

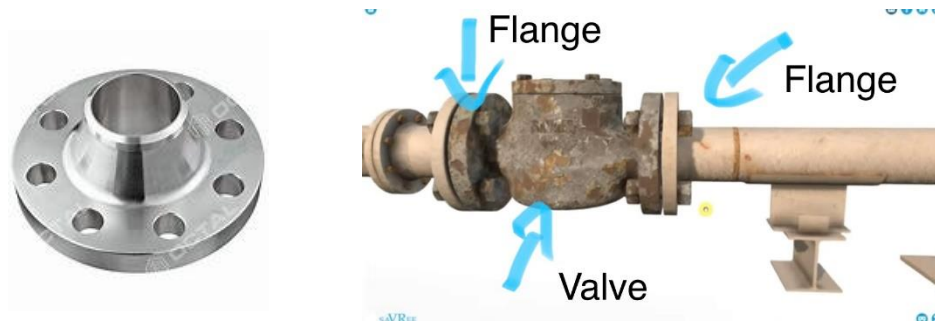
FLANGES

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What is Flange?

A flange is a method of connection pipes, valves, pumps, and other equipment to form a piping system. It is the second and most connection after welding. Flanges provides easy access for cleaning inspection or modification.



See the above picture. The valve can be dismantled easily for maintenance or modification. Two flanges on right side connected and two flanges are connected on left side.

To easily understand Flanges, you need to understand these 6 things:

- 1- Flange Type
- 2- Flange Face
- 3- Size
- 4- Schedule
- 5- Pressure-temperature rating
- 6- Material

1- FLANGE TYPE

Weld neck Flange:

Easy to recognize because of the long-tapered hub. It is the most widely used in process piping.

- Used for high pressure and high temperature application
- Decrease the high stress concentration at the bottom of the flange.
- Used in all pressure class



Slip on flange

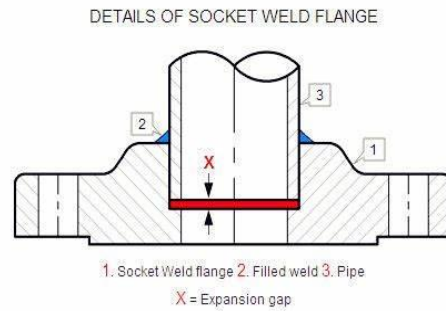
The flange slip over the pipe and welded with two filets welds on inside and outside of the flange. It has short service life compared to weld neck flange.



Socket weld flange

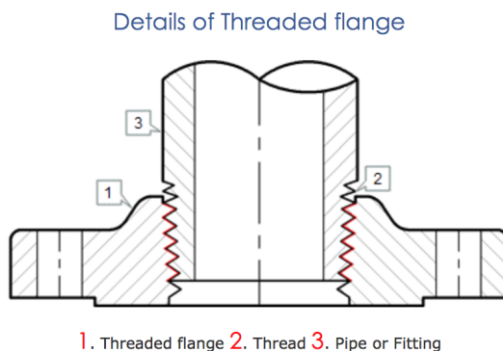
This flange is attached to the pipe by a filled weld. The flange has a socket, so the pipe is inserted and fits on the sockets

- Can be used in high pressure system
- A high skilled welder is required.
- There is an expansion gap that is must be $1/16''$ to prevent residual stress, as shown in photo



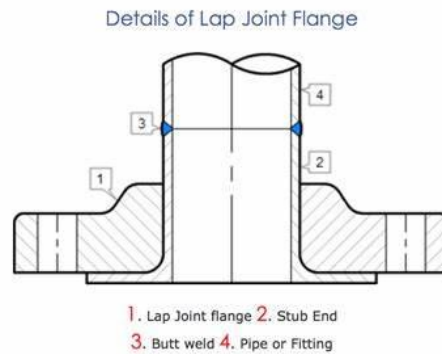
Threaded Flange

It has a female thread, so it's connected to a male thread. Unlike other flanges, threaded flange is connected to the pipe without welding. It is used for low temperature and low-pressure applications.



Lab Joint flange:

This flange consists of two parts, which are stub end and the flange. It is used for low pressure applications.



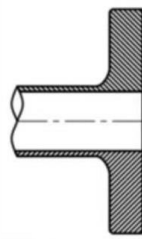
This table shows the features of each type. It simplifies a lot.

