

Steel Pipeline Flanges

Standard Practice
Developed and Approved by the
Manufacturers Standardization Society of the
Valve and Fittings Industry, Inc.
127 Park Street, NE
Vienna, Virginia 22180
Phone: (703) 281-6613
Fax: (703) 281-6671
E-mail: info@mss-hq.org



www.mss-hq.org

This MSS Standard Practice was developed under the consensus of the MSS Technical Committee 110 and the MSS Coordinating Committee. The content of this Standard Practice is the result of the efforts of competent and concerned volunteers to provide an effective, clear, and non-exclusive specification that will benefit the industry as a whole. This MSS Standard Practice is intended as a basis for common practice by the manufacturer, the user, and the general public. The existence of an MSS Standard Practice does not in itself preclude the manufacture, sale, or use of products not conforming to the Standard Practice. Mandatory conformance is established only by reference in a code, specification, sales contract, or public law, as applicable.

Unless otherwise specifically noted in this MSS SP, any standard referred to herein is identified by the date of issue that was applicable to the referenced standard(s) at the date of issue of this MSS SP. (See Annex D.)

In this Standard Practice all notes, annexes, tables, and figures are construed to be essential to the understanding of the message of the standard, and are considered part of the text unless noted as "supplemental". All appendices appearing in this document are construed as "supplemental". Supplemental information does not include mandatory requirements.

This document has been substantially revised from the previous 2006 edition. It is suggested that if the user is interested in knowing what changes have been made, that direct page by page comparison should be made of this document.

Non-toleranced dimensions in this Standard Practice are nominal, and unless otherwise specified, shall be considered "for reference only".

The Metric (SI) units and U.S. Customary units in this SP are regarded separately as the standard; each should be used independently of the other. Combining or converting values between the two systems may result in nonconformance with this Standard Practice.

Any part of this Standard Practice may be quoted. Credit lines should read 'Extracted from MSS SP-44-2010, with permission of the publisher, the Manufacturers Standardization Society.' Reproduction prohibited under copyright convention unless written permission is granted by the Manufacturers Standardization Society of the Valve and Fittings Industry, Inc.

Originally Approved July, 1952

Copyright ©, 1981, 1982, 1985, 1996, 2006, 2010 by
Manufacturers Standardization Society
of the
Valve and Fittings Industry, Inc.
Printed in U.S.A.

FOREWORD

The Manufacturers Standardization Society originally developed this Standard Practice in response to the continued requests for steel pipe flanges for pipeline use, particularly in sizes larger than those covered by ANSI Standard B16.5 on Steel Pipe Flanges and Flanged Fittings. The line pipe is uniquely characterized by high-strength, cold worked, thin-wall of the carbon steel grade, which necessitates special considerations for the welding end of the flanges.

The size and pressure class range was originally NPS 26 through NPS 36 in pressure classes customarily designated in ANSI Standard B16.5 as 300, 400, 600, and 900 lb. The 1970 edition deleted the slip-on flanges for lack of demand, and added a 150 lb. class and coverage for sizes NPS 12 through NPS 24. Additional coverage was also necessitated by the advent of the use of line pipe of grades having minimum specified yield strength higher than the 52,000 psi maximum contemplated at the time of initial development, and therefore still thinner walls.

In some instances, this advent widened the differential between the tensile properties of the flange steel versus that of the mating pipe steel. This, in turn necessitated greater flexibility in the selection of hub dimensions, so that various combinations of material-strength and flange-dimensions could be utilized to supply the flanges. Section 5 on Flange Design was introduced at this point, and is one of the key features of this Standard Practice. The 1972 edition included the coverage of blind flanges in all pressure classes and clarification of text requirements for better understanding and usage under the more diverse conditions.

The 1975 edition expanded the size range above size NPS 36. The drilling templates for the Class 150 flanges of the NPS 38 and larger sizes continued the previous philosophy of adopting the drilling template of the Class 125 of ANSI Standard B16.1. However, the drilling templates of the Class 300 flanges of the NPS 38 and larger sizes did not continue the adoption of the Class 250 of ANSI Standard B16.1 drilling templates, nor did the NPS 38 and larger sizes of Classes 400, 600, and 900 continue the extrapolation of ANSI B16.5 drilling templates; instead, these drilling templates were necessarily designed more compactly because of the increased loads. While these flanges are designated by the customary ANSI Standard Class 150, 300, 400, 600, and 900, their use is almost entirely confined to cross country transmission pipelines at atmospheric temperatures. The flanges have been designed primarily for use at their cold ratings which conform to the ANSI Standard B16.5 ratings of 100°F, and are intended primarily for attachment to relatively thin-wall, high-strength cold worked pipe, and high-strength butt-welding fittings in pipeline service at temperatures of 450°F and lower. However, flanges forged of other materials are capable of pressure temperature ratings as specified in Section 2.1.

