

Large-Diameter Carbon Steel Flanges

**(Nominal Pipe Sizes 26 Through 60;
Classes 75, 150, 300, 400, 600, and 900)**

Refining Department

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INTRODUCTION

This standard is a purchase specification for the procurement of carbon steel flanges, NPS 26 through 60. It establishes an economical series of standard flanges in six nominal classes for use with pipe, fittings, valves, and as pressure vessel shell flanges and nozzle flanges.

Flange dimensions are verified for bolt, gasket, and hydrostatic pressure loadings in accordance with the rules in Appendix II of the ASME *Boiler and Pressure Vessel Code*, Section VIII, Division 1, Pressure Vessels (referred to throughout as the "ASME Code"). Gaskets used in this analysis are in accordance with API Standard 601 and ANSI B16.21. Allowable stresses for design analysis are from the ASME Code and ANSI B31.3, *Chemical Plant and Petroleum Refinery Piping*. An allowable stress of 25 kips per square inch (172 megapascals) was used for the ASTM A 694 material in Tables 1-B and A-2 based upon MSS SP-44.

The pressure-temperature ratings established by the above-described design analysis are those of ANSI B16.5 (1977) for Classes 150, 300, 400, 600, and 900. The ratings for Class 75 are one-half of those for Class 150, with a maximum temperature limit of 650 F (344 C).

The pressure-temperature ratings for Classes 300, 400, 600, and 900 flanges mating with high-strength line pipe comply with ANSI B31.4 and B31.8. Flange dimensions for Classes 400, 600, and 900, NPS 38 and larger, are identical with those in MSS SP-44. Flanges NPS 26 through 36 are designed with the same philosophy as used for flanges NPS 38 and larger.

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NOTES TO PURCHASER

1. In addition to referencing API Standard 605, purchase orders for welding neck flanges or flanged piping components shall specify the following, where applicable:
 - a. Flange size (Tables 2 through 7).
 - b. Nominal class (Tables 1-A and 1-B) for plant piping and pipe line flanges.
 - c. Bore diameter for welding neck flanges (Tables 2 through 7).
 - d. For a valve, fitting, or nozzle neck, include the requirements for the component as well as for the flange.
 - e. Grade of high-yield-strength mating pipe, where applicable.
2. For gasket-bolting combinations other than those specified in this standard, the purchaser must verify that allowable stresses are not exceeded.
3. The need for impact testing should be considered.

Large-Diameter Carbon Steel Flanges

(Nominal Pipe Sizes 26 Through 60; Classes 75, 150, 300, 400, 600, and 900)

SECTION 1 — GENERAL

1.1 Scope

This standard covers raised-face carbon steel welding neck flanges in NPS 26 through 60 with pressure ratings of Classes 75, 150, 300, 400, and 600 and in NPS 26 through 48 with a pressure rating of Class 900. It also covers integral flanges for Classes 75, 150, and 300, cast or forged as the integral ends of flanged valves, fittings, or nozzle necks.

1.2 Size

The nominal size of the flange corresponds to the nominal pipe size of the pipe with which the flange is intended to be used. Flange sizes included vary by 2-inch increments from NPS 26 through 60 for Classes 75 through 600 and from NPS 26 through 48 for Class 900.

1.3 Details

Flange details covered by this standard include:

1. Dimensions (including facing and welding end)
2. Tolerances
3. Materials
4. Pressure-temperature ratings
5. Bolting and gaskets
6. Marking

1.4 Referenced Publications

The latest edition or revision of the following standards and specifications shall, to the extent specified, form a part of this standard:

ANSI¹

- B16.5 (1977) *Steel Pipe Flanges and Flanged Fittings*
B16.21 *Nonmetallic Gaskets for Pipe Flanges*

B16.25 *Butt Welding Ends*

B31.3 *Chemical Plant and Petroleum Refinery Piping*

B31.4 *Liquid Petroleum Transportation Piping Systems*

B31.8 *Gas Transmission and Distribution Piping Systems*

API

6D² *Specification for Pipeline Valves*

601 *Metallic Gaskets for Piping, Double-Jacketed Corrugated and Spiral Wound*

ASME³

Boiler and Pressure Vessel Code: Section VIII, Division 1, Pressure Vessels

ASTM⁴

A 105 *Forgings, Carbon Steel, for Piping Components*

A 193 *Alloy Steel and Stainless Steel Bolting Materials for High-Temperature Service*

A 194 *Carbon and Alloy Steel Nuts for Bolts for High-Pressure and High-Temperature Service*

A 216 *Carbon Steel Castings Suitable for Fusion Welding for High-Temperature Service*

A 694 *Forgings, Carbon and Alloy Steel, for Pipe Flanges, Fittings, Valves and Parts for High-Pressure Transmission Service*

MSS⁵

SP-9 *Spot Facing for Bronze, Iron and Steel Flanges*

SP-44 *Steel Pipe Line Flanges*

¹ American National Standards Institute, Inc., 1430 Broadway, New York, N.Y. 10018.

² American Petroleum Institute, Production Department, 211 N. Ervay, Suite 1700, Dallas, Tx. 75201.

³ American Society of Mechanical Engineers, 345 East 47th Street, New York, N.Y. 10017.

⁴ American Society for Testing and Materials, 1916 Race Street, Philadelphia, Pa. 19103.

⁵ Manufacturers Standardization Society of the Valve and Fittings Industry, 1815 N. Fort Meyer Drive, Arlington, Va. 22209.

SECTION 2 — DIMENSIONS

2.1 General

Flange dimensions shall conform with Tables 2 through 7 and B-1 through B-6.

Flange dimensions may require adjustment for flange material with yield strength in the welding section differing from that of the mating pipe.

The maximum inside diameters are calculated for full pressure rating at 100 F (38 C) using gaskets as specified in 6.2. These inside diameters can be increased when using flanges with lower pressures or adjusted gasket dimensions. Flange and bolt stresses should be verified by calculation considering both gasket seating stresses and operating stresses.

2.2 Excess Thickness and Back Facing or Spot Facing

The flange shall be either back faced or spot faced at the bolt holes on the flange back if: (1) the nut-bearing surface at the back of the flange is not parallel with the flange face within the tolerances listed in 3.1, (2) the fillet at the hub interferes with the nut-bearing surface, or (3) the flange thickness exceeds the minimum required thickness (Tables 2 through 7, C dimensions) by more than 0.19 inch (4.8 millimeters). The nut-bearing surface is the spot-facing diameter at the bolt holes as given in MSS SP-9. Spot facing shall be in accordance with MSS SP-9.

2.3 Bolt Holes

Bolt holes shall be drilled perpendicular to the flange face and shall be equally spaced. Bolt holes in an integral

flange of a flanged valve or fitting shall straddle the centerline.

2.4 Facing Finish

The flange facing finish shall be in accordance with ANSI B16.5 (1977) and the following additional requirements:

1. For Class 300 and smaller, the gasket surface shall have a roughness in the range of 125-500 microinches AARH.
2. For Class 400 and larger, the gasket surface finish shall have a roughness in the range of 125-250 microinches AARH.

2.5 Welding End

1. The welding end of a welding neck flange shall conform with ANSI B16.25.
2. When the specified minimum yield strength of the hub portion of any flange is less than that of the pipe to be matched, the minimum thickness of the hub at the welding end shall be such that the product of its thickness times its yield strength (at welding end) is at least equal to the product of the specified nominal wall thickness and the specified minimum yield strength of the pipe.
3. When the hub thickness at the welding end is greater than that of the mating pipe, the joint design shall be in accordance with ANSI B16.5 (1977), Figures 12, 13, or 14.

SECTION 3 — TOLERANCES

3.1 General

Tolerances shall be as follows:

Dimension	Tolerance	
	(inches)	(millimeters)
OD of raised face, <i>R</i>	± 0.03	± 0.8
Flange thickness, <i>C</i>	+ 0.19,* - 0	+ 4.8,* - 0
Hub length, overall, <i>Y</i>	± 0.12	± 3.2
OD of hub, <i>A</i>	+ 0.16, - 0.03	+ 4.0, - 0.8
Bolt circle diameter	± 0.06	± 1.6
Center-to-center of adjacent bolt holes	± 0.03	± 0.8
ID, welding neck flange, <i>B</i>	+ 0.12, - 0.06	+ 3.2, - 1.6
Parallelism, back-to-face of flange	a	

* Flanges shall have bearing surfaces for bolting that are parallel to the flange face within 1 degree. Any back facing or spot facing required to

accomplish parallelism between the flange face and nut-bearing surface on the back of the flange shall not reduce the flange thickness, *C*, below the dimension given in Tables 2 through 7.

3.2 Welding End

Tolerances for the welding end of a welding neck flange shall conform to the specifications in ANSI B16.25.

SECTION 4 — MATERIALS

4.1 Welding Neck Flanges

4.1.1 Welding neck flanges for Classes 75 through 600 with design stresses conforming to the ASME Code and for Classes 75 through 900 with design stresses conforming to ANSI B31.3 shall be carbon steel ASTM A105, normalized or quenched and tempered.

4.1.2 The hub thickness of the welding ends of Classes 75, 150, and 300 welding neck flanges will mate to pipe having a specified minimum yield strength of 52 kips per square inch (359 megapascals) with a 0.72 design factor.

4.1.3 Class 300 welding neck flanges mating with pipe having a specified minimum yield strength greater than 52 kips per square inch (359 megapascals) and Classes 400 through 900 mating with pipe having a specified minimum yield strength of 36 kips per square inch (248 megapascals) shall be ASTM A694, with flanges having a

specified minimum yield strength of 42 kips per square inch (290 megapascals) in the ring section and a minimum yield strength at the welding end at least equal to that specified for the mating pipe. When the yield strength of the welding end is less than that specified for the mating pipe, compensation in accordance with 2.5 shall be made.

4.1.4 When the specified minimum yield strengths of the sections to be joined are unequal, the deposited weld metal joining the two sections shall have mechanical properties at least equal to those of the section having the higher strength.

4.2 Integral Flanges

Flanges integral with nozzle necks, valve bodies, or fittings shall be cast carbon steel ASTM A216 Grade WCB or forged carbon steel ASTM A105.

SECTION 5 — PRESSURE-TEMPERATURE RATINGS

5.1 General

Flanges covered by this standard shall be designated as one of the following: Class 75, 150, 300, 400, 600, or 900. Ratings are the maximum allowable nonshock working pressures, expressed as gage pressure, at the temperature shown, for the applicable material. Ratings in Tables 1-A and 1-B are in U.S. customary units. Tables in Appendix A list ratings in metric units. For immediate temperatures, linear interpolation is permitted.

5.2 Bolting and Gasket Required

The ratings in this standard are based on the use of the bolting and gaskets described in 6.1 and 6.2. If other types of bolting, gasket material, or other dimensions are used, the user is responsible for such selections with respect to their suitability with the flange for the specific service conditions and for the ability of the gasket to withstand the required bolt load without injurious crushing.

(Tables and text continue on next page.)

Table 1-A — Pressure-Temperature Ratings for Plant Piping and Pressure Vessel Flanges^a

Metal Temperature (degrees Fahrenheit)	Pressure ^b (pounds per square inch gage)					
	Class					
	75	150	300	400	600	900
100	140	285	740	990	1480	2220
200	130	260	675	900	1350	2025
300	115	230	655	875	1315	1970
400	100	200	635	845	1270	1900
500	85	170	600	800	1200	1795
600	70	140	550	730	1095	1640
650	60	125	535	715	1075	1610
700	—	110	535	710	1065	1600
750	—	95	505	670	1010	1510
800	—	80	410	550	825	1235
850	—	65	270	355	535	805
900	—	50	170	230	345	515
950	—	35	105	140	205	310
1000 ^c	—	20	50	70	105	155

^a Based on the pressure-temperature ratings in ANSI B16.5 (1977), for use with flanges designed in accordance with the ASME Code or ANSI B31.3.

^b Pressure-temperature ratings are based on material specifications ASTM A105 and A216 Grade WCB. Limitations on the use of these materials shall be in accordance with the applicable code.

^c Maximum service temperature for Classes 150 through 900.

Table 1-B — Pressure-Temperature Ratings for Pipe Line Flanges^a

Metal Temperature (degrees Fahrenheit)	Pressure (pounds per square inch gage)			
	Class			
	300	400	600	900
100	740	990	1480	2220
250	740	990	1480	2220
300	715	955	1430	2145
350	690	925	1380	2070
400	665	890	1330	2000
450	640	860	1285	1925

^a Pressure-temperature ratings meet the requirements set forth in ANSI B31.4 and B31.8

SECTION 6 — BOLTING AND GASKETS

6.1 Bolting

6.1.1 High-Strength Bolting

Bolting materials having allowable stresses equal to or greater than those for ASTM A193 Grade B7 and ASTM A194 Grade 2 or 2H are considered high strength. These and other materials of comparable strength may be used in any flanged joint.

