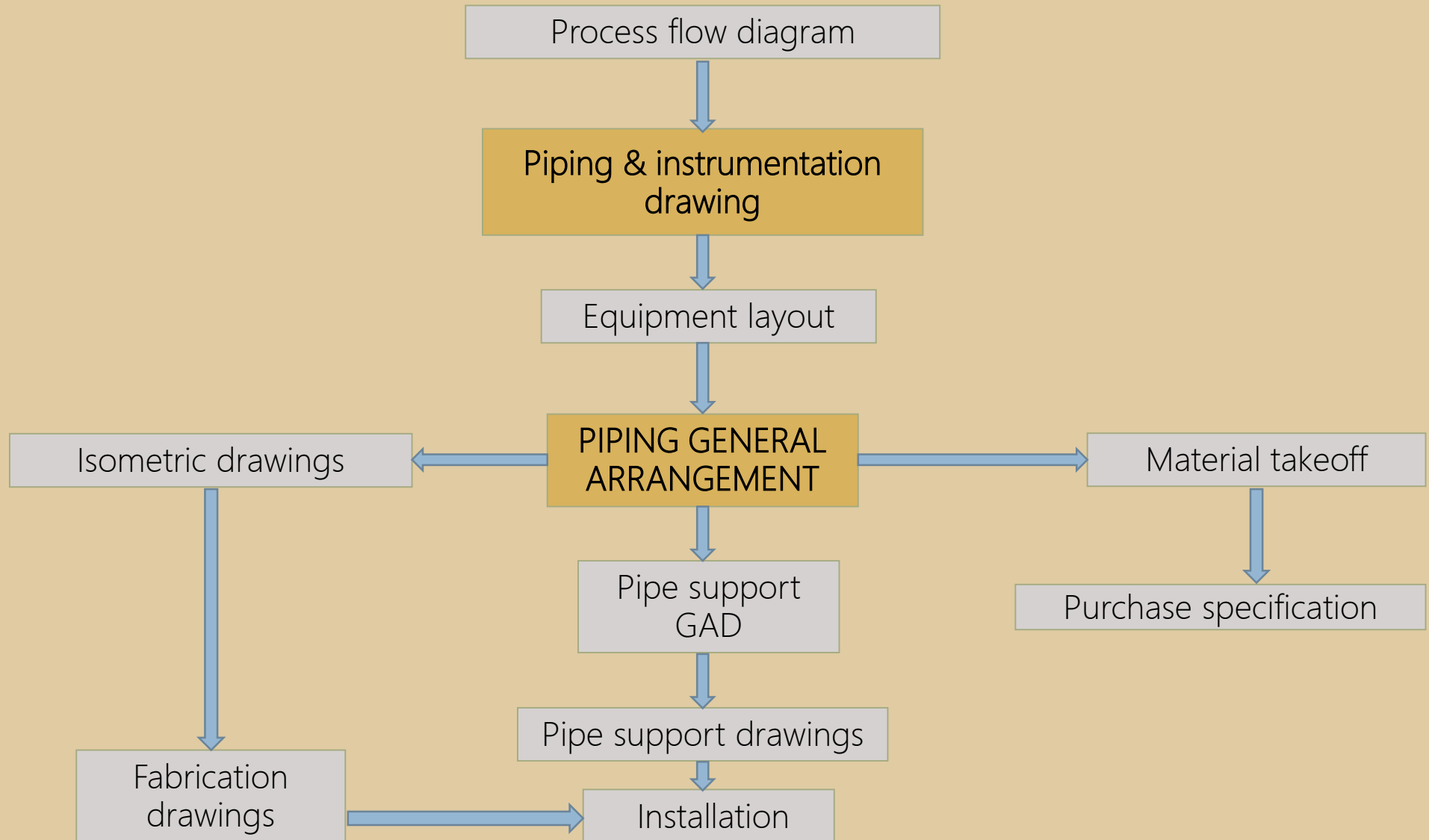


PRESENTATION ON PIPING

TOPICS COVERED

1. Introduction To Piping System
2. Piping Components
3. Testing Of Piping Systems

BLOCK DIAGRAM OF PIPING ENGINEERING



PIPING SYSTEM

- It convey the fluids, between the various equipment and end users.
- It consists of various components such as pipes, valves, fittings, online measuring instruments, etc.

DIFFERENCE BETWEEN PIPE AND TUBE

PIPE

- It is a tubular product of circular cross section that has specific sizes and thickness governed by particular dimensional standards.

TUBE

- It is a hollow product having circular, elliptical or square cross section or cross section of any closed perimeter. Tubes are also used for heat transfer purpose.

PIPE PRODUCTS

SEAMLESS PIPE

- A wrought tubular product made without a welded seam by drawing or extrusion process

WELDED PIPES

- Welded pipes are manufactured by ERW (Electric Resistance Welded).
- Pipes in small quantities are manufactured by EFW (electric fusion - welding) process .
- The longitudinal seam is welded by manual or automatic electric arc process.

CLASSIFICATION BASED ON END USE

LINE PIPE

- It is mainly used for conveying fluids over long distances and are subjected to fluid pressure. It is usually not subjected to high temperature.

PRESSURE PIPE

- These are subjected to fluid pressure and /or temperature. Fluid pressure is generally internal pressure or may be external pressure (e.g. Jacketed piping) and are mainly used as plant piping.

STRUCTURAL PIPE

- These are not used for conveying fluids and not subjected to fluid pressures or temperature. They are used as structural components (e.g. handrails, columns, sleeves etc.) and are subjected to static loads only.

NOMINAL PIPE SIZE (NPS)

- Pipes are designated by nominal size, starting from 1/8" nominal size, and increasing in steps.
- For the nominal size up to including 12" there is one unique OD (different from nominal size) and ID would vary depending on schedule number.
- For nominal sizes 14" and above O.D is same as nominal size.

WHY PIPE SIZE IS MORE IMPORTANT

- According to American Survey 30 % of the total cost of a chemical process plant goes for piping elements and valves. Take optimum pipe size while designing the pipe size.

AVAILABILITY OF PIPE SIZES

1. Sizes in steps of $\frac{1}{8}$ " from $\frac{1}{8}$ " to $\frac{1}{2}$ "
2. Sizes in steps of $\frac{1}{4}$ " from $\frac{1}{2}$ " to $1\frac{1}{2}$ "
3. Sizes in steps of $\frac{1}{2}$ " from $1\frac{1}{2}$ " to 4"
4. Sizes in steps of 1" from 4" to 6"
5. Sizes in steps of 2" from 6" to 36"

WALL THICKNESS TOLERANCE

MILL TOLERANCE

- During manufacturing of seamless pipe while positioning the mandrel, this can deviate from its center by maximum of $\pm 12.5\%$. Hence minimum thickness of seamless pipe is considered $\pm 12.5\%$ less from average wall thickness.

MILL LENGTH

- Also known as random length. The usual run off mill pipe is 16 to 20 Ft. in length. Line pipe and pipe for power plant used are sometimes made in double length of 30-35 ft.

SCHEDULE NUMBER

Pipes are designated by schedule number .

Schedule number is represented by the pressure carrying capacity of the pipe.

Schedule = 1000 P/S where

P = service pressure (psi) - (Internal pressure)

S = allowable stress (psi) - (Allowable tensile strength of material)

Irrespective of pipe dia., equal schedules have equal pressure carrying capacity. For stainless steels schedule number are designated by suffix S i.e. 5S, 10S, 40S, 80S etc.

For pipes of all dimensions the outside diameter (O.D.) remains relatively constant. The variation in wall thickness affects only the inside diameters (I.D.). The higher the schedule number is, the thicker the pipe is.

PIPING SCHEDULE

PIPE SCHEDULES & WEIGHTS					
		SCHEDULE 40		SCHEDULE 80	
NOMINAL PIPE SIZE	OUTSIDE DIAMETER	Wall Thick.	Wt. Per Ft.	Wall Thick.	Weight Per Ft.
1/8	0.405	0.068	0.245	0.095	0.315
1/4	0.540	0.088	0.425	0.119	0.535
3/8	0.675	0.091	0.568	0.126	0.739
1/2	0.840	0.109	0.851	0.147	1.088
3/4	1.050	0.113	1.131	0.154	1.474
1	1.315	0.133	1.679	0.179	2.172
1-1/4	1.660	0.140	2.273	0.191	2.997
1-1/2	1.900	0.145	2.718	0.200	3.631
2	2.375	0.154	3.653	0.218	5.022
2-1/2	2.875	0.203	5.793	0.275	7.661
3	3.500	0.216	7.576	0.300	10.250
3-1/2	4.000	0.226	9.109	0.318	12.510
4	4.500	0.237	10.790	0.337	14.980
5	5.563	0.258	14.620	0.375	20.780
6	6.625	0.280	18.970	0.432	28.570
8	8.625	0.322	28.550	0.500	43.390
10	10.750	0.365	40.480	0.500	54.740
12	12.750	0.375	49.560	0.500	65.420

PIPING SCHEDULE

Nominal Pipe Size		Outside Diameter (mm)	Wall Thickness (mm)																
			Stainless Steel				Carbon Steel												
DN	NPS		Sch 5S	Sch 10S	Sch 40S	Sch 80S	Sch 10	Sch 20	Sch 30	Sch 40	STD	Sch 60	Sch 80	XS	Sch 100	Sch 120	Sch 140	Sch 160	XXS
6	⅝	10.3		1.24	1.73	2.41	1.24		1.45	1.73	1.73		2.41	2.41					
8	¾	13.7		1.65	2.24	3.02	1.65		1.85	2.24	2.24		3.02	3.02					
10	⅞	17.1		1.65	2.31	3.20	1.65		1.85	2.31	2.31		3.20	3.20					
15	½	21.3	1.65	2.11	2.77	3.73	2.11		2.41	2.77	2.77		3.73	3.73				4.78	7.47
20	¾	26.7	1.65	2.11	2.87	3.91	2.11		2.41	2.87	2.87		3.91	3.91				5.56	7.82
25	1	33.4	1.65	2.77	3.38	4.55	2.77		2.90	3.38	3.38		4.55	4.55				6.35	9.09
32	1¼	42.2	1.65	2.77	3.56	4.85	2.77		2.97	3.56	3.56		4.85	4.85				6.35	9.70
40	1½	48.3	1.65	2.77	3.68	5.08	2.77		3.18	3.68	3.68		5.08	5.08				7.14	10.15
50	2	60.3	1.65	2.77	3.91	5.54	2.77		3.18	3.91	3.91		5.54	5.54				8.74	11.07
65	2½	73.0	2.11	3.05	5.16	7.01	3.05		4.78	5.16	5.16		7.01	7.01				9.53	14.02
80	3	88.9	2.11	3.05	5.49	7.62	3.05		4.78	5.49	5.49		7.62	7.62				11.13	15.24
90	3½	101.6	2.11	3.05	5.74	8.08	3.05		4.78	5.74	5.74		8.08	8.08					
100	4	114.3	2.11	3.05	6.02	8.56	3.05		4.78	6.02	6.02		8.56	8.56		11.13		13.49	17.12
125	5	141.3	2.77	3.40	6.55	9.53	3.40			6.55	6.55		9.53	9.53		12.70		15.88	19.05
150	6	168.3	2.77	3.40	7.11	10.97	3.40			7.11	7.11		10.97	10.97		14.27		18.26	21.95
200	8	219.1	2.77	3.76	8.18	12.70	3.76	6.35	7.04	8.18	8.18	10.31	12.70	12.70	15.09	18.26	20.62	23.01	22.23
250	10	273.1	3.40	4.19	9.27	12.70	4.19	6.35	7.80	9.27	9.27	12.70	15.09	12.70	18.26	21.44	25.40	28.58	25.40
300	12	323.9	3.96	4.57	9.53	12.70	4.57	6.35	8.38	10.31	9.53	14.27	17.48	12.70	21.44	25.40	28.58	33.32	25.40
350	14	355.6	3.96	4.78	9.53	12.70	6.35	7.92	9.53	11.13	9.53	15.09	19.05	12.70	23.83	27.79	31.75	35.71	
400	16	406.4	4.19	4.78	9.53	12.70	6.35	7.92	9.53	12.70	9.53	16.66	21.44	12.70	26.19	30.96	36.53	40.49	
450	18	457	4.19	4.78	9.53	12.70	6.35	7.92	11.13	14.27	9.53	19.05	23.83	12.70	29.36	34.93	39.67	45.24	
500	20	508	4.78	5.54	9.53	12.70	6.35	9.53	12.70	15.09	9.53	20.62	26.19	12.70	32.54	38.10	44.45	50.01	
550	22	559	4.78	5.54			6.35	9.53	12.70		9.53	22.23	28.58	12.70	34.93	41.28	47.63	53.98	
600	24	610	5.54	6.35	9.53	12.70	6.35	9.53	14.27	17.48	9.53	24.61	30.96	12.70	38.89	46.02	52.37	59.54	
650	26	660					7.92	12.70			9.53			12.70					
700	28	711					7.92	12.70	15.88		9.53			12.70					
750	30	762	6.35	7.92			7.92	12.70	15.88		9.53			12.70					

These dimensions are nominal – substantial tolerances apply to both OD and WT – refer to the standards for details.