The 1980 edition was created to bring the document into closer editorial alignment with ANSI B16.5. However, out of recognition of the successful experience of the pipeline industry, room temperature ratings were extended to 250°F. Derating above 250°F was accelerated such that the 450°F ratings are the same as ANSI B16.5. Users are cautioned that when these flanges are bolted to valves and used at temperatures between 100°F and 450°F, the rating of the valve will not be as high as the flange.

The 1990 revision of this SP was required to update the referenced standards list and delete the metric equivalents.

The 1991 revision of this SP was required to add blind flange machining guidance, flat face requirements and precautionary notes as well as update of referenced standards.

The 1996 revision adds a table with permissible imperfections in flange facing finish and clarifies Annex A design criteria. There were several errata, or corrections made to references to other standards. Dimensional tolerances have been changed where necessary to conform to ASME B16.5 and B16.47.

The 2006 revision was required to add metric equivalent units, notch toughness requirement, new bolting materials and update of reference standards list.

This 2010 revision recognized the existence of ASME B16.47 Series A flanges, which adopted MSS SP-44 dimensions but does not cover the SP-44 high strength materials used in the pipeline industry to match API line pipe of equivalent grades.

TABLE OF CONTENTS

<u>SECTION</u>	<u>PAGE</u>
1 SCOPE	1
2 DENOTATION	1
3 MATERIALS	2
4 HEAT TREATMENT	5
5 FLANGE DESIGN	6
6 MARKING	7
7 FACINGS	8
8 CODE LIMITATIONS	8
9 FLANGE BOLTING DIMENSIONS	8
10 TOLERANCES	9

TABLE

1	Tensile Requirements – (Metric & U.S. Customary)	3
2	List of Bolting Specifications	4
3	Pressure-Temperature Ratings, Maximum Allowable Working Pressures – (Metric & U.S. Customary)	5
4	Sheet Gasket Dimensions – (Metric)	12
5	Ring-Joint Gasket Dimensions – (Metric)	13
6	Class 150, 19.6 bar at Atmospheric Temperature Raised Face – (Metric)	14
7	Class 300, 51.0 bar at Atmospheric Temperature Raised Face and Ring-Type Joint – (Metric)	15
8	Class 400, 68.3 bar at Atmospheric Temperature Raised Face and Ring-Type Joint – (Metric)	16
9	Class 600, 102.1 bar at Atmospheric Temperature Raised Face and Ring-Type Joint – (Metric) ..	17
10	Class 900, 153.1 bar at Atmospheric Temperature Raised Face and Ring-Type Joint – (Metric) ..	18
11	Permissible Imperfections in Flange Facing Finish – (Metric & U.S. Customary)	19

FIGURE

1	Acceptable Design for Unequal Wall Thickness	10
2	Bevel Detail for Wall Thickness (T), 22mm (0.88 in.) or less	11
3	Bevel Detail for Wall Thickness (T), Greater than 22mm (0.88 in.)	11

ANNEX

A	Design Criteria	20
B	Blind Flange Design Criteria	21
C	U.S. Customary Tables	22
	Table C1 – Sheet Gasket Dimensions	23
	Table C2 – Ring Joint Gasket Dimensions	24
	Table C3 – Class 150, 285 psi at Atmospheric Temperature Raised Face	25
	Table C4 – Class 300, 740 psi at Atmospheric Temperature Raised Face & Ring Joint	26
	Table C5 – Class 400, 990 psi at Atmospheric Temperature Raised Face & Ring Joint	27
	Table C6 – Class 600, 1480 psi at Atmospheric Temperature Raised Face & Ring Joint	28
	Table C7 – Class 900, 2220 psi at Atmospheric Temperature Raised Face & Ring Joint	29
D	Referenced Standards and Applicable Dates	30



Manufacturers Standardization Society of the Valve And Fittings Industry, Inc.

127 Park Street, NE • Vienna, VA 22180-4602 • 703-281-6613 • FAX 703-281-6671 • www.mss-hq.org • e-mail: info@mss-hq.org

EXECUTIVE DIRECTOR: Robert F. O'Neill

ERRATA SHEET FOR MSS SP-44-2010 and SP-44-2006

May 20, 2011

This “normative” errata correction applies to MSS SP-44-2010 (current version) and SP-44-2006, involving *Steel Pipeline Flanges*.