6.1.2 Intermediate-Strength Bolting

ASTM A193 Grade B7M and ASTM A194 Grade 2M may be used in any flanged joint.

6.1.3 Low-Strength Bolting

Bolting materials having a minimum yield strength equal to or less than 30 kips per square inch (207 megapascals) shall be used only with gaskets described in 6.2.3. Flanged joints with low-strength carbon steel bolts

shall not be used above 400 degrees Fahrenheit (205 degrees Celsius) or below -20 degrees Fahrenheit (-29 degrees Celsius).

6.2 Gaskets

6.2.1 Nonmetallic gaskets shall conform to the dimensions specified in ANSI B16.21.

6.2.2 Metallic gaskets shall conform to API Standard 601, except that double-jacketed, corrugated, stainless steel gaskets may be used for Classes 150 and 300.

6.2.3 Gaskets for low-strength bolting shall be Group Ia [ANSI B16.5 (1977), Figure E1] with gasket factor, m equals 2 or less, and minimum design seating stress, y equals 1700 pounds per square inch (11.7 megapascals) or less.

6.2.4 Gasket material for flanges of Class 75 is limited to compressed asbestos in a flat-ring shape.

SECTION 7 — MARKING

7.1 Welding Neck Flange

Flanges shall be legibly and permanently marked on the flange periphery as follows:

Mark	Example
Manufacturer's name or trademark	AB Co.
Material, ASTM specification	A105
API standard and class	API 605-150
Flange size, nominal	54
Hub material/pipe material, where applicable ^a	F42/X60

^a For pipe line flanges designed in accordance with 2.5, in addition to the markings required above, the grade of the material in the welding end of the hub shall be shown. (Example: ASTM A694 F42/X60.)

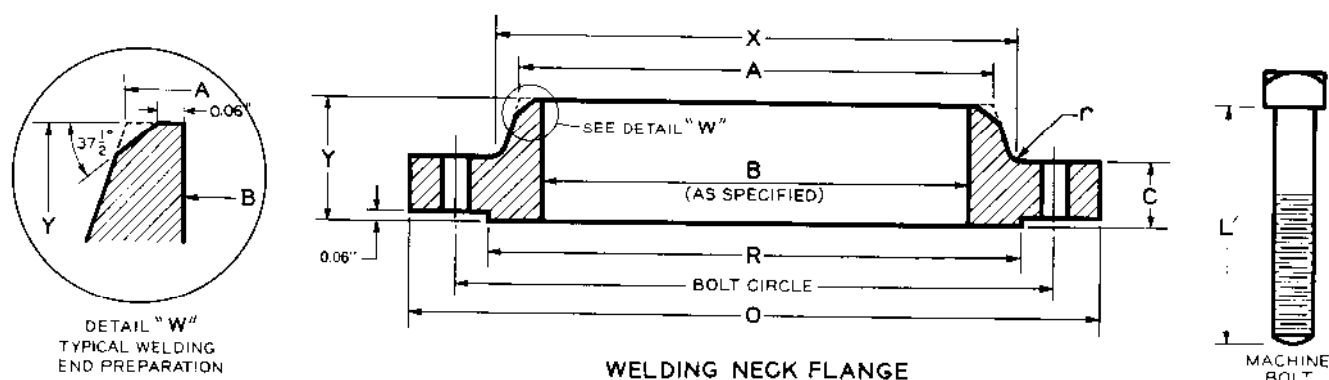
7.2 Valves and Fittings

For valves and fittings with integral end-flanges, the marking requirements specified in 7.1 for welding neck flanges shall appear on the body of the valve or fitting.

7.3 Marking Method

Marks shall be applied by integral casting, forging, or by steel stamping.

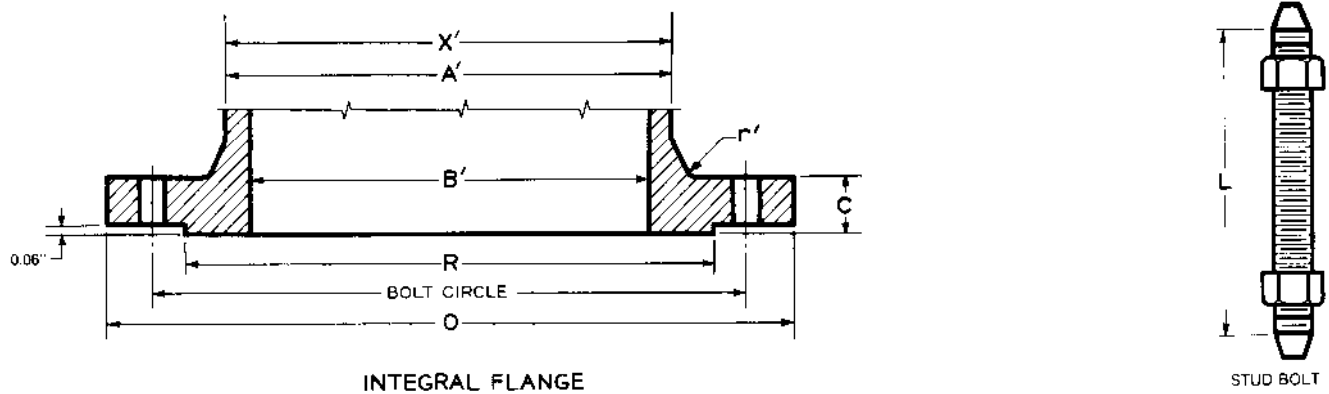
Table 2 — Dimensions for Class 75 Welding Neck and Integral Flanges (inches)



Welding Neck and Integral Flanges

NPS	Flange OD	Flange Thickness	Raised- Face Diameter	Drilling				Bolt Length	
				Bolt- Circle Diameter	Number of Bolts	Bolt Diameter	Bolt- Hole Diameter	Machine Bolt	Stud Bolt
	O	C	R					L'	L
26	30.00	1.31	27.75	28.50	36	5/8	0.75	4.00	4.50
28	32.00	1.31	29.75	30.50	40	5/8	0.75	4.00	4.50
30	34.00	1.31	31.75	32.50	44	5/8	0.75	4.00	4.50
32	36.00	1.38	33.75	34.50	48	5/8	0.75	4.25	4.75
34	38.00	1.38	35.75	36.50	52	5/8	0.75	4.25	4.75
36	40.69	1.44	38.00	39.06	40	3/4	0.88	4.50	5.00
38	42.69	1.50	40.00	41.06	40	3/4	0.88	4.50	5.25
40	44.69	1.50	42.00	43.06	44	3/4	0.88	4.50	5.25
42	46.69	1.56	44.00	45.06	48	3/4	0.88	4.75	5.25
44	49.25	1.69	46.25	47.38	36	7/8	1.00	5.25	5.75
46	51.25	1.75	48.25	49.38	40	7/8	1.00	5.25	6.00
48	53.25	1.81	50.25	51.38	44	7/8	1.00	5.50	6.00
50	55.25	1.88	52.25	53.38	44	7/8	1.00	5.50	6.25
52	57.38	1.88	54.25	55.50	48	7/8	1.00	5.75	6.25
54	59.38	1.94	56.25	57.50	48	7/8	1.00	5.75	6.25
56	62.00	2.00	58.50	59.88	40	1	1.12	6.00	6.75
58	64.00	2.06	60.50	61.88	44	1	1.12	6.00	6.75
60	66.00	2.19	62.50	63.88	44	1	1.12	6.25	7.00

Table 2 (Continued) — Dimensions for Class 75 Welding Neck and Integral Flanges (inches)



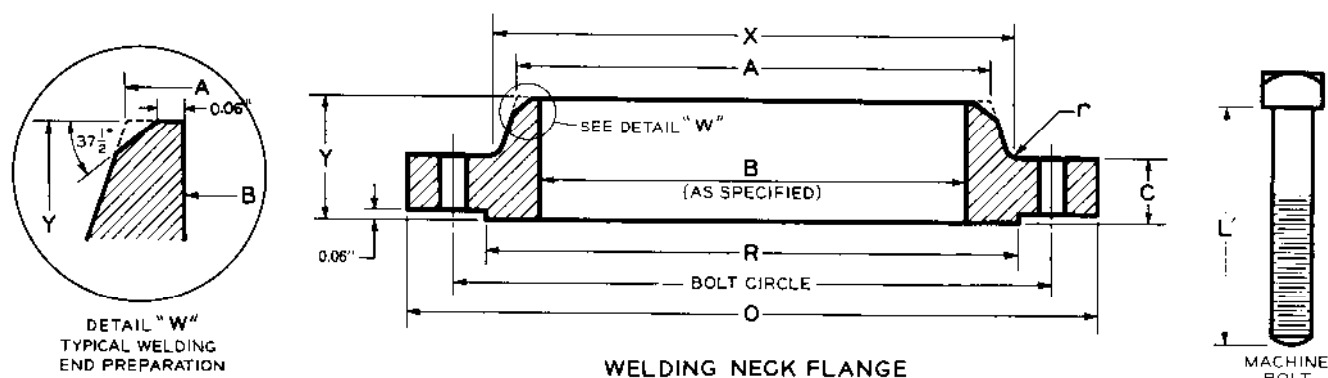
Welding Neck Flanges						Integral Flanges ^a				
Diameter at Large End of Hub	Diameter at Small End of Hub	Overall Length	Fillet Radius	Maximum ID ^b		Diameter at Large End of Neck	Diameter at Small End of Neck	ID	Fillet Radius	NPS
<i>X</i>	<i>A</i>	<i>y</i>	<i>r</i>	ASME Code	ANSI B31.3	<i>X'</i>	<i>A'</i>	<i>B'</i> ^c	<i>r'</i>	
26.62	26.06	2.31	0.31	25.50	25.50	26.62	26.62	25.38	0.38	26
28.62	28.06	2.44	0.31	27.50	27.50	28.62	28.62	27.38	0.38	28
30.62	30.06	2.56	0.31	29.50	29.50	30.62	30.62	29.38	0.38	30
32.62	32.06	2.75	0.31	31.50	31.50	32.62	32.62	31.31	0.38	32
34.62	34.06	2.88	0.31	33.50	33.50	34.62	34.62	33.25	0.50	34
36.81	36.06	3.38	0.38	35.50	35.50	36.81	36.81	35.25	0.50	36
38.81	38.06	3.50	0.38	37.50	37.50	38.81	38.81	37.25	0.50	38
40.81	40.06	3.62	0.38	39.50	39.50	40.81	40.81	39.19	0.50	40
42.81	42.06	3.75	0.38	41.50	41.50	42.81	42.81	41.19	0.50	42
44.88	44.06	4.12	0.38	43.50	43.50	44.88	44.88	43.12	0.50	44
46.88	46.06	4.25	0.38	45.50	45.50	46.88	46.88	45.12	0.50	46
48.88	48.06	4.38	0.38	47.50	47.50	48.88	48.88	47.06	0.50	48
50.94	50.06	4.56	0.38	49.50	49.50	50.88	50.88	49.06	0.50	50
52.94	52.06	4.75	0.38	51.50	51.50	53.00	53.00	51.06	0.50	52
55.00	54.06	4.94	0.38	53.50	53.50	55.00	55.00	53.06	0.62	54
57.12	56.06	5.31	0.44	55.50	55.50	57.12	57.12	55.00	0.62	56
59.12	58.06	5.44	0.44	57.50	57.50	59.12	59.12	57.00	0.62	58
61.12	60.06	5.69	0.44	59.50	59.50	61.12	61.12	59.00	0.62	60

^a Valves NPS 26 and larger probably will be of weld-end type. Should an integrally cast flanged valve be required, the ID must be reduced to provide for taper on hub or any casting variation allowance.

^b Dimension *B* (ID) shall be specified by the purchaser (see 2.1). The maximum ID includes the manufacturing tolerance allowed in 3.1.

^c ID (*B'*) is tabulated for ANSI B31.3, *Chemical Plant and Petroleum Refinery Piping*.

