

Table 9.3 Minimum Shell Thicknesses when Severe Conditions are not Expected

<i>Minimum Thickness (in mm)</i>							
<i>Nominal Diameter</i>	<i>Cast Iron</i>	<i>Carbon Steel (including Corrosion Allowance)</i>	<i>Copper and Copper Alloys</i>	<i>Aluminium and Aluminium Alloys</i>	<i>Austenitic Stainless Steel</i>	<i>Nickel</i>	<i>Monel Inconel</i>
150	10	5	3.2	5	3.2	3.2	3.2
200	10	6.3	3.2	5	3.2	3.2	3.2
250	10	6.3	3.2	5	3.2	3.2	3.2
300	13	6.3	3.2	5	3.2	3.2	3.2
350	13	6.3	5	5	3.2	5	3.2
400	13	6.3	5	6.3	3.2	5	3.2
500	13	8	6.3	8	3.2	6.3	3.2
600	16	8	6.3	8	5	6.3	5
700	16	10	8.3	10	5	8	5
800	16	10	10	11.2	6.3	8	6.3
900	19	10	10	11.2	6.3	10	6.3
1000	19	10	11.2	12.5	6.3	11.2	6.3
1100	22	11.2	11.2	14	6.3	11.2	6.3

Note: The thickness values are exclusive of the corrosion allowance.

Table 9.4 Minimum Tube Sheet Thicknesses

<i>Tube Outer Diameter mm</i>	<i>Thickness mm</i>
6	6
10	10
12	12
16	13
18, 19, 20	15
25, 25.4	19
31.8, 32	22.4
38, 40	25.4

Group 1.1 (Cast Iron)

Table 2-1.1 Pressure–Temperature Ratings for Group 1.1 Materials

Nominal Designation	Forgings		Castings		Plates		
C–Si	A 105 (1)		A 216 Gr. WCB (1)		A 515 Gr. 70 (1)		
C–Mn–Si	A 350 Gr. LF2 (1)				A 516 Gr. 70 (1), (2)		
C–Mn–Si–V	A 350 Gr. LF6 Cl. (A)						
3½ Ni	A 350 Gr. LF3				A 537 Cl. 1 (3)		
Working Pressure by Classes, bar							
Class Temp., °C	150	300	400	600	900	1500	2500
–29 to 38	19.6	51.1	68.1	102.1	153.2	255.3	425.5
50	19.2	50.1	66.8	100.2	150.4	250.6	417.7
100	17.7	46.6	62.1	93.2	139.8	233.0	388.3
150	15.8	45.1	60.1	90.2	135.2	225.4	375.6
200	13.8	43.8	58.4	87.6	131.4	219.0	365.0
250	12.1	41.9	55.9	83.9	125.8	209.7	349.5
300	10.2	39.8	53.1	79.6	119.5	199.1	331.8
325	9.3	38.7	51.6	77.4	116.1	193.6	322.6
350	8.4	37.6	50.1	75.1	112.7	187.8	313.0
375	7.4	36.4	48.5	72.7	109.1	181.8	303.1
400	6.5	34.7	46.3	69.4	104.2	173.6	289.3
425	5.5	28.8	38.4	57.5	86.3	143.8	239.7
450	4.6	23.0	30.7	46.0	69.0	115.0	191.7
475	3.7	17.4	23.2	34.9	52.3	87.2	145.3
500	2.8	11.8	15.7	23.5	35.3	58.8	97.9
538	1.4	5.9	7.9	11.8	17.7	29.5	49.2

Group 1.4 (Mild Steel and Carbon Steel)

