



Company Information & Technical Brochure





Company Profile

Founded in 1987 in Perth, Western Australia, PFP Aust has developed strong network associations globally with internationally recognised manufacturers supporting continued growth and increasing market demands for products such as Flanges, Pressure Vessel components, Valves, Engineered Products, Forged Components, Buttweld Fittings and Heavy Wall Pipes in general & sophisticated materials. In addition to these manufacturing associations PFP Aust has forged close relationships with a number of the world's best practice stockists, to supplement their own inventory which enables them to offer and service a comprehensive product range covering all grades of pipe, fittings, flanges and valves on either a stock basis and or a priority delivery, dependant upon the clients needs.

Since the late 1980's PFP Aust's products have been instrumental in the servicing of key oil and gas projects for a who's who of industry clients concentrated predominantly in Australasia.

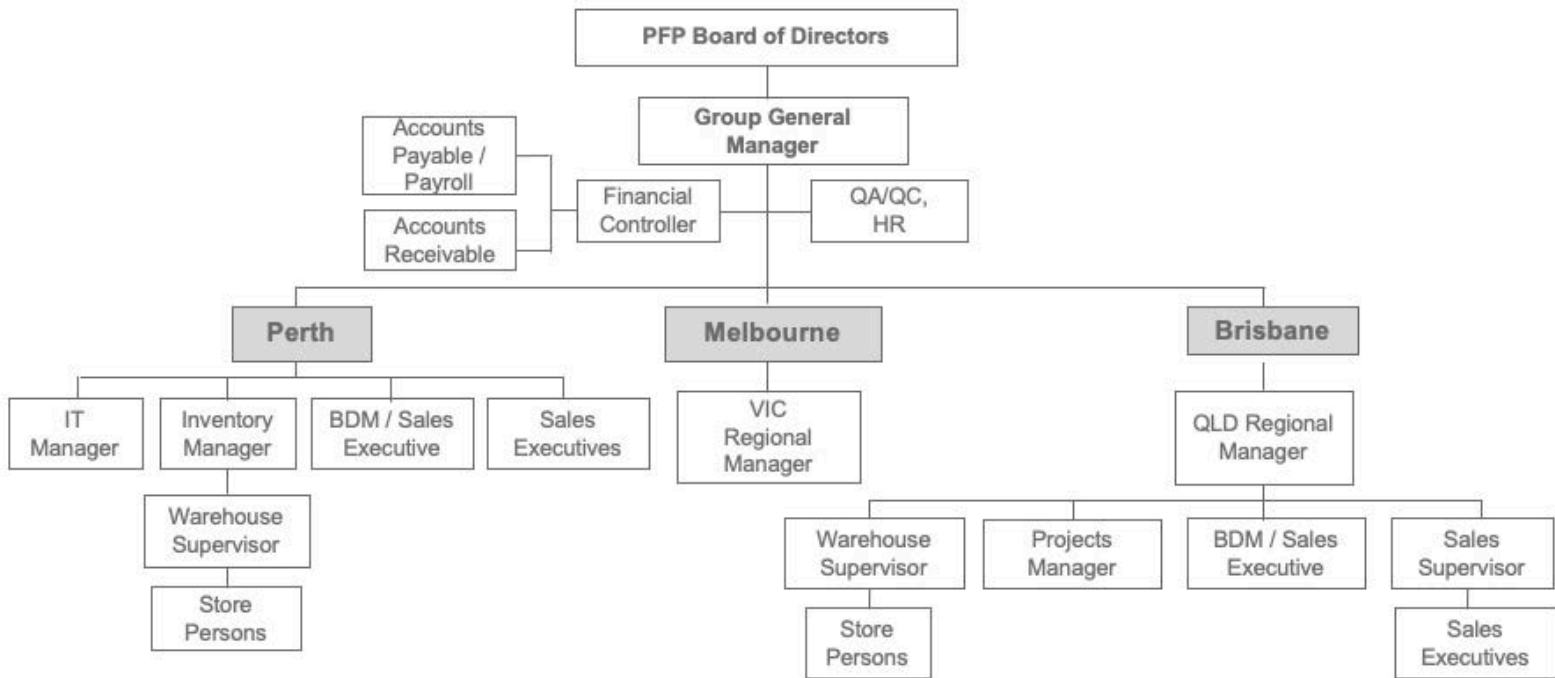
During 2000 the company took the next step towards expanding its market coverage and service to its target markets, with the opening of a branch in Brisbane Queensland, the primary objective being to service existing clients and develop new business on the East Coast of Australia, Papua New Guinea, New Zealand & New Caledonia. PFP's ongoing commitment to servicing its clients, incorporates the planned opening of additional branches during the coming years, which will ensure they maintain and improve their customer service objectives.

Throughout 2005 further expansion took place, through the growth of the Specialist Stock operation, resulting in the commitment to inventory increasing from the current 3000 tonnes of Buttweld Fittings & Flanges, warehoused at the Perth operation, to 4000 tonnes by the end of 2006, with additional commitments increasing this to 5000 tonnes by the end of 2007. The growth of this division is forecast to contribute to a significant increase in PFP Aust's scope of supply and the ability to service short lead and stock requirements of the industry.



PFP AUSTRALASIA

- PFP Aust Pty Ltd (Western Australia)
- PFP Aust Pty Ltd (Queensland)
- PFP Aust Pty Ltd (Melbourne)
- PFP Singapore Pte Ltd



COMPANY PROFILE & ORGANISATION

PROJECT PORTFOLIO



Project Portfolio

Field Development Name	Location	Client	Product	Field Development Name	Location	Client	Product
Alcan Gove Alumina Plant	Thailand / Queensland	Alcan Construction	Stainless, Duplex & Carbon Piping Items	Yabula Gas Conversion	Townsville Queensland	Queensland Nickel Ltd	Carbon Steel, Impact Tested Carbon Steel, High Yield Carbon Steel & Stainless Steel Pipe, Fittings & Flanges
Koeng Khoi II Project	New South Wales / Vietnam	Alstom Power	CS Pipe, Fittings and Flanges	South East Manada Gas Project	PNG	Oilsearch Ltd	Carbon Steel, Impact Tested Carbon Steel & Stainless Steel Pipe, Fittings & Flanges
Pohokura Gas Project	New Zealand	Transfield Worley JV (Shell Todd)	Stainless & Duplex Piping Items	Santos - Casino Gas Field Development	Melbourne	Mitchell Group	Carbon Steel, Impact Tested Carbon Steel, High Yield Carbon Steel & Stainless Steel Pipe, Fittings & Flanges
Basker Manta Project	Melbourne	Anzon Australia	Stainless, Duplex & Super Duplex Piping Items	TXU Electricity	Melbourne	Worley Parsons	Carbon Steel, Impact Tested Carbon Steel & Stainless Steel Pipe, Fittings & Flanges
NW Moran MEJ Projects	PNG	Oil Search Ltd	Carbon, Impact Tested Carbon & Duplex Piping Items	Eso - Turrum Gas Plant	Melbourne	Kellog Brown & Root (KBR)	Stainless Steel and Duplex Piping Materials
Enfield Subsea Pipeline	Western Australia	Technip Oceania (Woodside)	Duplex Pipe & Fittings (DNV OS F101)	Pohokura Gas Field (Top Sides)	New Zealand	Fitzroy Engineering	Duplex Pipe, Fittings & Flanges
General Maintenance	Western Australia	BP Refinery	Alloy & Titanium Piping Items	Pohokura Gas Field (Onshore Plant)	New Zealand	Transfield Worley Limited NZ	Duplex Pipe, Fittings & Flanges
Goro Nickel Plant	Queensland / New Caledonia	Inco Australia Management	Duplex & Titanium Piping Items	Santos Mutineer Exeter	Karratha North West Shelf	Subsea 7	DSS Pipe and API Flanges
QNI Debottlenecking	Queensland	Queensland Nickel Ltd	Carbon, Impact Tested Carbon & Duplex Piping Items	Goodwyn A Low Pressure Train Project	Offshore Karratha	TW / Woodside Alliance	CS, SS, DSS and SDSS Pipe, Fittings and Flanges
Water Treatment Plant	New Zealand	Contact Energy	Carbon Piping Items	QAL Refinery Modification Project	Brisbane	Queensland Alumina	CS Pipe fittings and Flanges
Ravensthorpe Nickel Project	Western Australia	GRD Kirfield Ltd	Carbon Steel Piping Items	North West Moran Development Project	PNG	Oilsearch Ltd	CS & ITCS Piping Items
Petronas Mult Basin	Sudan	PTE Heat Exchanger International	Tube Sheets and Forged Rings	Yabula Refinery H2S Upgrade	Brisbane	Queensland Nickel Ltd	CS & SS Piping Items
Jingemia Production Facility	Western Australia	Origin Energy	CS Pipe fittings and Flanges	Comalco Alumina Plant	Brisbane	Bechtel Australia	Special Piping Items (ITCS)
Alcan Gove (G3) Project	Queensland	Alcan Gove	Duplex Piping	Darwin LNG	Darwin	Bechtel (USA)	Carbon & Stainless Steel Piping Items
MEJ Surface Facilities Piping	PNG	Oil Search	HYCS / LTCS Piping	Yetagun Development	Singapore	Ranhill Worley SDN BHD	Double Block & Bleed Valve
Cliff Head	Western Australia	Worley Parsons / ROC Oil	CS & HY Piping Items to DNV OS F101	Yetagun Development	Batam	PT Profab	CS Pipe & Fittings
Persus over Goodwyn	Karratha North West Shelf	Transfield Worley JV	Duplex Stud Bolts	Minerva Gas Field	Melbourne	KBR / BHP Billiton	Stainless Steel Piping Items
Enfield Subsea Line	Western Australia	Technip	Duplex Line Pipe & Elbows to DNV OS F101	Minerva Gas Field	Melbourne	KBR / BHP Billiton	High Yield Carbon Steel Piping Items
Bayu-undan Gas Recycle Project (Shut Down & Maintenance Spares)	Western Australia	Conoco Phillips	Carbon Steel, Impact Tested Carbon Steel, High Yield Carbon Steel & Stainless Steel Pipe, Fittings & Flanges	Minerva Gas Field	Melbourne	KBR / BHP Billiton	Impact Tested Carbon Steel Piping Items
John Brookes Gas Project	Western Australia	AGC Group	CS Pipe fittings and Flanges	Comalco Alumina Project	Brisbane	Bechtel Australia	Hi Chrome Cast Liner Assemblies
John Brookes Gas Project	Western Australia	Apache Energy	High Yield Inconel Clad Barred Tees & Rings	TXU Seagas	Melbourne	Worley ABB	High pressure Carbon Steel Piping Items
QAL Unit 2 Flash Tanks	Gladstone Queensland	Queensland Alumina	Carbon Steel Pipe, Fittings & Flanges	Bass Gas	Melbourne	Clough	Spectacle Flanges & Barred Tees