Note the following correction:

1. **Page 26 (2010 version)/Page 25 (2006 version), Table C4, Headings/Sub-Headings: Pipe Size “42”/Drilling/No. of Bolt Holes.** The number of bolt holes for Pipe Size 42 should indicate “32” instead of the existing “28”. Note that Table C4 involves *Class 300, 740 psi at Atmospheric Temperature Raised Face and Ring-Type Joints*.

This Errata Sheet is included in the Standard Practice.

Future printing of the Standard Practice will include this revised data.

PRESIDENT: J.V. Ballun – Val-Matic Valve & Mfg. Corp.

VICE PRESIDENTS: T.J. Hannafin – KITZ Corp. of America • M.A. Clark – NIBCO, Inc.

TREASURER: G.M. Johnson – United Valve

STEEL PIPELINE FLANGES

1. SCOPE

1.1 General This Standard Practice covers pressure-temperature ratings, materials, dimensions, tolerances, marking, and testing. The welding neck type flanges shall be forged steel, and the blind flanges may be made of either forged steel or from steel plates.

1.1.1 Dimensional and tolerance requirements for sizes NPS 10 and smaller are provided by reference to ASME B16.5. When such flanges are made of materials meeting Table 1 requirements and meet all other stipulations of this standard, they shall be considered as complying therewith.

1.2 *References*

1.2.1 Referenced Standards Standards and specifications adopted by reference in this Standard Practice are shown in Annex D, for convenience of identifying edition number, date and source of supply.

A flange made in conformance with a prior edition of referenced standards and in all other respects conforming to this Standard Practice will be considered to be in conformance even though the edition reference may be changed in a subsequent revision of this Standard Practice.

1.2.2 Codes and Regulations A flange used under the jurisdiction of the ASME Boiler and Pressure Vessel Code, the ANSI Code for Pressure Piping, or Governmental Regulations, is subject to any limitation of that code or regulation. This includes any maximum temperature limitation for a material, or rule governing the use of a material at a low temperature.

1.3 Relevant Units This Standard Practice states values in both metric and U.S. Customary units. As an exception, diameter of bolts and flange bolt holes are expressed in inch units only. These systems of units are to be regarded separately as standard.

Within the text, the U.S. Customary units are shown in parentheses, combined tables, or in separate tables. The values stated in each system are not exact equivalents; therefore, it is required that each system of units be used independently of the other. Except for diameter of bolts and flange bolt holes, combining values from the two systems constitutes nonconformance with the Standard Practice.

2. DENOTATION

2.1 *Pressure-Temperature Ratings*

2.1.1 General Flanges covered by this Standard Practice shall be designated as one of the following: Class 150, 300, 400, 600 and 900. Pressure temperature ratings in Table 3 are in metric and U.S. Customary.

2.2 Size NPS, followed by a dimensionless number, is the designation for nominal flange size. NPS is related to the reference nominal diameter, DN, used in international standards. The specific relationship for the NPS size flange to DN size flange in this Standard Practice is as follows:

NPS	12	14	16	18	20	22	24
DN	300	350	400	450	500	550	600
NPS	26	28	30	32	34	36	38
DN	650	700	750	800	850	900	950

NPS	40	42	44	46	48	50
DN	1000	1050	1100	1150	1200	1250
NPS	52	54	56	58	60	
DN	1300	1350	1400	1450	1500	

3. **MATERIALS**

3.1 The steel used in the manufacture of these flanges shall be selected by the manufacturer to meet the following requirements.

3.1.1 All materials used for flanges shall be killed steel. Acceptable forging and plate (blind flanges) materials include the following:

Forgings ^(a)	Plates ^(a)
ASTM Specification	ASTM Specification
A 105	A 515 Grade 70
A 350	A 516 Grade 70
A 694	A 537
A 707	

Note (a): Selected material shall meet the specified grade requirements of Table 1 and other provisions of Section 3.

3.1.2 The steel used shall be suitable for field welding to other flanges, fittings, or pipe manufactured under ASTM specifications A 105, A 53, A 106, A 350, A 381, A 694, A 707, or API Standard 5L.

3.1.3 The steel used shall have a maximum carbon content of 0.35 and a carbon equivalent computed by the following equation:

$$C.E. = C + \frac{Mn}{6} + \frac{Cr + Mo + V}{5} + \frac{Ni + Cu}{15}$$

that should not exceed 0.48%, based on ladle analysis. If the carbon equivalent factor exceeds 0.48% the acceptance of the flanges shall be based on agreement between purchaser and manufacturer.

