	85.35	7.01	66.27 / 64.31
80	8.25	8.00	3.53	109.00	109.20	90.42	8.31	79.45 / 76.40	63.80	15.75	102.36	7.62	82.55 / 77.27

SOCKET WELD



SOCKET WELD FITTINGS B16.11 Dimensions in mm

SIZE	BORE B	BORE D MAX/MIN CLASS		SOCKET WALL C MIN CLASS		BODY WALL G MIN CLASS		SOCKET DEPTH J MIN	CENTRE TO BOTTOM OF SOCKET A				LAYING LENGTH		END WALL	
									90 ELBOWS, TEES CROSSES CLASS		45 ELBOWS CLASS		COUPLING E	COUPLING F	THICKNESS K MIN CLASS	
									3000	6000	3000	6000			3000	6000
6	11.2/10.8	7.6/6.1	4.8/3.2	3.18	3.43	2.41	3.15	9.5	11.00	11.00	8.00	8.00	6.5	16.0	4.8	6.4
8	14.6/14.2	10.0/8.5	7.1/5.6	3.30	4.01	3.02	3.68	9.5	11.00	13.50	8.00	8.00	6.5	16.0	4.8	6.4
10	18.0/17.6	13.3/11.8	9.9/8.4	3.50	4.37	3.20	4.01	9.5	13.50	15.50	8.00	11.00	6.5	17.5	4.8	6.4
15	22.2/21.8	16.6/15.0	12.5/11.0	4.09	5.18	3.73	4.78	9.5	15.50	19.00	11.00	12.50	9.5	22.5	6.4	7.9
20	27.6/27.2	21.7/20.2	16.3/14.8	4.27	6.04	3.91	5.56	12.5	19.00	22.50	13.00	14.00	9.5	24.0	6.4	7.9
25	34.3/33.9	27.4/25.9	21.5/19.9	4.98	6.93	4.55	6.35	12.5	22.50	27.00	14.00	17.50	12.5	28.5	9.6	11.2
32	43.1/42.7	35.8/34.3	30.2/28.7	5.28	6.93	4.85	6.35	12.5	27.00	32.00	17.50	20.50	12.5	30.0	9.6	11.2
40	49.2/48.8	41.6/40.1	34.7/33.2	5.54	7.80	5.08	7.14	12.5	32.00	38.00	20.50	25.50	12.5	32.0	11.2	12.7
50	61.7/61.2	53.3/51.7	43.6/42.1	6.04	9.50	5.54	8.74	16.0	38.00	41.00	25.50	28.50	19.0	41.0	12.7	15.7
65	74.4/73.9	64.2/61.2	-	7.67	-	7.01	-	16.0	41.00	-	28.50	-	19.0	43.0	15.7	19.0
80	90.3/89.8	79.4/76.4	-	8.30	-	7.62	-	16.0	57.00	-	32.00	-	19.0	44.5	19.0	22.4
100	115.7/115.2	103.8/100.7	-	9.35	-	8.56	-	19.0	66.50	-	41.00	-	19.0	48.0	22.4	28.4

WORKING PRESSURES

Possible Temperature Limitations

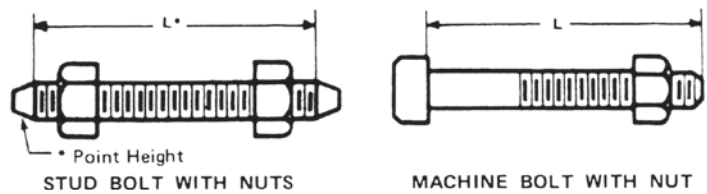
Nominal Pressure Ratings	TEMPERATURE °C																		
	38	66	93	121	149	177	204	232	260	288	316	343	371	399	427	427*	482*	510*	538*
3000lb	20670	20359	20084	19808	19602	19360	19119	18706	17948	16949	15915	14813	13504	12229	10507	8612	6373	4409	2445
6000lb	41340	40754	40168	39617	39232	38756	38239	37412	37412	33933	31831	29627	27008	24459	21014	17225	12780	8853	4926
Non-shock Working Pressures tabulated in kPa																			

+ These pressures are in accordance with ANSI Code for Pressure Piping (ASME B31.1)

* Suggest Alloy Steel above 482°C.

Bolting for ANSI B16.5 & BS3293 Flanges – Dimensions

To suit R.F. Flange sizes DN 15 to 600 to ANSI B16.5 and DN 750 & 900 to BS3293



Diameter of Bolts is shown in inches. For nominal diameters 1 inch and smaller, threads are U.N.C.; nominal diameters 1 1/8 inch and larger threads are 8 U.N. (8 T.P.I.).
Length of Bolts (L) is shown in millimetres **rounded** to the nearest 5mm. Stud Bolt lengths (L*) **do not** include the height of points. Machine Bolt lengths (L) include the height of point. **The length shown includes the height of the Raised Face in all cases.**

NOMINAL FLANGE SIZE		PN20 (CLASS 150)				PN50 (CLASS 300)				PN100 (CLASS 600)			PN150 (CLASS 900)			PN250 (CLASS 1500)			PN420 (CLASS 2500)			NOMINAL FLANGE SIZE	
		No. Bolts	Dia. Bolts ins.	L		No. Bolts	Dia. Bolts ins.	L		No. Bolts	Dia. Bolts ins.	L Stud Bolts mm	No. Bolts	Dia. Bolts ins.	L Stud Bolts mm	No. Bolts	Dia. Bolts ins.	L Stud Bolts mm	No. Bolts	Dia. Bolts ins.	L Stud Bolts mm		
				Stud Bolts mm	Mach. Bolts mm			Stud Bolts mm	Mach. Bolts mm														
15	½	4	½	60	45	4	½	65	55	4	½	80	USE PN250 DIMENSIONS IN THESE SIZES			4	¾	105	4	¾	125	15	½
20	¾	4	½	65	50	4	⅝	75	60	4	⅝	90				4	¾	115	4	¾	125	20	¾
25	1	4	½	65	55	4	⅝	80	65	4	⅝	90				4	⅞	125	4	⅞	140	25	1
32	1¼	4	½	70	55	4	⅝	80	65	4	⅝	100				4	⅞	125	4	1	150	32	1¼
40	1½	4	½	70	60	4	¾	90	75	4	¾	105				4	1	140	4	1-⅛	170	40	1½
50	2	4	⅝	80	65	8	⅝	90	75	8	⅝	105				8	⅞	145	8	1	175	50	2
65	2½	4	⅝	90	75	8	¾	100	85	8	¾	120	8	1	160	8	1-⅛	195	65	2½			
80	3	4	⅝	90	75	8	¾	110	90	8	¾	125	8	⅞	145	8	1-⅛	180	8	1-¼	220	80	3
90	3½	8	⅝	90	75	8	¾	110	95	8	⅞	140	-	-	-	-	-	-	-	-	-	90	3½
100	4	8	⅝	90	75	8	¾	110	95	8	⅞	145	8	1-⅛	170	8	1-¼	195	8	1-½	255	100	4
125	5	8	¾	90	80	8	¾	120	100	8	1	165	8	1-¼	190	8	1-½	250	8	1-¾	300	125	5
150	6	8	¾	100	85	12	¾	125	105	12	1	170	12	1-⅛	195	12	1-⅜	260	8	2	345	150	6
200	8	8	¾	110	90	12	⅞	140	110	12	1-⅛	195	12	1-⅜	220	12	1-⅝	290	12	2	380	200	8
250	10	12	⅞	115	95	16	1	155	130	16	1-¼	215	16	1-⅜	235	12	1-⅞	335	12	2-½	485	250	10
300	12	12	⅞	120	100	16	1-⅛	170	145	20	1-¼	220	20	1-⅜	255	16	2	375	12	2-¾	540	300	12
350	14	12	1	130	110	20	1-⅛	175	150	20	1-⅜	235	20	1-½	275	16	2-¼	405				350	14
400	16	16	1	135	115	20	1-¼	190	160	20	1-½	255	20	1-⅝	285	16	2-½	445				400	16
450	18	16	1-⅛	150	125	24	1-¼	195	170	20	1-⅝	275	20	1-⅞	325	16	2-¾	495				450	18
500	20	20	1-⅛	160	135	24	1-¼	205	180	24	1-⅝	290	20	2	345	16	3	540				500	20
600	24	20	1-¼	175	145	24	1-½	230	195	24	1-⅞	330	20	2-½	435	16	3-½	615				600	24
750	30	28	1-¼	190	160	28	1-¾	290	250	28	2	355	PN150, 250 & 420 – Not listed in BS 3293								750	30	
900	36	32	1-½	215	180	32	2	325	280	28	2-½	400									900	36	

Raised Face height of 1.6mm for PN20 & 50 and 6.4mm for PN100, 150, 250 & 420 is included in dimension L (Bolt Length).