Australasian & International Inventory

Size Range	Product	Schedules/Pressure Class	Grade/s
15 to 900NB	Flanges	Class 150 – All Schedules	A105 & LF2
15 to 600NB	Flanges	Class 300 – All Schedules	A105 & LF2
15 to 600 NB	Flanges	Class 600 – All Schedules	A105, LF2 & F52
15 to 600NB	Flanges	Class 900 – All Schedules	A105, LF2 & F52
15 to 600NB	Flanges	Class 1500 – All Schedules	A105, LF2 & F52
15 to 250NB	Flanges	Class 2500 – All Schedules	A105, LF2 & F52
15 to 900NB	Elbows, Reducers, Caps & Tees	STD & XS	WPB & WPL6
250 to 600NB	Elbows, Reducers, Caps & Tees	SCH 80	WPB & WPL6
100 to 300NB	Elbows, Reducers, Caps & Tees	SCH 120	WPB & WPL6
15 to 600NB	Elbows, Reducers, Caps & Tees	SCH 160	WPB & WPL6
15 to 150NB	Elbows, Reducers, Caps & Tees	SCH XXS	WPB & WPL6
15 to 600NB	Elbows, Reducers, Caps & Tees	STD, XS & S80	WPHY 52
15 to 200NB	Elbows, Reducers, Caps & Tees	SCH 160 & XXS	WPHY 52
15 to 600NB	Flanges	Class 150 – S10s, S40s & S80s	Stainless & Duplex
15 to 600NB	Flanges	Class 300 – S10s, S40s & S80s	Stainless & Duplex
15 to 300NB	Flanges	Class 600 – S10s, S40s & S80s	Stainless & Duplex
15 to 200NB	Flanges	Class 900 – S10s, S40s & S80s	Stainless & Duplex
15 to 150NB	Flanges	Class 1500 – S10s, S40s & S80s	Stainless & Duplex
15 to 300NB	Elbows, Reducers, Caps & Tees	S40s & S80s	Stainless & Duplex
15 to 150NB	Elbows, Reducers, Caps & Tees	SCH 160	Stainless & Duplex
15 to 600NB	Smls & Welded Pipe	S10s, S40s, S80s, S160 & XXS	Stainless & Duplex
15 to 600NB	Smls & Welded Pipe	STD, XS, S80, S100, S120, S160 & XXS	A333 Grade 3 & 6 & A335 P5 to 22
15 to 600NB	Smls & Welded Pipe	STD, XS, S80, S100, S120, S160 & XXS	API 5L X52 to 60

AUSTRALASIAN & INTERNATIONAL INVENTORY

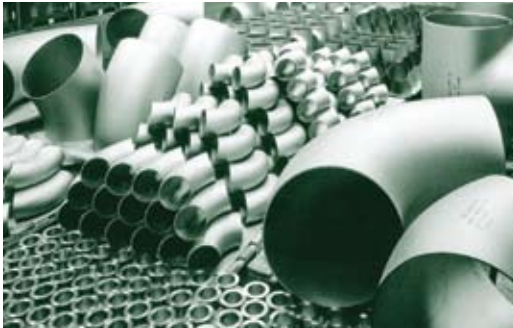
SCOPE OF SUPPLY

Scope Of Supply



PIPE WELDED AND SEAMLESS

Carbon, impact tested, high yield and chrome/moly, stainless steel, duplex, super duplex, special grades stainless, nickel alloys and titanium.



ANSI BW FITTINGS WELDED AND SEAMLESS

Carbon, impact tested, high yield and chrome/moly, stainless steel, duplex, super duplex, special grades stainless, nickel alloys and titanium

ANSI FLANGES

Carbon, impact tested, high yield, chrome/moly, stainless steel, duplex, super duplex, special grades stainless, nickel alloys and titanium.



MONOFLANGES

Carbon, impact tested, high yield, stainless, duplex, super duplex, special grades stainless and titanium.



COMPACT FLANGES AND CLAMP CONNECTORS

Carbon, impact tested, high yield, stainless, duplex, super duplex, special grades stainless and titanium.



SPECIALITY ENGINEERED FORGED ITEMS

Carbon, impact tested, high yield, stainless steels, special grades stainless, nickel alloys and titanium.

BOLTING

Austentic stainless steels, special grades stainless, duplex, super duplex, nickel alloys and titanium.



VALVES

Ball Valves - API 6D, API 6A, ANSI B16.34, BS5351
Gate, Globe & Check Valves - Valves to ASME, BS and API standards.
Compact Modular Valves - Comply with ASME/API/BS standards.
Carbon Steel, Stainless Steel, 6Mo, Titanium, Duplex, Super Duplex, Inconel™, Incoloy™ and Special Alloys



™ INCO trade marks.

Pipe Chart Carbon and Stainless Steel

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	19.05 205.74	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	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	14.27 209.64	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) t x 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 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						
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							
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							
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							
40	1000	1016.0						9.53 236.63				12.70 314.22							
42	1050	1066.8						9.53 248.52				12.70 330.19							
44	1100	1117.6						9.53 260.50				12.70 346.16							
46	1150	1168.4						9.53 272.25				12.70 351.82							
48	1200	1219.2						9.53 284.24				12.70 377.79							

PIPE SCHEDULE – ANSI B36.10 – METRIC

CARBON & STAINLESS STEEL PIPE WEIGHT AND DIMENSION CHART

GENERAL INFORMATION FLANGES AND BUTTWELDED FITTINGS



General Information Flanges & Butt weld Fittings

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.








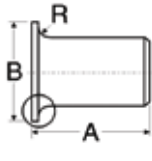
Ring Type Joint

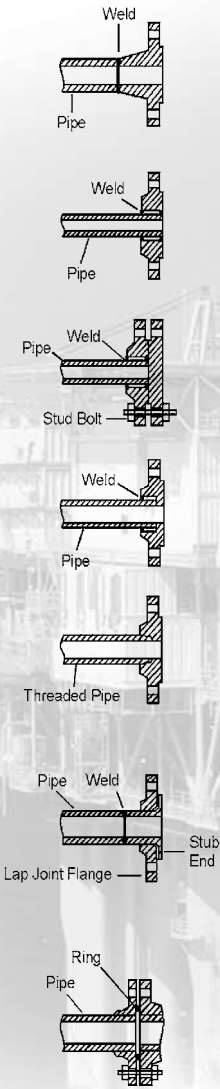
This is a method of ensuring leak proof flange connection at high pressures. A metal ring is compressed into a hexagonal groove on the face of the flange to make the seal. This jointing method can be employed on Weld Neck, Slip-on and Blind Flanges.

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 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.
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.