3.1.3.1 The choice and use of alloying elements, combined with the elements within the limits prescribed in Section 3.1.3 to give the required tensile properties prescribed in Section 3.1.4 shall be made by the flange manufacturer and included and reported in the ladle analysis to identify the type of steel.

3.1.4 The steel used shall have tensile properties conforming to the requirements prescribed in Table 1 and capable of meeting the requirements of Section 4 and the flange manufacturer's design conditions as given in Annex A.

3.1.4.1 The test specimens may be taken from the forgings or, at the manufacturers' option, from the billets or forging bar entering into the finished product, provided such test blank has undergone relatively the same forming and the equivalent heat treatment as the finished flange. The dimensions of the test blank must be such as to adequately reflect the heat treatment properties of the hub of the flange. Specimens shall be obtained from the midwall of the thinnest section of the hub of the flange or 19mm (3/4 in.) from the surface of the test blank. The orientation of specimens taken from a flange shall be longitudinal.

3.1.5 When specified in the purchase order, Notch Toughness properties shall be determined with full size Charpy Type A V-notch specimens in accordance with ASTM A 370. Sub size specimens shall be used only when material to be tested is of insufficient thickness. All specimens shall be taken with the axis of the specimen longitudinal to the direction of major working and with the notch perpendicular to the surface. For plate, (blind flanges only), specimens may be taken transverse to the direction of rolling. From each sheet of steel, one set (three specimens) shall be tested at a maximum temperature of -7°C (20°F) or at the minimum temperature for which the flange pressure temperature rating is listed, typically -29°C (-20°F) and show 27 J, joule, (20 ft-lb) minimum average. Percent shear shall be reported for informational purposes only.

The test specimens shall have received the same working and shall be in the same heat treatment as the flanges they represent, when determining the typical notch toughness properties of a given material.

3.2 Bolting Bolting listed in Table 2 shall be used in flanged joints covered by this Standard Practice. Bolting of other material may be used if permitted by the applicable code or governmental regulation. All bolting materials are subject to the following limitations.

3.2.1 High Strength Bolting Bolting materials having allowable stresses not less than those for ASTM A193 Gr B7 are listed as high strength in Table 2. These and other materials of comparable strength may be used in any flanged joint.

3.2.2 Intermediate Strength Bolting Bolting materials listed as intermediate strength in Table 2, and other bolting of comparable strength, may be used in any flanged joint, provided the user verifies their ability to seat the selected gasket and maintain a sealed joint under expected operating conditions.

3.2.3 Low Strength Bolting Bolting materials having not more than 207 MPa (30 ksi) specified minimum yield strength are listed as low strength in Table 2. These materials and others of comparable strength shall be used only in Class 150 and Class 300 joints, and only with gaskets described in 3.3.2.

TABLE 1

Tensile Requirements (Metric & U.S. Customary)

GRADE	YIELD POINT MIN.		TENSILE STRENGTH MIN.		ELONGATION IN 50 mm or 2 in. MIN. PERCENT
	MPa	ksi	MPa	ksi	
F36	248 ^(a)	36 ^(a)	414	60	20
F42	290	42	414	60	20
F46	317	46	414	60	20
F48	331	48	427	62	20
F50	345	50	441	64	20
F52	359	52	455	66	20
F56	386	56	469	68	20
F60	414	60	517	75	20
F65	448	65	531	77	18
F70	483	70	552	80	18

(a) Note: except as required in Section 4.2.

TABLE 2

List of Bolting Specifications

ASTM BOLTING MATERIALS					
HIGH STRENGTH ^(a)		INTERMEDIATE STRENGTH ^(b)		LOW STRENGTH ^(c)	
SPEC-GR.	NOTES	SPEC-GR.	NOTES	SPEC-GR.	NOTES
A193-B7		A193-B5		A193-B8	CL1 (g)
A193-B16		A193-B6		A193-B8C	CL1 (g)
A320-L7	(d)	A193-B6X		A193-B8M	CL1 (g)
A320-L7A	(d)	A193-B7M		A193-B8T	CL1 (g)
A320-L7B	(d)	A193-B8	CL2 (f)	A193-B8A	(g)
		A193-B8	CL2B (f)		
A320-L7C	(d)	A193-B8C	CL2 (f)	A193-B8CA	(g)
A320-L43	(d)	A193-B8M	CL2 (f)	A193-B8MA	(g)
		A193-B8M	CL2B (f)		
A354-BC		A193-B8T	CL2 (f)	A193-B8TA	(g)
A354-BD		A320-B8	CL2 (f)	A307-B	(h)
A540-B21		A320-B8C	CL2 (f)	A320-B8	CL1 (g)
A540-B22		A320-B8F	CL2 (f)	A320-B8C	CL1 (g)
A540-B23		A320-B8M	CL2 (f)	A320-B 8M	CL1 (g)
A540-B24		A320-B8T	CL2 (f)	A320-B8T	CL1 (g)
		A449	(i)		
		A453-651	(e)		
		A453-660	(e)		