Stainless steel pipe nominal dimensions based on ASTM A312M and ASME B36.19M-2004.

Carbon steel pipe nominal dimensions based on ASTM A106M and ASME B36.10M-2004. For other wall thicknesses and for sizes of carbon steel pipe above DN 750 consult ASME B36.10M.

COMPONENTS OF PIPING SYSTEM

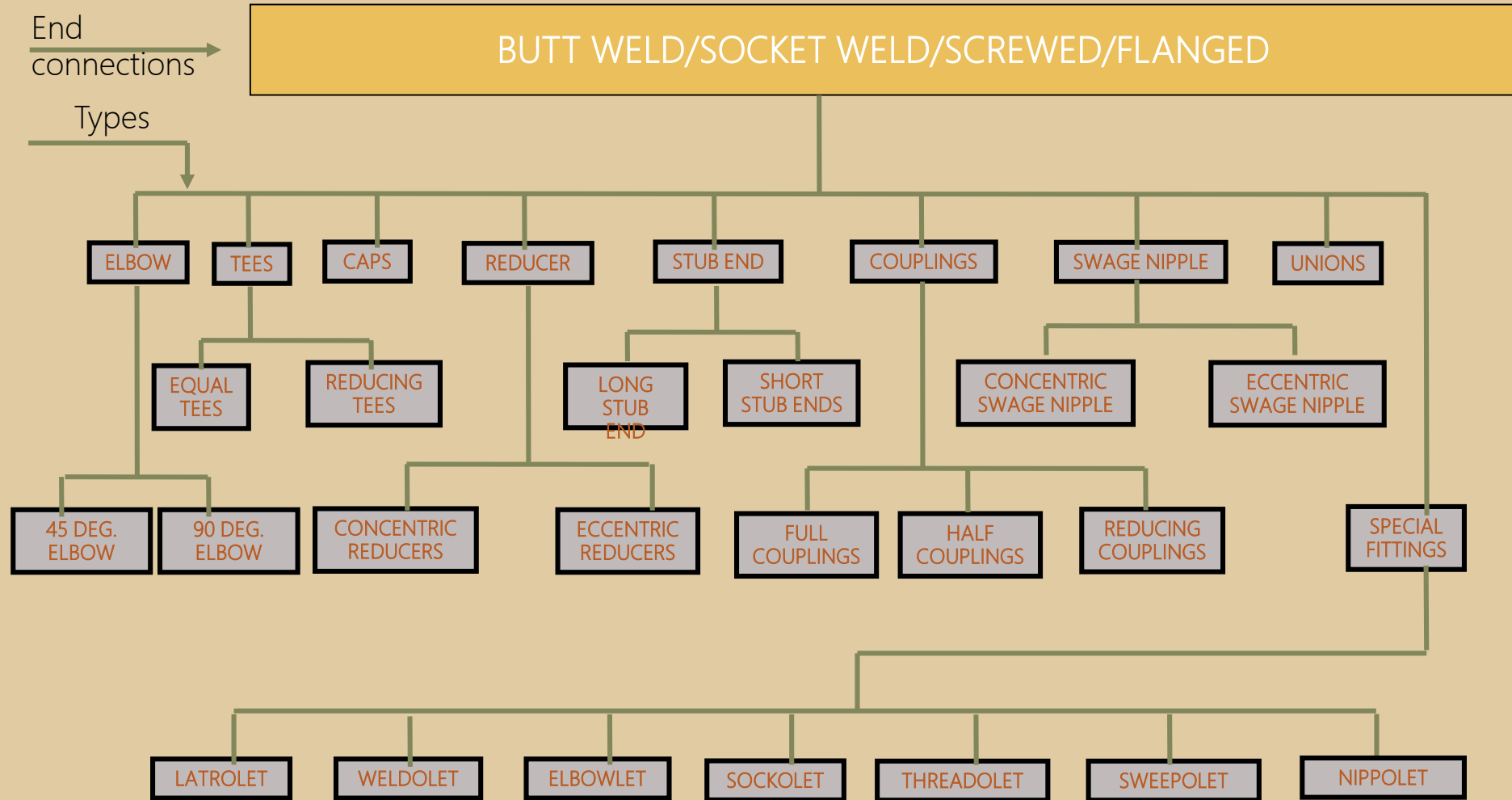
1. Pipe
2. Fittings (Elbows, Tees, Reducers, Couplings, Unions, Olets)
3. Flanges
4. Gaskets
5. Fasteners
6. Valves
7. Special fittings
8. Specialty items (strainers, traps, bellows etc.)

FITTINGS

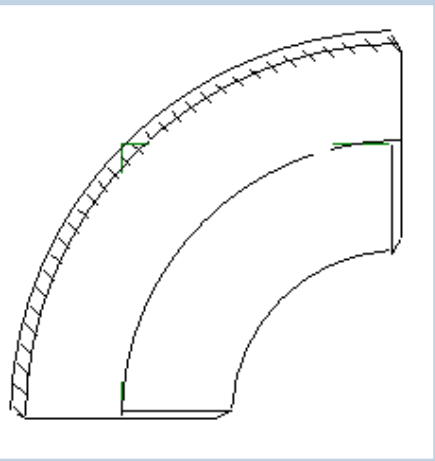
- Pipe fittings are the components which tie together pipelines, valves, and other parts of a piping system.
- Fittings may come in butt Welded, Socket welded, Screwed and flanged connections.
- They are used to change the size of the line or its direction.



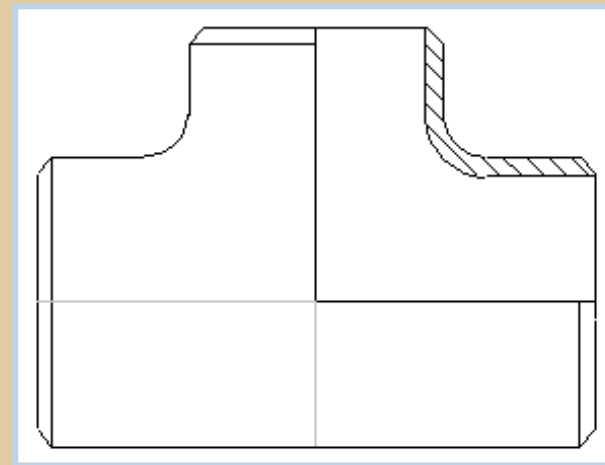
STANDARD PIPE FITTING



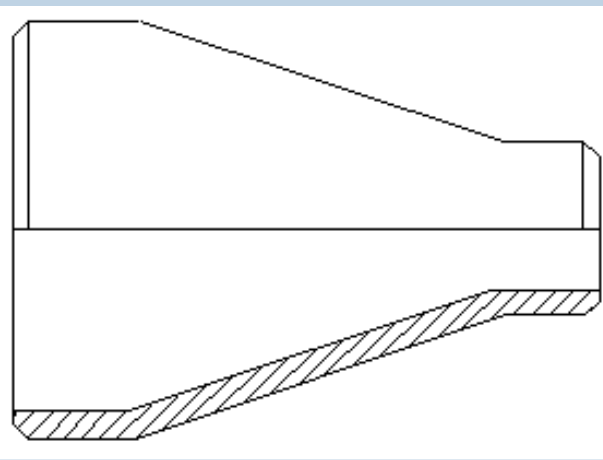
COMMON PIPE FITTINGS



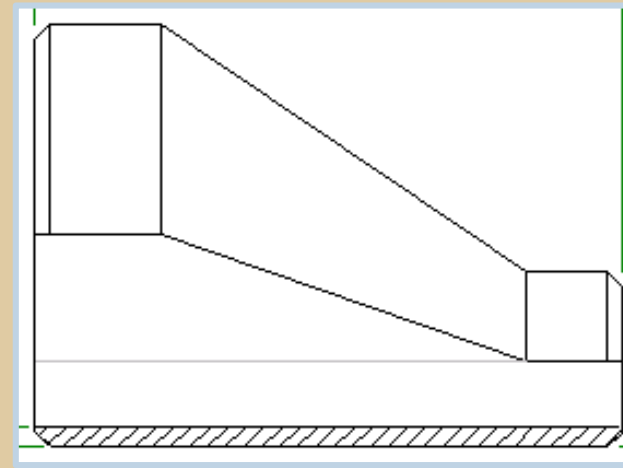
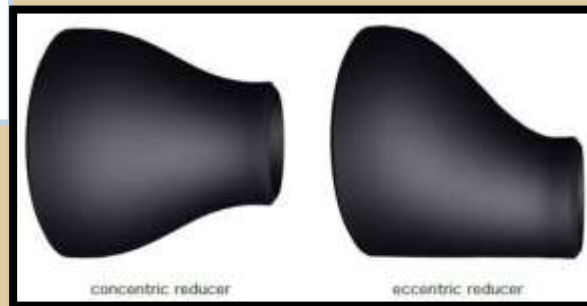
90° Elbow



Equal Tee



Concentric
Reducer



Eccentric
Reducer

TEES

STRAIGHT TEE / EQUAL TEE

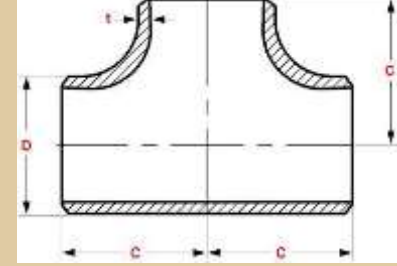
It is used when the branch and header are the same.

REDUCING TEE

It is used when the branch size is smaller than the header size.

POINT TO REMEMBER

It is expensive and requires three butt welds. Alternatively for low pressure services, branching off is done by direct welding of pipe to pipe instead of standard Tee.



ELBOWS

They are used to change direction of pipe.

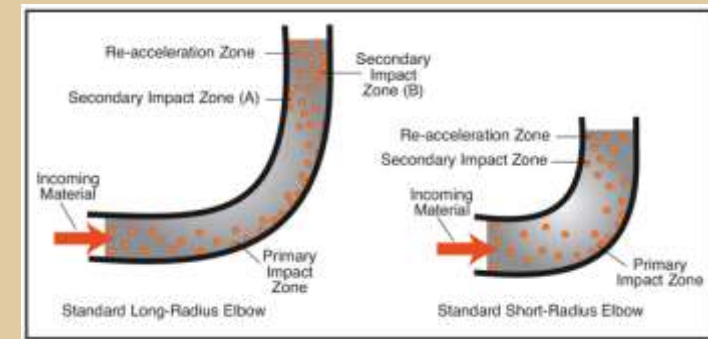
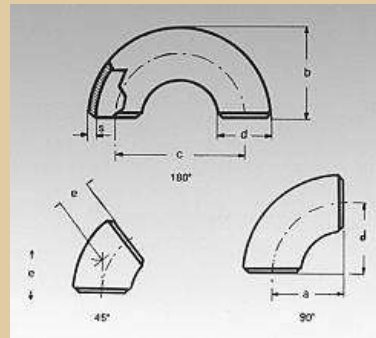
1. LONG RADIUS (LR) AND
2. SHORT RADIUS (SR) ELBOWS.

90 degree elbow comes in LR and SR.

45 degree elbow comes in LR only.

The LR elbows radius is 1.5 times the nominal size. The SR elbows radius is 1 times the nominal size.