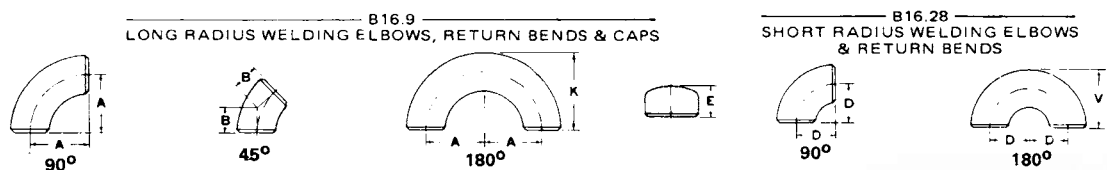
CARBON		ALLOY STEEL		STAINLESS STEEL		DUPLEX/S.DUPLEX	
A105(N)		A182 F1		A182 F394/H/L		- A182 F51/UNS S31803	
A181		A182 F2		A182 F310		- A182 F53/UNS S32750	
A266		A182 F5/A		A182 F316/H/L		- A182 F55/UNS S32760	
A350 LF1/LF2/2F3		A182 F6/A		A182 F321/H		- A182 F44/UNS S31254	
A694 F42		A182 F9		A182 F347/H		- A182 F49/UNS S24565	
A694 F52		A182 F11		A182 F348/H			
A694 F60		A182 F12		A182 F10			
A694 F65		A182 F22					
A707/3 CL.2/CL.3		A182 F91					
A707/5 CL.3							

Flange Material

NOT FERRITIC		ALUMINIUM		TITANIUM	
MONEL 400/UNS N04400				B381 F2	
INCONEL 660/US N06600				B381 F5	
INCONEL 625/UNS N00625				B381 F7	
INCOLOY 80/UNS N08800				B381 F12	
INCOLOY 825/UNS N08825					
ALLOY C276/UNS N10276					

Carbon Steel Buttweld Fittings

To ANSI B16.9, B16.28 & B51640



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	47.5	-	-	25.4	15	½	
20	¾	26.7	-	-	-	2.87		-	3.91		-	-	-	-	5.56	7.82	28.5	11	43	19	33	25.4	20	¾
25	1	33.4	-	-	-	3.38		-	4.55		-	-	-	-	6.35	9.09	38	22	55.5	25.4	41	38.1	25	1
32	1¼	42.2	-	-	-	3.56		-	4.85		-	-	-	-	6.35	9.70	47.5	25.4	70	32	52	38.1	32	1¼
40	1½	48.3	-	-	-	3.68		-	5.08		-	-	-	-	7.14	10.15	57	29	82.5	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	44.5	132	63.5	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		-	8.56		-	-	11.13	-	13.49	17.12	152	63.5	210	102	159	63.5	100	4
125	5	141.3	-	-	-	6.55	↑ SAME AS STD. WT. ↓	-	9.53	↑ SAME AS X. STG. ↓	-	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		18.26	21.44	25.40	28.58	25.40	381	159	517	254	390	127	250	10	
300	12	323.9	-	6.35	8.38	9.53		14.27	12.70		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	28.6 28.6	- 28.6	- 38.1	100	100	4	105	-	-	400	400	16	305	-	-		
25	25	1	1	38.1	-	-		90	3½	105	102	102		350	14	305	305	356		
	20		¾	38.1	38.1	50.8		80	3	105	98.4	102		300	12	305	295	356		
	15		½	38.1	38.1	50.8		65	2½	105	95.3	102		250	10	305	283	356		
								50	2	105	88.9	102		200	8	305	273	356		
32	32	1¼	1¼	47.6	-	-	125	40	1½	105	85.7	102	150	6	305	264	356			
	25		1	47.6	47.6	50.8		125	5	124	-	-	450	18	343	-	-			
	20		¾	47.6	47.6	50.8		100	4	124	117	127	400	16	343	330	381			
	15		½	47.6	47.6	50.8		90	3½	124	114	127	350	14	343	330	381			
40	40	1½	1½	57.2	-	-	125	80	3	124	111	127	300	12	343	321	381			
	32		1¼	57.2	57.2	63.5		65	2½	124	108	127	250	10	343	308	381			
	25		1	57.2	57.2	63.5		50	2	124	105	127	200	8	343	298	381			
	20		¾	57.2	57.2	63.5		150	150	6	143	-	-	500	20	381	-	-		
	15		½	57.2	57.2	63.5			125	5	143	137	140	450	18	381	368	508		
50	50	2	2	63.5	-	-	150	100	4	143	130	140	400	16	381	356	508			
	40		1½	63.5	60.3	76.2		90	3½	143	127	140	350	14	381	356	508			
	32		1¼	63.5	57.2	76.2		80	3	143	124	140	300	12	381	346	508			
	25		1	63.5	50.8	76.2		65	2½	143	121	140	250	10	381	333	508			
	20		¾	63.5	44.5	76.2		200	8	178	-	-	200	8	381	324	508			
65	65	2½	2½	76.2	-	-	200	150	6	178	168	152	600	600	24	432	-	-		
	50		2	76.2	69.9	88.9		125	5	178	162	152		500	20	432	432	508		
	40		1½	76.2	66.7	88.9		100	4	178	155	152		450	18	432	419	508		
	32		1¼	76.2	63.5	88.9		80	3	178	152	152		400	16	432	406	508		
	25		1	76.2	57.2	88.9		250	10	216	-	-		350	14	432	406	508		
80	80	3	3	85.7	-	-	250	200	8	216	203	178	300	12	432	397	508			
	65		2½	85.7	82.6	88.9		150	6	216	194	178	250	10	432	384	508			
	50		2	85.7	76.2	88.9		125	5	216	191	178	750	750	30	559	-	-		
	40		1½	85.7	73.0	88.9		100	4	216	184	178		600	24	559	533	610		
	32		1¼	85.7	69.9	88.9		300	12	254	-	-		500	20	559	508	610		
90	25	1	85.7	66.9	88.9	300	250	10	254	241	203	750	450	18	559	495	610			
							200	8	254	229	203		400	16	559	483	610			
	90	3½	95.3	-	-		150	6	254	219	203		900	900	36	673	-	-		
	80	3	95.3	92.1	102		100	4	254	210	203			750	30	673	635	610		
	65	2½	95.3	88.9	102	350	350	14	279	-	-	600		24	673	610	610			
	50	2	95.3	82.6	102		300	12	279	270	330	500	20	673	584	610				
	40	1½	95.3	79.4	102		250	10	279	257	330	450	18	673	572	610				
Note: All dimensions are in millimetres — (mm)																				

Note: All dimensions are in millimetres – (mm)

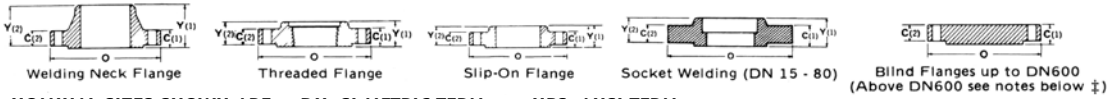
CARBON STEEL BUTTWELD FITTINGS – DIMENSIONS

FLANGES – FORGED TO AMERICAN STANDARDS – DIMENSIONS



Forged Flanges To American Standards

DN 15 to 600 are to ANSI B16.5 (BS 1560).
DN 750 & 900 are to BS 3293 for Slip-On & Weldneck only.