General Note:

Bolting materials shall not be used beyond temperature limits specified in the governing Code.

NOTES:

- These bolting materials may be used with all listed materials and gaskets.
- These bolting materials may be used with all listed materials and gaskets; provided it has been verified that a sealed joint can be maintained under rated pressure and temperature.
- These bolting materials may be used with all listed materials but are limited to Class 150 and Class 300 joints. See Section 3.3 for recommended gasket practices.
- This ferritic material is intended for low temperature service, use A194 Gr. 4 or Gr. 7 nuts.
- This special alloy is intended for high temperature service with austenitic stainless steel.
- This austenitic stainless steel has been carbide solution treated and strain hardened. Use A194 nuts of corresponding material.
- This austenitic stainless material has been carbide solution treated but not strain hardened. Use A194 nuts of corresponding material.
- This carbon steel fastener shall not be used above 205°C (400°F) or below -29°C (-20°F), see also Note (c). Bolts with drilled or undersized heads shall not be used.
- Acceptable nuts for use with quenched and tempered bolts are A194 Gr. 2 and Gr. 2H. Mechanical property requirements for studs shall be the same as those for bolts.

Pressure-Temperature Ratings Maximum Allowable Working Pressures (Metric & U.S. Customary)

3.3 Gasket Material

3.3.4 Sheet and ring joint gaskets for sizes NPS 10 and smaller shall conform to ASME B16.5 dimensions and recommendations.

4.2 It is recognized that the cooling rate in a quenching operation may be slower in the thicker ring section of the flange than in the thinner hub section. Hence, the increase in yield strength due to the quenching operation may be less in the ring section than in the hub section. This factor is accounted for in the section on design, Section 5.3. NPS 38 and larger sizes of the 300 and higher classes of welding neck flanges shall have 290 MPa (42 ksi) minimum yield strength in the ring section.

5. **FLANGE DESIGN**

5.1 *Drilling Templates* Drilling templates are derived as follows:

5.1.1 Class 150 flange drilling templates are the same as ASME B16.5 and Class 125 of ASME B16.1.

5.1.2 Sizes NPS 24 and smaller Class 300 flanges have drilling templates which are the same as ASME B16.5 and Class 250 of ASME B16.1. Sizes NPS 24 and smaller Class 400, 600 and 900 drilling templates are the same as ASME B16.5.

5.1.3 Sizes NPS 26 through NPS 60 Classes 150, 300, 400, 600 and 900 have drilling templates, which are the same as ASME B16.47, Series A flanges.

5.2 *Flange Ring Design* The outside diameter and flange thickness of sizes NPS 24 and smaller flanges are in accordance with ASME B16.5. The outside diameter and flange thickness of sizes NPS 26 through NPS 60 flanges are in accordance with ASME B16.47, Series A flanges. Larger sizes (NPS 26 through NPS 60) are designed in accordance with Appendix 2, Division 1, Section VIII, ASME Boiler and Pressure Vessel Code and the flange ring shall have sufficient pressure capacity for the service based on its strength in the normalized condition. This capacity shall be substantiated by the Rules for Bolted Flange Connections, Appendix 2, Division 1, Section VIII, ASME Boiler and Pressure Vessel Code, with allowable design stresses as given in Annex A of this standard.

5.3 *Hub Design* It should be recognized that ASME B16.5 and B16.47 base their welding neck flange ratings on their hubs at the welding ends having a thickness at least equal to that calculated for pipe having a 276MPa (40,000 psi) specified minimum yield strength and a maximum bore size. It should be recognized that when matching thinner wall, high strength pipe that existing hub designs in ASME B16.5 and B16.47 may not be adequate unless the following requirements are met:

5.3.1 Sizes NPS 60 and smaller. When the mechanical (minimum yield strength) properties of all sections of the flanges are equal to or higher than those of the pipe to be matched, the hub dimensions may be the same as those of ASME B16.5 or B16.47, Series A.