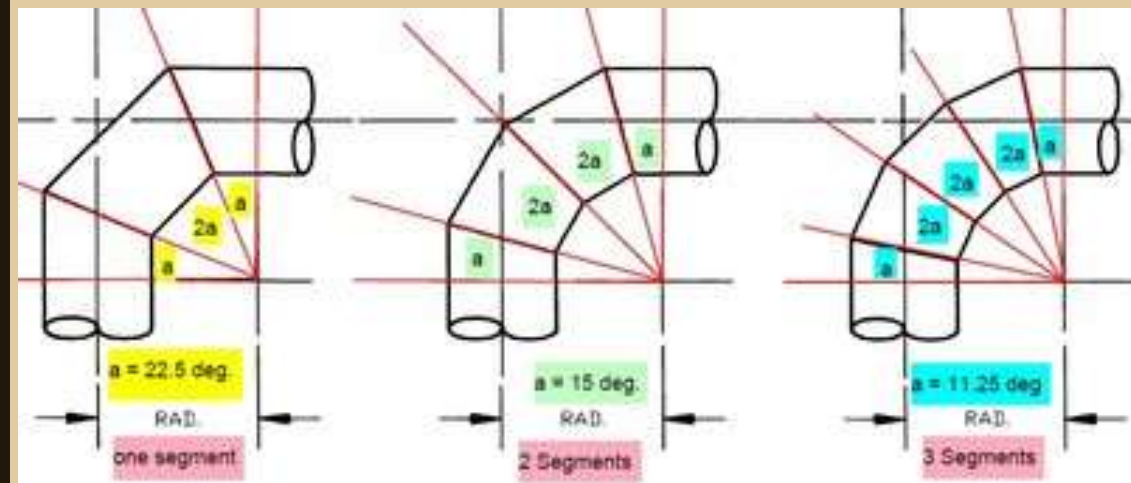
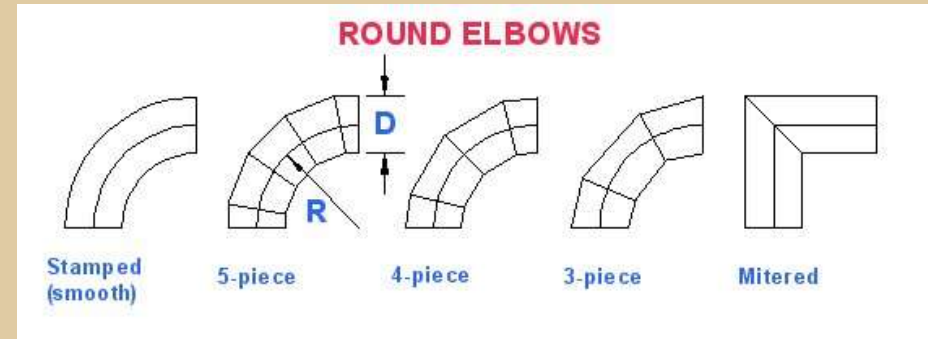
Normally elbows are butt-welded, socket welded or sometimes bolted connections are also available. Reducing elbows are available on 90 degree only and the radius is 1.5 times of the larger end



MITRE BENDS

These are fabricated bends for larger diameter piping, low pressure (50 psi or less) pressure applications.

It is made out of two, three, four segments of pipe pieces. These are normally used for non critical services. (water, drainage, and vent piping)



COUPLINGS & UNIONS

COUPLINGS

FULL COUPLING

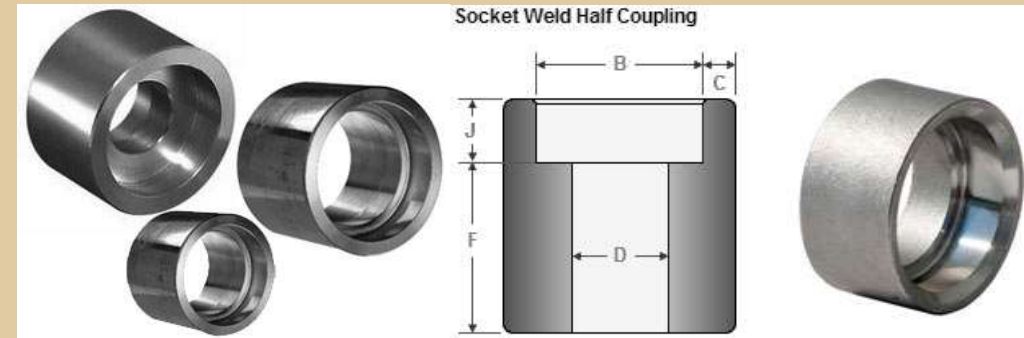
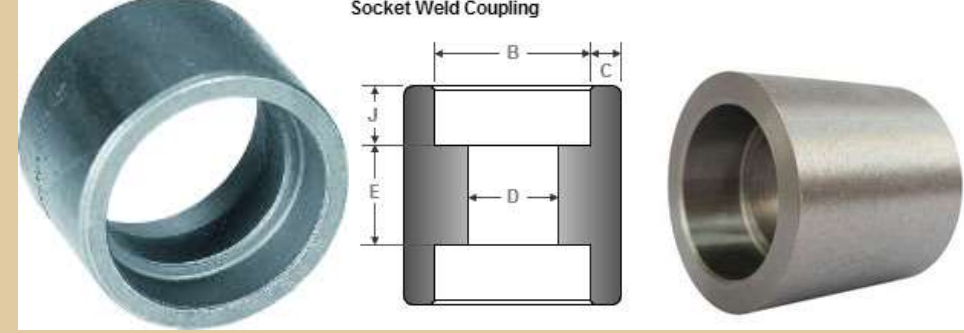
It is used to connect small bore pipes as projection of welding inside the pipe bore reduce the flow area

HALF COUPLING

It is used for branch connection

UNIONS

It is used where dismantling of the pipe is required more often. It can be with threaded end or socket weld ends.



REDUCERS

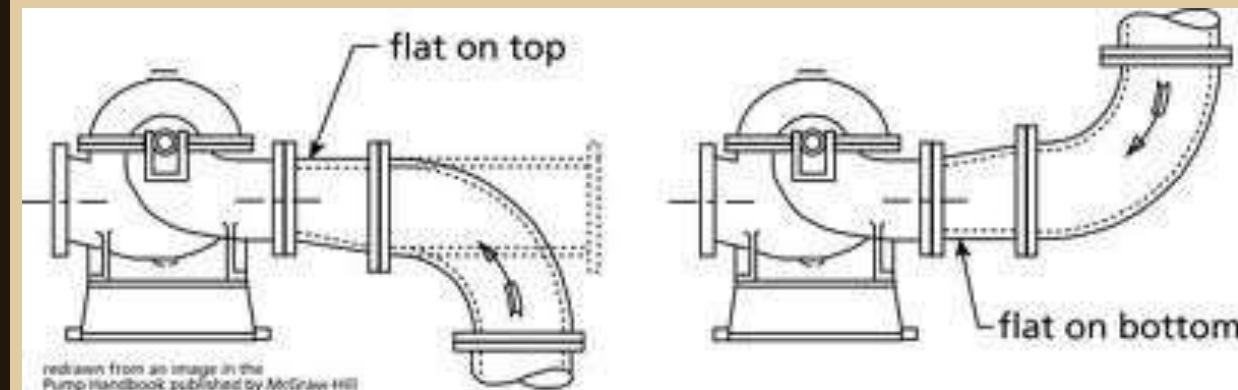
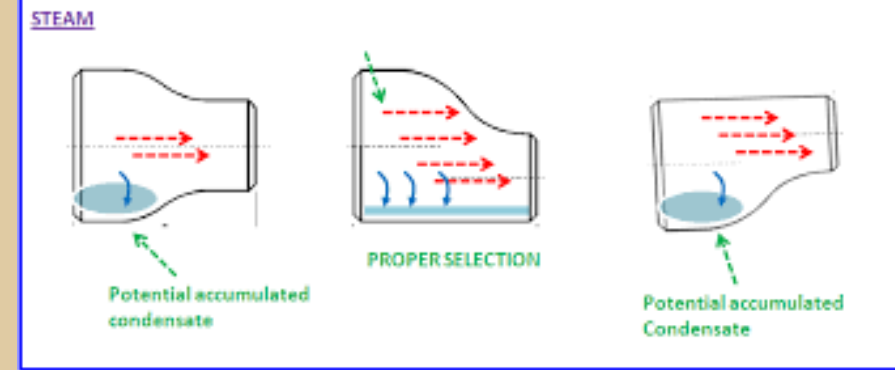
It makes reduction in line size

ECENTRIC REDUCER

It is used to pump suction to avoid cavitation with top surface being flat.

To maintain elevation bottom of pipe (BOP) in rack.

Offset dimension is $\frac{1}{2}$ the difference of the two inside diameters. Eccentric reducer are costlier than concentric reducer. Designer to optimize the requirement



REDUCERS

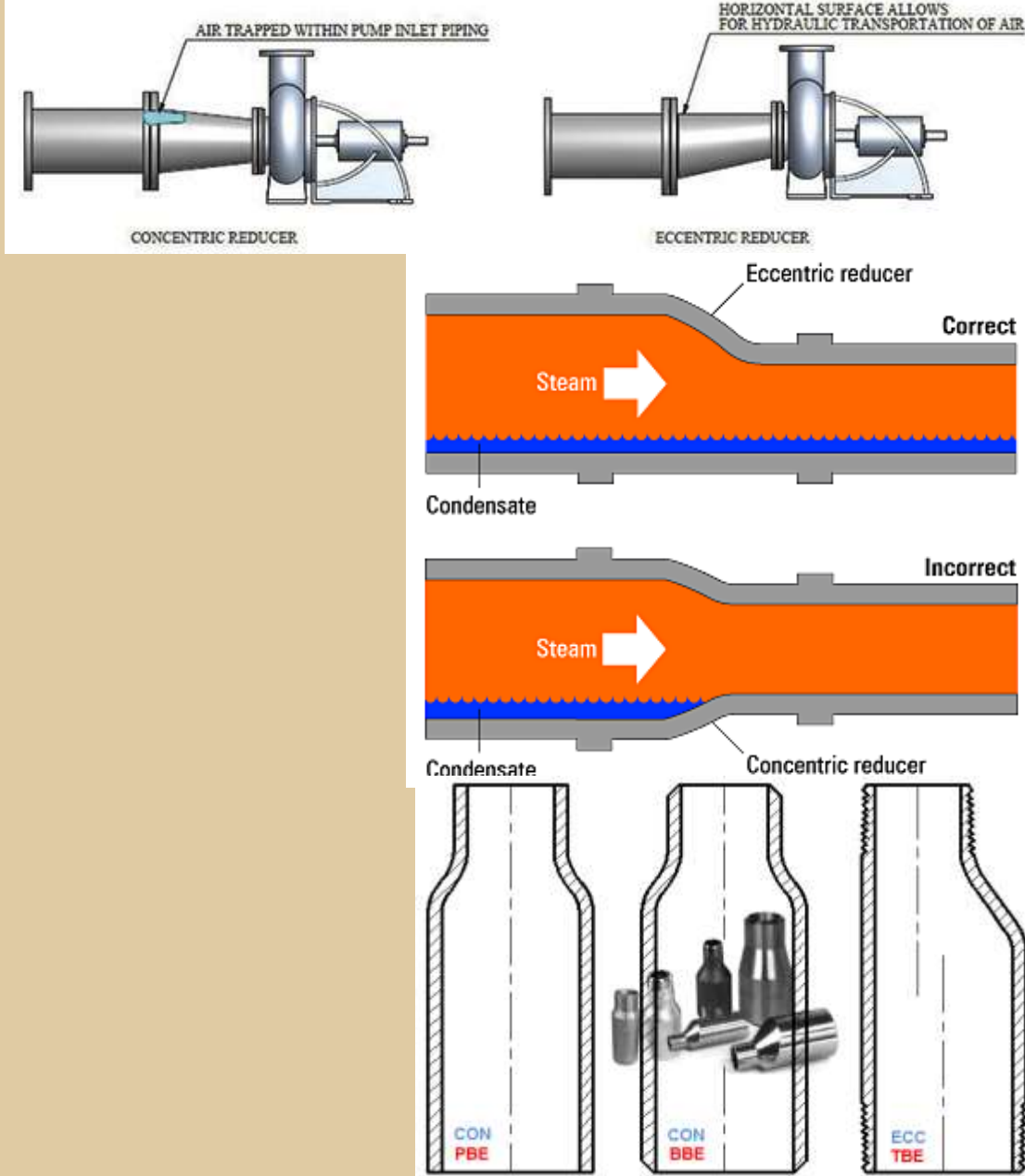
CONCENTRIC REDUCER

It is used on pump discharge, vertical pipe line etc.

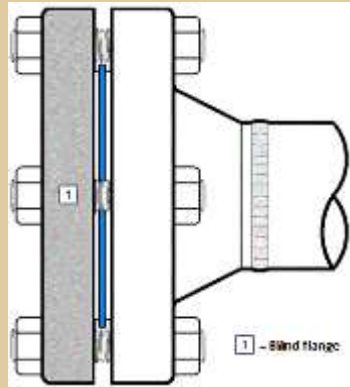
SWAGE NIPPLE

It is also like a reducer, it connect butt welded pipe to smaller screwed or welded pipe .

concentric and eccentric swage nipples are also available.