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	11.5	16	48	60.5	16	4	95	14.5	22	52	66.5	16	4	95	14.5	22	52	66.5	16	4	15	½
20	¾	100	13.0	16	52	70.0	16	4	120	16.0	25	57	82.5	20	4	120	16.0	25	57	82.5	20	4	20	¾
25	1	110	14.5	17	56	79.5	16	4	125	17.5	27	62	89.0	20	4	125	17.5	27	62	89.0	20	4	25	1
32	1¼	120	16.0	21	57	89.0	16	4	135	19.5	27	65	98.5	20	4	135	21.0	29	67	98.5	20	4	32	1¼
40	1½	127	17.5	22	62	98.5	16	4	155	21.0	30	68	114.5	22	4	155	22.5	32	70	114.5	22	4	40	1½
50	2	150	19.5	25	64	120.5	20	4	165	22.5	33	70	127.0	20	8	165	26.5	37	73	127.0	20	8	50	2
65	2½	180	22.5	29	70	139.5	20	4	190	25.5	38	76	149.0	22	8	190	29.0	41	79	149.0	22	8	65	2½
80	3	190	24.0	30	70	152.5	20	4	210	29.0	43	79	168.5	22	8	210	32.0	46	83	168.5	22	8	80	3
90	3½	215	24.0	32	71	178.0	20	8	230	30.5	44	81	184.0	22	8	230	35.0	49	86	184.0	26	8	90	3½
100	4	230	24.0	33	76	190.5	20	8	255	32.0	48	86	200.0	22	8	275	38.5	54	102	216.0	26	8	100	4
125	5	255	24.0	36	89	216.0	22	8	280	35.0	51	98	235.0	22	8	330	44.5	60	114	267.0	30	8	125	5
150	6	280	25.5	40	89	241.5	22	8	320	37.0	52	98	270.0	22	12	355	48.0	67	117	292.0	30	12	150	6
200	8	345	29.0	44	102	298.5	22	8	380	41.5	62	111	330.0	26	12	420	55.5	76	133	349.0	33	12	200	8
250	10	405	30.5	49	102	362.0	26	12	445	48.0	67	117	387.5	30	16	510	63.5	86	152	432.0	36	16	250	10
300	12	485	32.0	56	114	432.0	26	12	520	51.0	73	130	451.0	33	16	560	66.5	92	156	489.0	36	20	300	12
350	14	535	35.0	57	127	476.0	30	12	585	54.0	76	143	514.5	33	20	605	70.0	94	165	527.0	39	20	350	14
400	16	600	37.0	64	127	540.0	30	16	650	57.5	83	146	571.5	36	20	685	76.5	106	178	603.0	42	20	400	16
450	18	635	40.0	68	140	578.0	33	16	710	60.5	89	159	628.5	36	24	745	83.0	117	184	654.0	45	20	450	18
500	20	700	43.0	73	145	635.0	33	20	775	63.5	95	162	686.0	36	24	815	89.0	127	190	724.0	45	24	500	20
600	24	815	48.0	83	152	749.5	36	20	915	70.0	106	168	813.0	42	24	940	102.0	140	203	838.0	52	24	600	24
750	30	985	54.0‡	89	130.2	914.0	35	28	1090	92.0	210	210	997.0	48	28	1130	114.0	248	248	1022.0	54	28	750	30
900	36	1170	60.3‡	95	136.5	1086.0	41	32	1270	105.0	241	241	1168.0	54	32	1315	124.0	283	283	1194.0	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	0	C(2)†						0	C(2)†						0	C(2)†						DN	NPS
15	½	USE PN250 DIMENSIONS IN THESE SIZES							120	22.5	32	60	82.5	22	4	135	30.5	40	73	89.0	22	4	15	½
20	¾								130	25.5	35	70	89.0	22	4	140	32.0	43	79	95.0	22	4	20	¾
25	1								150	29.0	41	73	101.5	26	4	160	35.0	48	89	108.0	26	4	25	1
32	1¼								160	29.0	41	73	111.0	26	4	185	38.5	52	95	130.0	30	4	32	1¼
40	1½								180	32.0	44	83	124.0	30	4	205	44.5	60	111	146.0	33	4	40	1½
50	2								215	38.5	57	102	165.0	26	8	235	51.0	70	127	171.5	30	8	50	2
65	2½								245	41.5	64	105	190.5	30	8	270	57.5	79	143	197.0	33	8	65	2½
80	3	240	38.5	54	102	190.5	26	8	270	48.0	73	118	203.0	33	8	305	67.0	92	168	228.5	36	8	80	3
100	4	295	44.5	70	114	235.0	32	8	310	54.0	90	124	241.5	36	8	355	76.5	108	190	273.0	42	8	100	4
125	5	350	51.0	79	127	279.5	35	8	375	73.5	105	155	292.0	42	8	420	92.5	130	229	324.0	48	8	125	5
150	6	380	56.0	86	140	317.5	32	12	395	83.0	119	171	317.5	39	12	485	108.0	152	273	368.5	56	8	150	6
200	8	470	63.5	102	162	393.5	39	12	485	92.0	143	213	393.5	45	12	550	127.0	178	318	438.0	56	12	200	8
250	10	545	70.0	108	184	470.0	39	16	585	108.0	159	254	482.5	52	12	675	165.5	229	419	539.5	68	12	250	10
300	12	610	79.5	117	200	533.50	39	20	675	124.0	181	283	571.5	56	16	760	184.5	254	464	619.0	76	12	300	12
350	14	640	86.0	130	213	559.0	42	20	750	133.5		298	635.0	60	16								350	14
400	16	705	89.0	133	216	616.0	45	20	825	146.5		311	705.0	68	16								400	16
450	18	785	102.0	152	229	686.0	52	20	915	162.0		327	774.5	76	16								450	18
500	20	855	108.0	159	248	749.5	54	20	985	178.0		356	832.0	80	16								500	20
600	24	1040	140.0	203	292	901.5	68	20	1170	203.5		406	990.5	94	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																
	∇ DN	∇ 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	1¼	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						92.1	87.3	80.1		
186	125	5	141.3				128.2		122.3					115.9	109.6	103.2				
216	150	6	168.3				154.1		146.3					139.7	131.8	124.4				
270	200	8	219.1		206.4	205.0	202.7		198.5	193.7		188.9	182.6	177.8	173.1	174.6				
324	250	10	273.1		260.3	257.5	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	334.8	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	489.0	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 Steel Flanges

ASME B16.47-A (MSS-SP44)

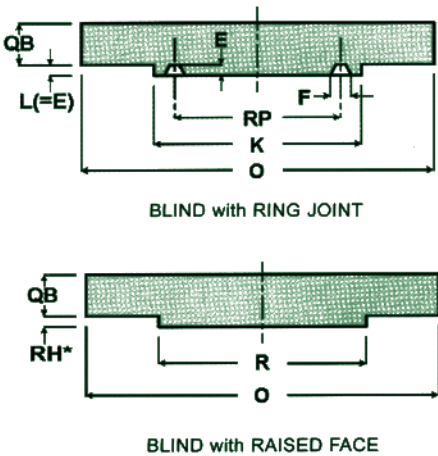
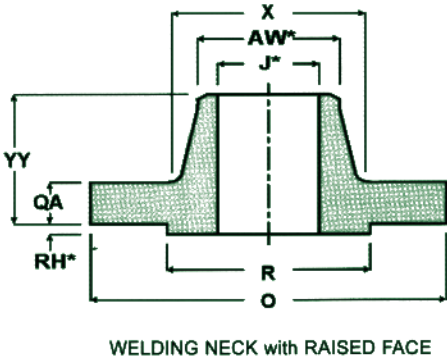
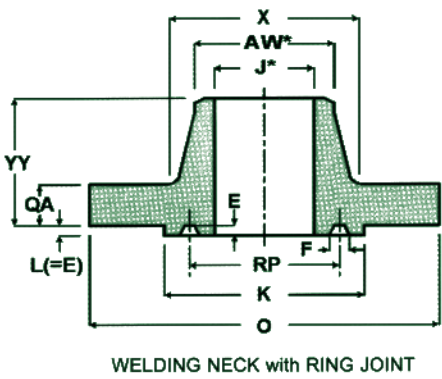
LARGE DIAMETER FLANGES SPECIFICATIONS ASME B16.47-A (MSS-SP44)

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 RF DIAMETER K	RING PITCH DIAMETER RP	DEPTH GROOVE E	WIDTH GROOVE F	RING NUMBER RN
150	650	870.0	68.4	68.4	120.7	676.2	806.4	24	35.0	749.4					
	700	927.2	71.4	71.4	125.5	727.0	863.6	28	35.0	800.2					
	750	984.3	74.7	74.7	136.7	781.1	914.4	28	35.0	857.3					
	800	1060.5	80.8	80.8	144.6	831.9	977.9	28	41.1	914.5					
	850	1111.3	82.6	82.6	149.4	882.7	1028.7	32	41.1	965.3					
	900	1168.5	90.5	90.5	157.3	933.5	1085.8	32	41.1	1022.4					
	950	1238.3	87.4	87.4	157.3	990.7	1149.3	32	41.1	1073.2					
300	1000	1289.1	90.5	90.5	163.6	1041.5	1200.1	36	41.1	1124.0					
	650	971.6	79.3	84.1	184.2	720.9	876.3	28	44.4	749.4	809.7	749.3	12.7	19.8	93
	700	1035.1	85.9	90.5	196.9	774.8	939.8	28	44.4	800.2	860.5	800.1	12.7	19.8	94
	750	1092.3	92.0	95.3	209.6	827.1	996.9	28	47.7	857.3	917.4	857.2	12.7	19.8	95
	800	1149.4	98.6	100.1	222.3	881.2	1054.1	28	50.8	914.5	984.2	914.4	14.2	23.0	96
	850	1206.6	101.7	104.7	231.7	936.8	1104.9	28	50.8	965.3	1035.0	965.2	14.2	23.0	97
	900	1270.1	104.7	111.3	241.4	990.7	1168.4	32	53.8	1022.4	1092.2	1022.3	14.2	23.0	98
600	950	1168.5	108.0	108.0	180.9	993.7	1092.2	32	41.1	1028.8					
	1000	1238.3	114.4	114.4	193.6	1047.8	1155.7	32	44.4	1085.9					
	650	1016.1	108.0	125.5	222.3	747.8	914.4	28	50.8	749.4	809.7	749.3	12.7	19.8	93
	700	1073.2	111.3	131.9	235.0	803.2	965.2	28	53.8	800.2	860.5	800.1	12.7	19.8	94
	750	1130.4	114.4	139.8	247.7	862.1	1022.3	28	53.8	857.3	917.4	857.2	12.7	19.8	95
	800	1193.9	117.4	147.6	260.4	917.5	1079.5	28	60.4	914.5	984.2	914.4	14.2	23.0	96
	850	1244.7	120.7	154.0	269.8	973.1	1130.3	28	60.4	965.3	1035.0	965.2	14.2	23.0	97
900	900	1314.5	124.0	162.1	282.5	1031.8	1193.8	28	66.5	1022.4	1092.2	1022.3	14.2	23.0	
	950	1270.1	152.5	155.5	254.1	1022.4	1162.0	28	60.4	1054.2					
	1000	1320.9	158.8	162.1	263.7	1073.2	1212.8	32	60.4	1111.3					
	650	1085.9	139.8	160.3	285.8	774.8	952.5	20	73.1	749.4	831.8	749.3	17.4	30.1	
	700	1168.5	142.8	171.5	298.5	831.9	1022.3	20	79.2	800.2	889.0	800.1	17.4	33.3	
	750	1232.0	149.4	182.4	311.2	889.1	1085.8	20	79.2	857.3	946.1	857.2	17.4	33.3	
	800	1314.5	158.8	193.6	330.3	946.2	1155.7	20	85.8	914.5	1003.3	914.4	17.4	33.3	
900	850	1397.1	165.2	204.8	349.3	1006.4	1225.5	20	91.9	965.3	1066.8	965.2	20.6	36.5	
	900	1460.6	171.5	214.4	362.0	1063.8	1289.0	20	91.9	1022.4	1123.9	1022.3	20.6	36.5	
	950	1460.6	190.6	216.0	352.6	1073.2	1289.0	20	91.9	1098.6					
	1000	1511.4	196.9	223.8	363.5	1127.3	1339.8	24	91.9	1162.1					