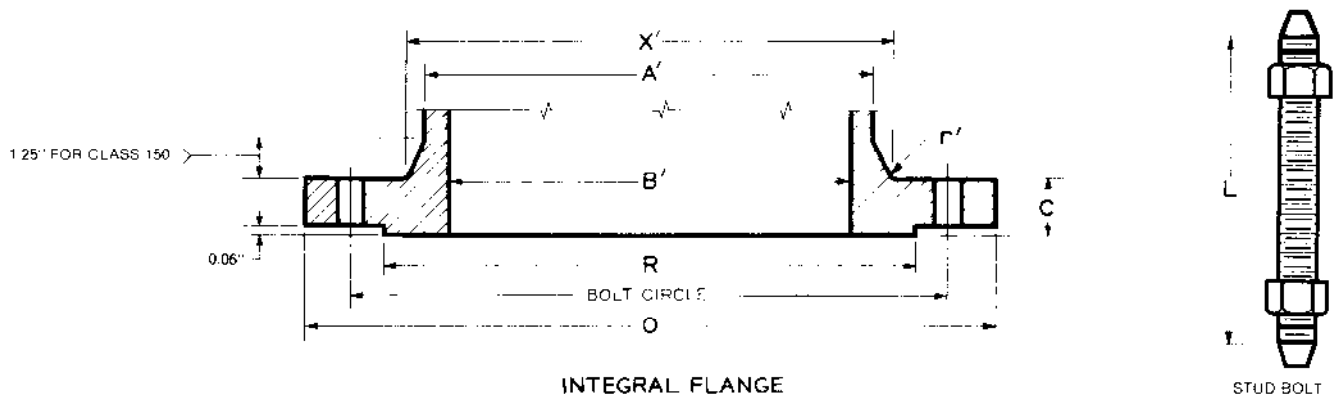
Table 3 — Dimensions for Class 150 Welding Neck and Integral Flanges (inches)



Welding Neck and Integral Flanges

NPS	Flange OD	Flange Thickness	Raised-Face Diameter	Drilling				Bolt Length	
				Bolt-Circle Diameter	Number of Bolts	Bolt Diameter	Bolt Hole Diameter	Machine Bolt	Stud Bolt
	<i>O</i>	<i>C</i>	<i>R</i>					<i>L'</i>	<i>L</i>
26	30.94	1.62	28.00	29.31	36	3/4	0.88	4.75	5.50
28	32.94	1.75	30.00	31.31	40	3/4	0.88	5.00	5.75
30	34.94	1.75	32.00	33.31	44	3/4	0.88	5.00	5.75
32	37.06	1.81	34.00	35.44	48	3/4	0.88	5.25	5.75
34	39.56	1.94	36.25	37.69	40	7/8	1.00	5.75	6.25
36	41.62	2.06	38.25	39.75	44	7/8	1.00	6.00	6.50
38	44.25	2.12	40.25	42.12	40	1	1.12	6.25	7.00
40	46.25	2.19	42.50	44.12	44	1	1.12	6.50	7.00
42	48.25	2.31	44.50	46.12	48	1	1.12	6.50	7.25
44	50.25	2.38	46.50	48.12	52	1	1.12	6.75	7.50
46	52.81	2.44	48.62	50.56	40	1 1/8	1.25	7.00	8.00
48	54.81	2.56	50.75	52.56	44	1 1/8	1.25	7.25	8.00
50	56.81	2.69	52.75	54.56	48	1 1/8	1.25	7.50	8.25
52	58.81	2.75	54.75	56.56	52	1 1/8	1.25	7.75	8.50
54	61.00	2.81	56.75	58.75	56	1 1/8	1.25	7.75	8.50
56	63.00	2.88	58.75	60.75	60	1 1/8	1.25	8.00	8.75
58	65.94	2.94	60.75	63.44	48	1 1/4	1.38	8.25	9.00
60	67.94	3.00	63.00	65.44	52	1 1/4	1.38	8.25	9.25

Table 3 (Continued) — Dimensions for Class 150 Welding Neck and Integral Flanges (inches)



INTEGRAL FLANGE

STUD BOLT

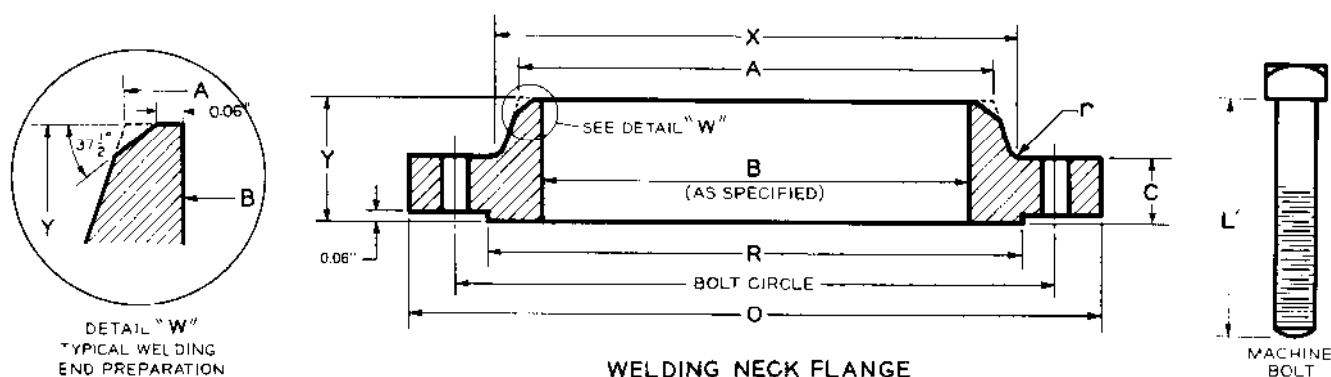
Welding Neck Flanges						Integral Flanges ^a				
Diameter at Large End of Hub	Diameter at Small End of Hub	Overall Length	Fillet Radius	Maximum ID ^b		Diameter at Large End of Neck	Diameter at Small End of Neck	ID	Fillet Radius	NPS
<i>X</i>	<i>A</i>	<i>y</i>	<i>r</i>	ASME Code	ANSI B31.3	<i>X'</i>	<i>A'</i>	<i>B'</i> ^c	<i>r'</i>	
26.94	26.06	3.50	0.38	25.44	25.50	27.06	26.62	25.31	0.50	26
28.94	28.06	3.75	0.38	27.44	27.50	29.06	28.62	27.19	0.50	28
31.00	30.06	3.94	0.38	29.44	29.50	31.06	30.62	29.12	0.50	30
33.06	32.06	4.25	0.38	31.44	31.50	33.19	32.75	31.19	0.50	32
35.12	34.06	4.34	0.38	33.38	33.50	35.19	34.75	33.06	0.50	34
37.19	36.06	4.62	0.38	35.38	35.50	37.25	36.81	35.06	0.50	36
39.25	38.12	4.88	0.38	37.38	37.50	39.38	38.94	37.00	0.50	38
41.31	40.12	5.06	0.38	39.31	39.50	41.38	40.94	38.94	0.50	40
43.38	42.12	5.25	0.44	41.31	41.50	43.38	42.94	40.88	0.62	42
45.38	44.12	5.38	0.44	43.25	43.50	45.38	44.94	42.88	0.62	44
47.44	46.12	5.69	0.44	45.19	45.50	47.56	47.12	44.81	0.62	46
49.50	48.12	5.88	0.44	47.19	47.44	49.56	49.12	46.75	0.62	48
51.50	50.12	6.06	0.44	49.12	49.44	51.56	51.12	48.75	0.62	50
53.56	52.12	6.19	0.44	51.12	51.44	53.56	53.12	50.75	0.62	52
55.62	54.12	6.38	0.44	53.06	53.31	55.75	55.31	52.75	0.62	54
57.69	56.12	6.56	0.56	55.06	55.38	57.75	57.31	54.75	0.75	56
59.69	58.12	6.88	0.56	57.06	57.38	59.94	59.50	56.62	0.75	58
61.81	60.12	7.06	0.56	59.00	59.25	61.94	61.50	58.50	0.75	60

^a Valves NPS 26 and larger probably will be of weld-end type. Should an integrally cast flanged valve be required, the ID must be reduced to provide for taper on hub or any casting variation allowance.

^b Dimension *B* (ID) shall be specified by the purchaser (see 2.1). The maximum ID includes the manufacturing tolerance allowed in 3.1.

^c ID (*B'*) is tabulated for ANSI B31.3, *Chemical Plant and Petroleum Refinery Piping*.

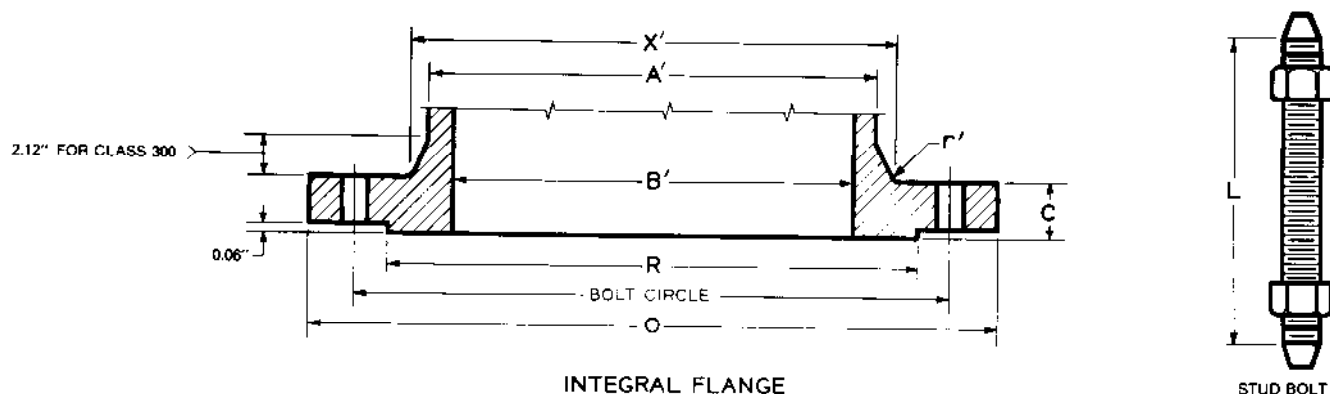
Table 4 — Dimensions for Class 300 Welding Neck and Integral Flanges (inches)



Welding Neck and Integral Flanges

NPS	Flange OD	Flange Thickness	Raised- Face Diameter	Drilling			Bolt Length		
				Bolt- Circle Diameter	Number of Bolts	Bolt Diameter	Bolt Hole Diameter	Machine Bolt	Stud Bolt
	O	C	R					L'	L
26	34.12	3.50	29.00	31.62	32	1 1/4	1.38	9.25	10.25
28	36.25	3.50	31.00	33.75	36	1 1/4	1.38	9.25	10.25
30	39.00	3.69	33.25	36.25	36	1 3/8	1.50	9.25	10.75
32	41.50	4.06	35.50	38.50	32	1 1/2	1.62	10.75	11.75
34	43.62	4.06	37.50	40.62	36	1 1/2	1.62	10.75	11.75
36	46.12	4.06	39.75	42.88	32	1 5/8	1.75	10.75	12.00
38	48.12	4.38	41.75	44.88	36	1 5/8	1.75	11.50	12.75
40	50.12	4.56	43.88	46.88	40	1 5/8	1.75	11.75	13.00
42	52.50	4.69	46.00	49.00	36	1 3/4	1.88	12.25	13.50
44	54.50	5.00	48.00	51.00	40	1 3/4	1.88	12.75	14.25
46	57.50	5.06	50.00	53.75	36	1 7/8	2.00	13.00	14.50
48	59.50	5.06	52.25	55.75	40	1 7/8	2.00	13.00	14.50
50	61.50	5.44	54.25	57.75	44	1 7/8	2.00	13.75	15.25
52	63.50	5.62	56.25	59.75	48	1 7/8	2.00	14.25	15.75
54	65.88	5.38	58.25	62.12	48	1 7/8	2.00	13.75	15.25
56	69.50	6.06	60.50	65.00	36	2 1/4	2.38	15.50	17.25
58	71.94	6.06	62.75	67.44	40	2 1/4	2.38	15.50	17.25
60	73.94	5.94	65.00	69.44	40	2 1/4	2.38	15.25	17.00

Table 4 (Continued) — Dimensions for Class 300 Welding Neck and Integral Flanges (inches)