FLANGES

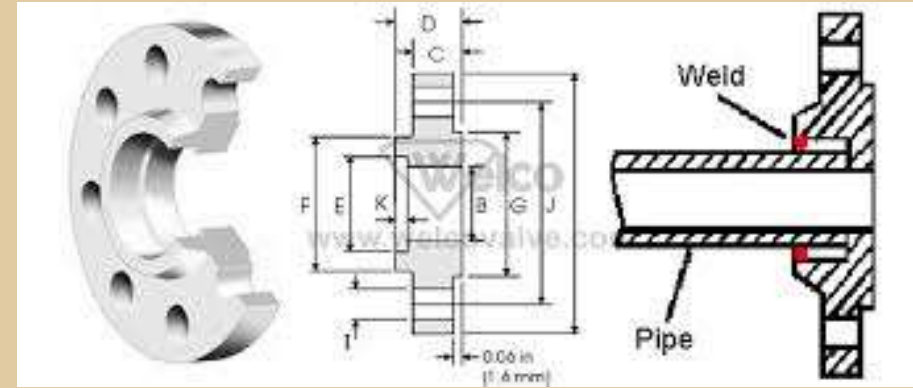


BLIND FLANGES

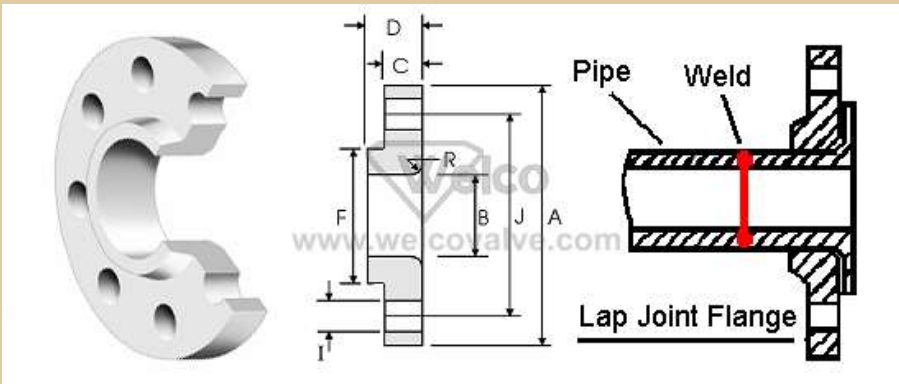


Slip on Flange

SLIP ON FLANGES



SOCKET WELDING FLANGE



LAP-JOINT FLANGE



THREADED FLANGES



WELDING NECK
FLANGES

FLANGES

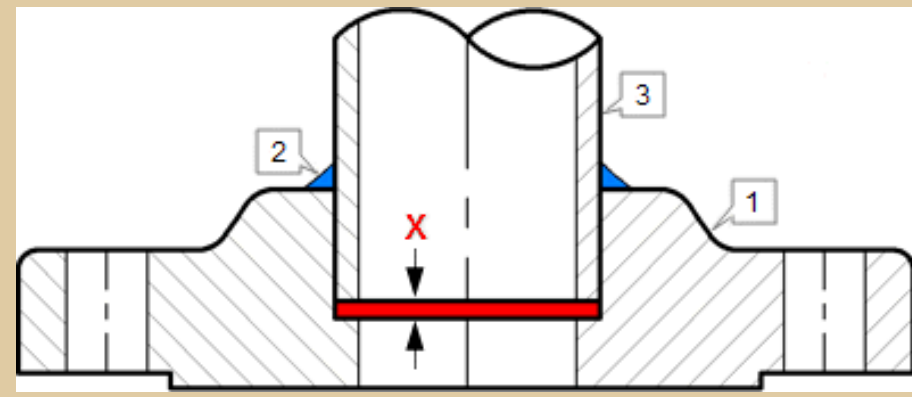
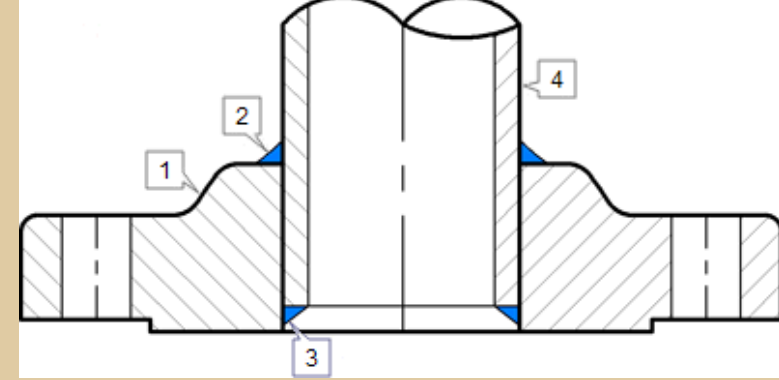
Flanges can be classified based on the attachment to the piping

SLIP ON

These flanges are attached by fillet welding inside as well as outside. Used where quick assembly, saving in cost and where extreme load condition are not present.

SOCKET WELD

These flanges are welded only one side. Is used for small bore only.



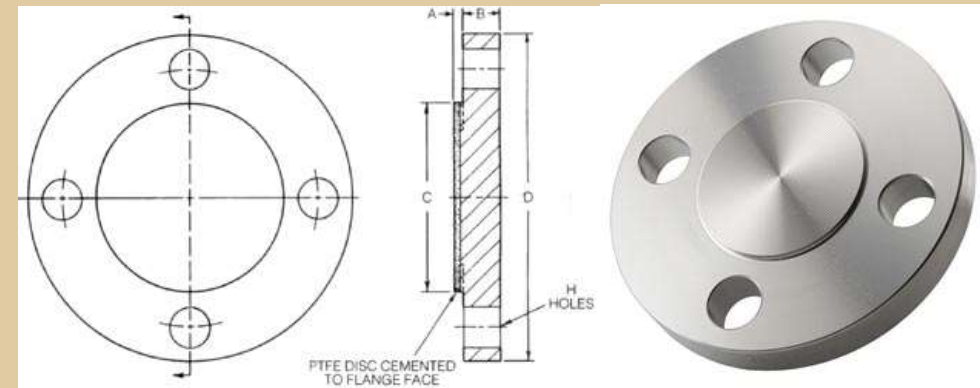
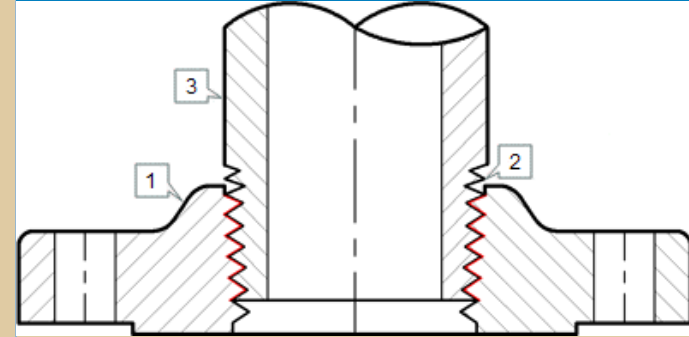
FLANGES

SCREWED

These flanges are used on pipe lines where low pressure and temperature are envisaged. Generally used in galvanized lines.

BLIND FLANGE

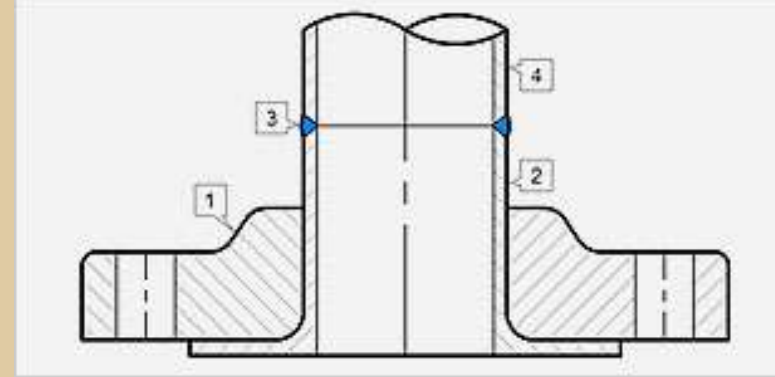
These flanges are used to close the ends which need to be reopened later, also used for blanking the dead end during hydro test.



FLANGES

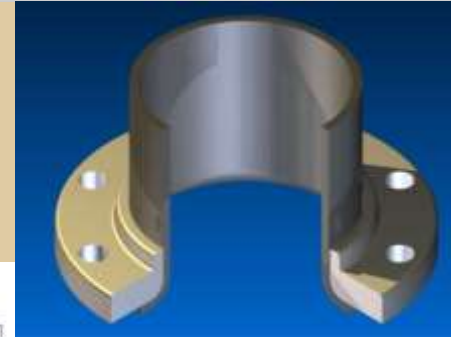
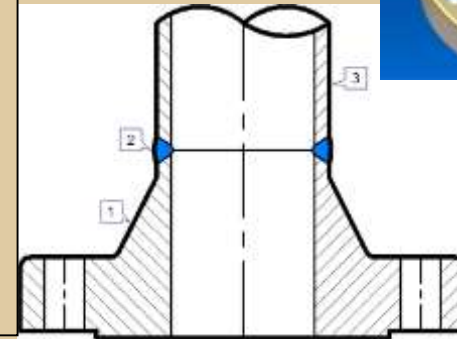
LAP JOINT

These flanges are used with stub ends when piping is of an exotic material. Stub ends will be butt welded to the piping and the flanges are kept loose over the same.



WELDING NECK

These flanges are generally butt welded to the pipes where excessive direct bending stress on the flanged joint or supporting heavy equipment are envisaged.



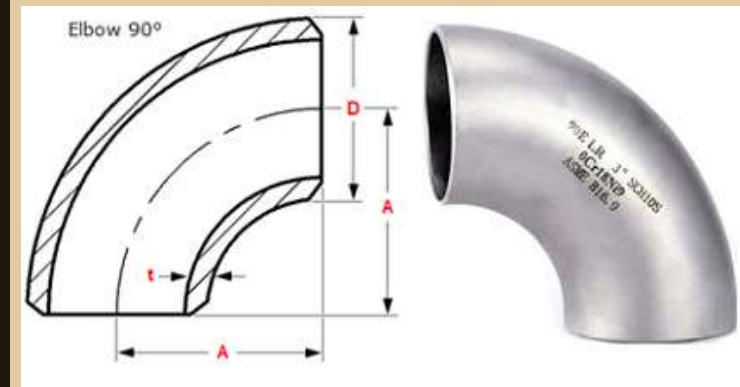
BUTT WELDED FITTINGS (ASME B16.9)

ADVANTAGES

Higher pressure and temperature conditions. Leak proof joints and almost maintenance free.

DISADVANTAGE

Weld projection will affect flow. Edge preparation is necessary.



RATING OF FLANGE

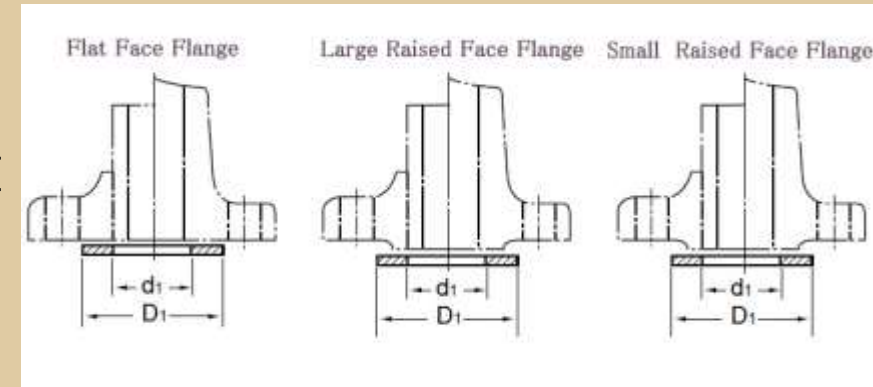
Flange are also classified by pressure – temperature ratings as per ANSI B 16.5. It is available in seven ratings 150#, 300#, 400#, 600#, 900#, 1500# and 2500#. These flange ratings are called nominal ratings. pressure – temperature combines determine the flange rating.