*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.



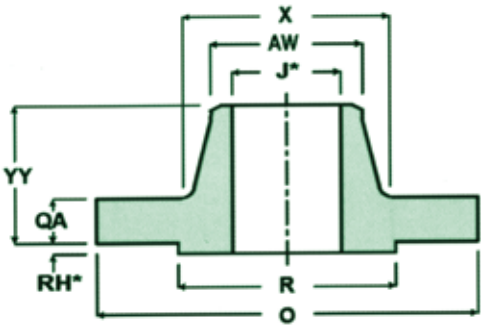
Forged Steel Flanges
ASME B16.47-B (API-605)

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

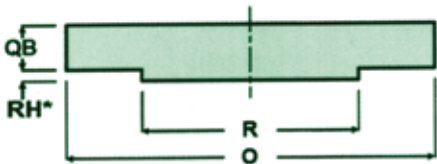
RATING	NOMINAL PIPE SIZE mm	OD FLANGE O	FLANGE THICKNESS WELD NECK QA	FLANGE THICKNESS BLIND QB	OVERALL HEIGHT YY	RF DIAMETER R	HUB DIAMETER X	NECK DIAMETER AW	PCD P	NO. OF BOLT HOLES N	HOLE DIAMETER HD
150	650	785.9	41.2	44.5	89.0	711.3	684.3	662.0	744.4	36	22.3
	700	836.7	44.5	47.8	95.3	762.1	735.1	712.8	795.2	40	22.3
	750	887.5	44.5	50.9	100.1	812.9	787.5	763.6	846.0	44	22.3
	800	941.4	46.0	53.9	108.0	863.7	839.8	814.4	900.1	48	22.3
	850	1004.9	49.3	57.2	110.3	920.8	892.1	865.2	957.3	40	25.4
	900	1057.2	52.4	58.7	117.4	971.6	944.7	916.0	1009.6	44	25.4
	950	1124.0	53.9	63.6	124.0	1022.4	993.7	968.3	1069.8	40	28.4
	1000	1174.8	55.7	66.6	128.6	1079.6	1049.3	1019.1	1120.6	44	28.4
	1050	1225.6	58.7	68.4	133.4	1130.4	1101.9	1069.9	1171.4	48	28.4
	1100	1276.4	60.5	71.4	136.7	1181.2	1152.7	1120.7	1222.2	52	28.4
	1150	1341.4	62.0	74.7	144.6	1235.0	1205.0	1171.5	1284.2	40	31.7
	1200	1392.2	65.1	77.8	149.4	1289.1	1257.4	1222.3	1335.0	44	31.7
300	650	866.7	89.0	89.0	144.6	736.7	701.6	665.3	803.1	32	35.0
	700	920.8	89.0	89.0	149.4	787.5	755.7	716.1	857.2	36	35.0
	750	990.7	93.8	93.8	158.0	844.6	812.9	768.4	920.7	36	38.1
	800	1054.2	103.2	103.2	168.2	901.8	863.7	819.2	977.9	32	41.1
	850	1108.0	103.2	103.2	173.0	952.6	917.5	870.0	1031.7	36	41.1
	900	1171.5	103.2	103.2	180.9	1009.7	965.3	920.8	1089.1	32	44.4
	950	1222.3	111.3	111.3	192.1	1060.5	1016.1	971.6	1139.9	36	44.4
	1000	1273.1	115.9	115.9	198.4	1114.6	1066.9	1022.4	1190.7	40	44.4
	1050	1333.6	119.2	119.2	204.8	1168.5	1117.7	1074.7	1244.6	36	47.7
	1100	1384.4	127.1	127.1	214.4	1219.3	1173.3	1125.5	1295.4	40	47.7
	1150	1460.6	128.6	130.1	222.3	1270.1	1228.9	1176.3	1365.2	36	50.8
	1200	1511.4	128.6	134.9	223.8	1327.2	1277.9	1227.1	1416.0	40	50.8
600	650	889.1	111.3	111.3	180.9	727.0	698.6	660.5	806.4	28	44.4
	700	952.6	115.9	115.9	190.6	784.4	752.4	711.3	863.6	28	47.7
	750	1022.4	125.5	127.1	204.8	841.3	806.5	762.1	927.1	28	50.8
	800	1085.9	130.1	134.9	216.0	895.4	860.6	812.9	984.2	28	53.8
	850	1162.1	141.3	144.3	233.5	952.6	914.5	863.7	1054.1	24	60.4
	900	1212.9	146.4	150.9	242.9	1009.7	968.3	914.5	1104.9	28	60.4
900	650	1022.4	134.9	154.0	258.9	762.1	743.0	660.5	901.7	20	66.5
	700	1105.0	147.6	166.7	276.4	819.2	797.1	711.3	971.5	20	73.1
	750	1181.2	155.5	176.1	289.1	876.4	851.0	762.1	1035.0	20	79.2
	800	1238.3	160.3	185.7	303.3	927.2	908.1	812.9	1092.2	20	79.2
	850	1314.5	171.5	195.1	319.1	990.7	962.2	863.7	1155.7	20	85.8
	900	1346.3	173.0	201.7	325.4	1028.8	1016.1	914.5	1200.1	24	79.2

*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.



WELDING NECK



BLIND

Forged Steel Flanges

BS 3293

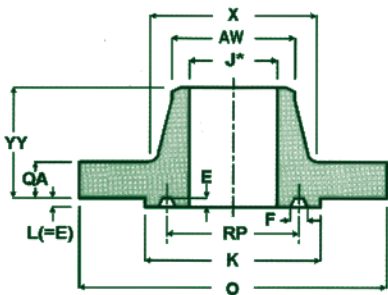
LARGE DIAMETER FLANGES SPECIFICATIONS BS 3293

RATING	NOMINAL PIPE SIZE	OD FLANGE	FLANGE THICKNESS	OVERALL HEIGHT	OVERALL HEIGHT	SLIP ON BORE	HUB DIAMETER	NECK DIAMETER	PCD	NUMBER HOLES	HOLE DIAMETER	RF DIAMETER	RTJ RJ DIAMETER	RING PITCH DIAMETER	DEPTH GROOVE	WIDTH GROOVE	RING NUMBER	LENGTH OF STUD BOLTS	
	mm	O	QA	YY	YS	SB	X	AW	P	N	HD	R	K	RP	E	F	RN	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	54.0	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	827.1	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		869.9	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		920.7	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	108.0	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

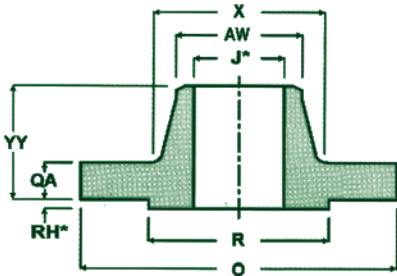
*RH SIZE: 150 & 300 RATING 1.6mm INCLUDED IN QA, YY AND YS DIMENSION.
600 & 900 RATING 6.4mm NOT INCLUDED IN QA AND YY DIMENSION.