5.3.2 In addition, when the minimum yield strength of the hub portion of any flange or its representative test specimen is less than that specified for 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) shall at least equal the product of the specified nominal wall thickness and minimum specified yield strength of the pipe to be matched. Under these conditions, sizes NPS 24 and smaller flanges may also have a single taper hub and the outside diameter of the hub at the base may be modified in accordance with ASME Boiler and Pressure Vessel Code, Section VIII, Division 1, Appendix 2 calculations.

5.3.3 When the manufacturer employs this option, the flange identification should be a combination of the class of material of the flange and of the pipe for which the flange has been designed. See Section 6.1.

5.3.4 When the hub thickness at the welding end must be greater than the adjoining pipe, the joint design shall be as shown in any of the three sketches in Figure 1.

5.4 *Welding End* — The welding end shall be in accordance with Figure 2 for wall thickness (of intended mating pipe) of 22 mm (0.88 in.) and less. For thicker walls, refer to Figure 3.

5.5 *Blind Flange*

5.5.1 The outside diameter and thickness of blind flanges shall be as listed in Tables 6, 7, 8, 9, 10, C3, C4, C5, C6 and C7. Thicknesses listed are based on material having mechanical properties for Grade F36 of Table 1. Drilling templates are per Section 5.1. Thinner flanges of higher strength material may be furnished in accordance with Annex B rules.

5.5.2 Blind flanges need not be faced in the center if, when this center is raised, its diameter is at least 127 mm (5 in.) smaller than the nominal pipe size. When the center part is depressed, its diameter shall not be greater than the gasket ID specified in Tables 4 and C1 less 51 mm (2 in.) (I.D. – 51mm/2in. = max. depression O.D.).

5.6 Dimensional requirements for NPS 10 and smaller shall be in accordance with ASME B16.5.

5.7 *Flat Face Flanges* This standard permits flat face flanges in all classes, by providing flanges having either the full thickness or the thickness with the raised face removed, without reduction of the pressure-temperature ratings subject to the following provisions.

5.7.1 The thickness of a Class 150 or 300 flange from which the raised face has been removed shall be no less than the applicable dimension C of Tables 6, 7, C3 and C4.

5.7.2 The thickness of a flange of Class 400 or higher from which the raised face has been removed shall be no less than the applicable C dimension of Tables 8, 9, 10, C5, C6 and C7.

5.7.3 The flange facing shall conform to Section 7.2 for the full width of seating of the gasket.

5.8 *Spot Facing* All flanges shall have bearing surfaces for bolting which shall be parallel to the flange face within 1 deg. Any back facing or spot facing required to accomplish parallelism shall not reduce the flange thickness C below the dimensions given in Tables 6,7,8,9,10, C3, C4, C5, C6 and C7. Any spot facing or back facing shall be in accordance with MSS SP-9.

6. MARKING

6.1 Flanges shall be marked in accordance with the rules established in MSS Standard Practice SP-25. In addition, the letters, "PL" shall precede the grade symbol marking. The grade symbol marked on the Welding Neck Flange shall designate the grade of material in the welding end of the hub. When flanges are produced under the option of Section 5.3.1, the marking will also include the grade of the material of the pipe which the flange will match. For example, a flange having a grade F42 hub designed to be used with grade X60 pipe would contain the marking PL F42/X60 in addition to the marking specified in MSS SP-25.

6.2 Flanges in sizes NPS 10 and smaller produced to B16.5 dimensions and complying with all other requirements of this Standard Practice shall be marked in accordance with Section 6.1.

7. FACINGS

7.1 Flange Facing Finish The finish of contact faces of pipe flanges shall be judged by visual comparison with Ra Standards (see ASME B46.1) and not by instruments having stylus tracers and electronic amplification. The finishes required are given below. Other finishes may be furnished by agreement between user and manufacturer.

7.2 Raised Face Either a serrated-concentric or serrated-spiral finish having from 3.2 μm (125 $\mu\text{in.}$) to 6.3 μm (250 $\mu\text{in.}$) average shall be furnished. The cutting tool employed should have an approximate 1.5mm (0.06 in.) or larger radius, and there should be from 1.7 to 2.2 grooves/mm (44 to 55 grooves per in.).

7.3 Ring Joint The side wall surface of gasket groove shall not exceed 1.6 μm (63 micro inch) roughness

7.4 Flange Facing Finish Imperfections in the flange facing finish shall not exceed the dimensions shown in Table 11. Adjacent imperfections shall be separated by a distance of at least four times the permissible radial projection. Protrusions above the separations are not allowed.