Table 2-1.4 Pressure–Temperature Ratings for Group 1.4 Materials

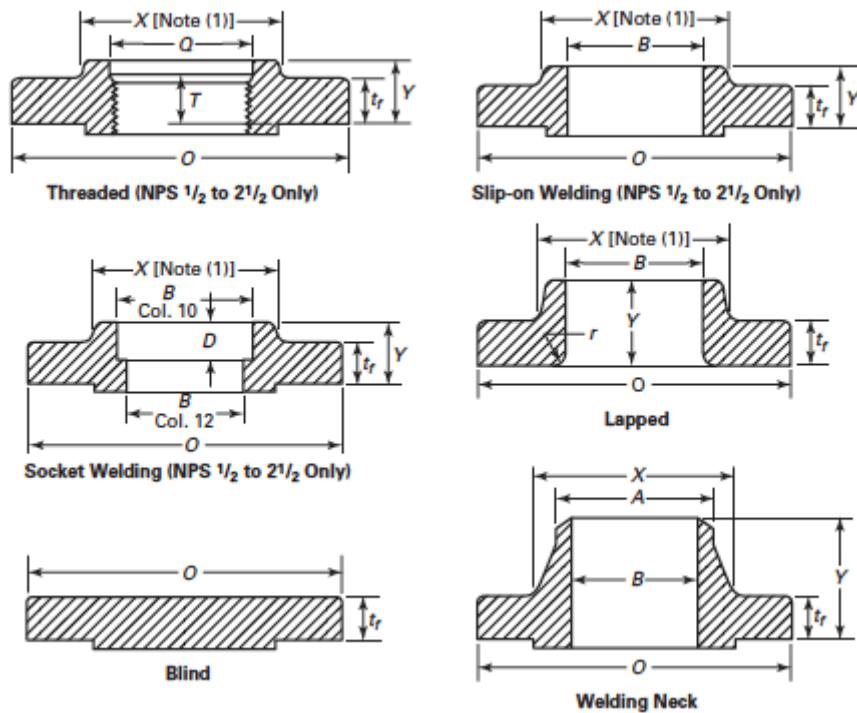
Nominal Designation	Forgings		Castings		Plates		
C–Si					A 515 Gr. 60 (1)		
C–Mn–Si	A 350 Gr. LF1, Cl. 1 (1)				A 516 Gr. 60 (1), (2)		
Working Pressures by Classes, bar							
Class Temp., °C	150	300	400	600	900	1500	2500
–29 to 38	16.3	42.6	56.7	85.1	127.7	212.8	354.6
50	16.0	41.8	55.7	83.5	125.3	208.9	348.1
100	14.9	38.8	51.8	77.7	116.5	194.2	329.6
150	14.4	37.6	50.1	75.1	112.7	187.8	313.0
200	13.8	36.4	48.5	72.8	109.2	182.1	303.4
250	12.1	34.9	46.6	69.8	104.7	174.6	291.0
300	10.2	33.2	44.2	66.4	99.5	165.9	276.5
325	9.3	32.2	43.0	64.5	96.7	161.2	268.6
350	8.4	31.2	41.7	62.5	93.7	156.2	260.4
375	7.4	30.4	40.5	60.7	91.1	151.8	253.0
400	6.5	29.3	39.1	58.7	88.0	146.7	244.5
425	5.5	25.8	34.4	51.5	77.3	128.8	214.7
450	4.6	21.4	28.5	42.7	64.1	106.8	178.0
475	3.7	14.1	18.8	28.2	42.3	70.5	117.4
500	2.8	10.3	13.7	20.6	30.9	51.5	85.9
538	1.4	5.9	7.9	11.8	17.7	29.5	49.2

Group 2.2 (Stainless Steel)