Material Specifications

ASTM A193 Grade B7

Standard specification for alloy steel and stainless steel bolting materials for high temperature service.

ASTM A194 Grade 2H

Standard specification for carbon and alloy steel nuts for bolts for high pressure and high temperature service.

ASTM A320

Standard specification for alloy steel bolting materials for low temperature service.

Grade L7 covers alloy steel stud bolts.

Grade L4 covers alloy steel nuts to suit Grade L7 stud bolts.

Bolting Standards & Materials

TYPICAL STEELS FOR BOLTING GRADES ASTM A193-A320	AISI	ASTM	UNS	W-Nr	CHEMICAL COMPOSITION %						MECHANICAL TESTS		
					C	Ni	Cr	Mo	Others	UTS MPa	YS MPa	KV J	
	501	B5	S50100	1.7362	>0,10	-	4-6	0,4-0,5	-	-	>690	>550	-
	410	B6	S41000	1.4006	<0,15	-	11,5-13,5	-	-	-	>760	>585	-
	4140	B7	G41400	1.7225	0,37-0,49	-	0,75-1,2	0,15-0,25	-	-	>860	>720	-
	-	B16	K14072	1.7711	0,36-0,47	-	0,8-1,15	0,5-0,65	V0,25-0,35	-	>860	>720	-
	4140	L7	G41400	1.7225	0,38-0,48	-	0,8-1,1	0,15-0,25	-	-	>860	>725	>27
	4140	L7M	G41400	1.7225	0,38-0,48	-	0,8-1,1	0,15-0,25	-	-	>690	>550	>27
	4340	L43	G43400	1.6565	0,38-0,43	1,65-2	0,7-0,9	0,2-0,3	-	-	>860	>725	>27
	4140	B7M	G41400	1.7225	0,37-0,49	-	0,75-1,2	0,15-0,25	-	-	>690	>550	-
304	B8	S30400	1.4301	<0,08	8-10,5	18-20	-	-	-	>515	>205	-	
347	B8C	S34700	1.4550	<0,08	9-13	17-19	-	Cb+Ta >10XC	-	>515	>205	-	
316	B8M	S31600	1.4401	<0,08	10-14	16-18	2-3	-	-	>515	>205	-	
-	B8S	S21800	-	<0,10	8-9	16-18	-	Si 3,5-4,5	N,08-,18	>655	>345	-	
321	B8T	S32100	1.4541	<0,08	9-12	17-19	-	Ti > 5XC	-	>515	>205	-	

HEAT-RESISTANT ALLOYS	Alloy	ASTM	UNS	W-Nr	CHEMICAL COMPOSITION %						MECHANICAL TESTS		
					C	Ni	Cr	Mo	Others		UTS MPa	YS MPa	KV J
	600	B166	N06600	2.4816	<0,15	>72	14-17	-	Fe 6-10	-	>550	>240	-
	660	A453	S66286	1.4980	<0,08	24-27	13,5-16	1-1,15	Ti 1,9-2,35	V0,1-0,5	>895	>585	-
	662A	A453	S66220	-	<0,08	24-28	12-15	2-3,5	Ti 1,8-2,1	Mn 0,4-1	>895	>585	-
	665B	A453	S66545	1.4943	<0,08	24-28	12-15	1,25-2,25	Ti 2,7-3,3	Mn 1,25-2	>860	>550	-
	718	B637	N07718	2.4668	<0,08	50-55	17-21	2,8-3,3	Cb 4,75-5,5	Ti 0,65-1,15	>1275	>1035	-
	X-750	B637	N07750	2.4669	<0,08	>70	14-17	-	Ti 2,25-2,75	Fe 5-9	>1170	>790	-
	800H	B408	N08810	1.4876	0,05-0,10	30-35	19-23	-	Fe > 39,5	-	>450	>170	-
	80A	B637	N07080	2.4952	<0.10	Balance	18-21	-	Fe < 3	Ti 1.8-2.7	>930	>620	-

CORROSION RESISTANT ALLOYS	ALLOY	ASTM	UNS	W-Nr	CHEMICAL COMPOSITION %						MECHANICAL TESTS		
					C	Ni	Cr	Mo	Others	UTS MPa	YS MPa	KV J	
	400	F467/8	N04400	2.4360	<0,30	63-70	-	-	Cu bal	-	>550	>275	-
	K-500	F467/8	N05500	2.4375	<0,25	63-70	-	-	Cu bal	Al 2,3-3,15	>900	>620	-
	600	B166	N06600	2.4816	<0,15	>72	14-17	-	Fe 6-10	-	>550	>240	-
	625	B446	N06625	2.4856	<0,10	>58	20-23	8-10	Cb 3,15-4,15	Fe < 5	>830	>415	-
	660	A453	S66286	1.4980	<0,08	24-27	13,5-16	1-1,5	Ti 1,9-2,35	V 0,1-0,5	>895	>585	-
	662A	A453	S66220	-	<0,08	24-28	12-15	2-3,5	Ti 1,8-2,1	Mn 0,4-1	>895	>585	-
	665B	A453	S66545	1.4943	<0,08	24-28	12-15	1,25-2,25	Ti 2,7-3,3	Mn 1,25-2	>860	>550	-
	718	B637	N07718	2.4668	<0,08	50-55	17-21	2,8-3,3	Cb 4,75-5,5	Ti 0,65-1,15	>1275	>1035	-

CORROSION RESISTANT ALLOYS WITH HIGH-YIELD LIMITS	ALLOY	ASTM	UNS	W-Nr	CHEMICAL COMPOSITION %						MECHANICAL TESTS		
					C	Ni	Cr	Mo	Others	UTS MPa	YS MPa	KV J	
	-	A479	S31803	1.4462	<0,03	4,5-6,5	21-23	2,5-3,5	N 0,08-0,2	-	>620	>450	-
	-	A479	S32750	1.4468	<0,03	6-8	24-26	3-5	N 0,24-0,32	-	>800	>550	-
	-	A276	S32760	1.4496	<0,03	6-8	24-26	3-4	N 0,2-0,3	Cu 0,5-1	>860	>720	-
	-	A479	S32550	1.4515	<0,04	4,5-6,5	24-27	2,9-3,9	N 0,1-0,25	Cu 1,5-2,5	>760	>550	-
	-	A479	S31254	1.4529	<0,02	17,5-18,5	19,5-20,5	6-6,5	N 0,18-0,22	Cu 0,5-1	>655	>305	-
	K-500	F467/8	N05500	2.4375	<0,25	63-70	-	-	Cu bal	Al 2,3-3,15	>900	>620	-
	660	A453	S66286	1.4980	<0,08	24-27	13,5-16	1-1,5	Ti 1,9-2,35	V 0,1-0,5	>895	>585	-