8. CODE LIMITATIONS

8.1 A product used under the jurisdiction of the ASME Boiler and Pressure Vessel Code or of the ASME Code for Pressure Piping, is subject to any limitation of that code. This includes any maximum temperature limitation for a material, or a code rule governing the use of a material at a low temperature.

8.2 Flange Testing Flanges are not required to be hydrostatically tested. Flanged joints may be subjected to system hydrostatic tests at pressures not exceeding 1.5 times the 38°C (100°F) rating.

9. FLANGE BOLTING DIMENSIONS

9.1 Alloy-steel stud-bolts threaded at both ends or full length, or bolts with hexagonal heads conforming to American National Standard heavy dimensions (ASME B18.2.1) may be used and shall have nuts conforming to American National Standard heavy dimensions (ASME B18.2.2).

9.2 Carbon-Steel bolts smaller than $\frac{3}{4}$ in. shall have square heads or heavy hex heads (ASME B18.2.1), and shall have heavy hex nuts (ASME B18.2.2). Bolts $\frac{3}{4}$ in. and larger shall have square heads or hex heads (ASME B18.2.1), and shall have hex nuts or heavy hex nuts (ASME B18.2.2).

9.3 Threads of carbon-steel bolts and stud bolts shall be coarse series, Class 2A (ASME B1.1), and nuts shall be coarse series, Class 2B.

9.4 All alloy-steel bolting shall be threaded in accordance with ASME B1.1. Nominal diameters 1 in. and smaller shall be of the coarse thread series; nominal diameters $1\frac{1}{8}$ in. and larger shall be of the 8 thread series. Bolts, studs and stud-bolts shall have a class 2A thread, and nuts shall have a class 2B thread.

9.5 Bolting to Cast Iron Flanges Where Class 150 steel flanges are bolted to Class 125 cast iron flanges or Class 300 steel flanges are bolted to Class 250 cast iron flanges, it is recommended that low strength bolting be used. If intermediate or high-strength bolting is used, it is recommended that the mating flanges be flat faced and that full faced gaskets extending to the O.D. of the flange be used.

10. TOLERANCES

10.1 Facings

Outside Diameter, 2 mm (0.06 in.) raised face:

$12 \leq \text{NPS} \leq 24$ ± 1.0 mm (± 0.03 in.)

$\text{NPS} \geq 26$ ± 2.0 mm (± 0.08 in.)

Outside Diameter, 7.0 mm (0.25 in.) raised face:

$12 \leq \text{NPS} \leq 24$ ± 0.5 mm (± 0.02 in.)

$\text{NPS} \geq 26$ ± 1.0 mm (± 0.04 in.)

10.2 Flange Thickness

$\text{NPS} \leq 18$ +3.0 mm, -0.0 mm (+0.12 in., -0.0 in.)

$\text{NPS} \geq 20$ +5.0 mm, -0.0 mm (+0.19 in., -0.0 in.)

10.3 Hub Dimensions (including welding ends)

10.3.1 Nominal Outside Diameter of Welding End of welding neck flanges (Dimension H, in Tables 6, 7, 8, 9, 10, C3, C4, C5, C6 and C7.

$12 \leq \text{NPS} \leq 24$

+4.0 mm, -1.0 mm (+0.16 in., -0.03 in.)

$\text{NPS} \geq 26$

+5.0 mm, -1.5 mm (+0.21 in., -0.06 in.)

10.3.2 Nominal Inside Diameter of Welding Ends of welding neck flanges (Dimension B in the referenced Figures).

$12 \leq \text{NPS} \leq 18$ ± 1.5 mm (± 0.06 in.)

$\text{NPS} \geq 20$ +3.0 mm, -1.5 mm (+0.12 in., -0.06 in.)

10.3.3 *Thickness of Hub* Regardless of tolerances specified for dimensions A and B, the thickness of hub at the welding end shall never be less than 87½ percent of the nominal thickness of the pipe to which the flange is to be attached or the minimum wall as specified by the purchaser.

10.4 Overall Length through Hub on Welding Neck Flanges

$12 \leq \text{NPS} \leq 24$

+3.0 mm, -5.0 mm (+0.12 in., -0.18 in.)

$\text{NPS} \geq 26$ ± 5.0 mm (± 0.19 in.)