Flange Type	NPS (inch)	ASME Class	Faces	Joint Integrity	Weld	ASME Standards
Welding Neck Flange	All	All	All	High	One butt weld.	B16.5, B31.3
Slip-on Flange	Many	Generally, ≤ 600	FF, RF	Medium	One or two fillet welds.	B16.5, B31.3
Socket Weld Flange	Generally, $\leq \frac{1}{2}$ to 2. Max ≤ 4	≤ 600	FF, RF	Medium	One fillet weld.	B16.5, B31.3
Lap Joint Ring Flange	Not used for small sizes.	NA	FF	NA	None	B16.5, B31.3
Stub End of Lap Joint Flange		150 to 2500	FF, RF, RTJ	High	One butt weld.	B16.9, B31.3
Threaded Flange	Generally, $\leq \frac{1}{2}$ to 2. Max ≤ 4	≤ 300	FF, RF	Low	None	B1.20.1, B31.3
Blind Flange	All	All	All	NA	None	B16.5, B31.3

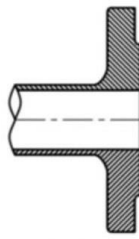
2- FLANGE FACE

Flange face is the area where gasket is installed. The three common types are Flat, Raised, Ring type

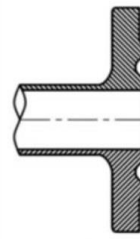
Flange Faces



Flat



Raised



RTJ

Characteristics	Flange Face Type		
	Flat Face	Raised Face	Ring-Type Joint
Sealing Area	Large	Medium	Small
Sealing Face	Inner diameter to outside diameter.	Inner diameter to raised face outside diameter.	Groove in flange face.
Pressure Range	Narrow. Low pressures only.	Broad	Broad. Generally used for higher pressures.
Pressure Class	125#, 250#	All.	All. Generally $\geq 900\#$
Temperature Range	Narrow. Low temperatures only.	Broad	Broad
Gasket Type	Soft. Non-metallic.	Non-metallic, semi-metallic.	Hard. Metal.

3- Size

From 1/2" to 24" NPS according to ASME B16.5

26" to 60" NPS according to ASME B16.47.

What is ASME 16.5B?

ASME 16.5B is a standard for a pipe flange and flanged fittings that covers the flanges sizes from NPS 1/2" to 24". And same for B16.47

*Nominal Pipe Size (NPS) is basically representing the pipe size
The Larger NPS, the Thicker Wall Thickness Becomes

4- Pressure-temperature rating

*ASME has developed a flange class considering temperature and pressure rating.

There are seven classes:



150# 300# 400# 600# 900# 1500# 2500#

These pressure classes of flanges are commonly known as "pounds" or "Class".

Higher the flange rating, heavier the flange and can withstand higher pressure and temperature.

Working Pressure (bar) (psi)							
Temperature (°C) (°F)	Class						
	150	300	400	600	900	1500	2500
-29 - 38	19.8 287	51.7 749	68.9 999	103.4 1499	155 2246	259 3754	431 6246
50	19.5 283	51.7 749	68.9 999	103.4 1499	155 2246	259 3754	431 6246
100	17.7 257	51.5 746	68.7 996	103.0 1493	155 2246	258 3739	429 6217
150	15.8 229	50.2 728	66.8 968	100.3 1454	151 2188	251 3638	418 6058
200	13.8 200	48.6 704	64.8 939	97.2 1409	146 2116	243 3522	405 5870
250	12.1 175	46.3 671	61.7 894	92.7 1343	139 2014	232 3362	386 5594
300	10.2 148	42.9 622	57.0 826	85.7 1242	129 1870	214 3101	357 5174
325	9.3 135	41.4 600	55.0 797	82.6 1197	124 1797	207 3000	344 4986
350	8.4 122	40.0 580	53.4 774	80.0 1159	120 1739	200 2899	334 4841
375	7.4 107	37.8 548	50.4 730	75.7 1097	114 1652	189 2739	315 4565
400	6.5 94.2	34.7 503	46.3 671	69.4 1006	104 1507	174 2522	290 4203
425	5.5 79.7	28.8 417	38.4 557	57.5 833	86.3 1251	144 2087	240 3478
450	4.6 66.7	23.0 333	30.7 445	46.0 667	69.0 1000	115 1667	192 2783
475	3.7 53.6	17.1 248	22.8 330	34.2 496	51.3 743	85.4 1238	142 2058
500	2.8 40.6	11.6 168	15.4 223	23.2 336	34.7 503	57.9 839	96.5 1399
538	1.4 20.3	5.9 85.5	7.9 114	11.8 171	17.7 257	29.5 428	49.2 713

Blue is in Psi

Black is in Bar

*ASME stands for American Society for Mechanical Engineers.