CORROSION RESISTANT ALLOYS WITH LOW SPECIFIC WEIGHT	ALLOY	ASTM	UNS	W-Nr	CHEMICAL COMPOSITION %					MECHANICAL TESTS			
					C	Ti	N	H	Fe	O	UTS MPa	YS MPa	KV J
	Ti gr. 1	B348	R50250	3.7025	<0,10	Balance	<0,03	<0,01	<0,2	<0,18	>240	>170	-
	Ti gr. 2	B348	R50400	3.7035	<0,10	Balance	<0,03	<0,01	<0,3	<0,25	>345	>275	-
	Ti gr. 3	B348	R50500	3.7055	<0,10	Balance	<0,05	<0,01	<0,35	<0,35	>450	>380	-
	Ti gr. 4	B348	R50700	3.7065	<0,10	Balance	<0,05	<0,01	<0,4	<0,40	>550	>483	-
	Ti gr. 5	B348	R56400	3.7165	<0,10	Balance	<0,05	<0,01	<0,4	<0,20	>895	>825	-
	Ti gr. 6	B348	R54520	-	<0,10	Balance	<0,05	<0,01	<0,5	<0,20	>825	>795	-
	Ti gr. 7	B348	R52400	3.7235	<0,10	Balance	<0,03	<0,01	<0,3	<0,25	>345	>275	-
	Ti gr. 10	B348	R58030	-	<0,10	Balance	<0,05	<0,02	<0,35	<0,18	>690	>620	-
Ti gr. 11	B348	R52250	3.7225	<0,10	Balance	<0,03	<0,01	<0,2	<0,18	>240	>170	-	
Ti gr. 12	B348	R53400	-	<0,08	Balance	<0,03	<0,01	<0,3	<0,25	>483	>345	-	

Valve Standards

An Overview of the American Petroleum Institute - API - Valve Standards

Valve standards from API - the American Petroleum Institute:

- **API SPEC 6D** – Specification for Pipeline Valves. API Specification 6D is an adoption of IO 14313:1999, Petroleum and Natural Gas Industries-Pipeline Transportation Systems-Pipeline Valves. This International Standard specifies requirements and gives recommendations for the design, manufacturing, testing and documentation of ball, check, gate and plug valves for application in pipeline systems.
- **API 526** – Flanged Steel Pressure Relief Valves. The standard is a purchase specification for flanged steel pressure relief valves. Basic requirements are given for direct spring-loaded pressure relief valves and pilot-operated pressure relief valves as follows: orifice designation and area/valve size and pressure rating, inlet and outlet; materials; pressure-temperature limits; and centre-to-face dimensions, inlet and outlet.
- **API 527** – Seat Tightness of Pressure Relief Valves R(2002). Describes methods of determining the seat tightness of metal and soft-seated pressure relief valves, including those of conventional, bellows and pilot-operated designs.
- **ANSI/API STD 594** – Check Valves: Flanged, Lug, Wafer and Butt welding. API Standard 594 covers design, material, face-to-face dimensions, pressure-temperature ratings and examination, inspection and test requirements for two types of check valves.
- **API 598** – Valve Inspection and Testing. The standard covers inspection, supplementary examination and pressure test requirements for both resilient-seated and metal-to-metal seated gate, globe, plug, ball, check and butterfly valves. Pertains to inspection by the purchaser and to any supplementary examinations the purchaser may require at the valve manufacturer's plant.
- **ANSI/API 599** – Metal Plug Valves - Flanged, Threaded and Welding Ends. A purchase specification that covers requirements for metal plug valves with flanged or butt welding ends, and ductile iron plug valves with flanged ends, in sizes NPS 1 through NPS 24, which correspond to nominal pipe sizes in ASME B36.10M. Valve bodies conforming to ASME B16.34 may have flanged end and one butt welding end. It also covers both lubricated and non-lubricated valves that have two-way coaxial ports, and includes requirements for valves fitted with internal body, plug or port linings or applied hard facings on the body, body ports, plug or plug port.
- **ANSI/API 600** – Bolted Bonnet Steel Gate Valves for Petroleum and Natural Gas Industries - Modified National Adoption of ISO 10434:1998.
- **API 602** – Compact Steel Gate Valves - Flanged, Threaded, Welding and Extended-Body Ends. The standard covers threaded-end, socket-welding-end, butt welding-end and flanged-end compact carbon steel gate valves in sizes NPS4 and smaller.
- **ANSI/API 603** – Corrosion-Resistant, Bolted Bonnet Gate Valves - Flanged and Butt welding Ends. The standard covers corrosion-resistant bolted bonnet gate valves with flanged or butt weld ends in sizes NPS ½ through 24, corresponding to nominal pipe sizes in ASME B36.10M, and Classes 150, 300 and 600, as specified in ASME B16.34.
- **ANSI/API 607** – Fire Test for Soft-Seated Quarter Turn Valves. The standard covers the requirements for testing and evaluating the performance of straightway, soft-seated quarter turn valves when the valves are exposed to certain fire conditions defined in this standard. The procedures described in this standard apply to all classes and sizes of such valves that are made of materials listed in ASME B16.34.
- **API 609** – Butterfly Valves: Double Flanged, Lug and Wafer-Type. The standard covers design, materials, face-to-face dimensions, pressure-temperature ratings and examination, inspection and test requirements for gray iron, ductile iron, bronze, steel, nickel-base alloy, or special alloy butterfly valves that provide tight shutoff in the closed position and are suitable for flow regulation.
- **API 6FA** – Specification for Fire Test for Valves. The standard covers the requirements for testing and evaluating the performance of API Spec 6A and Spec 6D valves with automatic backseats when exposed to specifically defined fire conditions.
- **API 6RS** – Referenced Standards for Committee 6, Standardization of Valves and Wellhead Equipment.
- **API 11V6** – Design of Continuous Flow Gas Lift Installations Using Injection Pressure Operated Valves. The standard sets guidelines for continuous flow gas lift installation designs using injection pressure operated valves.
- **ANSI/API RP 11V7** – Recommended Practice for Repair, Testing and Setting Gas Lift Valves. The standard applies to repair, testing and setting gas lift valves and reverse flow (check) valves.
- **API 520-1** – Sizing, Selection and Installation of Pressure-Relieving Devices in Refineries: Part I - Sizing and Selection. The recommended practice applies to the sizing and selection of pressure relief devices used in refineries and related industries for equipment that has a maximum allowable working pressure of 15 psig (1.03 bar g or 103 kPa g) or greater.
- **API 520-2** – Recommended Practice 520: Sizing, Selection and Installation of Pressure-Relieving Devices in Refineries: Part II - Installation. The recommended practice covers methods of installation for pressure-relief devices for equipment that has a maximum allowable working pressure of 15 psig (1.03 bar g or 103 kPa g) or greater. It covers gas, vapor, steam, two-phase and incompressible fluid service.
- **ANSI/API 574** – Inspection Practices for Piping System Components. The standard covers the inspection of piping, tubing, valves (other than control valves) and fittings used in petroleum refineries.
- **ANSI/API 576** – Inspection of Pressure-Relieving Devices. The recommended practice describes the inspection and repair practices for automatic pressure-relieving devices commonly used in the oil and petrochemical industries.
- **ANSI/API 608** – Metal Ball Valves - Flanged and Butt welding Ends. The standard covers Class 150 and Class 300 metal ball valves that have either butt welding or flanged ends and are for use in on-off service.

Valves

Ball Valves

Codes

API 6D, API 6A, ANSI B16.34, BS5351

Construction

- Trunnion mounted side and top entry and welded body
- Floating ball type

Services

Low to high temperatures from -196 to 400 deg C, metal to metal, cryogenic, crude oil, gas, sea water and sour, etc

Sizes

1/4 to 60 inch

Pressure Classes

ANSI 150 to 2500#

API 3000 to 15000#

End Connections

Flanged, butt weld, hubs

Materials of Construction

Carbon Steel, Stainless Steel, 6mo, Titanium, Duplex, Super Duplex, Inconel, Incoloy and Special Alloys

Bore

Full, reduced and venturi

Fire Safe

BS6755, API RP 6FA, API 607

Gate, Globe, Check & Butterfly Valves

Codes

ASME, ANSI, BS & API

Sizes

1/2 to 60 inch

Pressure Classes

ANSI 150 to 4500#

API 2000 to 15000#

End Connections

Flanged, Butt weld, Socket Weld, Screwed and Wafer

Materials of Construction

Materials in Castings and or Forgings include Carbon, Stainless, Duplex, Super Duplex and Nickel Alloys.