FLANGE RATING All Dimension in Inches																		
LINE SIZE	150#			300#			600#			900#			1500#			2500#		
	O.D.	I.D.	THKS	O.D.	I.D.	THKS	O.D.	I.D.	THKS	O.D.	I.D.	THKS	O.D.	I.D.	THKS	O.D.	I.D.	THKS
1/2	1 3/4	5/8	5/16	2	5/8	5/16	2	5/8	5/16	2 3/8	5/8	5/16	2 3/8	5/8	5/16	2 5/8	5/8	3/8
3/4	2 1/8	7/8	5/16	2 1/2	7/8	5/16	2 1/2	7/8	5/16	2 5/8	7/8	5/16	2 5/8	7/8	3/8	2 7/8	7/8	3/8
1	2 1/2	1 1/8	5/16	2 3/4	1 1/8	5/16	2 3/4	1	5/16	3	1	5/16	3	1	3/8	3 1/4	1	3/8
1 1/4	2 7/8	1 5/8	5/16	3 1/8	1 5/8	5/16	3 1/8	1 3/8	3/8	3 3/8	1 3/8	3/8	3 3/8	1 3/8	3/8	4	1 3/8	1/2
1 1/2	3 1/4	1 7/8	5/16	3 5/8	1 7/8	5/16	3 5/8	1 5/8	3/8	3 3/4	1 5/8	3/8	3 3/4	1 5/8	1/2	4 1/2	1 5/8	5/8
2	4	2 3/8	5/16	4 1/4	2 3/8	3/8	4 1/4	2 1/8	3/8	5 1/2	2 1/8	1/2	5 1/2	2	1/2	5 5/8	2	5/8
2 1/2	4 3/4	2 7/8	5/16	5	2 7/8	3/8	5	2 5/8	1/2	6 3/8	2 5/8	1/2	6 3/8	2 1/2	5/8	6 1/2	2 3/8	3/4
3	5 1/4	3 1/2	5/16	5 3/4	3 1/2	3/8	5 3/4	3 1/4	1/2	6 1/2	3 1/4	5/8	6 3/4	3	3/4	7 5/8	3	7/8
3 1/2	6 1/4	4	3/8	6 3/8	4	3/8	6 1/4	3 3/4	5/8									
4	6 3/4	4 1/2	3/8	7	4 1/2	1/2	7 1/2	4 1/4	5/8	8	4 1/4	3/4	8 1/8	4	7/8	9 1/8	4	1 1/8
5	7 5/8	5 1/2	3/8	8 3/8	5 1/2	5/8	9 3/8	5 3/8	3/4	9 5/8	5 1/4	7/8	9 7/8	5	1 1/8	10 7/8	5	1 3/8
6	8 5/8	6 5/8	1/2	9 3/4	6 5/8	5/8	10 3/8	6 3/8	7/8	11	6 3/8	1	11	6	1 3/8	12 3/8	6	1 5/8
8	10 7/8	8 5/8	1/2	12	8 5/8	7/8	12 1/2	8 3/8	1 1/8	14	8 3/8	1 3/8	13 3/4	8	1 5/8	15 1/8	7 7/8	2 1/8
10	13 1/4	10 3/4	5/8	14 1/8	10 3/4	1	15 5/8	10 3/8	1 3/8	17	10 3/8	1 5/8	17	10	2	18 5/8	9 3/4	2 5/8
12	16	12 3/4	3/4	16 1/2	12 3/4	1 1/8	17 5/8	12 3/8	1 5/8	19 1/2	12 3/8	1 7/8	20 3/8	12	2 3/8	21 1/2	11 3/8	3 1/8
14	17 5/8	14	3/4	19	14	1 1/4	19 1/4	13 5/8	1 3/4	20 3/8	13 5/8	2 1/8	22 5/8	13 1/8	2 5/8			
16	20 1/8	16	7/8	21 1/8	16	1 1/2	22 1/8	15 5/8	2	22 1/2	15 5/8	2 3/8	25 1/8	15	3			
18	21 1/2	18	1	23 3/8	18	1 5/8	24	17 5/8	2 1/8	25	17 5/8	2 5/8	27 5/8	16 7/8	3 3/8			
20	23 3/4	20	1 1/8	25 5/8	20	1 3/4	26 3/4	19 1/2	2 1/2	27 3/8	19 1/2	2 7/8	29 5/8	18 7/8	3 3/4			
22	25 7/8	22	1 1/4	27 5/8	22	1 7/8	28 3/4	21 1/2	2 3/4									
24	28 1/8	24	1 3/8	30 3/8	24	2	31	23 1/2	2 7/8	32 7/8	23 1/2	3 1/2	35 3/8	22 5/8	4 3/8			
26	30 3/8	26	1 1/2	32 3/4	26	2	34	25 1/2	3 1/8	34 5/8	25 1/2	3 3/4						
28	32 5/8	28	1 5/8	35 1/4	28	2 1/8	35 7/8	27 1/2	3 3/8	37 1/8	27 1/2	4 1/8						
30	34 5/8	30	1 3/4	37 3/8	30	2 3/8	38 1/8	29 1/2	3 5/8	39 5/8	29 1/2	4 3/8						
32	36 7/8	32	1 3/4	39 1/2	32	2 1/2	40 1/8	31 1/2	3 3/4	42 1/8	31 1/2	4 3/4						
34	38 7/8	34	1 7/8	41 1/2	34	2 5/8	42 1/8	33 1/2	4 1/8	44 5/8	33 1/2	5						
36	41 1/8	36	2	43 7/8	36	2 3/4	44 3/8	35 1/2	4 1/4	47 1/8	35 1/2	5 1/4						
38	43 5/8	38	2 1/8	41 3/8	38	3	43 3/8	37 1/2	4 1/2	47 1/8	37 1/2	5 1/2						
40	45 5/8	40	2 1/4	43 3/4	40	3 1/8	45 3/8	39 1/2	4 3/4	49 1/8	39 1/2	5 7/8						
42	47 7/8	42	2 3/8	45 3/4	42	3 1/4	47 7/8	41 1/2	5	51 1/8	41 1/2	6 1/8						
44	50 1/8	44	2 1/2	47 7/8	44	3 3/8	49 7/8	43 1/2	5 1/4	53 3/4	43 1/2	6 3/8						
46	52 1/8	46	2 1/2	50	46	3 5/8	51 7/8	45 1/2	5 1/2	56 3/8	45 1/2	6 3/4						
48	54 3/8	48	2 5/8	52	48	3 3/4	54 5/8	47 1/2	5 3/4	58 3/8	47 1/2	7						

CLASSIFICATION OF FLANGES (BASED ON FACING)

FLAT FACE

Normally C I flanges having 125 # has a flat face. Since no raised face it requires full faced gasket.



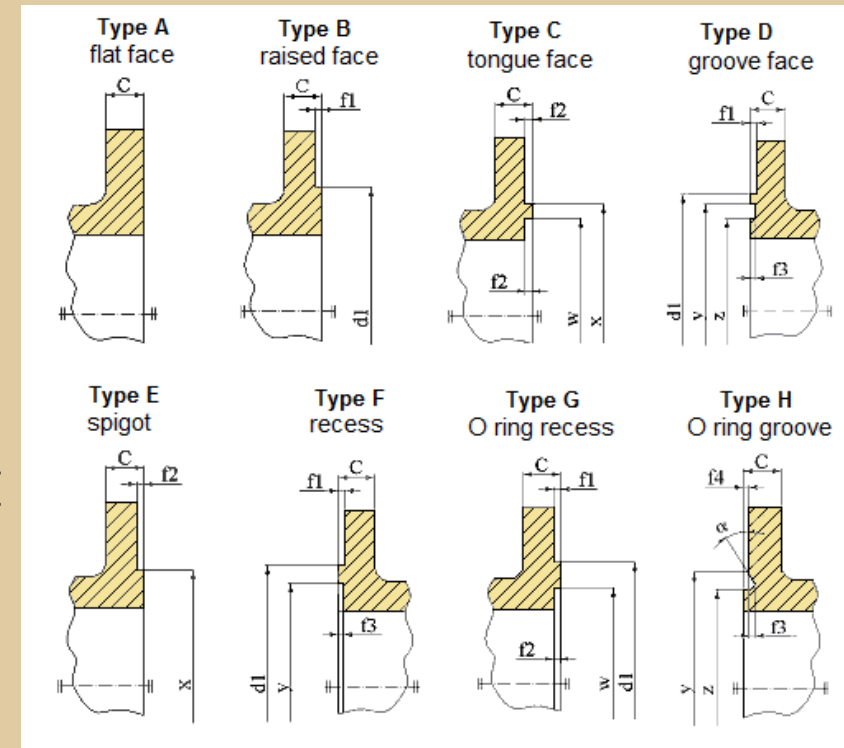
RAISE FACE

Raised face $1/16''$ for 150 # and 300 #

Raised face $1/4''$ for other series

RING TYPE JOINT

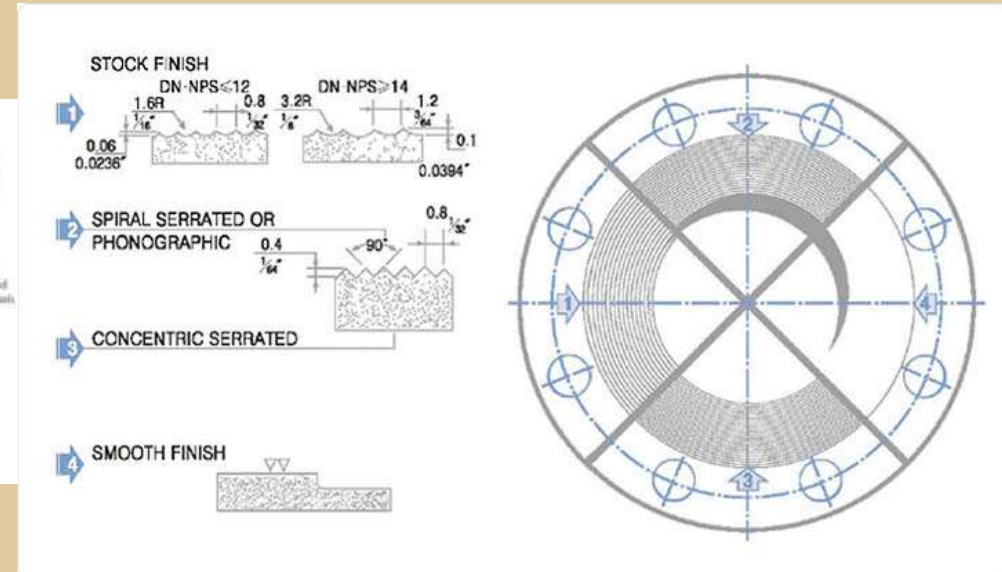
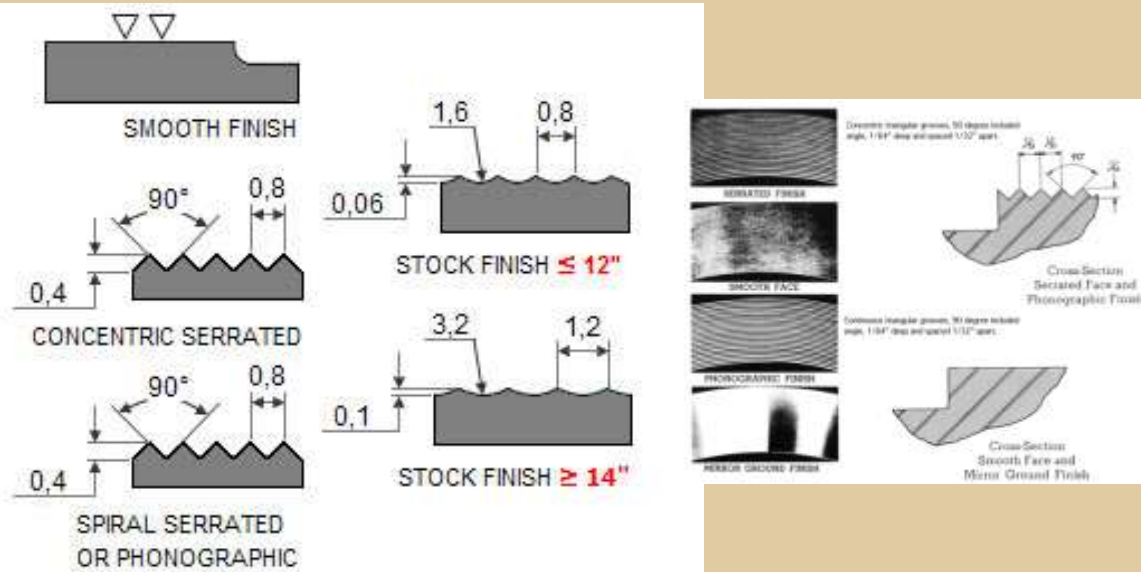
Metallic rings are used in this ring type joint (RTJ) flanges



SURFACE FINISH ON THE FLANGE

Normally smooth finish is recommended for metallic gaskets.

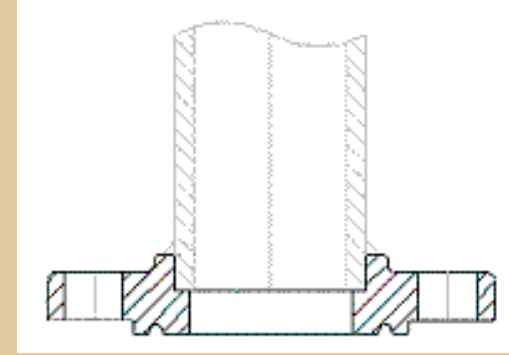
Serrated finish are used when non metallic gaskets are used.



SOCKET WELDED FITTINGS (ASME B16.11)

ADVANTAGES

Fast production, No need to bevel the edges. Can be used in lieu of thread fittings. Weldment can not extend in to the pipe line.



DISADVANTAGE

The 1/16" recess pocket liquid. Use not permitted by code if severe erosion or crevice corrosion anticipated.



FLANGED FITTINGS

(ASME B16.1 AND B16.5)

ADVANTAGE

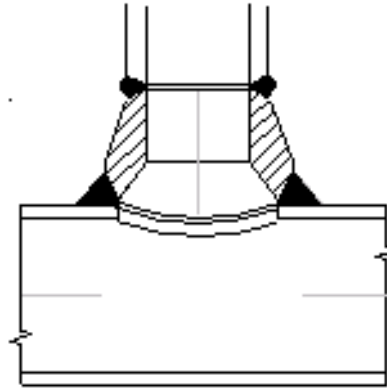
Easy to dismantle and assemble.