INTEGRAL FLANGE

STUD BOLT

Welding Neck Flanges							Integral Flanges ^d				
Diameter at Large End of Hub	Diameter at Small End of Hub	Overall Length	Fillet Radius	Maximum ID ^b			Diameter at Large End of Neck	Diameter at Small End of Neck	ID	Fillet Radius	NPS
				ASME Code	ANSI B31.3	ANSI ^c B31.4/B31.8					
X	A	y	r	B	B	B ^d	X'	A'	B' ^e	r'	
27.62	26.19	5.69	0.56	24.88	25.25	25.50	28.12	27.12	25.00	0.62	26
29.75	28.19	5.88	0.56	26.75	27.12	27.50	30.25	29.25	27.00	0.62	28
32.00	30.25	6.22	0.56	28.62	29.06	29.50	32.50	31.50	29.00	0.62	30
34.00	32.25	6.62	0.62	30.56	31.00	31.25	34.50	33.50	30.75	0.75	32
36.12	34.25	6.81	0.62	32.44	32.88	33.25	36.62	35.62	32.75	0.75	34
38.00	36.25	7.12	0.62	34.31	34.88	35.12	38.62	37.62	34.50	0.75	36
40.00	38.25	7.56	0.62	36.25	37.06	37.12	40.62	39.62	36.50	0.75	38
42.00	40.25	7.81	0.62	38.25	39.06	39.12	42.62	41.38	38.50	0.75	40
44.00	42.31	8.06	0.62	40.00	40.88	41.12	44.50	43.38	40.25	0.75	42
46.19	44.31	8.44	0.62	42.00	43.00	43.00	46.50	45.62	42.19	0.75	44
48.38	46.31	8.75	0.62	44.00	44.88	44.88	49.00	47.88	44.12	0.75	46
50.31	48.31	8.81	0.62	45.75	46.56	46.81	51.00	49.88	46.00	0.75	48
52.38	50.31	9.25	0.62	47.75	48.69	48.69	53.00	51.88	47.94	0.75	50
54.44	52.31	9.56	0.62	49.75	50.62	50.69	55.00	53.88	49.88	0.75	52
56.50	54.31	9.44	0.62	51.50	52.31	52.56	57.38	56.25	51.75	0.88	54
58.81	56.31	10.56	0.69	53.62	54.38	54.56	59.50	58.38	53.69	0.88	56
60.94	58.31	10.81	0.69	55.50	56.38	56.44	61.94	60.81	55.62	0.88	58
62.94	60.31	10.69	0.69	57.25	58.19	58.38	63.94	62.69	57.50	0.88	60

^a Valves NPS 26 and larger probably will be of weld-end type. Should an integrally cast flanged valve be required, the ID must be reduced to provide for taper on hub or any casting variation allowance.

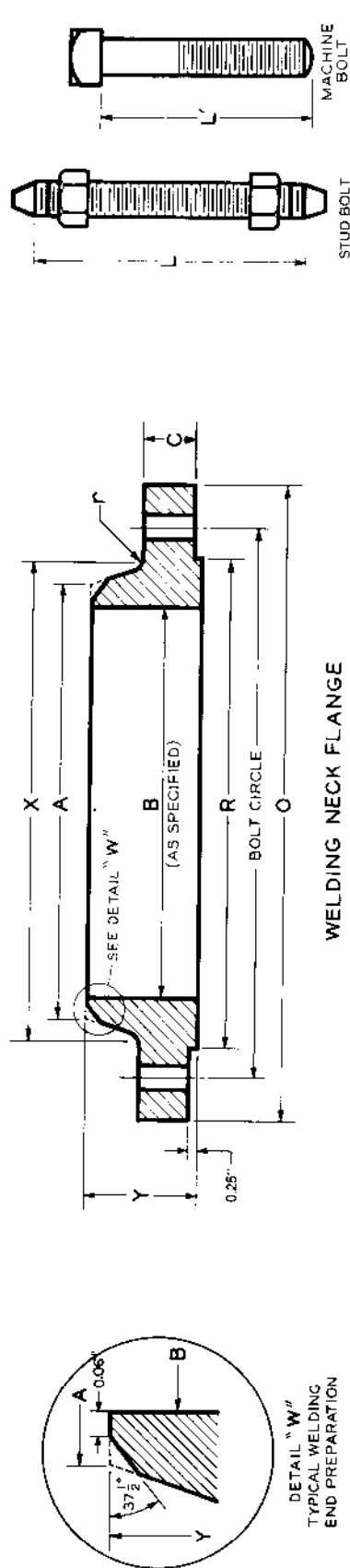
^b Dimension B (ID) shall be specified by the purchaser (see 2.1). The maximum ID includes the manufacturing tolerance allowed in 3.1.

^c Maximum ID for mating to pipe having a specified minimum yield strength of 65 kips per square inch and a design factor of 0.72 is based upon the flange material having a specified minimum yield strength of 42 kips per square inch in the ring section of the flange and minimum yield strength at the welding end of 65 kips per square inch.

^d Maximum ID to meet an allowable flange stress of 25 kips per square inch for all types of gaskets. Flange ID is smaller than pipe ID when mating with X65 pipe with design factor of 0.72. Flanges may be tapered to meet pipe ID.

^e ID, (B') is tabulated for ANSI B31.3, *Chemical Plant and Petroleum Refinery Piping*.

Table 5 — Dimensions for Class 400 Welding Neck Flanges (inches)



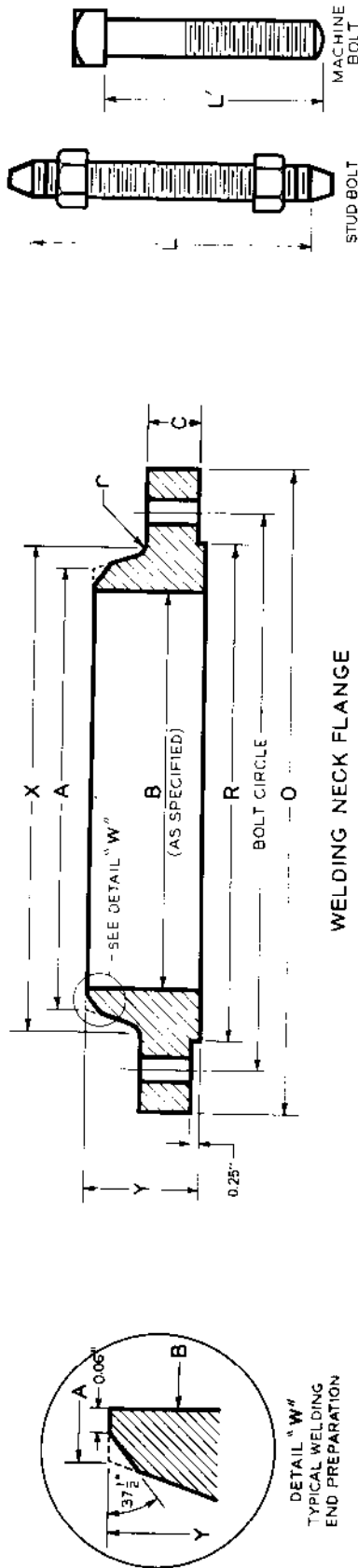
WELDING NECK FLANGE

NPS	Flange OD	Flange Thickness	Raised-Face Diameter	Drilling			Bolt Length			Diameter at Large End of Hub		Diameter at Small End of Hub		Overall Length	Fillet Radius	Maximum ID ^a				NPS
				Bolt-Circle Diameter	Number of Bolts	Bolt Diameter	Bolt-Hole Diameter	Machine Bolt	Stud Bolt	L	X	A	Y			r	ASME Code	ANSI B31.3	ANSI B31.4 & B31.8	
26	33.50	3.50	28.00	30.75	28	1 3/8	1.50	10.00	11.00	27.12	26.00	5.88	.44	24.31	25.12	25.50	26			
28	36.00	3.75	30.00	33.00	24	1 1/2	1.62	10.50	11.75	29.12	28.00	6.25	.50	26.06	27.00	27.44	28			
30	38.25	4.00	32.25	35.25	28	1 1/2	1.62	11.00	12.25	31.25	30.00	6.69	.50	28.06	29.00	29.38	30			
32	40.75	4.25	34.38	37.50	28	1 5/8	1.75	11.75	13.00	33.25	32.00	7.06	.50	29.88	30.88	31.31	32			
34	42.75	4.38	36.50	39.50	32	1 5/8	1.75	12.00	13.25	35.38	34.00	7.38	.56	31.88	32.88	33.25	34			
36	45.50	4.69	38.62	42.00	28	1 3/4	1.88	12.75	14.00	37.50	36.00	7.88	.56	33.75	34.88	35.19	36			
38	47.50	4.88	40.75	44.00	32	1 3/4	1.88	13.00	14.50	39.50	38.00	8.12	.56	35.69	36.81	37.19	38			
40	50.00	5.12	43.00	46.25	32	1 7/8	2.00	13.75	15.25	41.50	40.00	8.50	.56	37.50	38.69	39.12	40			
42	52.00	5.25	45.00	48.25	32	1 7/8	2.00	14.00	15.50	43.62	42.00	8.81	.56	39.50	40.69	41.06	42			
44	54.50	5.50	47.25	50.50	32	2	2.12	14.50	16.25	45.62	44.00	9.19	.56	41.38	42.56	43.06	44			
46	56.75	5.75	49.50	52.75	36	2	2.12	15.00	16.75	47.75	46.00	9.62	.56	43.31	44.56	45.00	46			
48	59.50	6.00	51.50	55.25	28	2 1/4	2.38	15.75	17.75	49.88	48.00	10.12	.56	45.19	46.56	46.94	48			
50	61.75	6.19	53.62	57.50	32	2 1/4	2.38	16.25	18.00	52.00	50.00	10.56	.56	47.12	48.56	48.94	50			
52	63.75	6.38	55.62	59.50	32	2 1/4	2.38	16.50	18.50	54.00	52.00	10.88	.56	49.00	50.44	50.88	52			
54	67.00	6.69	57.88	62.25	28	2 1/2	2.62	17.50	19.75	56.12	54.00	11.38	.56	50.88	52.38	52.81	54			
56	69.00	6.88	60.12	64.25	32	2 1/2	2.62	17.75	20.00	58.25	56.00	11.75	.56	52.88	54.38	54.81	56			
58	71.00	7.00	62.12	66.25	32	2 1/2	2.62	18.00	20.25	60.25	58.00	12.06	.56	54.75	56.31	56.75	58			
60	74.25	7.31	64.38	69.00	32	2 3/4	2.88	19.00	21.50	62.38	60.00	12.56	.56	56.56	58.19	58.69	60			

^a Dimension B (ID) shall be specified by the purchaser (see 2.1). The maximum ID includes the manufacturing tolerance allowed in 3.1.

^b Maximum ID for mating to pipe having a specified minimum yield strength of 65 kips per square inch and a design factor of 0.72 is based upon the flange material having a specified minimum yield strength of 42 kips per square inch in the ring section of the flange and minimum yield strength at the welding end of 65 kips per square inch.

Table 6 — Dimensions for Class 600 Welding Neck Flanges (inches)