ANSI Flanges & Butt weld Fittings – Weights

APPROXIMATE WEIGHT OF POPULAR SIZES																			
NOMINAL PIPE SIZE ANSI B36.10		SCHEDULE NO	BUTTWELD FITTINGS			ANSI FLANGES													
			90° L/R ELBOWS	TEES EQUAL	CON & ECC RED	CLASS 150			CLASS 300			CLASS 600		CLASS 900		CLASS 1500		CLASS 2500	
						SOW / SW THREAD	W / N	BLIND	SOW / SW THREAD	W / N	BLIND	W / N	BLIND	W / N	BLIND	W / N	BLIND	W / N	BLIND
DN	NPS		KG/EA	KG/EA	KG/EA	KG/EA	KG/EA	KG/EA	KG/EA	KG/EA	KG/EA	KG/EA	KG/EA	KG/EA	KG/EA	KG/EA	KG/EA	KG/EA	KG/EA
15	½	40 80	0.08 0.10	0.16 0.21	-	.45	.79	.57	.73	.91	.79	.91	0.70	2.00	1.80	1.90	1.80	3.60	3.00
20	¾	40 80	0.08 0.11	0.21 0.27	0.07 0.10	.68	.86	.91	1.25	1.41	1.13	1.59	1.20	2.72	2.40	2.60	2.40	4.00	4.50
25	1	40 80	0.17 0.21	0.34 0.43	0.14 0.18	.95	1.09	1.09	1.36	1.81	1.77	1.86	1.50	3.86	3.60	3.80	3.60	6.00	5.00
32	1¼	40 80	0.28 0.39	0.64 0.75	0.18 0.23	1.13	1.41	1.25	2.04	2.27	2.68	2.72	2.00	4.54	4.10	4.40	4.10	9.00	8.00
40	1½	40 80	0.39 0.50	0.95 1.13	0.27 0.32	1.36	1.81	1.70	2.81	3.06	2.83	3.74	3.20	6.35	5.80	6.10	5.80	13.00	11.00
50	2	40 80	0.68 1.00	1.45 1.72	0.41 0.54	2.22	2.83	2.77	3.13	3.74	3.52	4.65	4.30	10.89	10.10	11.10	10.10	19.00	17.00
65	2½	40 80	1.36 1.82	2.45 2.95	0.68 0.91	3.82	4.42	4.04	4.54	5.56	5.44	6.44	6.00	16.33	14.00	15.50	14.00	24.00	25.00
80	3	40 80	2.18 2.86	3.45 4.30	0.91 1.27	4.08	5.22	5.44	6.12	7.37	7.26	8.50	8.00	14.51	13.10	20.40	19.00	43.00	39.00
90	3½	40 80	3.05 4.1	4.5 5.9	1.36 1.81	4.99	5.44	6.35	7.71	9.53	9.98	12.25	10.50	-	-	-	-	-	-
100	4	40 80	4.2 5.7	5.7 7.3	1.59 2.18	5.94	7.48	7.37	9.53	11.79	11.79	17.24	18.00	23.13	22.10	30.50	30.00	66.00	60.00
125	5	40 80	6.8 10.0	9.1 11.8	2.7 3.8	6.12	9.53	9.07	12.70	15.42	15.88	30.84	28.50	39.01	36.50	58.00	58.00	111.00	101.00
150	6	40 80	10.9 16.3	13.6 19.0	3.9 5.4	8.16	11.34	12.70	16.33	19.96	20.87	34.02	35.50	49.90	47.40	70.00	72.00	172.00	156.00
200	8	40 80	21.8 33.1	25 33.5	5.9 8.6	12.70	19.05	21.77	25.40	32.21	38.10	52.16	58.00	84.82	82.50	125.00	122.00	261.00	242.00
250	10	40 60	38.6 52	41 54	10 14	17.24	25.40	31.75	35.38	44.00	53.34	90.36	98.00	121.56	123.00	204.00	210.00	485.00	465.00
300	12	Std XS	57 75	57 77	15 20	27.22	38.10	45.36	50.80	64.41	86.18	101.60	125.00	168.74	174.00	303.00	315.00	730.00	665.00
350	14	30 XS	73 97	73 93	28 37	35.38	51.26	58.97	74.39	84.37	107.05	157.40	151.00	254.92	225.00	427.00	423.00	-	-
400	16	30 40	98 130	91 120	35 46	42.18	63.50	77.11	101.60	111.58	145.15	209.11	215.00	310.71	280.00	570.00	590.00	-	-
450	18	Std XS	120 165	135 190	40 53	52.62	68.04	102.51	126.10	138.35	181.89	217.27	287.00	419.12	400.00	740.00	795.00	-	-
500	20	20 30	150 200	168 245	61 82	65.32	81.65	123.38	149.69	174.63	231.33	312.98	366.00	527.98	503.00	935.00	1030.00	-	-
600	24	20 XS	220 280	240 350	77 95	91.63	118.84	203.21	222.26	247.21	342.92	443.16	532.00	680.39	953.00	1515.00	1650.00	-	-
750	30	Std 20	332 440	388 484	107 143	142.88	163.29	326.59	367.41	421.84	680.39	589.67	908.00	975.22	1373.00	-	-	-	-
900	36	Std 20	481 638	588 731	129 172	217.72	235.87	510.29	544.31	589.67	1031.92	793.79	1339.00	1564.89	2225.00	-	-	-	-
DIMENSIONS			WEIGHT IN KILOGRAMS																
APPROXIMATE WEIGHT PER UNIT FOR AUSTENITIC BUTTWELD FITTINGS AND FLANGES MAY BE OBTAINED BY APPLYING A FACTOR OF 1.015 APPROXIMATE WEIGHT PER UNIT FOR TITANIUM BUTTWELD FITTINGS AND FLANGES, APPLY A FACTOR OF 0.57																			

- NOTES:
- UP TO NPS10”DN250 STD WT, 40S AND SCH40 HAVE THE SAME WALL THICKNESS. UP TO NPS8”DN200 XS, 80S AND SCH80 HAVE THE SAME WALL THICKNESS.
 - BUTTWELD FITTINGS – ANSI B16.9
 - FLANGES ≤ 600NB – ANSI B16.5
 - FLANGES > 600NB – BS3293

Flange ASME B16.47-A (MSS SP 44)

NPS SIZE	CLASS 150		CLASS 300		CLASS 600		CLASS 900	
	WELDING NECK	BLIND	WELDING NECK	BLIND	WELDING NECK	BLIND	WELDING NECK	BLIND
22	109	162	204	284	310	437		
26	154	321	291	477	450	777	890	1100
28	175	380	352	584	506	909	1055	1350
30	204	450	405	685	575	1074	1230	1610
32	254	560	465	793	642	1253	1480	1940
34	273	625	523	919	705	1427	1750	2310
36	321	760	580	1072	800	1665	1997	2660
38	358	830	624	900	674	1509	2000	2690
40	386	925	691	1066	725	1695	2161	2950
42	442	1080	728	1206	895	2028	2379	3280
44	491	1230	785	1378	951	2246	3321	3810
46	525	1345	859	1570	1055	2543	3224	4430
48	580	1520	997	1745	1247	2951	3500	4860
50	624	1668	1074	1983	1423	3381		
52	689	1867	1228	2194	1493	3682		
54	760	2088	1371	2538	1637	4091		
56	845	2308	1521	2728	1843	4585		
58	923	2554	1668	2975	1954	4986		
60	971	2765	1832	3250	2353	5750		

Weight in "Kg"

Flange ASME B16.47-B (API 605)