Table 2-2.2 Pressure-Temperature Ratings for Group 2.2 Materials

Nominal Designation	Forgings		Castings		Plates		
16Cr-12Ni-2Mo	A 182 Gr. F316 (1)	A 182 Gr. F316H	A 351 Gr. CF3M (2)	A 351 Gr. CF8M (1)	A 240 Gr. 316 (1)	A 240 Gr. 316H	
18Cr-13Ni-3Mo	A182 Gr. F317 (1)			A 240 Gr. 317 (1)			
19Cr-10Ni-3Mo	A 351 Gr. C68M (3)						
Working Pressures by Classes, bar							
Class Temp., °C	150	300	400	600	900	1500	2500
-29 to 38	19.0	49.6	66.2	99.3	148.9	248.2	413.7
50	18.4	48.1	64.2	96.2	144.3	240.6	400.9
100	16.2	42.2	56.3	84.4	126.6	211.0	351.6
150	14.8	38.5	51.3	77.0	115.5	192.5	320.8
200	13.7	35.7	47.6	71.3	107.0	178.3	297.2
250	12.1	33.4	44.5	66.8	100.1	166.9	278.1
300	10.2	31.6	42.2	63.2	94.9	158.1	263.5
325	9.3	30.9	41.2	61.8	92.7	154.4	257.4
350	8.4	30.3	40.4	60.7	91.0	151.6	252.7
375	7.4	29.9	39.8	59.8	89.6	149.4	249.0
400	6.5	29.4	39.3	58.9	88.3	147.2	245.3
425	5.5	29.1	38.9	58.3	87.4	145.7	242.9
450	4.6	28.8	38.5	57.7	86.5	144.2	240.4
475	3.7	28.7	38.2	57.3	86.0	143.4	238.9
500	2.8	28.2	37.6	56.5	84.7	140.9	235.0
538	1.4	25.2	33.4	50.0	75.2	125.5	208.9
550	...	25.0	33.3	49.8	74.8	124.9	208.0
575	...	24.0	31.9	47.9	71.8	119.7	199.5
600	...	19.9	26.5	39.8	59.7	99.5	165.9
625	...	15.8	21.1	31.6	47.4	79.1	131.8
650	...	12.7	16.9	25.3	38.0	63.3	105.5
675	...	10.3	13.8	20.6	31.0	51.6	86.0
700	...	8.4	11.2	16.8	25.1	41.9	69.8
725	...	7.0	9.3	14.0	21.0	34.9	58.2
750	...	5.9	7.8	11.7	17.6	29.3	48.9
775	...	4.6	6.2	9.0	13.7	22.8	38.0
800	...	3.5	4.8	7.0	10.5	17.4	29.2
816	...	2.8	3.8	5.9	8.6	14.1	23.8

Types of flanges



Flange Sizes (Except Ring Gaskets)

Table F4 Dimensions of Facings (Other Than Ring Joints, All Pressure Rating Classes)

Nominal Pipe Size	Outside Diameter			Inside Diameter of Large and Small Tongue, U	Inside Diameter of Small Male [Note (1)]	Outside Diameter			Inside Diameter of Large and Small Groove, Y	Raised Face [Notes (2), (3)]	Height		Depth of Groove or Female [Notes (2), (5)]	Minimum Outside Diameter of Raised Portion [Notes (6), (7)]		
	Large Male and Tongue, R	Small Male, S [Note (1)]	Small Tongue, T			Large Female and Groove, W	Small Female, X	Small Groove, Z			Large and Small Tongue [Notes (2), (4)]	Small Male and Tongue [Notes (2), (4)]		Small Groove, K	Large Female and Groove, L	Nominal Pipe Size
1/2	1.38	0.72	1.38	1.00	...	1.44	0.78	1.44	0.94	...	...	...	1.75	1.81	1/2
3/4	1.69	0.94	1.69	1.31	...	1.75	1.00	1.75	1.25	...	...	...	2.06	2.12	3/4
1	2.00	1.19	1.88	1.50	...	2.06	1.25	1.94	1.44	...	...	...	2.25	2.44	1
1 1/4	2.50	1.50	2.25	1.88	...	2.56	1.56	2.31	1.81	...	...	...	2.62	2.94	1 1/4
1 1/2	2.88	1.75	2.50	2.12	...	2.94	1.81	2.56	2.06	...	...	...	2.88	3.31	1 1/2
2	3.62	2.25	3.25	2.88	...	3.69	2.31	3.31	2.81	...	...	...	3.62	4.06	2
2 1/2	4.12	2.69	3.75	3.38	...	4.19	2.75	3.81	3.31	...	...	...	4.12	4.56	2 1/2
3	5.00	3.31	4.62	4.25	...	5.06	3.38	4.69	4.19	...	...	...	5.00	5.44	3
3 1/2	5.50	3.81	5.12	4.75	...	5.56	3.88	5.19	4.69	...	...	...	5.50	5.94	3 1/2
4	6.19	4.31	5.69	5.19	...	6.25	4.38	5.75	5.12	...	...	...	6.19	6.62	4
5	7.31	5.38	6.81	6.31	...	7.38	5.44	6.88	6.25	...	...	...	7.31	7.75	5
6	8.50	6.38	8.00	7.50	...	8.56	6.44	8.06	7.44	...	...	...	8.50	8.94	6
8	10.62	8.38	10.00	9.38	...	10.69	8.44	10.06	9.31	...	...	...	10.62	11.06	8
10	12.75	10.50	12.00	11.25	...	12.81	10.56	12.06	11.19	...	...	...	12.75	13.19	10
12	15.00	12.50	14.25	13.50	...	15.06	12.56	14.31	13.44	...	...	...	15.00	15.44	12
14	16.25	13.75	15.50	14.75	...	16.31	13.81	15.56	14.69	...	...	...	16.25	16.69	14
16	18.50	15.75	17.62	16.75	...	18.56	15.81	17.69	16.69	...	...	...	18.50	18.94	16
18	21.00	17.75	20.12	19.25	...	21.06	17.81	20.19	19.19	...	...	...	21.00	21.44	18
20	23.00	19.75	22.00	21.00	...	23.06	19.81	22.06	20.94	...	...	...	23.00	23.44	20
24	27.25	23.75	26.25	25.25	...	27.31	23.81	26.31	25.19	...	...	...	27.25	27.69	24