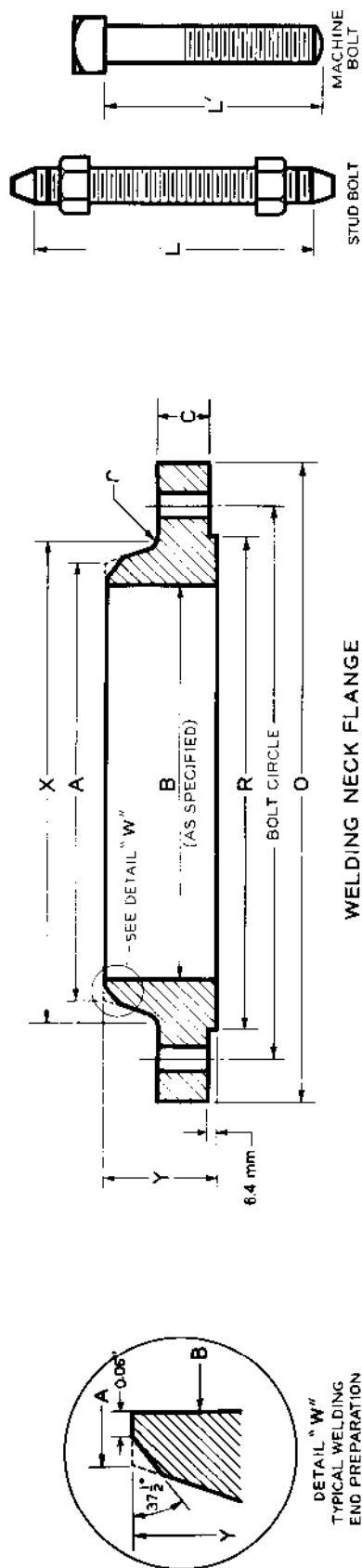
WELDING NECK FLANGE

NPS	Flange OD	Flange Thickness	Raised-Face Diameter	Drilling				Bolt Length		Diameter at Large End of Hub	Diameter at Small End of Hub	Overall Length	Fillet Radius	Maximum ID ^a				NPS
				Bolt-Number of Bolts	Bolt Diameter	Bolt-Hole Diameter	Machine Bolt	Stud Bolt	ASME Code					ANSI B31.3	ANSI B31.4 & B31.8			
	<i>O</i>	<i>C</i>	<i>R</i>				<i>L'</i>	<i>L</i>	<i>X</i>	<i>A</i>	<i>Y</i>	<i>r</i>	<i>B</i>	<i>B</i>	<i>B^b</i>			
26	35.00	4.38	28.62	28	1 5/8	1.75	12.00	13.25	27.50	26.00	7.12	.50	23.56	24.88	25.12	26		
28	37.50	4.56	30.88	28	1 3/4	1.88	12.50	13.75	29.62	28.00	7.50	.50	25.44	26.81	27.06	28		
30	40.25	4.94	33.12	28	1 7/8	2.00	13.25	14.75	31.75	30.00	8.06	.50	27.31	28.81	29.00	30		
32	42.75	5.12	35.25	28	2	2.12	13.75	16.50	33.88	32.00	8.50	.50	29.19	30.69	30.94	32		
34	45.75	5.56	37.50	24	2 1/4	2.38	15.00	16.75	36.00	34.00	9.19	.56	31.00	32.62	32.88	34		
36	47.75	5.75	39.75	28	2 1/4	2.38	15.25	17.25	38.12	36.00	9.56	.56	33.00	34.62	34.81	36		
38	50.00	6.00	41.50	28	2 1/4	2.38	15.75	17.75	40.25	38.00	10.00	.56	34.81	36.62	36.75	38		
40	52.00	6.25	43.75	32	2 1/4	2.38	16.25	18.25	42.25	40.00	10.38	.56	36.69	38.38	38.69	40		
42	55.25	6.62	46.00	28	2 1/2	2.62	17.25	19.50	44.38	42.00	11.00	.56	38.50	40.25	40.62	42		
44	57.25	6.81	48.25	32	2 1/2	2.62	17.75	20.00	46.50	44.00	11.38	.56	40.44	42.25	42.56	44		
46	59.50	7.06	50.25	32	2 1/2	2.62	18.25	20.50	48.62	46.00	11.81	.56	42.31	44.19	44.50	46		
48	62.75	7.44	52.50	32	2 3/4	2.88	19.25	21.75	50.75	48.00	12.44	.56	44.12	46.12	46.44	48		
50	65.75	7.75	54.50	28	3	3.12	20.00	22.75	52.88	50.00	12.94	.56	46.00	48.06	48.38	50		
52	67.75	8.00	56.50	32	3	3.12	20.50	23.25	54.88	52.00	13.25	.56	47.88	49.88	50.31	52		
54	70.00	8.25	58.75	32	3	3.12	21.00	23.75	57.00	54.00	13.75	.56	49.69	51.81	52.25	54		
56	73.00	8.56	60.75	32	3 1/4	3.38	22.00	25.00	59.12	56.00	14.25	.62	51.50	53.69	54.19	56		
58	75.00	8.75	63.00	32	3 1/4	3.38	22.25	25.25	61.12	58.00	14.56	.62	53.31	55.56	56.12	58		
60	78.50	9.19	65.25	28	3 1/2	3.62	23.50	26.75	63.38	60.00	15.31	.69	55.25	57.56	58.06	60		

^a Dimension B (ID) shall be specified by the purchaser (see 2.1). The maximum ID includes the manufacturing tolerance allowed in 3.1.

^b Maximum ID for mating to pipe having a specified minimum yield strength of 65 kips per square inch and a design factor of 0.72 is based upon the flange material having a specified minimum yield strength of 42 kips per square inch in the ring section of the flange and minimum yield strength at the welding end of 65 kips per square inch.

Table 7 — Dimensions for Class 900 Welding Neck Flanges (inches)



WELDING NECK FLANGE

NPS	Flange OD	Flange Thickness	Raised-Face Diameter	Bolt-Circle Diameter	Number of Bolts	Drilling	Bolt Length			Diameter at Large End of Hub	Diameter at Small End of Hub	Overall Length	Fillet Radius	Maximum ID ^a	
							L'	Machine Bolt	Stud Bolt					ANSI B31.3	ANSI B31.4 & B31.8
	O	C	R						L	X'	A'	Y	r	B	B ^b
26	40.25	5.31	30.00	35.50	20	2 1/2	14.75	16.75	16.75	29.25	26.00	10.19	.44	24.38	24.75
28	43.50	5.81	32.25	38.25	20	2 3/4	16.00	18.50	18.50	31.38	28.00	10.88	.50	26.25	26.62
30	46.50	6.12	34.50	40.75	20	3	16.75	19.50	19.50	33.50	30.00	11.38	.50	28.06	28.56
32	48.75	6.31	36.50	43.00	20	3	17.25	20.00	20.00	35.75	32.00	11.94	.50	30.00	30.44
34	51.75	6.75	39.00	45.50	20	3 1/4	18.25	21.25	21.25	37.88	34.00	12.56	.56	31.94	32.38
36	53.00	6.81	40.50	47.25	24	3	18.25	21.00	21.00	40.00	36.00	12.81	.56	33.81	34.25
38	57.50	7.50	43.25	50.75	20	3 1/2	20.00	23.25	23.25	42.25	38.00	13.88	.75	35.62	36.19
40	59.50	7.75	45.75	52.75	24	3 1/2	20.50	23.75	23.75	44.38	40.00	14.31	.81	37.50	38.06
42	61.50	8.12	47.75	54.75	24	3 1/2	21.25	24.50	24.50	46.31	42.00	14.62	.81	39.44	40.00
44	64.88	8.44	50.00	57.62	24	3 3/4	22.25	25.75	25.75	48.62	44.00	15.38	.88	41.25	41.88
46	68.25	8.88	52.50	60.50	24	4	23.25	27.00	27.00	50.88	46.00	16.19	.88	43.12	43.81
48	70.25	9.19	54.50	62.50	24	4	24.00	27.75	27.75	52.88	48.00	16.50	.94	45.06	45.69

^a Dimension B (ID) shall be specified by the purchaser (see 2.1). The maximum ID includes the manufacturing tolerance allowed in 3.1.

^b Maximum ID for mating to pipe having a specified minimum yield strength of 65 kips per square inch and a design factor of 0.72 is based upon the flange material having a specified minimum yield strength of 42 kips per square inch in the ring section of the flange and minimum yield strength at the welding end of 65 kips per square inch.

APPENDIX A

PRESSURE-TEMPERATURE RATINGS IN SI UNITS

This appendix contains the SI version of pressure-temperature ratings. Each table (A-1 and A-2) lists the rated gage pressure in bar at temperature in degrees Celsius for each class.

The pressure unit (1 bar) equals 100,000 pascals (100.0 kilopascals). The conversion factor is as follows:

$$1 \text{ bar} = 14.5038 \text{ pounds per square inch}$$

Table A-1 — Pressure-Temperature Ratings (SI) for Plant Piping and Pressure Vessel Flanges^a

Metal Temperature (degrees Celsius)	Pressure ^b (bar, gage)					
	Class					
	75	150	300	400	600	900
38	9.8	19.6	51.1	68.1	102.1	153.2
50	9.6	19.2	50.1	66.8	100.2	150.2
100	8.8	17.7	46.4	61.8	92.8	139.1
150	7.9	15.8	45.2	60.3	90.5	135.7
200	7.0	14.0	43.8	58.4	87.6	131.5
250	6.0	12.1	41.7	55.6	83.4	125.2
300	5.1	10.2	38.7	51.6	77.5	116.2
350	4.2	8.4	37.0	49.3	73.9	110.9
375	—	7.4	36.5	48.6	72.9	109.4
400	—	6.5	34.5	46.0	69.0	103.5
425	—	5.6	28.8	38.3	57.5	86.3
450	—	4.7	20.0	26.7	40.1	60.1
475	—	3.7	13.5	18.1	27.1	40.6
500	—	2.8	8.8	11.7	17.6	26.4
525	—	1.9	5.2	6.9	10.4	15.5
540 ^c	—	1.3	3.3	4.3	6.5	9.8

^a Based on the pressure-temperature ratings in ANSI B16.5 (1977), for use with flanges designed in accordance with the ASME Code or ANSI B31.3.

^b Pressure-temperature ratings are based on materials specifications ASTM A105 and A216 Grade WCB. Limitations on the use of these materials shall be in accordance with the applicable code.

^c Maximum service temperature for Classes 150 through 900.

Table A-2 — Pressure-Temperature Ratings (SI) for Pipe Line Flanges^a

Metal Temperature (degrees Celsius)	Pressure (bar, gage)			
	Class			
	300	400	600	900
38	51.1	68.1	102.1	153.2
50	51.1	68.1	102.1	153.2
100	51.1	68.1	102.1	153.2
120	51.1	68.1	102.1	153.2
150	49.3	65.8	98.6	147.9
175	47.6	63.8	95.1	142.7
200	45.9	61.4	91.7	137.9
230	44.1	59.3	88.6	132.7

^a Pressure-temperature ratings meet the requirements set forth in ANSI B31.4 and B31.8.

APPENDIX B

DIMENSIONAL TABLES IN SI UNITS

This appendix contains metricated (SI) tables of dimensions corresponding to tables elsewhere in this standard that list U.S. customary values (decimal inch).

Dimensions are in millimeters. The conversion factor is as follows:

$$1 \text{ millimeter} = 0.03937 \text{ inch}$$

Table B-1 — Dimensions for Class 75 Welding Neck and Integral Flanges (SI)

Table B-2 — Dimensions for Class 150 Welding Neck and Integral Flanges (SI)

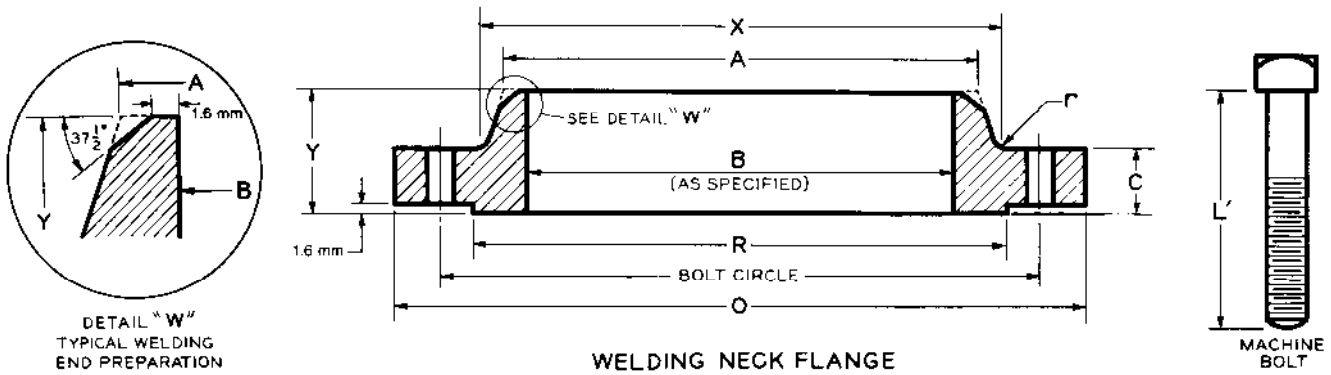
Table B-3 — Dimensions for Class 300 Welding Neck and Integral Flanges (SI)

Table B-4 — Dimensions for Class 400 Welding Neck Flanges (SI)

Table B-5 — Dimensions for Class 600 Welding Neck Flanges (SI)

Table B-6 — Dimensions for Class 900 Welding Neck Flanges (SI)

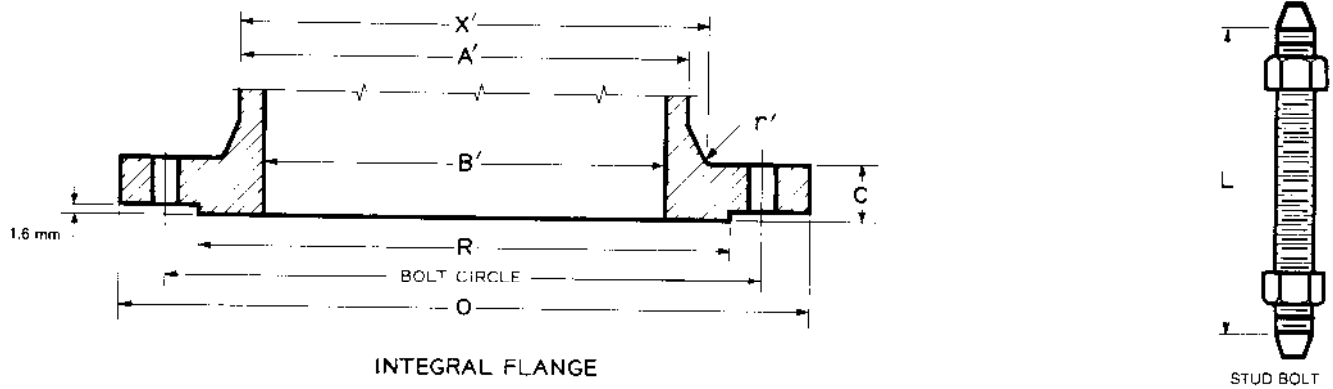
Table B-1 — Dimensions for Class 75 Welding Neck and Integral Flanges (SI) (millimeters)