NPS SIZE	CLASS 150		CLASS 300		CLASS 600		CLASS 900	
	WELDING NECK	BLIND	WELDING NECK	BLIND	WELDING NECK	BLIND	WELDING NECK	BLIND
26	65	165	193	404	260	534		
28	75	200	211	457	305	637		
30	82	226	258	555	378	793		
32	94	263	315	693	436	925		
34	113	320	339	765	550	1150		
36	128	374	380	858	591	1290		
38	153	434	425	1005	668	1481		
40	166	489	459	1132	718	1662		
42	182	560	514	1280	888	1989		
44	195	626	567	1466	942	2188		
46	229	709	666	1657	1046	2458		
48	248	799	687	1772	1237	2859		
50	268	899	797	2029	1412	3280		
52	284	985	806	2230	1481	3573		
54	309	1081	840	2310	1623	3949		
56	329	1181	1117	2891	1829	4423		
58	391	1322	1194	3093	1939	4791		
60	414	1430	1215	3213	2336	5533		

Weight in "Kg"

Stud Bolts – Weights

WEIGHTS OF STUD BOLTS (ANSI) Dimensions in kilos per 100 pieces with 2 assembled nuts																				
diam. length (mm)	3/8"	7/16"	1/2"	9/16"	5/8"	3/4"	7/8"	1"	1 1/8"	1 1/4"	1 3/8"	1 1/2"	1 5/8"	1 3/4"	1 7/8"	2"	2 1/4"	2 1/2"	2 3/4"	3"
60	5,5	7,6	10,8	13,5																
70	5,9	8,2	11,6	14,5	19,8															
80	6,3	8,8	12,4	15,5	21	32,4														
90	6,7	9,4	13,2	16,5	22,2	34,3	50													
100	7,1	10	14	17,5	23,4	36,2	52,6	71,8												
110	7,5	10,6	14,8	18,5	24,6	38,1	55,2	75,2	102											
120	7,9	11,2	15,6	19,5	25,8	40	57,8	78,6	106	137										
130	8,5	11,8	16,4	20,5	27	41,9	60,4	82	111	142	179									
140	8,9	12,2	17,2	21,5	28,2	43,8	63	85,4	115	147	186	234								
150	9,4	12,8	18,00	22,5	29,4	45,7	65,6	88,8	119	153	193	242	289							
160		13,4	18,8	23,5	30,6	47,6	68,2	92,2	123	158	200	250	298	363						
170		14,0	19,6	24,5	32,3	49,5	70,8	95,6	128	164	206	258	308	374	437					
180		14,7	20,4	25,5	33,5	50,8	73,4	99	132	169	213	266	317	385	449					
190			21,2	26,5	34,8	52,7	75,5	103	136	174	220	275	326	396	462					
200			22,0	27,6	36,1	54,5	78,0	106	141	180	226	283	336	407	475					
210				28,6	37,3	56,3	80,5	108	145	185	233	291	345	418	488					
220				29,6	38,6	58,1	83,1	112	149	191	240	299	354	429	500	593				
230				30,6	39,8	60,0	85,6	115	153	196	246	307	364	440	513	607	811			
240					41,1	61,8	88,2	118	158	201	253	316	373	451	526	622	830			
250						63,7	90,7	122	162	206	260	324	382	463	538	637	849			
260							93,3	125	166	212	267	332	391	474	551	651	868			
270								128	171	217	273	340	401	485	564	666	887			
280								132	175	223	279	345	410	496	576	680	906			
290								135	179	228	285	350	419	507	589	695	925			
300								138	184	233	292	358	429	518	602	710	944			
320									192	244	305	374	449	540	627	739	982	1255		
340									201	255	319	390	468	562	653	768	1020	1301	1629	
360									210	266	332	406	487	583	678	797	1058	1347	1685	
380										277	345	422	506	605	703	826	1096	1394	1742	2147
400										288	359	437	524	627	731	856	1126	1440	1798	2214
420											372	453	543	649	756	884	1164	1487	1854	2282
440											385	469	562	672	781	913	1201	1533	1911	2350
460											399	485	581	690	807	942	1239	1579	1967	2417
480												501	600	716	832	971	1276	1626	2024	2484
500												517	619	738	858	1000	1313	1672	2080	2552
520													638	760	884	1029	1350	1719	2136	2620
540													656	782	909	1058	1388	1765	2193	2687
560													675	804	935	1088	1425	1811	2249	2755
580															960	1117	1462	1859	2306	2822
600															986	1146	1500	1904	2362	2890
620															1011	1175	1537	1951	2419	2957
640																1205	1574	1997	2475	3025
660																1233	1611	2043	2531	3092
680																	1649	2090	2588	3160
700																	1686	2136	2644	3227

MATERIALS		PIPING COMPONENTS				RAW MATERIAL FOR WELDING FITTINGS		
		Pipe	Tubing	Welding Fittings	Flanges	Pipe	Plate	Forgings
Carbon Steel	Grade A	A53-4 A106-A A135-A A139-A A155-C50, C55 API-5L-A	A192 A161 A178-A - -	A234-WPA	A105	A106-A	A285-C	A105
	Grade B	A53-B A106-B A135-B A139-B A155-KC65. KC70 API-5L-B	A178-C A210-A A178-C - - -	A234-WPB	A105	A106-B	A515-70	A105
	Grade C	A106-C	A210-C	A234-WPC	A105	A106-C		
	Low Temperature	A333-6	A334-6	A420-WPL6	A350-LF2	A333-6	A516-65	A350-LF2
	High Yield	A381-35	-	Grade WPHY35	A105	A106-B	A515-65	A105
		API-5LX-X42, X46, X52	-	Grade WPHY42 Grade WPHY52	A694-F42 A694-F52	A381-42 A381-52	A242 A441	A694-F42 A694-F52
Carbon Moly Steel	½ Mo	A155-CM70	A209-T1a A250-T1a	A234-WP1	A182-F1	A335-P1	A204-B	A182-F1
		A335-P1 A369-FP1	A161-T1					
Chrome Moly Steel	½ Cr-½ Mo	A155 - ½ CR A335-P2 A369-FP2	A213-T2	Grade WP2	A182-F2	A335-P2	A387-A	A182-F2
	1Cr-½ Mo	A155-1CR A335-P12 A369-FP12	A213-T12	A234-WP12	A182-F12	A335-P12	A387-B	A182-F12
	1¼ Cr-½ Mo	A155 - 1¼ Cr A335-P11 A369-FP11	A213-T11	A234-WP11	A182-F11	A335-P11	A387-C	A182-F11
	2¼ Cr-1Mo	A155-2¼Cr A335-P22 A369-FP22	A213-T22	A234-WP22	A182-F22	A335-P22	A387-D	A182-F22
	5Cr-½ Mo	A155-5CR A335-P5 A369-FP5	A213-T5	A234-WP5	A182-F5	A335-P5	A357	A182-F5
	7Cr-½ Mo	A335-P7 A369-FP7	A213-T7	Grade WP7	A182-F7	A335-P7		A182-F7
	9Cr-1Mo	A335-P9 A369-FP9	A213-T9	Grade WP9	A182-F9	A335-P9		A182-F9
Low Temp. Ferritic Steel	3 ½ Ni	A333-3	A334-3	A420-WPL3	A350-LF3	A333-3	A203-D	A350-LF3
	Low Alloy Steel	A333-9	A334-9	A420-WPL9	A350-LF9	A333-9	-	A350-LF9
Austenitic Stainless Steel	18Cr-8Ni	A312-TP304L A358-TP304L	A213-TP304L A249-TP304L A409-TP304L	A774-TP304L A403-WP304L	A182-F304L	A312-TP304L	A240-TP304L A666-TP304L	A182-F304L
	18Cr-8Ni-Mo	A312-TP316L A358-TP316L	A213-TP316L A249-TP316L A409-TP316L	A774-TP316L A403-WP316L	A182-F316L	A312-TP316L	A240-T316L A666-TP316L	A182-F316L
	18Cr-8Ni Ni-Ti	A312-TP321 A358-TP321	A213-TP321 A249-TP321 A409-TP321	A774-TP321 A403-WP321	A182-F321	A312-TP321	A240-TP321	A182-F321
Duplex Stainless Steel	22Cr, 5Ni, 2.50Mo	A790/A928 UNS31803	A789 UNS31803	A815 UNS31803	A182F51	A790 UNS31803	A240 UNS31803	A182-F51
Super Duplex Stainless Steel	25Cr-7Ni-4Mo-N 25Cr-7Ni3.5Mo-N-W	A790/A928 UNS32750 UNS32760	A789 UNS32750 UNS32760	A815 UNS32750 UNS32760	A182-F53 A182-F55	A790 UNS32750 UNS32760	A240 UNS32750 UNS32760	A182-F53 A182-F55
Nickel Alloy	*Incoloy 825	B423/B705 UNSNO8825	B423 B704 UNSNO8825	B366 WPNiCMC	B564 UNSNO8825	B423/705 UNSNO8825	B424 UNSNO8825	B564 UNSNO8825
	*Inconel 625	B444/705 UNSNO6625	B704 UNSNO6625	B366 WPNCMC	B564 UNSNO6625	B444 UNSNO6625	B443 UNSNO6625	B564 UNSNO6625
	*Monel 400	B165/725 UNSNO4400	B165/730 UNSNO4400	B366 WPNC	B564 UNSNO4400	B165/725 USNO4400	B127 UNSNO4400	B564 UNSNO4400
Titanium	Ti2	B337 Grade 2	B338 Grade 2	B363-WPT2	B381-F2	B337 Grade 2	B265 Grade 2	B381-F2
	Ti7(Pd)	B337 Grade 7	B338 Grade 7	B363-WPT7	B381-F7	B337 Grade 7	B265 Grade 7	B381-F7
	Ti12 (Mo+Ni)	B337 Grade 12	B338 Grade 12	B363-WPT12	B381-F12	B337 Grade 7	B265 Grade 12	B381-F12