GENERAL NOTES:

- (a) Dimensions are in inches.
- (b) For facing requirements for flanges end flanged fittings, see paras. 6.3 and 6.4 and Fig. F7.
- (c) For facing requirements for lapped joints, see para. 6.4.3 and Fig. F7.
- (d) For facing tolerances, see para. 7.3.

NOTES:

- (1) For small male and female joints, care should be taken in the use of these dimensions to insure that the inside diameter of fitting or pipe is small enough to permit sufficient bearing surface to prevent the crushing of the gasket. This applies particularly where the joint is made on the end of the pipe. Inside diameter of fitting should match inside diameter of pipe as specified by purchaser. Threaded companion flanges for small male and female joints are furnished with plain face and are threaded with American National Standard Locknut Thread (NPSL).
- (2) See para. 6.4.3 and Fig. F7 for thickness and outside diameters of laps.
- (3) Height of raised face either 0.06 in. or 0.25 in. See para. 6.4.1.
- (4) Height of large and small male and tongue is 0.25 in.
- (5) Depth of groove or female is 0.19 in.
- (6) Raised portion of full face may be furnished unless otherwise specified on order.
- (7) Large male and female faces and large tongue and groove are not applicable to Class 150 because of potential dimensional conflicts.

Flange Sizes (For Ring Gaskets)

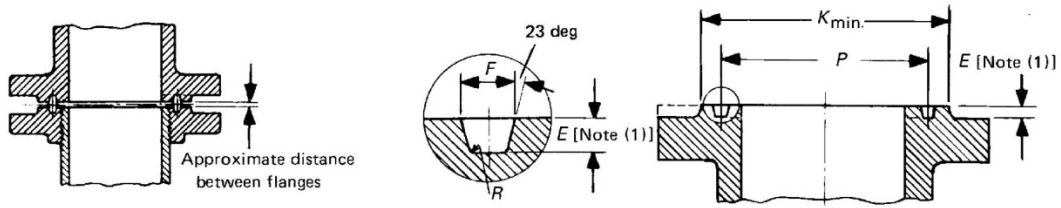


Table F5 Dimensions of Ring-Joint Facings (All Pressure Rating Classes)