Welding Neck and Integral Flanges

NPS	Flange OD	Flange Thickness	Raised- Face Diameter	Drilling				Bolt Length	
				Bolt- Circle Diameter	Number of Bolts	Bolt Diameter (inches)	Bolt Hole Diameter	Machine Bolt	Stud Bolt
	<i>O</i>	<i>C</i>	<i>R</i>					<i>L'</i>	<i>L</i>
26	762	33.3	704.8	723.9	36	5/8	19.0	102	114
28	813	33.3	755.6	774.7	40	5/8	19.0	102	114
30	864	33.3	806.4	825.5	44	5/8	19.0	102	114
32	914	34.9	857.2	876.3	48	5/8	19.0	108	121
34	965	34.9	908.0	927.1	52	5/8	19.0	108	121
36	1033	36.5	965.2	992.2	40	3/4	22.2	114	127
38	1084	38.1	1016.0	1043.0	40	3/4	22.2	114	133
40	1135	38.1	1066.8	1093.8	44	3/4	22.2	114	133
42	1186	39.7	1117.6	1144.6	48	3/4	22.2	121	133
44	1251	42.9	1174.8	1203.3	36	7/8	25.4	133	146
46	1302	44.4	1225.6	1254.1	40	7/8	25.4	133	152
48	1353	46.0	1276.4	1304.9	44	7/8	25.4	140	152
50	1403	47.6	1327.2	1355.7	44	7/8	25.4	140	159
52	1457	47.6	1378.0	1409.7	48	7/8	25.4	140	159
54	1508	49.2	1428.8	1460.5	48	7/8	25.4	146	159
56	1575	50.8	1485.9	1520.8	40	1	28.6	152	171
58	1626	52.4	1536.7	1571.6	44	1	28.6	152	171
60	1676	55.6	1587.5	1622.4	44	1	28.6	159	178

Table B-1 (Continued)—Dimensions for Class 75 Welding Neck and Integral Flanges (SI) (millimeters)



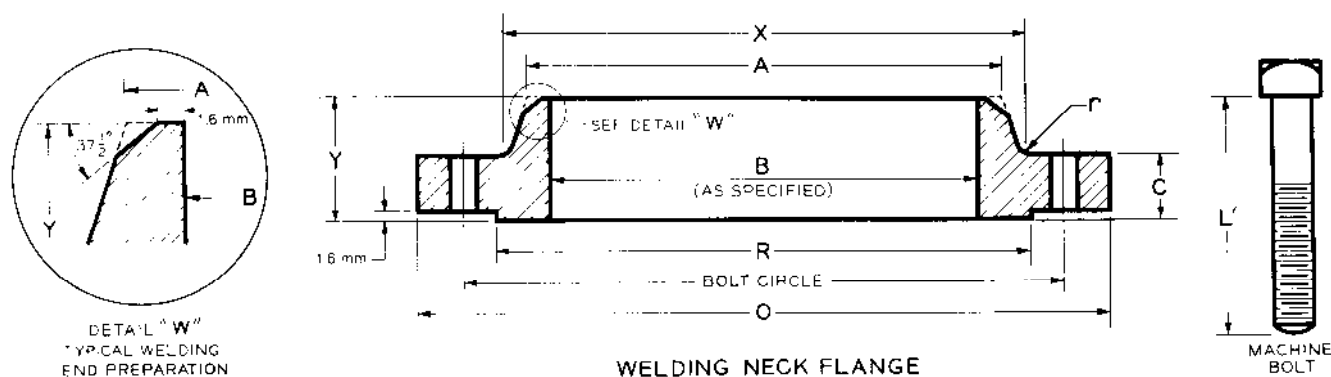
Welding Neck Flanges						Integral Flanges ^a				
Diameter at Large End of Hub	Diameter at Small End of Hub	Overall Length	Fillet Radius	Maximum ID ^b		Diameter at Large End of Neck	Diameter at Small End of Neck	ID	Fillet Radius	NPS
<i>X</i>	<i>A</i>	<i>y</i>	<i>r</i>	ASME Code	ANSI B31.3	<i>X'</i>	<i>A'</i>	<i>B'</i> ^c	<i>r'</i>	
676.3	662.0	58.7	7.9	647.7	647.7	676.3	676.3	644.5	9.5	26
727.1	712.8	61.9	7.9	698.5	698.5	727.1	727.1	695.3	9.5	28
777.9	763.6	65.1	7.9	749.3	749.3	777.9	777.9	746.1	9.5	30
828.7	814.4	69.8	7.9	800.1	800.1	828.7	828.7	795.3	9.5	32
879.5	865.2	73.0	7.9	850.9	850.9	879.5	879.5	844.6	12.7	34
935.0	916.0	85.7	9.5	901.7	901.7	935.0	935.0	895.4	12.7	36
985.8	966.8	88.9	9.5	952.5	952.5	985.8	985.8	946.2	12.7	38
1036.6	1017.6	92.1	9.5	1003.3	1003.3	1036.6	1036.6	995.4	12.7	40
1087.4	1068.4	95.2	9.5	1054.1	1054.1	1087.4	1087.4	1046.2	12.7	42
1139.8	1119.2	104.8	9.5	1104.9	1104.9	1139.8	1139.8	1095.4	12.7	44
1190.6	1170.0	108.0	9.5	1155.7	1155.7	1190.6	1190.6	1146.2	12.7	46
1241.4	1220.8	111.1	9.5	1206.5	1206.5	1241.4	1241.4	1195.4	12.7	48
1293.8	1271.6	115.9	9.5	1257.3	1257.3	1292.2	1292.2	1246.2	12.7	50
1344.6	1322.4	120.7	9.5	1308.1	1308.1	1346.2	1346.2	1297.0	12.7	52
1397.0	1373.2	125.4	9.5	1358.9	1358.9	1397.0	1397.0	1347.8	15.9	54
1451.0	1424.0	134.9	11.1	1409.7	1409.7	1451.0	1451.0	1397.0	15.9	56
1501.8	1474.8	138.1	11.1	1460.5	1460.5	1501.8	1501.8	1447.8	15.9	58
1552.6	1525.6	144.5	11.1	1511.3	1511.3	1552.6	1552.6	1498.6	15.9	60

^a Valves NPS 26 and larger probably will be of weld-end type. Should an integrally cast flanged valve be required, the ID must be reduced to provide for taper on hub or any casting variation allowance.

^b Dimension *B* (ID) shall be specified by the purchaser (see 2.1). The maximum ID includes the manufacturing tolerance allowed in 3.1.

^c ID (*B'*) is tabulated for ANSI B31.3, *Chemical Plant and Petroleum Refinery Piping*.

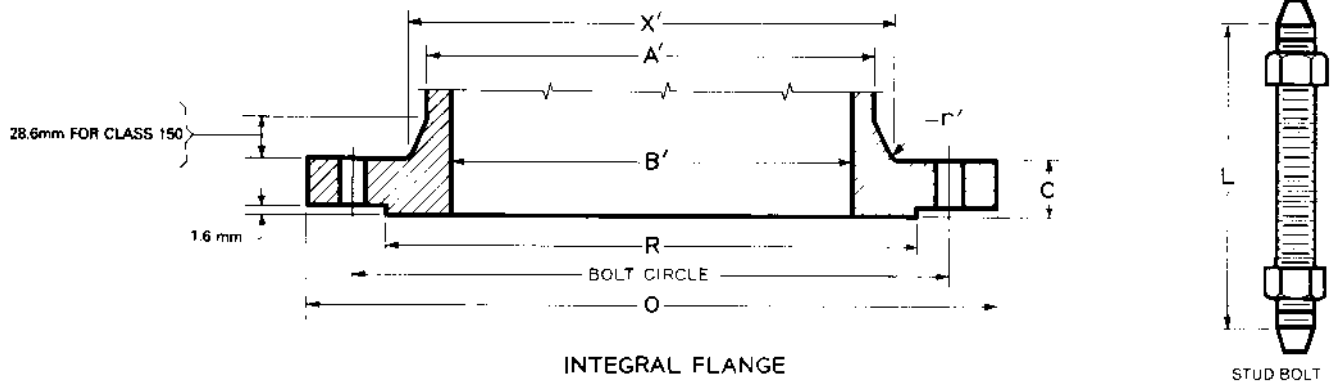
Table B-2 — Dimensions for Class 150 Welding Neck and Integral Flanges (SI) (millimeters)



Welding Neck and Integral Flanges

Drilling and Bolt Length										
NPS	Flange OD	Flange Thickness	Raised- Face Diameter	Drilling				Bolt Length		
				Bolt- Circle Diameter	Number of Bolts	Bolt Diameter (inches)	Bolt Hole Diameter	Machine Bolt	Stud Bolt	
	<i>O</i>	<i>C</i>	<i>R</i>						<i>L'</i>	<i>L</i>
650	26	786	41.3	711.2	744.5	36	3/4	22.2	121	140
700	28	837	44.4	762.0	795.3	40	3/4	22.2	127	146
	30	887	44.4	812.8	846.1	44	3/4	22.2	127	146
800	32	941	46.0	863.6	900.1	48	3/4	22.2	133	146
	34	1005	49.2	920.8	957.3	40	7/8	25.4	146	159
900	36	1057	52.4	971.6	1009.6	44	7/8	25.4	152	165
	38	1124	54.0	1022.4	1070.0	40	1	28.6	159	178
000	40	1175	55.6	1079.5	1120.8	44	1	28.6	165	178
	42	1226	58.7	1130.3	1171.6	48	1	28.6	165	184
200	44	1276	60.3	1181.1	1222.4	52	1	28.6	171	190
	46	1341	61.9	1235.1	1284.3	40	1 1/8	31.8	178	203
	48	1392	65.1	1289.0	1335.1	44	1 1/8	31.8	184	203
	50	1443	68.3	1339.8	1385.9	48	1 1/8	31.8	190	210
	52	1494	69.8	1390.6	1436.7	52	1 1/8	31.8	197	216
	54	1549	71.4	1441.4	1492.2	56	1 1/8	31.8	197	216
500	56	1600	73.0	1492.3	1543.0	60	1 1/8	31.8	203	222
	58	1675	74.6	1543.0	1611.3	48	1 1/4	34.9	210	229
	60	1726	76.2	1600.2	1662.1	52	1 1/4	34.9	210	235

Table B-2 (Continued) — Dimensions for Class 150 Welding Neck and Integral Flanges (SI) (millimeters)