* Inco Trade Mark

Metallurgical Terms

Alloy	Any metallic material containing two or more chemical elements.	Impact Test	A test for evaluating the resistance of a material to shock stresses.
Alloy Steel	A steel containing, in addition to carbon and normal impurities, some alloying element or elements intentionally added or permitted to remain for the purpose of modifying or enhancing its chemical, physical or mechanical properties.	Indication	In non-destructive inspection a response or evidence of a response that requires interpretation to determine its significance.
Alloying Element	Any element intentionally added to or allowed to remain in a metal, for the purpose of modifying chemical, physical or mechanical properties.	Magnetic Particle Inspection	A method of examination in which an object is magnetized and a magnetic powder is applied to the surface. Faults which cause discontinuities are revealed by the concentration of powder
Annealing	A process involving heating and cooling, applied usually to induce softening.	Mechanical Properties	Properties relating to the behaviour of materials under load in conventional mechanical tests, such as elastic moduli, tensile strength, elongation, hardness.
Billet	A semi-finished rolled or forged steel product, usually square or round in section, intended for re-rolling or forging.	Normalizing	Heating steel to, and if necessary holding at, a suitable temperature above the transformation range, followed by cooling in a still atmosphere at ambient temperature, in order to produce a medium-to-fine pearlitic microstructure.
Cladding	A process for covering one metal with another. Processes include hot rolling, explosive bonding, welding, casting, chemical deposition and heavy electro plating.	Phase	A homogeneous, physically distinct part of a system and which is confined to a definite region of space being separated from the other parts of the system by bounding interfaces.
Creep	The time-dependant part of plastic deformation in a material under stress.	Pickling	Removal of oxide films from metal by immersion in an acid.
Drop Forging	A forging produced by hot working metal with a drop hammer.	Plastic Deformation	Deformation that does or will remain permanent after removal of the load that caused it.
Ductility	That property of a material that permits plastic deformation before fracture.	Proof Stress	That stress at which a material exhibits a specified limiting permanent set. Synonymous with yield strength.
Duplex Structure	A microstructure containing two phases. Example of this is Austenite and Ferrite in Duplex Stainless Steels.	Reduction of Area	The fraction by which the original cross-sectional area of a tensile test specimen is reduced at the place of fracture.
Dye Penetrant Testing	Penetrant with dye added to make it more readily visible under ordinary or ultra violet light. Commonly used for detecting surface cracks.	Recrystallization	The replacement of the crystal grains of a metal or alloy by a new generation of grains.
Eddy Current	Non-destructive testing method in which eddy current flow is induced in the test component. Changes in the flow caused by structural variation in the component are detected by a nearby coil or coils and subsequently analysed by suitable nstrumentation and other techniques.	Salt Bath	The term used in reference to the bath of molten salt that is used for the heating, hardening or tempering of various alloys.
Elongation	In tensile testing, the increase in the gauge length, measured after fracture of the test specimen within the gauge length, usually expressed as a percentage of the original gauge length.	Solution Heat Treatment	A treatment in which an alloy is heated to a suitable temperature and held at this temperature for a sufficient length of time to allow an element or elements to enter into solid solution.
Extrusion	The forcing of compressed material through an orifice or into a cavity.	Spheroidizing	A heat treatment process having as its object the production of a microstructure in which the dispersed phase occurs in a roughly spheroidal or globular form.
Fatigue	A condition in metals resulting from fluctuating stresses, leading to failure at a stress substantially below the normal tensile strength of the material.	Stainless Steel	Traditionally a stainless steel is considered to be an iron-based alloy containing more than 12% chromium.
Flare Test	A test applied to tubing, involving a tapered expansion over a cone.	Stress	The intensity of force acting on any plane within a body.
Flattening Test	A quality test for tubing in which a specimen is flattened between parallel plates that are closed to a specified gap.	Stress Relieving	Heating a metal to, and if necessary holding at, some temperature generally below the recrystallization range, followed by uniform cooling for the sole purpose of removing internal stresses.
Forging	The shaping of metal using a hammer or a press.	Tensile Strength	The maximum nominal stress reached during a tensile test on a material, ie the maximum load divided by the original crossectional area.
Hardness	The resistance offered by a metallic material to plastic deformation by indentation or penetration.	Ultrasonic Test	A test to determine the presence of internal flaws involving the transmission of high frequency sound waves that are reflected by the defects.
Heat Treatment	An operation or combination of operations involving the heating or cooling of a metal or alloy in the solid state for the purpose of obtaining certain desired conditions or properties.	Work Hardening	An increase in the hardness and / or mechanical strength of a metal resulting from plastic deformation.
Heat Affected Zone	That portion of the base metal that is not melted during brazing, cutting or welding but whose microstructure and properties are altered by the heat generated by the process.	Yield Point	In mechanical testing of certain metals, notably annealed or normalized low-carbon steels, this is the point on the load-deformation curve at which macroscopic plastic deformation commences under a constant or reduced load.
High Frequency Furnace	A furnace in which currents at a frequency above 500 Hertz are used to induce eddy currents in a charge which in turn generate heat in a conducting material.	Young's Modulus	The ratio of axial stress to axial strain in the elastic region of a tensile test.