DISAVANTAGE

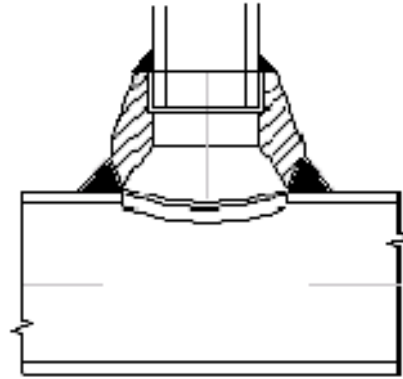
Costlier than equally rated butt welded fitting.

Occupy more space, and more weight load.

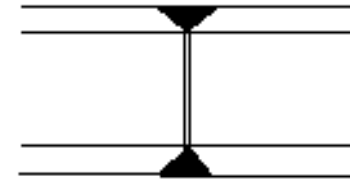
REINFORCED FITTINGS



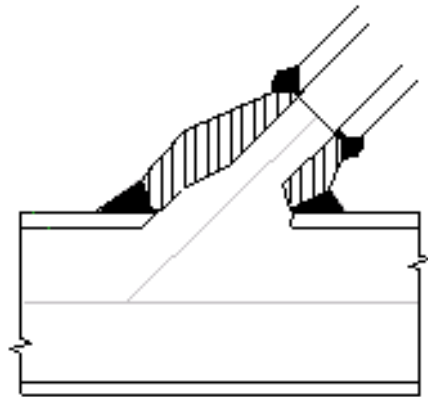
Weldolet



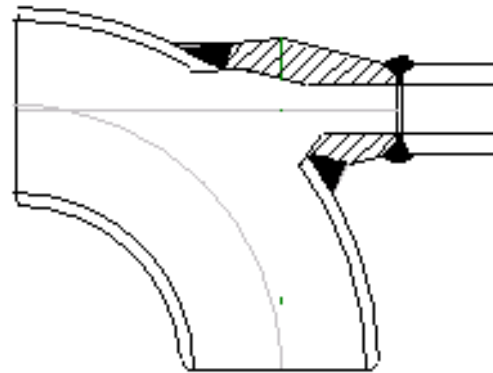
Sockolet



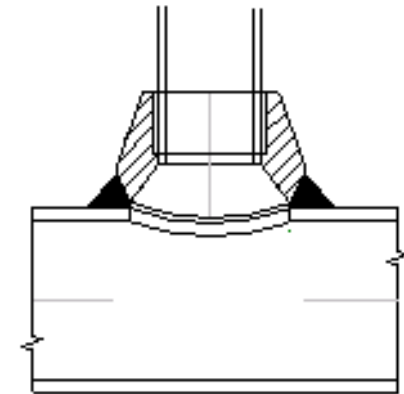
Pipe to Pipe Welding



Buttwelded Latrolet



Buttwelded Elbowlet



Thredolet

REINFORCED FITTINGS

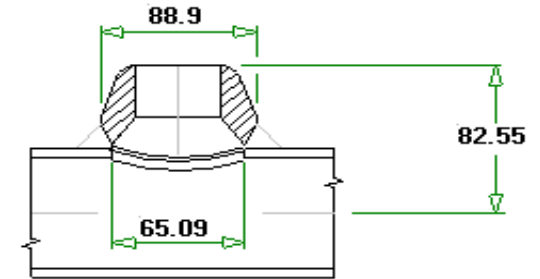
WELDOLET

An economical butt -weld branch connection, is designed to minimize stress concentration and provide integral reinforcement.

SOCKOLET

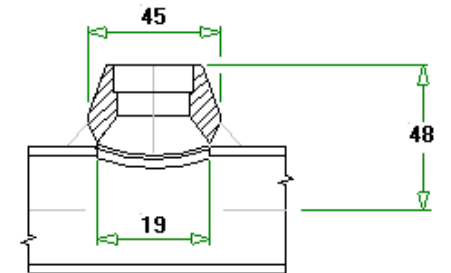
Utilizes the basic weldolet design configuration and incorporates a sockolet -weld outlet.

3" x 2" ButtWelded Olets Sch-80



Weldolet
Weight = 0.79 Kg

1" x 1/2" SocketWelded Olets 6000#



Sockolet
Weight = 0.23 Kg

REINFORCED FITTINGS

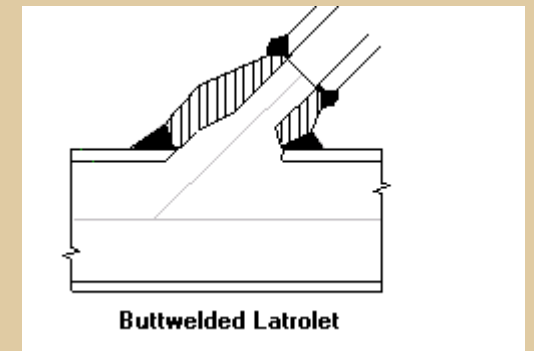
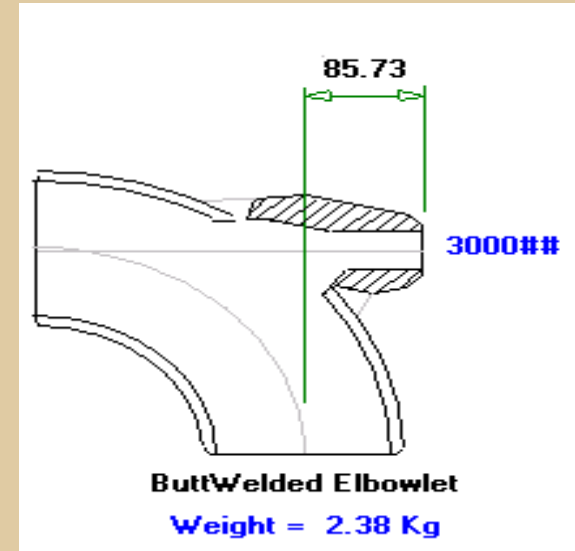
ELBOWOLET

utilizes the basic weldolet configuration, provides a branch connection on elbow.

LATROLET

Used for 45 degree lateral connections.

Similarly, elbolet, sweepolet etc are available



THERMAL EXPANSION OF PIPE

Each material has its own coefficient of thermal expansion.

If the pipe is of carbon steel or low alloy steel, it will expand at the rate of 6 to 7mm every meter length as the temperature raises to 500 degree C.

To accommodate the thermal expansion, these joints are provided.

EXPANSION JOINTS

Expansion joints are used to accommodate certain degree of linear expansion and torsional misalignments in the piping system

BELLOW TYPE

Metallic bellows of compatible materials (usually stainless steels) are used to compensate the thermal expansion. Thickness of bellows normally 1 to 2mm.

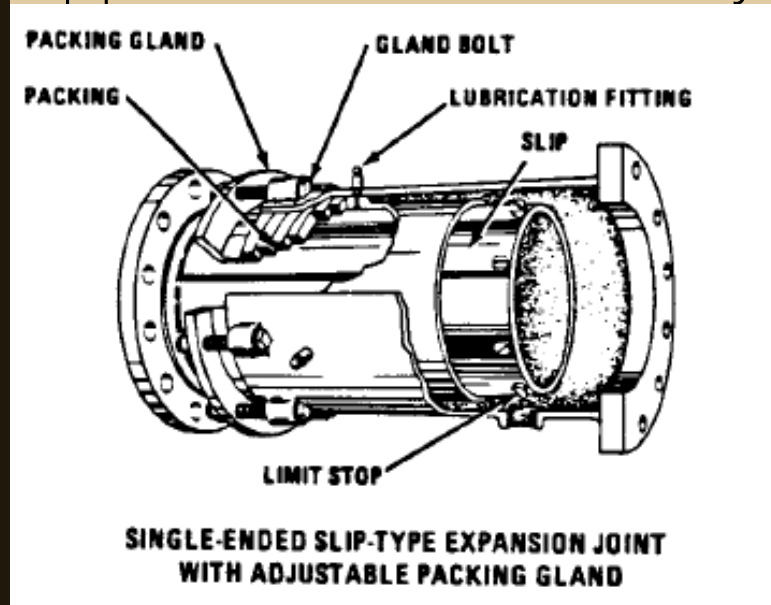


EXPANSION LOOPS

Expansion loops are widely used for high temperatures & high pressures applications. Ideally suitable for longitudinal movements and certain degree of torsional movement.

TELESCOPIC TYPE

These joints are ideally suitable for low temperature & low pressure application. Suitable only for axial expansion.



VALVES

valves are installed in between the pipes / equipment to perform following functions :

Isolation (gate valve, ball valve, butterfly valves etc.)

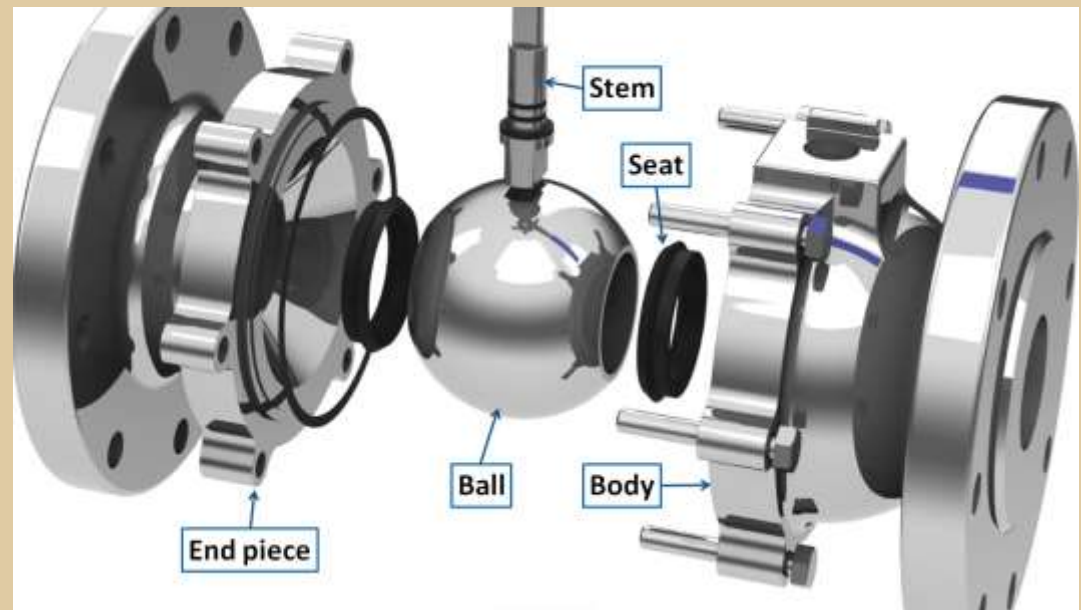
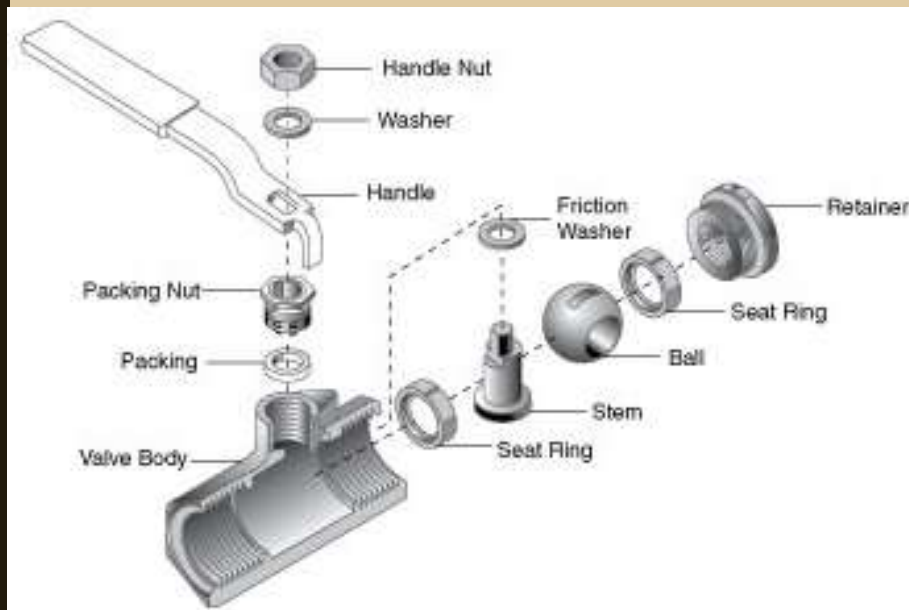
Regulation (globe valve etc.)

Non return (check valve, SDNR etc.)

Special purpose (foot valve etc.)