Nominal Pipe Size							Groove Dimensions				
1	2	3	4	5	6	7	8	9	10	11	12
Class 150	Class 300	Class 400 [Note (2)]	Class 600	Class 900 [Note (3)]	Class 1500	Class 2500	Groove Number	Pitch Diameter, P	Depth, E [Note (1)]	Width, F	Radius at Bottom, R
...	1/2	...	1/2	...	...	...	R11	1.344	0.219	0.281	0.03
...	...	...	...	...	1/2	...	12	1.562	0.250	0.344	0.03
...	3/4	...	3/4	...	...	1/2	13	1.688	0.250	0.344	0.03
...	...	...	...	...	3/4	...	14	1.750	0.250	0.344	0.03
1	...	...	...	...	...	...	15	1.875	0.250	0.344	0.03
...	1	...	1	...	1	3/4	16	2.000	0.250	0.344	0.03
1 1/4	...	...	...	...	...	...	17	2.250	0.250	0.344	0.03
...	1 1/4	...	1 1/4	...	1 1/4	1	18	2.375	0.250	0.344	0.03
1 1/2	...	...	...	...	...	...	19	2.562	0.250	0.344	0.03
...	1 1/2	...	1 1/2	...	1 1/2	...	20	2.688	0.250	0.344	0.03
...	...	...	...	...	...	1 1/4	21	2.844	0.312	0.469	0.03
2	...	...	...	...	...	...	22	3.250	0.250	0.344	0.03
...	2	...	2	...	...	1 1/2	23	3.250	0.312	0.469	0.03
...	...	...	...	...	2	...	24	3.750	0.312	0.469	0.03
2 1/2	...	...	...	...	...	...	25	4.000	0.250	0.344	0.03
...	2 1/2	...	2 1/2	...	...	2	26	4.000	0.312	0.469	0.03
...	...	...	...	...	2 1/2	...	27	4.250	0.312	0.469	0.03
...	...	...	...	...	...	2 1/2	28	4.375	0.375	0.531	0.06
3	...	...	...	...	...	...	29	4.500	0.250	0.344	0.03
...	(4)	...	(4)	...	...	...	30	4.625	0.312	0.469	0.03
...	3 (4)	...	3 (4)	3	...	...	31	4.875	0.312	0.469	0.03
...	...	...	...	...	...	3	32	5.000	0.375	0.531	0.06
3 1/2	...	...	...	...	...	...	33	5.188	0.250	0.344	0.03
...	3 1/2	...	3 1/2	...	...	...	34	5.188	0.312	0.469	0.03
...	...	...	...	...	3	...	35	5.375	0.312	0.469	0.03
4	...	...	...	...	...	...	36	5.875	0.250	0.344	0.03
...	4	4	4	4	...	...	37	5.875	0.312	0.469	0.03
...	...	...	...	...	...	4	38	6.188	0.438	0.656	0.06
...	...	...	...	...	4	...	39	6.375	0.312	0.469	0.03
5	...	...	...	...	...	...	40	6.750	0.250	0.344	0.03
...	5	5	5	5	...	...	41	7.125	0.312	0.469	0.03
...	...	...	...	...	...	5	42	7.500	0.500	0.781	0.06
6	...	...	...	...	...	...	43	7.625	0.250	0.344	0.03
...	...	...	...	...	5	...	44	7.625	0.312	0.469	0.03
...	6	6	6	6	...	...	45	8.312	0.312	0.469	0.03
...	...	...	...	...	6	...	46	8.312	0.375	0.531	0.06
...	...	...	...	...	...	6	47	9.000	0.500	0.781	0.06
8	...	...	...	...	...	...	48	9.750	0.250	0.344	0.03
...	8	8	8	8	...	...	49	10.625	0.312	0.469	0.03
...	...	...	...	...	8	...	50	10.625	0.438	0.656	0.06

Table F5 Dimensions of Ring-Joint Facings (All Pressure Rating Classes) (Cont'd)



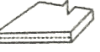
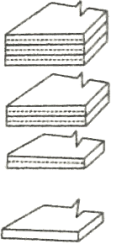
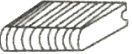