*WN BORE J: TO BE SPECIFIED BY PURCHASER.

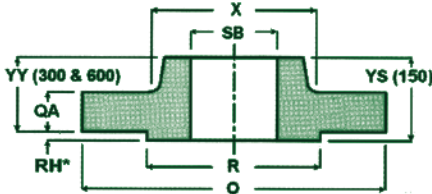
ALL DIMENSIONS mm.



WELDING NECK with RING JOINT



WELDING NECK



SLIP-ON

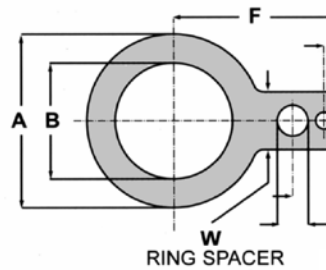
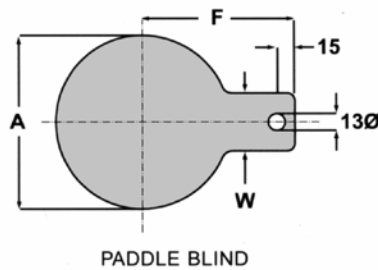
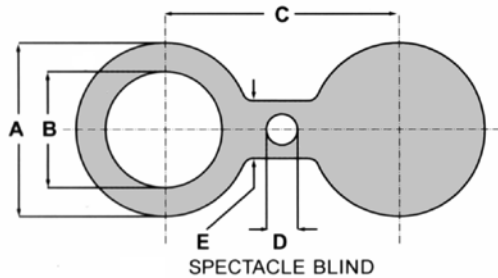
FORGED STEEL FLANGES TO BS 3293

SPECTACLE BLIND, PADDLE BLIND AND RING SPACER



Spectacle Blind, Paddle Blind and Ring Spacers

Specification: ANSI B16.5*



3.2 – 6.3 Ra FINISH BOTH SIDES T = THICKNESS

- *NOTE: (1) Use Paddle Blinds and Ring Spacers where no dimensions are shown for Spectacle Blind.
(2) *Dimensions based on sizes designed to suit ANSI B16.5 Flanges.
(3) All dimensions are in mm

NOMINAL BORE mm	ANSI 150										ANSI 300									
	A	B	C	D	E	W	F	G	T		A	B	C	D	E	W	F	G	T	
25	63.0	29.0	79.0	16.0	42.0	32.0	145.0	40.0	6.0		70.0	29.0	89.0	16.0	45.0	32.0	150.0	40.0	6.0	
40	82.0	42.0	98.0	16.0	50.0	32.0	155.0	40.0	6.0		92.0	42.0	114.0	22.0	50.0	32.0	170.0	40.0	6.0	
50	101.0	54.0	121.0	19.0	60.0	32.0	165.0	40.0	6.0		108.0	54.0	127.0	19.0	60.0	25.0	173.0	40.0	10.0	
80	132.0	80.0	152.0	19.0	60.0	32.0	175.0	40.0	6.0		146.0	80.0	168.0	22.0	60.0	32.0	195.0	40.0	10.0	
100	171.0	104.0	191.0	19.0	70.0	32.0	205.0	40.0	10.0		177.0	104.0	200.0	22.0	65.0	32.0	215.0	40.0	12.0	
150	218.0	156.0	241.0	22.0	80.0	32.0	230.0	40.0	10.0		247.0	156.0	270.0	22.0	80.0	32.0	250.0	40.0	20.0	
200	276.0	204.0	298.0	22.0	90.0	40.0	260.0	45.0	16.0		304.0	204.0	330.0	25.0	90.0	40.0	280.0	45.0	22.0	
250	336.0	256.0	362.0	25.0	100.0	40.0	295.0	45.0	16.0		358.0	256.0	387.0	29.0	100.0	40.0	312.0	45.0	25.0	
300	406.0	306.0	432.0	25.0	110.0	50.0	330.0	45.0	20.0		419.0	306.0				50.0	350.0	45.0	30.0	
350	447.0	338.0	476.0	29.0	120.0	50.0	360.0	45.0	22.0		482.0	338.0				40.0	383.0	45.0	32.0	
400	510.0	389.0				50.0	390.0	45.0	25.0		535.0	384.0				50.0	415.0	45.0	36.0	
450	545.0	440.0				50.0	410.0	45.0	25.0		592.0	434.0				40.0	445.0	45.0	42.0	
500	600.0	491.0				60.0	440.0	45.0	30.0		650.0	485.0				45.0	447.0	45.0	46.0	
600	715.0	593.0				60.0	500.0	50.0	36.0		770.0	578.0				60.0	547.0	45.0	55.0	

NOMINAL BORE mm	ANSI 600										ANSI 900									
	A	B	C	D	E	W	F	G	T		A	B	C	D	E	W	F	G	T	
25	70.0	29.0	89.0	16.0	52.0	32.0	150.0	40.0	6.0		76.0	29.0	102.0	25.0	60.0	32.0	164.0	40.0	10.0	
40	92.0	42.0	114.0	22.0	65.0	32.0	170.0	40.0	10.0		95.0	42.0	124.0	29.0	65.0	32.0	179.0	40.0	10.0	
50	108.0	52.0	127.0	19.0	65.0	25.0	173.0	40.0	10.0		139.0	52.0	165.0	25.0	70.0	32.0	198.0	40.0	12.0	
80	146.0	76.0	168.0	22.0	65.0	32.0	195.0	40.0	16.0		164.0	76.0	191.0	25.0	75.0	32.0	210.0	40.0	16.0	
100	190.0	100.0	216.0	25.0	75.0	32.0	225.0	40.0	16.0		202.0	100.0	235.0	32.0	90.0	32.0	235.0	40.0	20.0	
150	263.0	149.0	292.0	29.0	85.0	32.0	267.0	40.0	25.0		284.0	149.0	318.0	32.0	100.0	32.0	280.0	40.0	30.0	
200	317.0	196.0	349.0	32.0	95.0	40.0	300.0	45.0	30.0		354.0	196.0	394.0	39.0	110.0	40.0	325.0	45.0	36.0	
250	397.0	246.0				40.0	345.0	45.0	36.0		430.0	246.0				40.0	363.0	45.0	42.0	
300	454.0	292.0				38.0	370.0	45.0	42.0		493.0	292.0				40.0	395.0	45.0	50.0	
350	488.0	320.0				40.0	393.0	45.0	46.0		515.0	320.0				40.0	410.0	45.0	55.0	
400	561.0	366.0				50.0	432.0	45.0	50.0		570.0	366.0				50.0	443.0	45.0	65.0	
450	610.0	412.0				50.0	463.0	45.0	60.0		635.0	412.0				50.0	485.0	45.0	70.0	
500	680.0	460.0				45.0	500.0	45.0	65.0		695.0	460.0				60.0	520.0	45.0	80.0	
600	786.0	552.0				50.0	560.0	50.0	80.0		835.0	552.0				60.0	615.0	50.0	95.0	

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	-

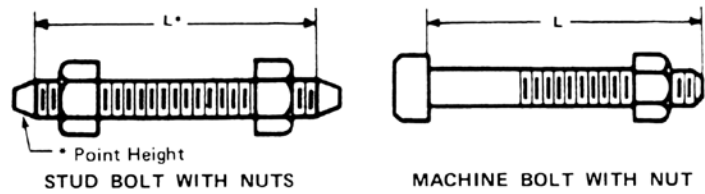
CORROSION RESISTANT ALLOYS WITH LOW SPECIFIC WEIGHT	ALLOY	ASTM	UNS	W-Nr	CHEMICAL COMPOSITION %						MECHANICAL TESTS		
					C	Ti	N	H	Fe	O	UTS MPa	YS MPa	KV J
	Ti gr. 1	B348	R50250	3.7025	<0,10	Balance	<0,03	<0,01	<0,2	<0,18	>240	>170	-
	Ti gr. 2	B348	R50400	3.7035	<0,10	Balance	<0,03	<0,01	<0,3	<0,25	>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	-

BOLTING STANDARDS AND MATERIALS

BOLTING FOR AMERICAN STANDARD FLANGES

Bolting For American Standard Flanges

To suit R.F. Flange sizes DN 15 to 600 to ANSI B16.5 (BS1560) 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 SIZES SHOWN ARE																						▽ DN: SI METRIC TERM			⊥ NPS: ANSI TERM		
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	No. Bolts	Dia. Bolts ins.	L	No. Bolts	Dia. Bolts ins.	L									
				Stud Bolts mm	Mach. Bolts mm			Stud Bolts mm	Mach. Bolts mm			Stud Bolts mm			Stud Bolts mm			Stud Bolts mm									
▽ DN	⊥ NPS																				▽ DN	⊥ NPS					
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	⅝	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	1-¼	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	1-¾	260	8	2	345	150	6				
200	8	8	¾	110	90	12	⅞	140	110	12	1-⅛	195	12	1-¾	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	1-¾	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	1-¾	255	16	2	375	12	2-¾	540	300	12				
350	14	12	1	130	110	20	1-⅛	175	150	20	1-¾	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	1-¾	175	145	24	1-½	230	195	24	1-⅞	330	20	2-½	435	16	3-½	615				600	24				
750	30	28	1-¾	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.