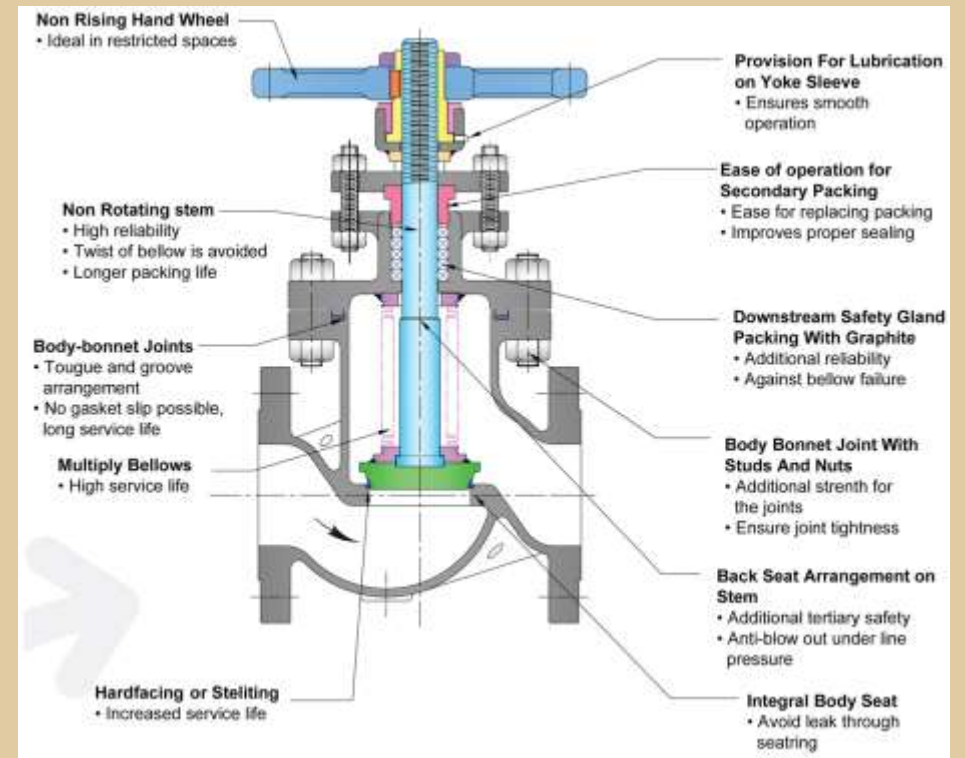
BALL VALVE

Ball valve is normally used for positive shut off. Operation by a quarter turn of operating handle. The ball valve offers minimum resistance to flow. Widely used on onshore/offshore and petrochemicals.



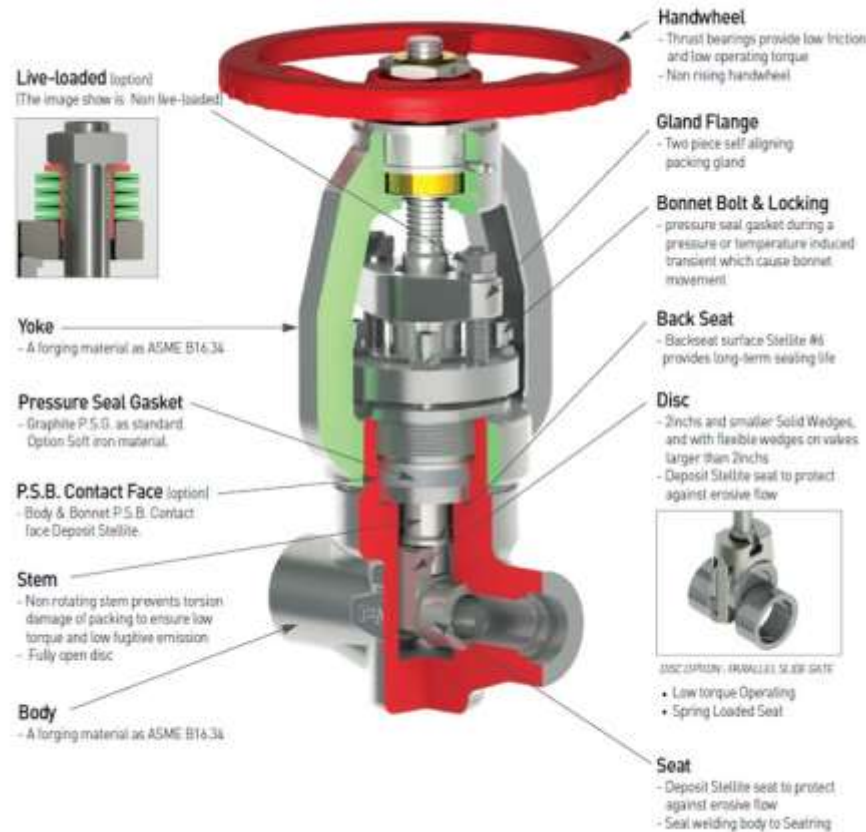
GLOBE VALVE

Due to its globular body, it is called Globe Valve. There is higher resistance and pressure drop in this valve. Most suitable for throttling the flow.



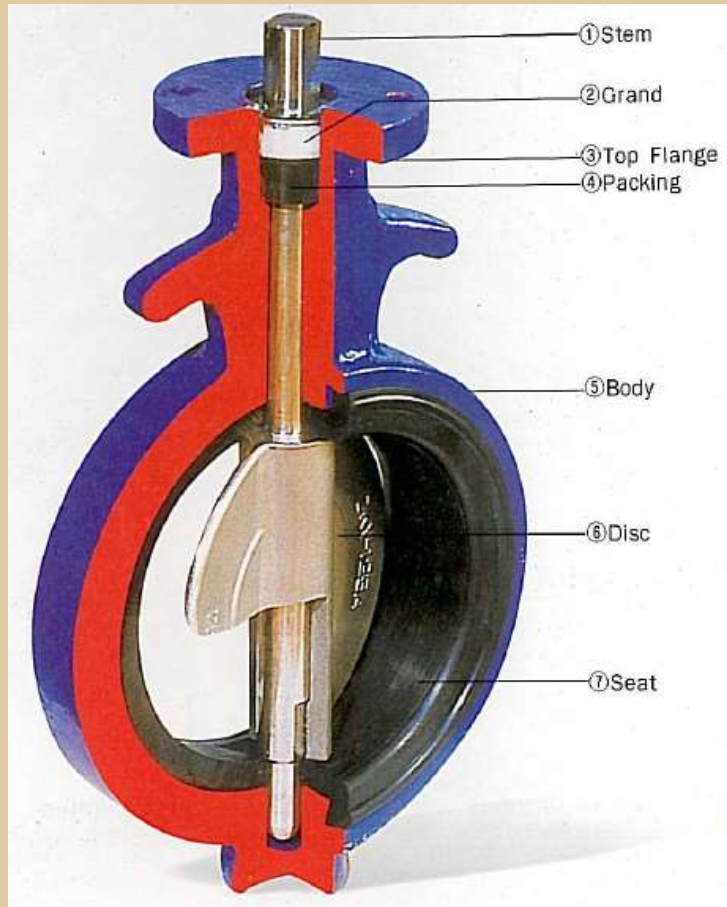
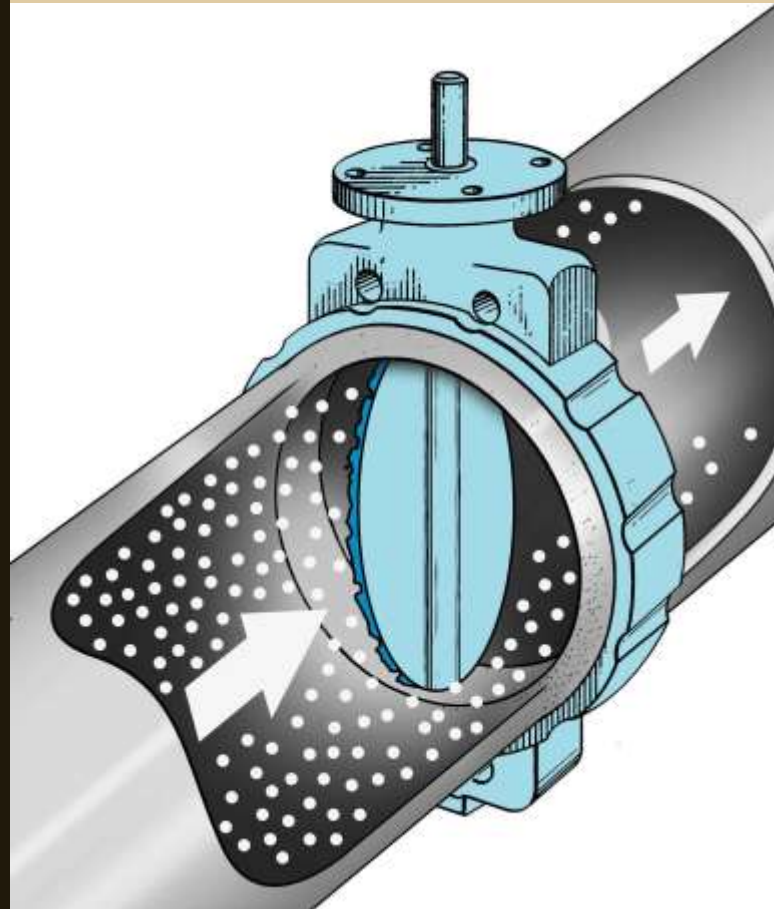
GATE VALVE

Flow is axial piping. Lower pressure drop. It is not recommended for throttling the flow.



BUTTERFLY VALVE

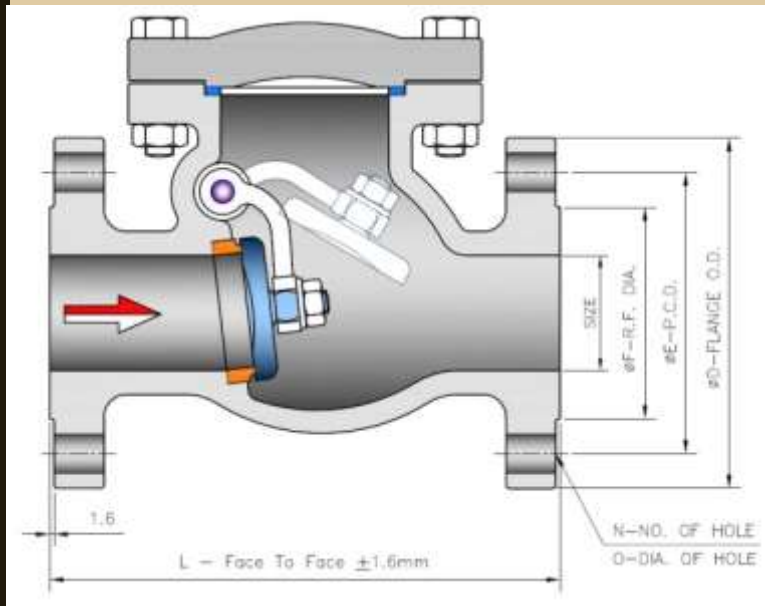
It is widely used on low pressure application . It may be used to control and regulate the flow.



CHECK VALVE / NON RETURN VALVE

Swing Check Valve

This valve allows flow in one direction only. Return flow will automatically close the valve, thus preventing flow in reverse direction.



TESTING OF PIPING SYSTEM

(AS PER ANSI B 31.3)

Piping system can be tested for leak tightness and pressure integrity by hydro test / pneumatic test methods.

HYDROSTATIC TEST

TEST PRESSURE $= (1.5 \times \text{Design Pressure} \times \text{stress value at test temp}) / \text{stress value at design temperature}$

TEST DURATION

A leak test shall be maintained for at least 10 minutes, and all joints may be examined for leaks.

TEST MEDIUM

Water at ambient temperature is the test medium. In case of possibility of freezing exists, other fluids may be used.

PNEUMATIC TEST

TEST PRESSURE

$(1.1 \times \text{Design Pressure} \times \text{stress value at test Temperature}) / \text{stress value at design temperature}$

TEST DURATION

A leak test shall be maintained for at least 10 minutes, and all joints may be examined for leaks.

TEST MEDIUM

Air at ambient temperature is the test medium.