13	14	15	16	17	18	19	20	21	22	23	24		
Diameter of Raised Portion, <i>K</i>					Approximate Distance Between Flanges								
Class	Class	Class	Class	Class	Class	Class	Class	Class	Class	Class	Class		
150	300	400	600	900	1500	2500	150	300	400	600	900	1500	2500
...	2.00	...	...	...	...	...	0.12	...	0.12	...	...	...	...
...	...	...	2.38	...	...	...	...	...	...	...	...	0.16	...
...	2.50	...	...	2.56	...	...	0.16	...	0.16	...	...	...	0.16
...	...	...	2.62	...	...	...	...	...	...	...	...	0.16	...
2.50	...	...	...	...	...	0.16	...	...	...	...	...	...	...
...	2.75	...	2.81	2.88	...	...	0.16	...	0.16	...	0.16	...	0.16
2.88	...	...	...	...	...	0.16	...	...	...	...	...	...	...
...	3.12	...	3.19	3.25	...	...	0.16	...	0.16	...	0.16	...	0.16
3.25	...	...	...	...	...	0.16	...	...	...	...	...	...	...
...	3.56	...	3.62	...	...	...	0.16	...	0.16	...	0.16	...	...
...	...	...	...	4.00	...	...	...	...	...	...	...	...	0.12
4.00	...	...	...	...	...	0.16	...	...	...	...	...	...	...
...	4.25	...	...	4.50	...	...	0.22	...	0.19	...	...	...	0.12
...	...	...	4.88	...	...	...	...	...	...	...	0.12	...	...
4.75	...	...	...	...	...	0.16	...	...	...	...	...	...	...
...	5.00	...	...	5.25	...	...	0.22	...	0.19	...	...	...	0.12
...	...	...	5.38	...	...	...	...	...	...	...	0.12	...	...
...	...	...	...	5.88	...	...	...	...	...	...	...	...	0.12
5.25	...	...	...	...	...	0.16	...	...	...	...	...	...	...
...
...	5.75	6.12	...	...	...	...	0.22	...	0.19	0.16	...	...	...
...	...	...	...	6.62	...	...	...	...	...	...	...	...	0.12
6.06	...	...	...	...	...	0.16	...	...	...	...	...	...	...
...	6.25	...	...	...	...	...	0.22	...	0.19	...	...	...	...
...	...	...	6.62	...	...	...	...	...	...	...	0.12	...	...
6.75	...	...	...	...	...	0.16	...	...	...	...	...	...	...
...	6.88	7.12	...	...	...	...	0.22	0.22	0.19	0.16	...	...	...
...	...	...	...	8.00	...	...	...	...	...	...	...	...	0.16
...	...	...	7.62	...	...	...	...	...	...	...	0.12	...	...
7.62	...	...	...	...	...	0.16	...	...	...	...	...	...	...
...	8.25	8.50	...	...	...	...	0.22	0.22	0.19	0.16	...	...	...
...	...	...	...	9.50	...	...	...	...	...	...	...	...	0.16
8.62	...	...	...	...	...	0.16	...	...	...	...	...	...	...
...	...	...	9.00	...	...	...	...	...	...	...	0.12	...	...
...	9.50	9.50	...	...	...	...	0.22	0.22	0.19	0.16	...	...	...
...	...	...	9.75	...	...	...	...	...	...	...	0.12	...	...
...	...	...	...	11.00	...	...	...	...	...	...	...	...	0.16
10.75	...	...	...	...	...	0.16	...	...	...	...	...	...	...
...	11.88	12.12	...	...	...	...	0.22	0.22	0.19	0.16	...	...	...
...	...	...	12.50	...	...	...	...	...	...	...	0.16	...	...