API - 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 on 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 NPS 4 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.

OVERVIEW OF API VALVE STANDARDS

VALVE RANGE

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

Applications

Onshore, offshore, subsea, pipelines, manifolds, risers, ESDV, gas/oil transmission, treatment and distribution, metering stations, power generation, flowlines, drilling, exploration

Sizes

½ to 60 inch

Pressure Classes

ANSI 150 to 4500#
API 2000 to 15000#

End Connections

Flanged, buttweld, 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 Valves

Valves to ASME, ANSI, BS and API standards. Materials in castings and forgings include Carbon, Steel, Stainless Steel, Duplex, Super Duplex and Special Alloys

Compact Modular Valves and Monoflanges

Key Design Features

- Top or side entry (TF & TT models only)
- Floating or trunnion mounted (TF & TT models only)
- Compact one piece body
- Weight savings
- Fire safe and antistatic

Ball

- Single/double block and bleed
- Screwed or bolted bonnet
- Monoflanges single/double block and bleed
- Anti blow out proof stems
- Bubble tight seats

Gate

Double block and bleed

Needle

Single/double block and bleed

Monoflange

Single/double block and bleed

Sizes

¼ to 6 inch

Pressure Classes

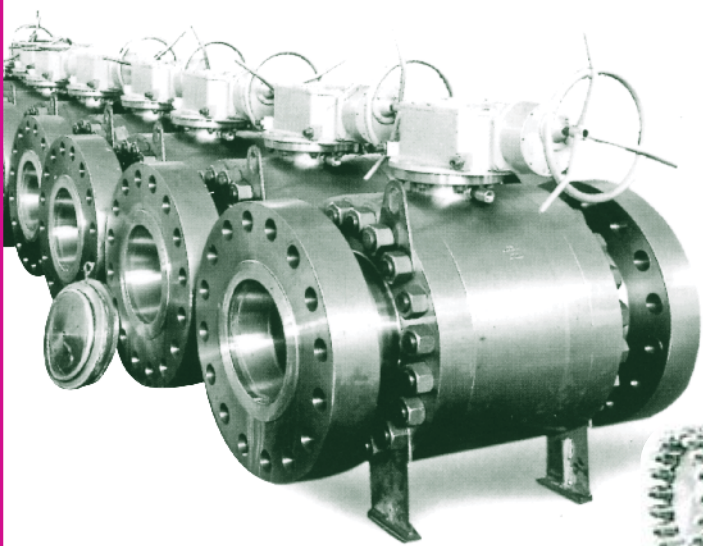
ANSI 150 to 2500#
API 3000 to 15000#

End Connections

Flanged, buttweld, hubs

Materials

Available in all grades of materials



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. Sizes and weight are given in the tables.

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.

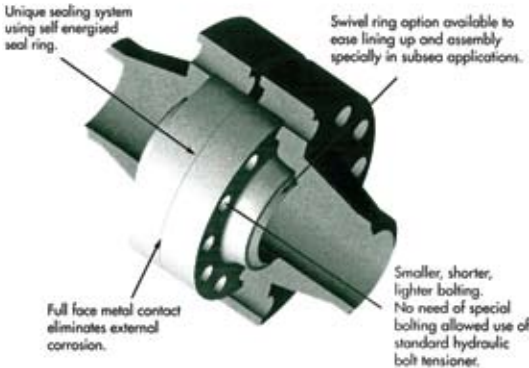
Applications

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.

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.		



Drawing showing standard ANSI Flange and Compact Flange comparison

Clamp Connector

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

The Connector is designed to offer the strength and sealing integrity of a welded joint and the versatility of a mechanical joint. It serves the same purpose as a bolted flange assembly, with the advantages of being more easily installed, lighter and smaller.

A self-energised, pressure activated connection, the clamp-type connector consists of four basic elements:

- (1) Hub
- (2) Clamps
- (3) Seal
- (4) Bolting

Availability is ½” NPS to 24” NP in materials carbon steel, stainless steel, duplex and super duplex.

Specifications and codes include, API ASME, BS and NACE. Material specifications to ASTM and BS.

For more detailed information, please contact the nearest PFP Office.



COMPACT FLANGES & CLAMP CONNECTORS

SPECIAL ENGINEERING PRODUCTS

Special Engineering Products

Special Products

- Sphere Tees
- Spherical Wye & Wyes
- Bull Head Tees
- Forged Tees (large dia)
- Flow Tees
- Lateral Fittings
- Production Manifolds
- Manifold Blocks
- Girth Flanges
- Tube Sheets
- Channel Flanges
- 'Y' Standard & Piggable
- Buckle Arrestors
- Misalignment Flanges
- Bulkheads
- Anchor Flanges/Anchor Block
- Compact Flange Connectors
- Hubs
- Clamps Connectors
- Clad Pipe Metallurgical / Mechanical Bond
- General non-specific components requiring 'tailored' engineering and construction for a variety of project functions.



Approximate Weights Butt weld Fittings and ANSI Flanges

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

APPROXIMATE WEIGHTS BUTTWELD FITTINGS & ANSI FLANGES

APPROXIMATE WEIGHT OF ASME B16.47 FLANGES

Approximate Weight of ASME B16.47 Flanges

Flange ASME B16.47-A (MSS SP 44)								
DN 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	324	900	674	1509	2000	2690
40	386	925	391	1066	725	1695	2161	2950
42	442	1080	428	1206	895	2028	2379	3280
44	491	1230	485	1378	951	2246	3321	3810
46	525	1345	559	1570	1055	2543	3224	4430
48	580	1520	597	1745	1247	2951	3500	4860
50	624	1668	674	1983	1423	3381		
52	689	1867	728	2194	1493	3682		
54	760	2088	871	2538	1637	4091		
56	845	2308	921	2728	1843	4585		
58	923	2554	968	2975	1954	4986		
60	971	2765	1032	3250	2353	5750		

Weight in "Kg"

Flange ASME B16.47-B (API 605)								
DN 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"

Approximate Weight of Stud Bolts

WEIGHTS OF STUD BOLTS (ANSI) Dimensions in kilos per 100 pieces with 2 assembled nuts																				
diam. long.	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

APPROXIMATE WEIGHT OF STUD BOLTS

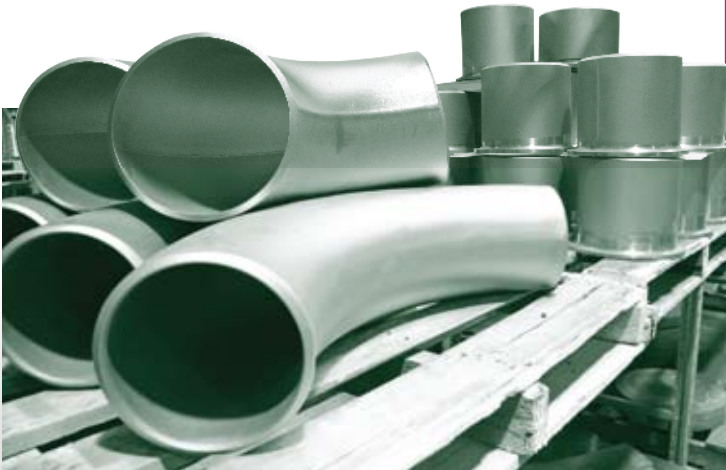
DIMENSIONAL TOLERANCES BUTTWELDED FITTINGS

Dimensional Tolerances Buttweld Fittings

ANSI B16.9 & B16.28

Cross-sectional tolerances for all butt welding fittings (ASME/ANSI B16.9 and B16.28)

Nominal Pipe Size (NPS)	All Fittings				
	OD at Bevel		ID at Bevel ±		Wall thickness
	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 & B16.28)