Chemical Elements, Physical Properties & Galvanic Series

CHEMICAL ELEMENTS								PHYSICAL PROPERTIES OF CERTAIN CHEMICAL ELEMENTS						
Chemical Element	Symbol	Atomic Number	Atomic Weight	Chemical Element	Symbol	Atomic Number	Atomic Weight	Chemical Element	Symbol	Density at 20°C	Coefficient of Linear Expansion at 0-100°C (X10 ⁶)	Thermal Conductivity at 20°C W/m °C	Melting Point °C	Boiling Point °C
Actinium	Ac	89	227	Mercury	Hg	80	200.59	Aluminium	Al	2.70	23,7	219	660	2467
Aluminium	Al	13	26,98	Molybdenum	Mo	42	95,94	Antimony	Sb	6,68	9,4	19	631	1380
Americium	Am	95	243	Neodymium	Nd	60	144,24	Arsenic	As	5,78	4,7	-	817(28 atm)	613 (subl.)
Antimony	Sb	51	121,75	Neon	Ne	10	20,18	Beryllium	Be	1,85	11,6	147	1283	2970
Argon	Ar	18	39,95	Neptunium	Np	93	237	Bismuth	Bi	9,78	13,4	8	271	1560
Arsenic	As	33	74,92	Nickel	Ni	28	58,71	Boron	B	3,33	8	-	2300	2250 (subl.)
Astatine	At	85	210	Niobium	Nb	41	92,91	Calcium	Ca	1,54	19	126	845	1487
Barium	Ba	56	137,34	Nitrogen	N	7	14,01	Carbon (diamond)	C	3,51	1,3	1,56	>3550	4827
Berkelium	Bk	97	247	Nobelium	No	102	254	Carbon (graphite)	C	2,26	2,0	0,49	>3550	4827
Beryllium	Be	4	9,01	Osmium	Os	76	190,2	Chromium	Cr	7,23	6,8	68	1890	2482
Bismuth	Bi	83	208,98	Oxygen	O	8	16,00	Cobalt	Co	8,89	12,6	69	1492	2900
Boron	B	5	10,81	Palladium	Pd	46	106,4	Copper	Cu	8,94	16,2	394	1083	2595
Bromine	Br	35	79,90	Phosphorus	P	15	30,97	Gold	Au	19,31	14,4	307	1063	2966
Cadmium	Cd	48	112,40	Platinum	Pt	78	195,09	Iron	Fe	7,87	12,3	79	1535	3000
Calcium	Ca	20	40,08	Plutonium	Pu	94	244	Lead	Pb	11,34	28,9	35	327	1744
Californium	Cf	98	251	Polonium	Po	84	209	Lithium	Li	0,53	60	71	179	1371
Carbon	C	6	12,01	Potassium	K	19	39,10	Magnesium	Mg	1,74	26,1	149	651	1107
Cerium	Ce	58	140,12	Praseodymium	Pr	59	140,91	Manganese	Mn	7,50	23	-	1244	2097
Cesium	Cs	55	132,91	Promethium	Pm	61	145	Mercury	Hg	13,55	182 ¹⁾	8	-39	357
Chlorine	Cl	17	35,45	Protactinium	Pa	91	231	Molybdenum	Mo	10,2	5,2	144	2610	5560
Chromium	Cr	24	52,00	Radium	Ra	88	226	Nickel	Ni	8,90	13,1	92	1453	2732
Cobalt	Co	27	58,93	Radon	Rn	86	222	Niobium	Nb	8,56	8	55	2468	4927
Copper	Cu	29	63,55	Rhenium	Re	75	186,2	Palladium	Pd	11,9	11,7	70	1552	2927
Curium	Cm	96	247	Rhodium	Rh	45	102,91	Phosphorus (yell.)	P	1,83	125	-	44	280
Dysprosium	Dy	66	162,50	Rubidium	Rb	37	85,47	Platinum	Pt	21,4	9,0	71	1769	3830
Einsteinium	Es	99	254	Ruthenium	Ru	44	101,07	Potassium	K	0,86	84	100	64	774
Erbium	Er	68	167,26	Samarium	Sm	62	150,35	Selenium	Se	4,8	38	-	217	685
Europium	Eu	63	151,96	Scandium	Sc	21	44,96	Silicon	Si	2,33	2,5	84	1410	2355
Fermium	Fm	100	257	Selenium	Se	34	78,96	Silver	Ag	10,49	19,0	418	961	2212
Fluorine	F	9	19,00	Silicon	Si	14	28,09	Sodium	Na	0,96	70	134	98	892
Francium	Fr	87	223	Silver	Ag	47	107,87	Sulphur	S	2,07	64	-	119	445
Gadolinium	Gd	64	157,25	Sodium	Na	11	22,99	Tantalum	Ta	16,7	6,5	55	2996	5400
Gallium	Ga	31	69,72	Strontium	Sr	38	87,62	Tin	Sn	7,31	23	62	232	2270

Conversion Chart – Temperature

- (A) To use, locate "given temperature" in "given temperature" column (coloured YELLOW) whether °C or °F
- (B) If "given temperature" is in **degrees Celcius (°C)**, read **degrees Fahrenheit (°F)** in right hand column.
- (B) If "given temperature" is in **degrees Fahrenheit (°F)**, read **degrees Celcius (°C)** in left hand column.
- (D)

Example

(i) Given temperature is **35°C = 95°F** from right hand column

(ii) Given temperature is **35°F = 1.7°C** from left hand column

-320 to 27			28 to 77			78 to 235			240 to 485			490 to 2400		
°C	Given Temp	°F	°C	Given Temp	°F	°C	Given Temp	°F	°C	Given Temp	°F	°C	Given Temp	°F
-196	-320	-	-2.2	28	82.4	25.6	78	172.4	116	240	464	254	490	914
-184	-300	-	-1.7	29	84.2	26.1	79	174.2	118	245	473	257	495	923
-173	-280	-	-1.1	30	86.0	26.7	80	176.0	121	250	482	260	500	932
-162	-260	-436	-0.6	31	87.8	27.2	81	177.8	124	255	491	266	510	950
-151	-240	-400	0.0	32	89.6	27.8	82	179.6	127	260	500	271	520	968
-140	-220	-364	0.6	33	91.4	28.3	83	181.4	129	265	509	277	530	986
-129	-200	-328	1.1	34	93.2	28.9	84	183.20	132	270	518	282	540	1004
-115	-175	-283	1.7	35	95.0	29.4	85	185.0	135	275	527	288	550	1022
-101	-150	-238	2.2	36	96.8	30.0	86	186.8	138	280	536	293	560	1040
-90	-130	-202	2.8	37	98.6	30.6	87	188.6	141	285	545	299	570	1058
-84	-120	-184	3.3	38	100.4	31.1	88	190.4	143	290	554	304	580	1076
-79	-110	-166	3.9	39	102.2	31.7	89	192.2	146	295	563	310	590	1094
-73	-100	-148	4.4	40	104.0	32.2	90	194.0	149	300	572	316	600	1112
-68	-90	-130	5.0	41	105.8	32.8	91	195.8	152	305	581	321	610	1130
-62	-80	-112	5.6	42	107.6	33.3	92	197.6	154	310	590	327	620	1148
-57	-70	-94	6.1	43	109.4	33.9	93	199.4	157	315	599	332	630	1166
-51	-60	-76	6.7	44	111.2	34.4	94	201.2	160	320	608	338	640	1184
-46	-50	-58	7.2	45	113.0	35.0	95	203.0	163	325	617	343	650	1202
-40	-40	-40	7.8	46	114.8	35.6	96	204.8	166	330	626	349	660	1220
-34	-30	-22	8.3	47	116.6	36.1	97	206.6	168	335	635	354	670	1238
-29	-20	-4	8.9	48	118.4	36.7	98	208.4	171	340	644	360	680	1256
-23	-10	14	9.4	49	120.2	37.2	99	210.2	174	345	653	366	690	1274
-17.8	0	32	10.0	50	122.0	37.8	100	212.0	177	350	662	371	700	1292
-17.2	1	33.8	10.6	51	123.8	41	105	221	179	355	671	377	710	1310
-16.7	2	35.6	11.1	52	125.6	43	110	230	182	360	680	382	720	1328
-16.1	3	37.4	11.7	53	127.4	46	115	239	185	365	689	388	730	1346
-15.6	4	39.2	12.2	54	129.2	49	120	248	188	370	698	393	740	1364
-15.0	5	41.0	12.8	55	131.0	52	125	257	191	375	707	399	750	1382
-14.4	6	42.8	13.3	56	132.8	54	130	266	193	380	716	404	760	1400
-13.9	7	44.6	13.9	57	134.6	57	135	275	196	385	725	410	770	1418
-13.3	8	46.4	14.4	58	136.4	60	140	284	199	390	734	416	780	1436
-12.8	9	48.2	15.0	59	138.2	63	145	293	202	395	743	421	790	1454
-12.2	10	50.0	15.6	60	140.0	66	150	302	204	400	752	427	800	1472
-11.7	11	51.8	16.1	61	141.8	68	155	311	207	405	761	432	810	1490
-11.1	12	53.6	16.7	62	143.6	71	160	320	210	410	770	438	820	1508
-10.6	13	55.4	17.2	63	145.4	74	165	329	213	415	779	443	830	1526
-10.0	14	57.2	17.8	64	147.2	77	170	338	216	420	788	454	850	1562
-9.4	15	59.0	18.3	65	149.0	79	175	347	218	425	797	468	875	1607
-8.9	16	60.8	18.9	66	150.8	82	180	356	221	430	806	482	900	1652
-8.3	17	62.6	19.4	67	152.6	85	185	365	224	435	815	510	950	1742
-7.8	18	64.4	20.0	68	154.4	88	190	374	227	440	824	538	1000	1832
-7.2	19	66.2	20.6	69	156.2	91	195	383	229	445	833	566	1050	1922
-6.7	20	68.0	21.1	70	158.0	93	200	392	232	450	842	593	1100	2012
-6.1	21	69.8	21.7	71	159.8	96	205	401	235	455	851	621	1150	2102
-5.6	22	71.6	22.2	72	161.6	99	210	410	238	460	860	649	1200	2192
-5.0	23	73.4	22.8	73	163.4	102	215	419	241	465	869	704	1300	2372
-4.4	24	75.2	23.3	74	165.2	104	220	428	243	470	878	760	1400	2552
-3.9	25	77.0	23.9	75	167.0	107	225	437	246	475	887	816	1500	2732
-3.3	26	78.8	24.4	76	168.8	110	230	446	249	480	896	1093	2000	3632
-2.8	27	80.6	25.0	77	170.6	113	235	455	252	485	905	1316	2400	4352