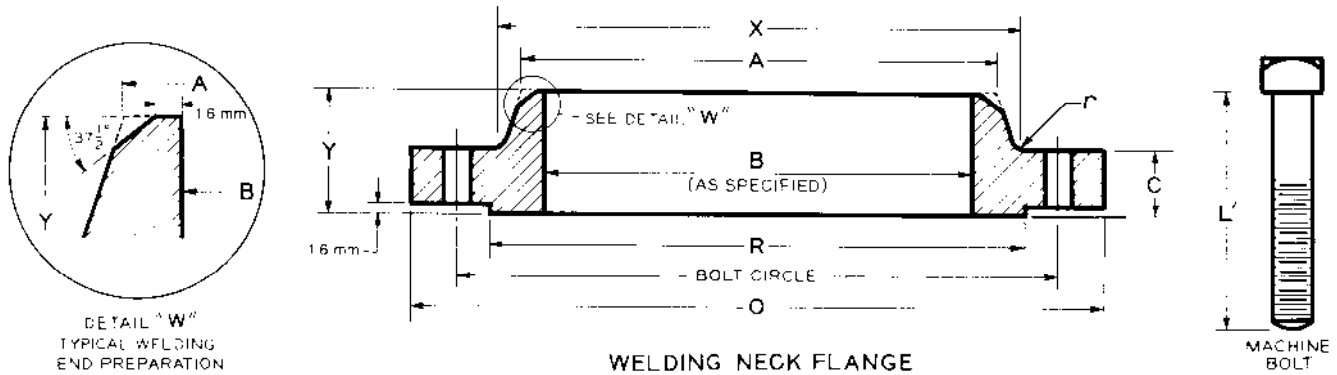
Welding Neck Flanges						Integral Flanges ^a				
Diameter at Large End of Hub	Diameter at Small End of Hub	Overall Length	Fillet Radius	Maximum ID ^b		Diameter at Large End of Neck	Diameter at Small End of Neck	ID	Fillet Radius	NPS
<i>X</i>	<i>A</i>	<i>y</i>	<i>r</i>	ASME Code	ANSI B31.3	<i>X'</i>	<i>A'</i>	<i>B'</i> ^c	<i>r'</i>	
684.2	662.0	88.9	9.5	646.1	647.7	687.4	676.3	642.9	12.7	26
735.0	712.8	95.2	9.5	696.5	698.5	738.2	727.1	690.6	12.7	28
787.4	763.6	100.0	9.5	747.7	749.3	789.0	777.9	739.8	12.7	30
839.8	814.4	108.0	9.5	798.5	800.1	843.0	831.8	792.2	12.7	32
892.2	865.2	110.3	9.5	847.7	850.9	893.8	882.6	839.8	12.7	34
944.6	916.0	117.5	9.5	898.5	901.7	946.2	935.0	890.6	12.7	36
997.0	968.4	123.8	9.5	949.3	925.5	1000.1	989.0	939.8	12.7	38
1049.3	1019.2	128.6	9.5	998.5	1003.3	1050.9	1039.8	989.0	12.7	40
1101.7	1070.0	133.4	11.1	1049.3	1054.1	1101.7	1090.6	1038.2	15.9	42
1152.5	1120.8	136.5	11.1	1098.6	1104.9	1152.5	1141.4	1089.0	15.9	44
1204.9	1171.6	144.5	11.1	1147.8	1155.7	1208.1	1197.0	1138.2	15.9	46
1257.3	1222.4	149.2	11.1	1198.6	1204.9	1258.9	1247.8	1187.4	15.9	48
1308.1	1273.2	154.0	11.1	1247.8	1255.7	1309.7	1298.6	1238.2	15.9	50
1369.5	1324.0	157.2	11.1	1298.6	1306.5	1360.5	1349.4	1289.0	15.9	52
1412.9	1374.8	161.9	11.1	1347.8	1354.1	1416.0	1404.9	1339.8	15.9	54
1465.3	1425.6	166.7	14.3	1398.6	1406.5	1466.8	1455.7	1390.6	19.0	56
1516.1	1476.4	174.6	14.3	1449.4	1457.3	1522.4	1511.3	1438.2	19.0	58
1570.0	1527.2	179.4	14.3	1498.6	1505.0	1573.2	1562.1	1485.9	19.0	60

^a Valves NPS 26 and larger probably will be of weld-end type. Should an integrally cast flanged valve be required, the ID must be reduced to provide for taper on hub or any casting variation allowance.

^b Dimension *B* (ID) shall be specified by the purchaser (see 2.1). The maximum ID includes the manufacturing tolerance allowed in 3.1.

^c ID (*B'*) is tabulated for ANSI B31.3, *Chemical Plant and Petroleum Refinery Piping*.

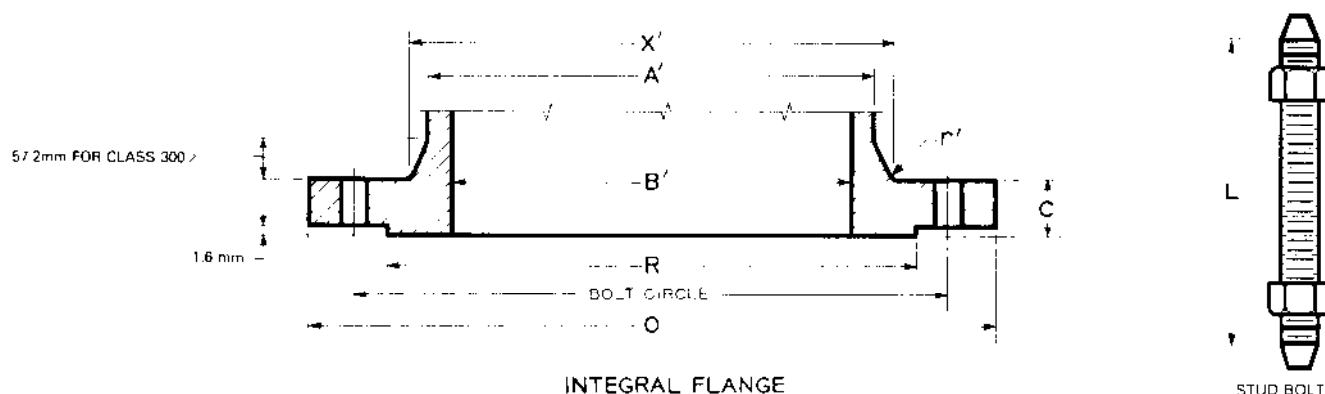
Table B-3 — Dimensions for Class 300 Welding Neck and Integral Flanges (SI) (millimeters)



Welding Neck and Integral Flanges

NPS	Flange OD	Flange Thickness	Raised- Face Diameter	Drilling				Bolt Length	
				Bolt- Circle Diameter	Number of Bolts	Bolt Diameter (inches)	Bolt Hole Diameter	Machine Bolt	Stud Bolt
	<i>O</i>	<i>C</i>	<i>R</i>					<i>L'</i>	<i>L</i>
26	867	88.9	736.6	803.3	32	1 1/4	34.9	235	260
28	921	88.9	787.4	857.2	36	1 1/4	34.9	235	260
30	991	93.7	844.6	920.8	36	1 3/8	38.1	248	273
32	1054	103.2	901.7	977.9	32	1 1/2	41.3	273	298
34	1108	103.2	952.5	1031.9	36	1 1/2	41.3	273	298
36	1172	103.2	1009.6	1089.0	32	1 5/8	44.4	273	305
38	1222	111.1	1060.4	1139.8	36	1 5/8	44.4	292	324
40	1273	115.9	1114.4	1190.6	40	1 5/8	44.4	298	330
42	1334	119.1	1168.4	1244.6	36	1 3/4	47.6	311	343
44	1384	127.0	1219.2	1295.4	40	1 3/4	47.6	324	362
46	1460	128.6	1270.0	1365.2	36	1 7/8	50.8	330	368
48	1511	128.6	1327.2	1416.0	40	1 7/8	50.8	330	368
50	1562	138.1	1378.0	1466.8	44	1 7/8	50.8	349	387
52	1613	142.9	1428.8	1517.6	48	1 7/8	50.8	362	400
54	1673	136.5	1479.6	1578.0	48	1 7/8	50.8	349	387
56	1765	154.0	1536.7	1651.0	36	2 1/4	60.3	394	438
58	1827	154.0	1593.8	1712.9	40	2 1/4	60.3	394	438
60	1878	150.8	1651.0	1763.7	40	2 1/4	60.3	387	432

Table B-3 (Continued) — Dimensions for Class 300 Welding Neck and Integral Flanges (SI) (millimeters)



Welding Neck Flanges							Integral Flanges ^a				
Diameter at Large End of Hub	Diameter at Small End of Hub	Overall Length	Fillet Radius	Maximum ID ^b			Diameter at Large End of Neck	Diameter at Small End of Neck	ID	Fillet Radius	NPS
				ASME Code	ANSI B31.3	ANSI ^c B31.4 & B31.8					
<i>X</i>	<i>A</i>	<i>y</i>	<i>r</i>	<i>B</i>	<i>B</i>	<i>B</i> ^d	<i>X'</i>	<i>A'</i>	<i>B'</i> ^e	<i>r'</i>	
701.7	665.2	144.5	14.3	631.8	641.4	647.7	714.4	689.0	635.0	15.9	26
755.6	716.0	149.2	14.3	679.4	689.0	698.5	768.4	743.0	685.8	15.9	28
812.8	768.4	158.0	14.3	727.1	738.2	749.3	825.5	800.1	736.6	15.9	30
863.6	819.2	168.3	15.9	776.3	787.4	793.7	876.3	850.9	781.0	19.0	32
917.6	870.0	173.0	15.9	823.9	835.0	844.5	930.3	904.9	831.8	19.0	34
965.2	920.8	181.0	15.9	871.5	885.8	892.2	981.1	955.7	876.3	19.0	36
1016.0	971.6	192.1	15.9	920.8	941.4	943.0	1031.9	1006.5	927.1	19.0	38
1066.8	1022.4	198.4	15.9	971.6	992.2	993.8	1082.7	1050.9	977.9	19.0	40
1117.6	1074.7	204.8	15.9	1016.0	1038.2	1044.6	1130.3	1101.7	1022.4	19.0	42
1173.2	1125.5	214.3	15.9	1066.8	1092.2	1092.2	1181.1	1158.9	1071.6	19.0	44
1228.7	1176.3	222.2	15.9	1117.6	1139.8	1139.8	1244.6	1216.0	1120.8	19.0	46
1277.9	1227.1	223.8	15.9	1162.0	1182.7	1189.0	1295.4	1266.8	1168.4	19.0	48
1330.3	1277.9	235.0	15.9	1212.8	1236.7	1236.7	1346.2	1317.6	1217.6	19.0	50
1382.7	1328.7	242.9	15.9	1263.6	1285.9	1287.5	1397.0	1368.4	1266.8	19.0	52
1435.1	1379.5	239.7	15.9	1308.1	1328.7	1335.0	1457.3	1428.8	1314.4	22.2	54
1493.8	1430.3	268.3	17.5	1362.1	1381.1	1385.8	1511.3	1482.7	1363.7	22.2	56
1547.8	1481.1	274.6	17.5	1409.7	1431.9	1433.6	1573.2	1544.6	1412.9	22.2	58
1598.6	1531.9	271.5	17.5	1454.2	1478.0	1482.8	1624.0	1692.3	1460.5	22.2	60

^a Valves NPS 26 and larger probably will be of weld-end type. Should an integrally cast flanged valve be required, the ID must be reduced to provide for taper on hub or any casting variation allowance.

^b Dimension *B* (ID) shall be specified by the purchaser (see 2.1). The maximum ID includes the manufacturing tolerance allowed in 3.1.

^c Maximum ID for mating to pipe having a specified minimum yield strength of 448 megapascals and a design factor of 0.72 is based upon the flange material having a specified minimum yield strength of 290 megapascals in the ring section of the flange and minimum yield strength at the welding end of 448 megapascals.

^d Maximum ID to meet an allowable flange stress of 172 megapascals for all types of gaskets. Flange ID is smaller than pipe ID when mating with X65 pipe with a design factor of 0.72. Flanges may be tapered to meet pipe ID.

^e ID (*B'*) is tabulated for ANSI B31.3, *Chemical Plant and Petroleum Refinery Piping*.

Table B-4 — Dimensions for Class 400 Welding Neck Flanges (SI) (millimeters)