ASME B31.3-2011, Table F5.1, Dimensions of Ring-Joint Facings (All Pressure Rating Classes) (Cont'd)

Table F5 Dimensions of Ring-Joint Facings (All Pressure Rating Classes) (Cont'd)

1	2	3	4	5	6	7	8	9	10	11	12	
Nominal Pipe Size							Groove Dimensions					
Class 150	Class 300	Class 400 [Note (2)]	Class 600	Class 900 [Note (3)]	Class 1500	Class 2500	Groove Number	Pitch Diameter <i>P</i>	Depth, <i>E</i> [Note (1)]	Width <i>F</i>	Radius at Bottom <i>R</i>	
...	8	51	11.000	0.562	0.906	0.06
10	...	...	...	...	...	...	52	12.000	0.250	0.344	0.03
...	10	10	10	10	...	...	53	12.750	0.312	0.469	0.03
...	...	...	...	...	10	...	54	12.750	0.438	0.656	0.06
...	...	...	...	...	...	10	55	13.500	0.688	1.188	0.09
12	...	...	...	...	...	...	56	15.000	0.250	0.344	0.03
...	12	12	12	12	...	...	57	15.000	0.312	0.469	0.03
...	...	...	...	...	12	...	58	15.000	0.562	0.906	0.06
14	...	...	...	...	...	...	59	15.625	0.250	0.344	0.03
...	...	...	...	...	...	12	60	16.000	0.688	1.312	0.09
...	14	14	14	...	...	...	61	16.500	0.312	0.469	0.03
...	...	...	...	14	...	...	62	16.500	0.438	0.656	0.06
...	...	...	...	...	14	...	63	16.500	0.625	1.062	0.09
16	...	...	...	...	...	...	64	17.875	0.250	0.344	0.03
...	16	16	16	...	...	...	65	18.500	0.312	0.469	0.03
...	...	...	...	16	...	...	66	18.500	0.438	0.656	0.06
...	...	...	...	...	16	...	67	18.500	0.688	1.188	0.09
18	...	...	...	...	...	...	68	20.375	0.250	0.344	0.03
...	18	18	18	...	...	...	69	21.000	0.312	0.469	0.03
...	...	...	...	18	...	...	70	21.000	0.500	0.781	0.06
...	...	...	...	...	18	...	71	21.000	0.688	1.188	0.09
20	...	...	...	...	...	...	72	22.000	0.250	0.344	0.03
...	20	20	20	...	...	...	73	23.000	0.375	0.531	0.06
...	...	...	...	20	...	...	74	23.000	0.500	0.781	0.06
...	...	...	...	...	20	...	75	23.000	0.688	1.312	0.09
24	...	...	...	...	...	...	76	26.500	0.250	0.344	0.03
...	24	24	24	...	...	...	77	27.250	0.438	0.656	0.06
...	...	...	...	24	...	...	78	27.250	0.625	1.062	0.09
...	...	...	...	...	24	...	79	27.250	0.812	1.438	0.09

Table 5.3 Gaskets Types and Materials

Sketch	Dimension N (min) mm	Gasket Material	Gasket Factor	Minimum Design Seating Stress N/mm ²	Refer to Table 6.8	
					Use Facing Sketch	Use Column
	10	Rubber without fabric or a high percentage of asbestos fibre: Below 70 IR HD 70 IR HD or higher	0.50 1.00	0 1.4	1 (a, b, c, d) 4, 5	II
		Asbestos with 3.2 mm thick a suitable binder for the operating conditions 1.6 mm thick 0.8 mm thick	2.00 2.75 3.50	11.2 26 45.7		
		Rubber with cotton fabric insertion	1.25	2.8		
		Rubber with asbestos fabric insertion, with or without wire reinforcement	2.25 2.50 2.75	15.5 20.4 26	1 (a, b, c, d)	
		Spiral-wound metal, asbestos filled	2.50 3.00	20.4 31.6		
		Corrugated metal, asbestos inserted or Corrugated metal, jacketed asbestos filled	2.50 2.75 3.00 3.25 3.50	20.4 26 31.6 38.7 45.7	1 (a, b)	II
		Corrugated metal	2.75 3.00 3.25 3.50 3.75	26 31 38.7 45.7 53.4	1 (a, b, c, d)	

(Continued)