5- Schedule

Pipe or flange schedule number can be:

5 SCH, 10 SCH, 20 SCH, 30 SCH, 40 SCH, 60 SCH , 80 SCH , 100 SCH , 120 SCH , 140 SCH , 160 SCH

If it is stainless steel, S is added

Example: 5s SCH, 10s SCH etc.

40 SCH and 80 SCH are the most used.

NOMINAL WALL THICKNESS														
Nom Pipe Size	OD	Sch 10	Sch 20	Sch 30	STD Wall	Sch 40	Sch 60	EXT Hvy	Sch 80	Sch 100	Sch 120	Sch 140	Sch 160	XX Hvy
½	0.84	0.083	.....	.....	0.109	0.109	.....	0.147	0.147	.....	.....	.....	0.188	0.294
¾	1.05	0.083	.....	.....	0.113	0.113	.....	0.154	0.154	.....	.....	.....	0.219	0.308
1	1.315	0.109	.....	.....	0.133	0.133	.....	0.179	0.179	.....	.....	.....	0.25	0.358
1 ¼	1.66	0.109	.....	.....	0.14	0.14	.....	0.191	0.191	.....	.....	.....	0.25	0.382
1 ½	1.9	0.109	.....	.....	0.145	0.145	.....	0.2	0.2	.....	.....	.....	0.281	0.4
2	2.375	0.109	.....	.....	0.154	0.154	.....	0.218	0.218	.....	.....	.....	0.344	0.436
2 ½	2.875	0.12	.....	.....	0.203	0.203	.....	0.276	0.276	.....	.....	.....	0.375	0.552
3	3.5	0.12	.....	.....	0.216	0.216	.....	0.3	0.3	.....	.....	.....	0.438	0.6
3 ½	4	0.12	.....	.....	0.226	0.226	.....	0.318	0.318	.....	.....	.....	.....	0.636
4	4.5	0.12	.....	.....	0.237	0.237	.....	0.337	0.337	.....	0.438	.....	0.531	0.674
5	5.563	0.134	.....	.....	0.258	0.258	.....	0.375	0.375	.....	0.5	.....	0.625	0.75
6	6.625	0.134	.....	.....	0.28	0.28	.....	0.432	0.432	.....	0.562	.....	0.719	0.864
8	8.625	0.148	0.25	0.277	0.322	0.322	0.406	0.5	0.5	0.594	0.719	0.812	0.906	0.875
10	10.75	0.165	0.25	0.307	0.365	0.365	0.5	0.5	0.594	0.719	0.844	1	1.125	1
12	12.75	0.18	0.25	0.33	0.375	0.406	0.562	0.5	0.688	0.844	1	1.125	1.312	1
14	14	0.25	0.312	0.375	0.375	0.438	0.594	0.5	0.75	0.938	1.094	1.25	1.406	.....
16	16	0.25	0.312	0.375	0.375	0.5	0.656	0.5	0.844	1.031	1.219	1.438	1.594	.....
18	18	0.25	0.312	0.438	0.375	0.562	0.75	0.5	0.938	1.156	1.375	1.562	1.781	.....
20	20	0.25	0.375	0.5	0.375	0.594	0.812	0.5	1.031	1.281	1.5	1.75	1.969	.....
22	22	0.25	.....	.....	0.375	.....	.....	0.5	.....	.....	.....	.....	.....	.....
24	24	0.25	0.375	0.562	0.375	0.688	0.969	0.5	1.219	1.531	1.812	2.062	2.344	.....

6- Material

Carbon Steel (CS)

ASTM 105 N

Stainless Steel (SS)

ASTM A182 F304 or F316

Example:



This is a Stainless steel, Weld Neck, 600# class, 6 inch, Raised Face Flange

or

6" 600# ASTM A182 F304 Sch80 WN RF

WN= Weld neck

RF= Raised Face