DEGREES: FAHRENHEIT TO CELCIUS

(° F – 32) x 5/9 = ° C

DEGREES: CELCIUS TO FAHRENHEIT

(° C x 9/5) + 32 = ° F

Conversion Factors

“SI” – Denotes the INTERNATIONAL SYSTEM of Metric Units adopted in Australia

MULTIPLY COLUMN "A" BY COLUMN "B" TO OBTAIN COLUMN "C"							
THIS TABLE MAY BE USED IN TWO WAYS:				ALTERNATIVELY			
DIVIDE COLUMN "C" BY COLUMN "B" TO OBTAIN COLUMN "A"							
REMARKS	A MULTIPLY	B BY	C TO OBTAIN	REMARKS	A MULTIPLY	B BY	C TO OBTAIN
AREA: Symbol m ² The SI unit of AREA is the SQUARE METRE	Square inches Square feet Square yards acre hectare (ha)	645.16 .0929 0.836 4047 10000	mm ² m ² m ² m ² m ²	REMARKS POWER: Symbol W The SI unit of POWER is the WATT.	Btu per hour (Btu/hr) horsepower (hp) ton of refrigeration	0.2931 0.7457 3.517	W kW kW
DENSITY:Symbol kg/m ³ The SI unit of DENSITY is the kilogram per cubic metre.	lb/in ³ lb/ft ³ lb/yd ³	27.68 16.02 0.5933	t/m ³ kg/m ³ kg/m ³	PRESSURE: Symbol Pa The SI unit of PRESSURE or stress is the NEWTON PER SQUARE METRE which has been given the name PASCAL.	lbf/in2 kip/in2 (1000 psi) lbf/ft2 kgf/cm2 bar	6.895 6.895 47.88 98.07 100	kPa MPa Pa kPa kPa
ENERGY: Symbol J The SI unit of energy is the joule. 1 J = 1 N.m A joule is the energy expended or the work done when a force of one newton moves the point of application a distance of one metre in the direction of that force.	1. ELECTRICAL ENERGY kilowatt hour (kW.h)	3.6	MJ	1 N/m ² = 1 Pa = 0.000145 lbf/in ² A pascal is the pressure or stress which arises when a force of one newton is applied uniformly over an area of one square metre.	Vertical column (head) of water. (H2Oat20°C) metres of water feet of water	 9.79 2.984	 kPa kPa
	2. HEAT ENERGY British thermal unit (Btu) Btu/gal Btu/ft3	1.055 0.2321 37.26	kJ kJ/L tt kJ/m ³		orr (vacuum) 1 mm Hg. (mercury) 1 in. Hg.(mercury) atmosphere (atm) microns	0.1333 0.1333 3.386 101.325 0.133	kPa kPa kPa kPa Pa
	3. MECHANICAL ENERGY <u>foot poundal</u> ft.pdl <u>inch pound-force</u> in.lbf <u>foot pound-force</u> ft.lbf <u>foot ton force</u> ft.tonf <u>metre kilogram force</u> m.kgf	.04214 0.1130 1.356 3.037 9.807	J J J kJ J	TORQUE: Symbol N.m (Moment of force) The SI unit of TORQUE is the NEWTON METRE. The NEWTON METRE is the work done when a force of one newton moves the point of application a distance of one metre in the direction of that force.	<u>Poundal-foot</u> pdl.ft <u>pound-force inch</u> lbf.inch lbf.inch <u>pound-force feet</u> lbf .ft lbf.ft <u>ton-force feet</u> tonf.ft <u>kilogram-force</u> kgf.m kgf .cm	.04214 0.1130 1.152 1.356 13.83 3.037 9.807 0.09807	N.m N.m kgf .cm N.m kgf .cm kN.m N.m N.m
FORCE: Symbol N (NEWTON) The SI unit of FORCE (kg.m/s ²) has been given the special name - NEWTON. The newton is the force which when applied to a body having a mass of one kilogram, causes an acceleration of one metre per second per second in the direction of application of the force.	Poundal (pdl) Pound-force (lbf) ton-force (tonf) *kilogram-force (kgf) *also known as kilopond (kp)	0.1383 4.448 9.964 9.807	N N kN N	1 N.m = 1 J	ft. per second (ft/s) ft. per minute (f t/m in) miles per hour miles per hour	0.3048 0.00508 0.4470 1.609	m/s m/s m/s km/h
FORCE PER UNIT LENGTH the SI unit is NEWTON PER METRE: Symbol N/m	pounds-force per inch (lbf/in) pounds-force per foot (lbf/ft) ton-force per foot (ton/ft)	175.1 14.59 32.69	N/m N/m kN/m	VOLUME: CAPACITY: Symbol m ³ The SI unit of VOLUME is the CUBIC METRE.	DRY: cubic inch (in ³) cubic foot (ft ³) cubic yard (yd ³)	16387 0.02832 0.7646	mm3 m3 m3
LENGTH: Symbol m The SI unit of LENGTH is the METRE.	inches feet yards chain mile mile	25.4 0.3048 0.9144 20.12 1609 1.609	millimetres (mm) metres (m) metres (m) metres (m) metres (m) kilometres (km)	NOTE: tt Capital "L" is now the legal preferred symbol for litre in Australia.	litre (L) tt litre (L) tt gallons (Imp) IMPERIAL LIQUID fluid ounce pint (20fl.oz) quart (2 pints) gallon (Imp) gallon (US) litre (water 4°C) Imp. gallons (water 20°C)	1000000 0.001 0.004546 28.41 568.3 1.137 4.546 3.785 1.000 4.536	mm ³ m ³ m ³ millilitre (ml) millilitre (ml) litre (L) tt litre (L) tt litre (L) tt kilogram (kg) kilograms (kg)
MASS: Symbol kg The SI unit of MASS is the KILOGRAM.	ounce pound slug ton (2240 lb) short ton (2000 lb) ton (2240 lb) pounds per foot (lb/ft) pounds per yard (lb/vd)	28.35 0.4536 14.59 1016.05 907.2 1.016 1.488 0.4961	grams (g) kilograms (kg) kg kg kg tonne (t) kg/m kq/m	VOLUME: RATE OF FLOW. Symbol m ³ /s The SI unit of VOLUME RATE OF FLOW is the CUBIC METRE PER SECOND.	Imp. gal. per minute (gal/min) Imp. gal. per minute Imp. gal. per minute cubic ft. per minute cubic ft. per minute	.0000758 0.272765 .0758 .000472 0.472	m ³ /s m ³ /hr. litre per second (L/s) m ³ /s litre per second (L/s) 1 m ³ = 1 kL km per litre litres per km
				SUNDRY ITEMS:	miles per gallon gallons per mile	0.3540 2.825	