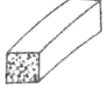
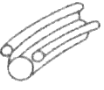
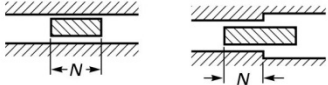
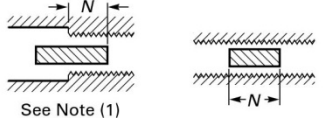
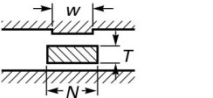
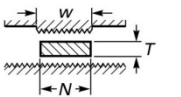
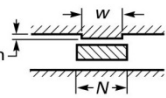
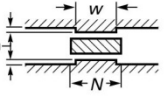
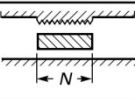
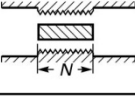
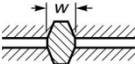
Sketch	Dimension N (min) mm	Gasket Material	Gasket Factor	Minimum Design Seating Stress N/mm ²	Refer to Table 6.8	
					Use Facing Sketch	Use Column
		Flat metal jacketed asbestos filled	Soft aluminium 3.25 Soft copper or brass 3.50 Iron or soft steel 3.75 Monel metal or 4-6% chrome steel 3.50	38.7 45.7 53.4 56.2	1a, 1b, 1c, 1d, 2	
		Grooved metal	Stainless steel 3.75 Soft aluminium 3.25 Soft copper or brass 3.50 Iron or soft steel 3.75 Monel metal or 4-6% chrome steel 3.75	63.3 38.7 45.7 53.4 63.3	1 (a, b, c, d) 2, 3	II
	6	Solid flat metal	Stainless steel 4.25 Soft aluminium 4.00 Soft copper or brass 4.75 Iron or soft steel 5.50 Monel metal or 4-6% chrome steel 6.00	71 61.9 91.4 126.6 153.3	1 (a, b, c, d) 2, 3, 4, 5	I
		Ring joint	Stainless steel 6.50 Iron or soft steel 5.50 Monel metal or 4-6% chrome steel 6.00 Stainless steel 6.50	182.8 126.6 153.3 182.8	6	
		Rubber o-rings Below 75 IRHD Between 75 and 85 IRHD	3 6	0.0 1.5	7 only	
		Rubber square section rings; Below 75 IRHD Between 75 and 85 IRHD	4 9	1.0 2.8	8 only	II
		Rubber T-section rings: Below 75 IRHD Between 75 and 85 IRHD	4 9	1.0 2.8	9 only	

TABLE 2-5.2
EFFECTIVE GASKET WIDTH

Facing Sketch (Exaggerated)	Basic Gasket Seating Width b_o	
	Column I	Column II
(1a) 	$\frac{N}{2}$	$\frac{N}{2}$
(1b)  See Note (1)		
(1c)  $w \leq N$	$\frac{w+T}{2}; \left(\frac{w+N}{4} \text{ max}\right)$	$\frac{w+T}{2}; \left(\frac{w+N}{4} \text{ max}\right)$
(1d)  See Note (1) $w \leq N$		
(2)  $\frac{1}{64}$ in. (0.4 mm) nubbin $w \leq N/2$	$\frac{w+N}{4}$	$\frac{w+3N}{8}$
(3)  $\frac{1}{64}$ in. (0.4 mm) nubbin $w \leq N/2$	$\frac{N}{4}$	$\frac{3N}{8}$
(4)  See Note (1)	$\frac{3N}{8}$	$\frac{7N}{16}$
(5)  See Note (1)	$\frac{N}{4}$	$\frac{3N}{8}$
(6) 	$\frac{w}{8}$	...

Nominal Diameter × Pitch		
5 × 0.8	27 × 3	64 × 4
6 × 1	30 × 3	72 × 6
8 × 1	33 × 3	80 × 6
10 × 1.5	36 × 3	90 × 6
12 × 1.5	39 × 3	100 × 6
14 × 1.5	42 × 3	110 × 6
16 × 2	45 × 3	125 × 6
18 × 2	48 × 4	140 × 6
20 × 2	52 × 4	160 × 6
22 × 2	56 × 4	180 × 6
24 × 2	60 × 4	200 × 6

Table 2.4 : ISO Metric Bolt Sizes