CHECK LIST FOR HYDRO TEST

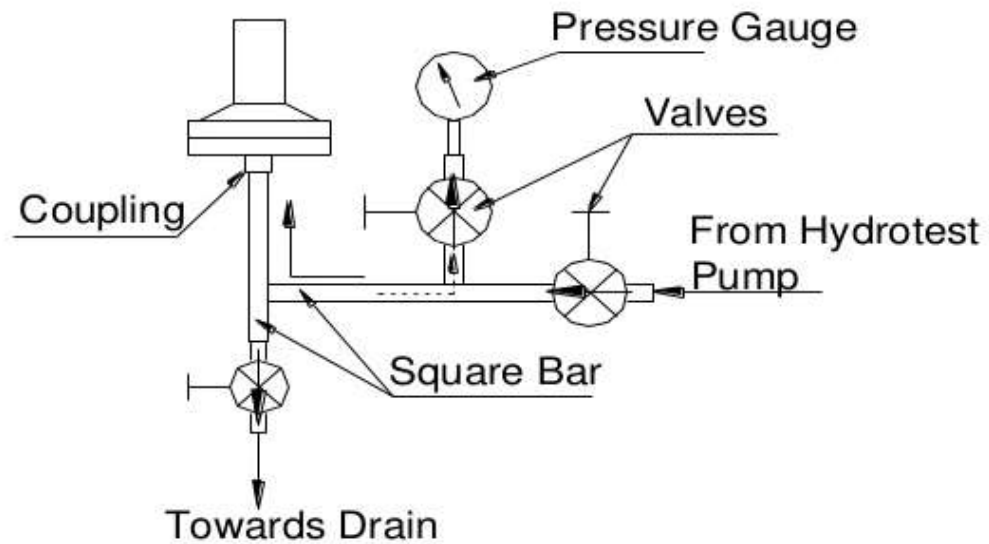
1. COMPLETION OF WELDING ON PRESSURE PARTS.
2. ALL LONG SEAMS & CIRC. SEAMS ARE MADE VISIBLE FOR INSPECTION.
3. COMPLETION OF ALL NDT.
4. GASKETS & GASKET SEATINGS ARE CHECKED FOR ANY DAMAGE.
5. EQUIPMENT WHICH IS NOT TO BE TESTED SHALL BE EITHER DISCONNECTED OR ISOLATED.
5. RAISE THE PRESSURE TILL 50% OF TEST PRESSURE.
6. INCREASE THE PRESSURE IN INCREMENTS OF 10% OF TEST PRESSURE.

CHECK LIST FOR HYDRO TEST

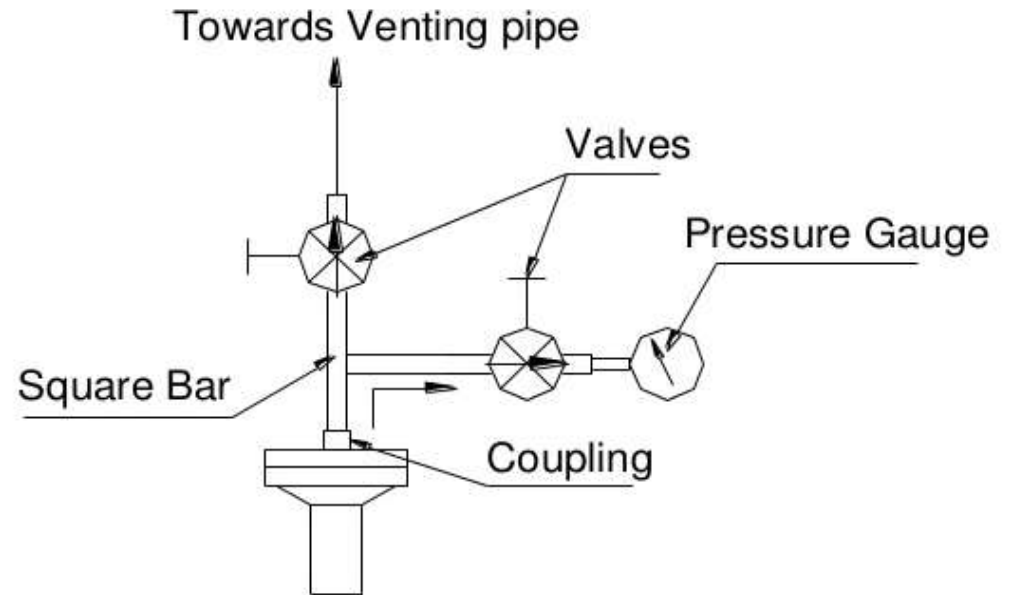
7. STOP PUMPING FOR 5 MINUTES AFTER EACH INCREMENT OF 10% OF RISE IN PRESSURE.
8. IF ANY LEAKAGE IS OBSERVED THROUGH GASKET CONNECTION, REPEAT THE TEST AFTER DEPRESSURISING THE SYSTEM.

FITTING ARRANGEMENT

Arrangement for Inlet Pressure Gauge



Arrangement for Outlet Pressure Gauge



IMPORTANT SAFETY POINTS

- DRAIN THE PIPE ONLY WHEN TOP OUT LET IS KEPT OPEN.
- USE MINIMUM 2 GAUGES FOR ANY HYDROTEST.
- NEVER USE HIGH DISCHARGE PUMPS FOR TESTING LOW VOLUME PIPE. (VOLUM LESS THAN 10 M³).
- NEVER PRESSURISE ANY VESSEL ABOVE TEST PRESSURE.

COMMAN ABBREVIATION IN PIPING

EJMA	Expansion Joint Manufacture Association .
IGSCC	Inter Granular Stress Corrosion Cracking.
NFPA	National Fire Protection Association
SCC	Stress Corrosion Cracking.
HVAC	Heating, Ventilating and Air Conditioning .
AISC	American Institute of Steel Construction.
ANSI	American National Standard Institute.
AISI	American Institute Of Steel & Iron.
MSSSP	Manufacture Standard Society & Standard Practice.
TEMA	Tubular Exchanger Manufacturers Association.

REASON FOR CHECKING 1.5 TIMES OF DESIGN PRESSURE

Normally 66% of yield strength (i.e. $\frac{2}{3}$ yield strength) or $\frac{1}{3}$ of the tensile strength whichever is less is taken as a basic Allowable stress for metals considered for design calculation. When you test the materials for 1.5 times of the design pressure it is not exceeding 100% of yield strength of the material. Hence all pipelines are tested for 1.5 times of the design pressure.

$\frac{2}{3}$ of yield strength is 66 %

1.5 times of 66 % is 99 %

REASON FOR 22% ELONGATION ON STEEL.

Normally 12 % of the ductility required in final product during manufacturing. 6 to 8 % ductility lost in manufacturing and 2 % is considered for non - homogenous material.

Hence material selected should have minimum 22% elongation.

PIPING FABRICATION

- Cutting
- Bending
- Forming
- welding

Cutting and beveling of the edges by Mechanical Methods (lathes, grinding Wheels / Thermal methods (oxy – fuel gas cutting, Arc cutting.)

PIPING THINNING

Bending results in the thinning of the outer surface (extrados) and thickening of the inner surface (intrados) of the pipe.

It can be approximated by multiplying the thickness of the pipe before bending by

$$R/(R+ r)$$

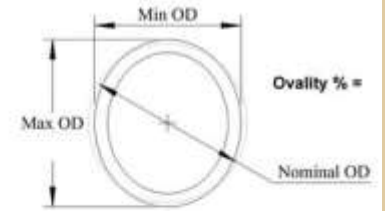
Where R - Radius of Bend &

r - Pipe radius. (Half of the O.D)

Ovality

The pipe while being bent assumes a oval shape with the major axis perpendicular to the plane of the bend

Acceptable normally 8% for internal pressure & 3% for external pressure.



Ovality Calculated by:

$$\text{Ovality \%} = \frac{(\text{Max OD} - \text{Min OD})}{\text{Nominal OD}} \times 100$$

Measuring Minimum OD:



Measuring Maximum OD:

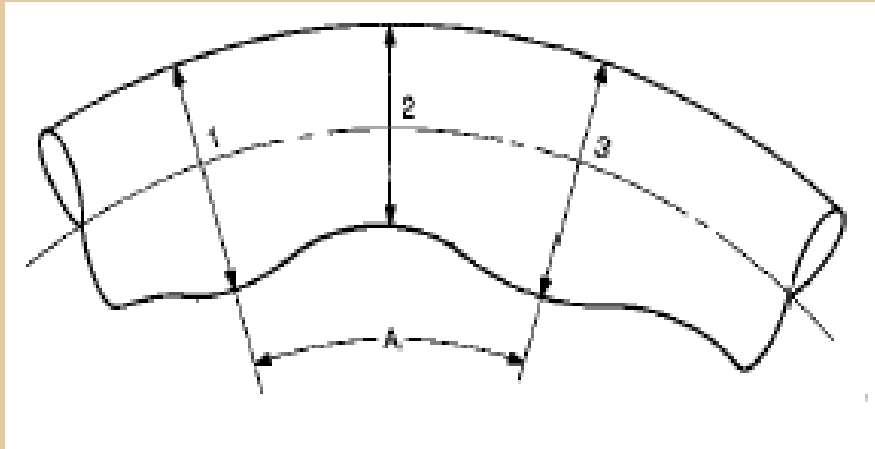


BUCKLING

Bending of pipe with large diameter to thickness ratios often results in buckling rather than thickening of the intrados even where internal mandrels are used.

Ratio of the distance between the crest to depth must be equal to or greater than 12 ($A/\text{depth} > 12$).

Depth = $((OD1) + (OD3))/2 - (OD2)$.



BENDING

COLD BENDING

Where sufficient quantities of repetitive bends are required, ferrous pipes and tubes up to NPS 10 or 12 with wall thickness of $\frac{1}{2}$ in or less are most often bent at ambient temperature using some type of bending machine.

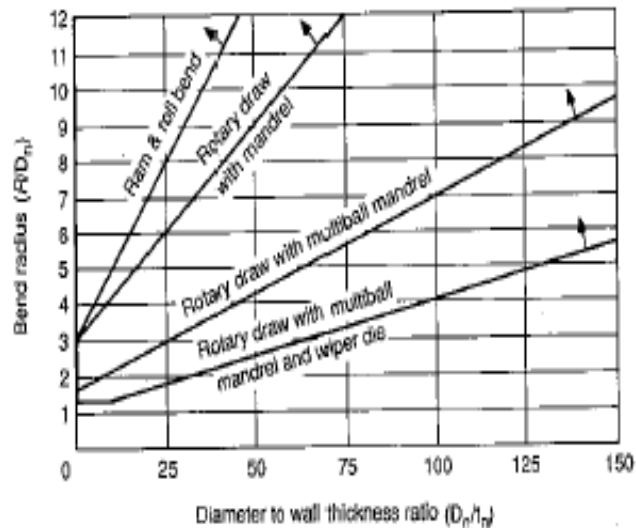


FIGURE A6.10 Cold bending ranges. (Pipe Fabrication Institute PFI ES-24)

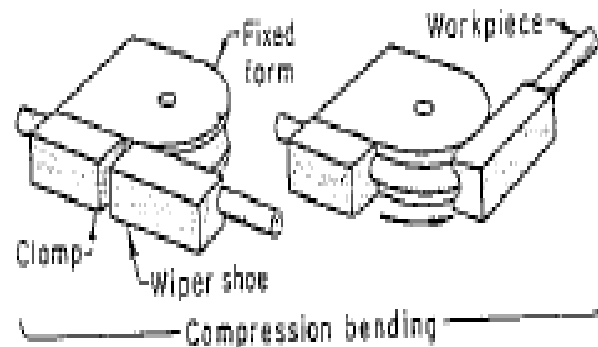
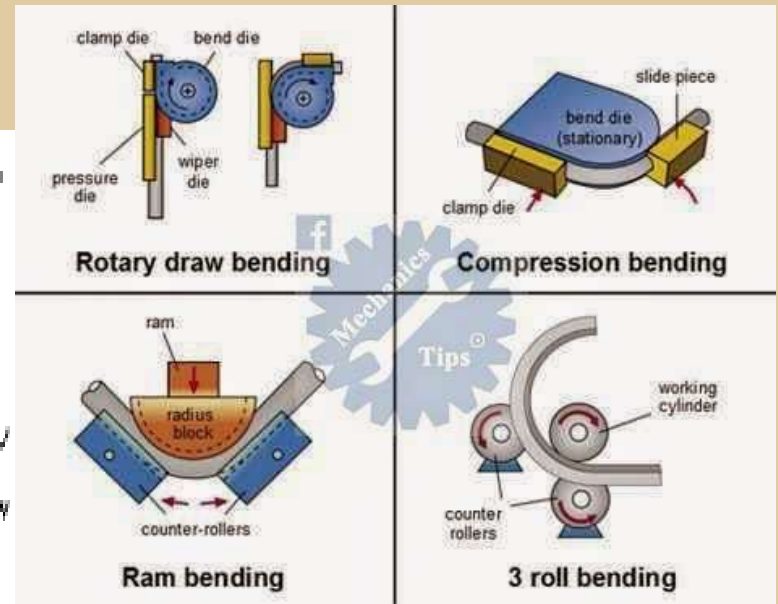


FIGURE A6.8 Comparison of the essential elements of draw bending and compression bending. (Metals Handbook³⁰)



HOT BENDING

Carried out in the temperature range of 1036*c to 1121*c by induction bending. Where suitable cold bending equipment is unavailable

Pipes of size NPS 3 ½ to NPS 64, radius of 8 to 400 inch and wall thickness 4" can be bend by Induction Bender .