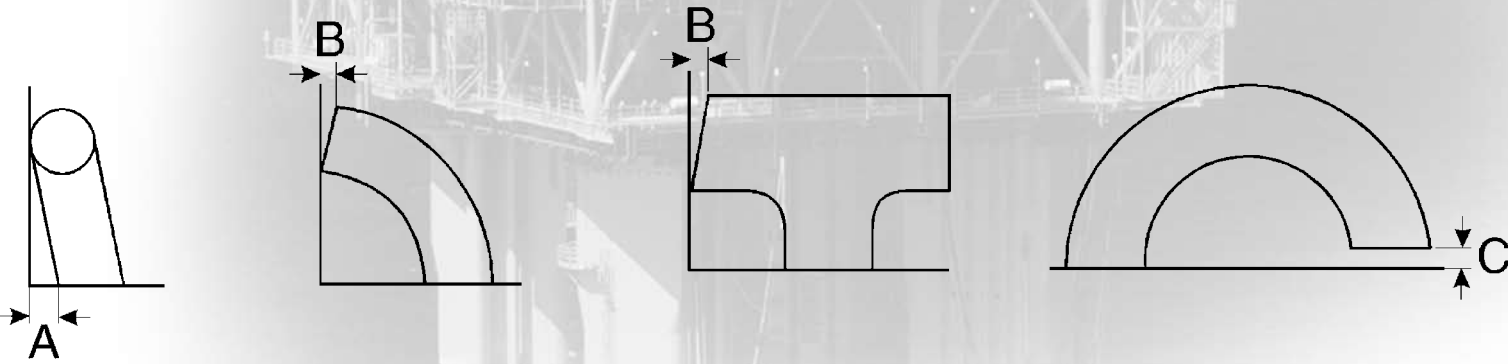
Nominal Pipe Size (NPS)	90° & 45° Long Radius Elbows 90° Short Radius Elbows and Tees		180° Returns			
	Centre-to-End Dimension ± A, B		Centre-to-Centre Dimension ± B (=2 x A)		Back-to-Face Dimension ± C	
	in	mm	in	mm	in	mm
½ to 2½	0.06	2	0.25	6	0.25	6
3 to 3½	0.06	2	0.25	6	0.25	6
4	0.06	2	0.25	6	0.25	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 & B16.28)

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 buttweld 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 and B16.28 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

Dimensional Tolerances for ANSI Flanges

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 and British Standard Institution BS1560.

DIMENSIONS IN INCHES

THREADED, SOCKET-WELDING SLIP-ON, LAP JOINT AND BLIND FLANGES		
OUTSIDE DIAMETER	When O.D. is 24" or less	± 0.06"
	When O.D. is over 24"	± 0.12"
INSIDE DIAMETER	Threaded	To Standard Gauge Limits
	Socket-welding Slip-on and Lap Joint Sizes 10" and smaller	+ 0.03" , - 0"
	Sizes 12" and larger	+ 0.06" , - 0"
DIAMETER OF COUNTERBORE	Same as for Inside Diameter	
DIAMETER OF CONTACT FACE	1/16" Raised Face	± 0.03"
	1/4" Raised Face Tounge and Groove or Male and Female	± 0.016"
OUTSIDE DIAMETER OF HUB	Sizes 12" or smaller	+ 0.09" , - 0.06"
	Sizes 14" or larger	± 0.12"
DRILLING	Bolt Circle ≤ 24" > 24"	± 0.03" ± 0.03"
	Bolt Hole Spacing	± 0.016"
	Eccentricity of Bolt Circle and Facing (with respect to bore)	0.03" Max
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"

* TOLERANCE FOR THESE DIMENSIONS NOT COVERED BY ANSI B16.5

WELDING NECK FLANGES		
OUTSIDE DIAMETER	When O.D. is 24" or less	± 0.06"
	When O.D. is over 24"	± 0.12"
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	± 0.016"
	1/4" Raised Face	
	Tounge and Groove or Male and Female	
DIAMETER OF HUB AT POINT OF WELDING	Sizes 5" or smaller	+ 0.09" , - 0.03"
	Sizes 6" or larger	+ 0.16" , - 0.03"
DIAMETER OF HUB AT BASE	When Hub Base is 24" or less	± 0.06"
	When Hub Base is over 24"	± 0.12
DRILLING	Bolt Circle ≤ 24" > 24"	± 0.03" ± 0.06"
	Bolt Hole Spacing	± 0.016"
	Eccentricity of Bolt Circle and Facing (with respect to bore)	0.03" Max
LENGTH THRU HUB	Sizes 10" and smaller	± 0.06"
	Sizes 12" and larger	± 0.12"
THICKNESS	Sizes 12" and smaller	+ 0.12" , - 0"
	Sizes 12" and larger	+ 0.19" , - 0"



Material Specifications For Piping Components

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 WYP35	A105	A106-B	A515-65	A105
		API-5LX-X42, X46, X52	-	Grade WPY42 Grade WPY52	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 N	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	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	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	A213-TP321 A249-TP321 A409-TP321	A774-TP321 A403-WP321	A182-F321	A312-TP321	A240-TP321	A182-F321
Duplex Stainless Steel	22Cr-5.5Ni -N	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

Definitions of 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 instrumentation 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 crosssectional 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.

1) Coefficient of cubical expansion

CORROSION SUSCEPTIBILITY OF METALS (GALVANIC SERIES)

Most susceptible to corrosive attack
(less noble)

Magnesium and its alloys
Zinc and its alloys
Aluminium and its alloys
Cadmium
Mild steel
Cast iron
Stainless steel, 1% Cr, type 410 (active)
Lead-tin solder, 50/50
Stainless steel, 18/18 type 304 (active)
Stainless steel, 18/18/3% Mo, type 316 (active)
Lead
Tin
BRASSES
Gunmetals
Aluminium bronzes
Copper
Copper-nickel alloys
Monel
Titanium and its alloys
Stainless steel, 18/8, type 304 (passive)
Stainless steel, 18/8/3% Mo, type 316 (passive)
Silver
Gold
Platinum

Least susceptible to corrosive attack
(more noble)

Temperature Conversion Chart

- (A) To use, locate "given temperature" in "given temperature" column (coloured GREEN) 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°F** 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

Useful Conversion Factors - Imperial to Metric (Approximate)

“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	645.16	mm ²	REMARKS POWER: Symbol W The SI unit of POWER is the WATT.	Btu per hour (Btu/hr)	0.2931	W
	Square feet	.0929	m ²		horsepower (hp)	0.7457	kW
The SI unit of AREA is the SQUARE METRE	Square yards	0.836	m ²		ton of refrigeration	3.517	kW
	acre	4047	m ²				
DENSITY: Symbol kg/m ³ The SI unit of DENSITY is the kilogram per cubic metre.	hectare (ha)	10000	m ²	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	6.895	kPa
					kip/in2 (1000 psi)	6.895	MPa
ENERGY: Symbol J The SI unit of energy is the joule.	lb/in ³	27.68	t/m ³	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.	lbf/ft2	47.88	Pa
	lb/ft ³	16.02	kg/m ³		kgf/cm2	98.07	kPa
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.	lb/yd ³	0.5933	kg/m ³		bar	100	kPa
1. ELECTRICAL ENERGY kilowatt hour (kW.h)		3.6	MJ		Vertical column (head) of water. (H2Oat20°C) metres of water		kPa
					feet of water	9.79 2.984	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	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.	orr (vacuum)	0.1333	kPa
					1 mm Hg. (mercury)	0.1333	kPa
3. MECHANICAL ENERGY foot poundal ft.pdl inch pound-force in.lbf foot pound-force ft.lbf foot ton force ft.tonf metre kilogram force m.kgf		.04214	J	1 N.m = 1 J	1 in. Hg.(mercury)	3.386	kPa
		0.1130	J		atmosphere (atm)	101.325	kPa
		1.356	J		microns	0.133	Pa
		3.037	kJ				
		9.807	J	VELOCITY: Symbol m/s The SI unit of VELOCITY is the METRE PER SECOND	Poundal-foot pdl.ft pound-force inch lbf.inch lbf.inch pound-force feet lbf.ft lbf.ft ton-force feet tonf.ft kilogram-force kgf.m kgf.cm	0.1333 0.1333 3.386 101.325 0.133	kPa kPa kPa kPa Pa
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)	0.1383	N			0.4214	N.m
	Pound-force (lbf)	4.448	N			0.1130 1.152	N.m kgf.cm
	ton-force (tonf)	9.964	kN	VOLUME: CAPACITY: Symbol m ³ The SI unit of VOLUME is the CUBIC METRE.		1.356 13.83	N.m kgf.cm
	*kilogram-force (kgf)	9.807	N			3.037	kN.m
	*also known as kilopond (kp)			NOTE: tt Capital “L” is now the legal preferred symbol for litre in Australia.		9.807 0.09807	N.m N.m
FORCE PER UNIT LENGTH the SI unit is NEWTON PER METRE: Symbol N/m	pounds-force per inch (lbf/in)	175.1	N/m			0.3048	m/s
	pounds-force per foot (lbf/ft)	14.59	N/m			0.00508	m/s
LENGTH: Symbol m The SI unit of LENGTH is the METRE.	ton-force per foot (ton/ft)	32.69	kN/m			0.4470	m/s
						1.609	km/h
				VOLUME: RATE OF FLOW. Symbol m ³ /s The SI unit of VOLUME RATE OF FLOW is the CUBIC METRE PER SECOND.			
MASS: Symbol kg The SI unit of MASS is the KILOGRAM.							
				SUNDRY ITEMS:			