WELDING NECK FLANGE

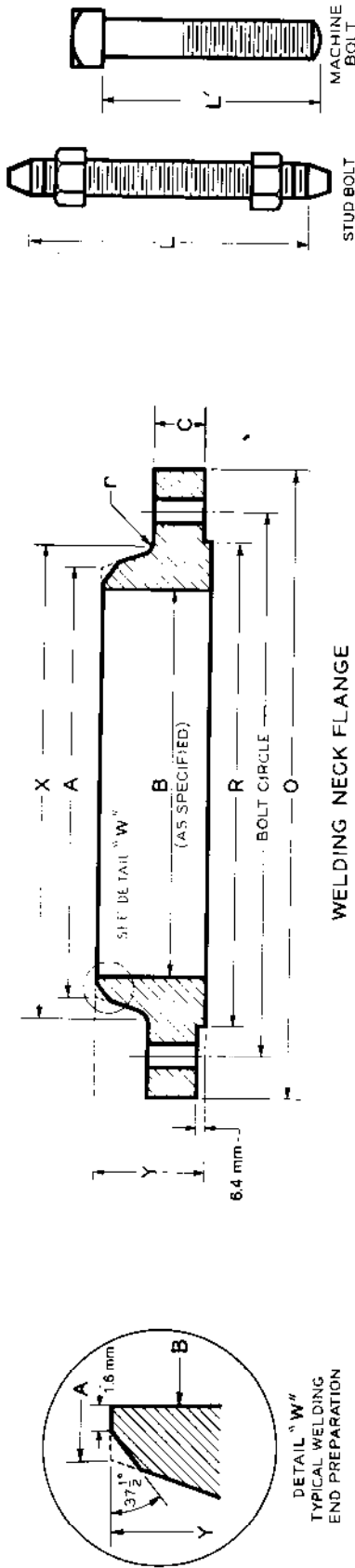
NPS	Flange OD	Flange Thickness	Raised-Face Diameter	Drilling				Bolt Length			Diameter at Large End of Hub		Diameter at Small End of Hub		Overall Length	Fillet Radius	Maximum ID ^a			
				Bolt-Circle Diameter	Number of Bolts	Bolt Diameter	Bolt-Hole Diameter	Machine Bolt	Stud Bolt	X	A	Y	r	ASME Code			ANSI B31.3	ANSI B31.4 & B31.8		
	O	C	R					L'	L								B	B	B ^b	
26	851	8.89	711.2	781.0	28	1 3/8	38.1	254	279	689.0	739.8	660.4	149.2	11.1	617.5	638.2	647.7	26		
28	914	95.2	762.0	838.2	24	1 1/2	41.3	267	298	739.8	793.8	711.2	158.8	12.7	662.0	685.8	696.9	28		
30	972	101.6	819.2	895.4	28	1 1/2	41.3	279	311	793.8	844.6	762.0	169.9	12.7	712.8	736.6	746.1	30		
32	1035	108.0	873.1	952.5	28	1 5/8	44.4	298	330	844.6	898.5	812.8	179.4	12.7	758.8	784.2	795.3	32		
34	1086	111.1	927.1	1003.3	32	1 5/8	44.4	305	337	898.5	952.5	863.6	187.3	14.3	809.6	835.0	844.6	34		
36	1156	119.1	981.1	1066.8	28	1 3/4	47.6	324	356	952.5	1003.3	914.4	200.0	14.3	857.2	885.8	893.8	36		
38	1206	123.8	1035.0	1117.6	32	1 3/4	47.6	330	368	1003.3	1054.1	965.2	206.4	14.3	906.5	935.0	944.6	38		
40	1270	130.2	1092.2	1174.8	32	1 7/8	50.8	349	387	1054.1	1108.1	1016.0	215.9	14.3	952.5	982.7	993.8	40		
42	1321	133.4	1143.0	1225.6	32	1 7/8	50.8	356	394	1108.1	1158.9	1066.8	223.8	14.3	1003.3	1033.5	1043.0	42		
44	1384	139.7	1200.2	1282.7	32	2	54.0	368	413	1158.9	1212.8	1117.6	233.4	14.3	1050.9	1081.1	1093.8	44		
46	1441	146.0	1257.3	1339.8	36	2	54.0	381	425	1212.8	1266.8	1168.4	244.5	14.3	1100.1	1131.9	1143.0	46		
48	1511	152.4	1308.1	1403.4	28	2 1/4	60.3	400	451	1266.8	1320.8	1219.2	257.2	14.3	1147.8	1182.7	1192.2	48		
50	1568	157.2	1362.1	1460.5	32	2 1/4	60.3	413	457	1320.8	1371.6	1270.0	268.3	14.3	1197.0	1233.5	1243.0	50		
52	1619	161.9	1412.9	1511.3	32	2 1/4	60.3	419	470	1371.6	1425.6	1320.8	276.2	14.3	1244.6	1281.1	1292.2	52		
54	1702	169.7	1470.0	1581.2	28	2 1/2	66.7	444	502	1425.6	1479.6	1371.6	288.9	14.3	1292.2	1330.3	1341.4	54		
56	1753	174.6	1527.2	1632.0	32	2 1/2	66.7	451	508	1479.6	1530.4	1422.4	298.4	14.3	1343.0	1381.1	1392.2	56		
58	1803	177.8	1578.0	1682.8	32	2 1/2	66.7	457	514	1530.4	1584.3	1473.2	306.4	14.3	1390.6	1430.3	1441.4	58		
60	1886	185.7	1635.1	1752.6	32	2 3/4	73.0	483	546	1584.3	1638.3	1524.0	319.1	14.3	1436.7	1478.0	1490.7	60		

^a Dimension B (ID) shall be specified by the purchaser (see 2.1). The maximum ID includes the manufacturing tolerance allowed in 3.1.

^b Maximum ID for mating to pipe having a specified minimum yield strength of 448 megapascals and a design factor of 0.72 is based upon

the flange material having a specified minimum yield strength of 290 megapascals in the ring section of the flange and minimum yield strength at the welding end of 448 megapascals.

Table B-5—Dimensions for Class 600 Welding Neck Flanges (SI) (millimeters)

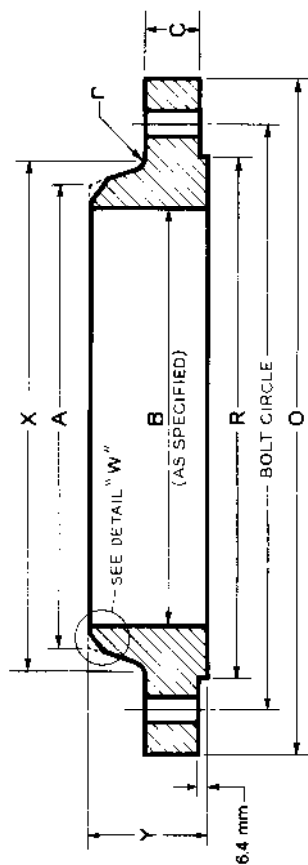
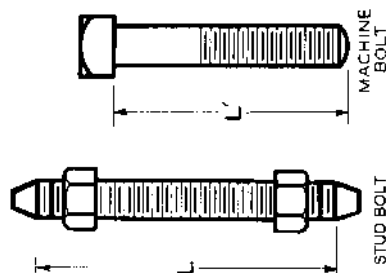


NPS	Flange OD	Flange Thickness	Raised-Face Diameter	Drilling			Bolt Length		Diameter at Large End of Hub	Diameter at Small End of Hub	Overall Length	Fillet Radius	Maximum ID ^a					
				Bolt-Circle Diameter	Number of Bolts	Bolt Diameter	Bolt-Hole Diameter	Machine Bolt					Stud Bolt	ASME Code	ANSI B31.3	ANSI B31.4 & B31.8	ANSI B ^b	
<i>O</i>	<i>C</i>	<i>R</i>	<i>L'</i>	<i>L</i>	<i>X</i>	<i>A</i>	<i>Y</i>	<i>B</i>	<i>B</i>	<i>B</i>	<i>B</i>	<i>B</i>	<i>B</i>	<i>B</i>	<i>B</i>	<i>B</i>	<i>B</i>	NPS
26	889	111.1	727.1	806.4	28	1 5/8	44.4	305	337	698.5	660.4	181.0	12.7	598.5	631.8	631.8	638.2	26
28	952	115.9	784.2	863.6	28	1 3/4	47.6	318	349	752.5	711.2	190.5	12.7	646.1	681.0	681.0	687.4	28
30	1022	125.4	841.4	927.1	28	1 7/8	50.8	337	375	806.4	762.0	204.8	12.7	693.7	731.8	731.8	736.6	30
32	1086	130.2	895.4	984.2	28	2	54.0	349	394	860.4	812.8	215.9	12.7	741.4	779.5	779.5	785.8	32
34	1162	141.3	952.5	1054.1	24	2 1/4	60.3	381	425	914.4	863.6	233.4	14.3	787.4	828.7	828.7	835.0	34
36	1213	146.0	1009.6	1104.9	28	2 1/4	60.3	387	438	968.4	914.4	242.9	14.3	838.2	879.5	879.5	884.2	36
38	1270	152.4	1054.1	1162.0	28	2 1/4	60.3	400	451	1022.4	965.2	254.0	14.3	884.2	930.3	930.3	933.4	38
40	1321	158.8	1111.2	1212.8	32	2 1/4	66.7	413	464	1073.2	1016.0	263.5	14.3	931.9	974.7	974.7	982.7	40
42	1403	168.3	1168.4	1282.7	28	2 1/2	66.7	438	495	1127.1	1066.8	279.4	14.3	977.9	1022.4	1022.4	1031.9	42
44	1454	173.0	1225.6	1333.5	32	2 1/2	66.7	451	508	1181.1	1117.6	288.9	14.3	1027.1	1073.2	1073.2	1081.9	44
46	1511	179.4	1276.4	1390.6	32	2 1/2	73.0	464	521	1235.1	1168.4	300.0	14.3	1074.7	1122.4	1122.4	1130.3	46
48	1594	188.9	1333.5	1460.5	32	2 3/4	79.4	489	552	1289.0	1219.2	315.9	14.3	1120.8	1171.6	1171.6	1179.5	48
50	1670	196.8	1384.3	1524.0	28	3	79.4	508	578	1343.0	1270.0	328.6	14.3	1168.4	1220.8	1220.8	1228.7	50
52	1721	203.2	1435.1	1574.8	32	3	79.4	521	591	1393.8	1320.8	336.6	14.3	1216.0	1266.8	1266.8	1277.9	52
54	1778	209.6	1492.2	1632.0	32	3	85.7	533	603	1447.8	1371.6	349.2	14.3	1262.1	1316.0	1316.0	1327.2	54
56	1854	217.5	1543.0	1691.4	32	3 1/4	85.7	559	635	1501.8	1422.4	362.0	15.9	1308.1	1363.7	1363.7	1376.4	56
58	1905	222.2	1600.2	1746.2	32	3 1/4	85.7	565	641	1552.6	1413.2	369.9	15.9	1354.1	1411.3	1411.3	1425.6	58
60	1994	233.4	1657.4	1822.4	28	3 1/2	92.1	597	679	1609.7	1524.0	388.9	17.5	1403.4	1462.1	1462.1	1474.8	60

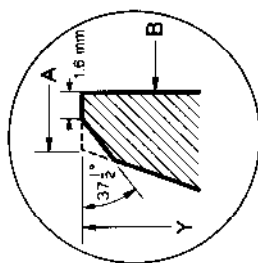
^a Dimension B (ID) shall be specified by the purchaser (see 2.1). The maximum ID includes the manufacturing tolerance allowed in 3.1.

^b Maximum ID for mating to pipe having a specified minimum yield strength of 448 megapascals and a design factor of 0.72 is based upon the flange material having a specified minimum yield strength of 290 megapascals in the ring section of the flange and minimum yield strength at the welding end of 448 megapascals.

Table B-6 — Dimensions for Class 900 Welding Neck Flanges (SI) (millimeters)



WELDING NECK FLANGE

TYPICAL WELDING
END PREPARATION

NPS	Flange OD	Flange Thickness	Raised- Face Diameter	Drilling				Bolt Length		Diameter		Fillet Radius	Maximum ID ^a		NPS
				Bolt- Circle Diameter	Number of Bolts	Bolt Diameter	Bolt- Hole Diameter	Machine Bolt	Stud Bolt	Diameter at Large End of Hub	Diameter at Small End of Hub		ANSI B31.3	ANSI B31.4 & B31.8	
<i>O</i>		<i>C</i>	<i>R</i>					<i>L'</i>	<i>L</i>	<i>X</i>	<i>A</i>	<i>r</i>	<i>B</i>	<i>B^b</i>	
26	1022	134.9	762.0	901.7	20	2 1/2	66.7	375	425	743.0	660.4	258.8	619.1	628.6	26
28	1105	147.6	819.2	971.6	20	2 3/4	73.0	406	470	796.9	711.2	276.2	666.8	676.3	28
30	1181	155.6	876.3	1035.0	20	3	79.4	425	495	850.9	762.0	288.9	712.8	725.5	30
32	1238	160.3	927.1	1092.2	20	3	79.4	438	508	908.0	812.8	303.2	762.0	773.1	32
34	1314	171.4	990.6	1155.7	20	3 1/4	85.7	464	540	962.0	863.6	319.1	811.2	822.3	34
36	1346	173.0	1028.7	1200.2	24	3	79.4	464	533	1016.0	914.4	325.4	858.8	870.0	36
38	1460	190.5	1099.0	1289.0	20	3 1/2	92.1	508	591	1073.2	965.2	352.4	904.9	919.2	38
40	1511	196.8	1162.0	1339.8	24	3 1/2	92.1	521	603	1127.1	1016.0	363.5	952.5	966.8	40
42	1562	206.4	1212.8	1390.6	24	3 1/2	92.1	540	622	1176.3	1066.8	371.5	1001.7	1016.0	42
44	1648	214.3	1270.0	1463.7	24	3 3/4	98.4	565	654	1235.1	1117.6	390.5	1047.8	1063.6	44
46	1734	225.4	1333.5	1536.7	24	4	104.8	591	686	1292.2	1168.4	411.2	1095.4	1112.8	46
48	1784	233.4	1384.3	1587.5	24	4	104.8	610	705	1343.0	1219.2	419.7	1144.6	1160.5	48

^a Dimension B (ID) shall be specified by the purchaser (see 2.1). The maximum ID includes the manufacturing tolerance allowed in 3.1.^b Maximum ID for mating to pipe having a specified minimum yield strength of 448 megapascals and a design factor of 0.72 is based upon the flange material having a specified minimum yield strength of 290 megapascals in the ring section of the flange and minimum yield strength at the welding end of 448 megapascals.