10.5 Drilling and Facing

10.5.1 Bolt Circle Diameter, ± 1.5 mm (± 0.06 in.)

10.5.2 Center-to-Center of adjacent bolt holes, ± 0.8 mm (± 0.03 in.)

10.5.3 Eccentricity between bolt circle diameter and machined facing diameters.

$12 \leq \text{NPS} \leq 24$ 1.5 mm (0.06 in.)

$\text{NPS} \geq 26$ 2.0 mm (0.09 in.)

10.6 *Sizes NPS 10 and Smaller* Tolerances for these sizes shall be as specified in ASME B16.5.

The listing of decimal tolerances does not imply method of measurement.

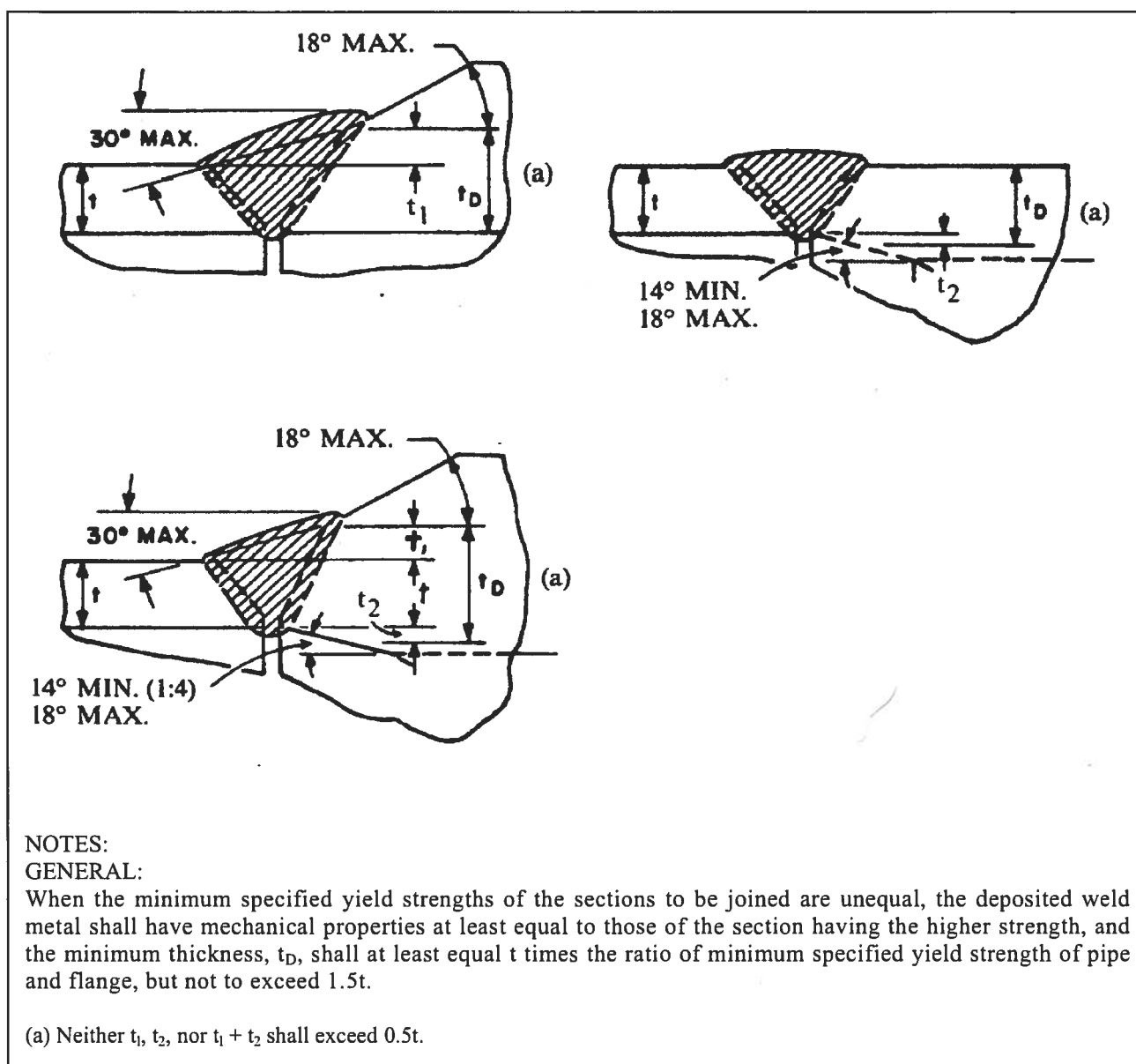


FIGURE 1 Acceptable Design for Unequal Wall Thickness⁽¹⁾
(See Section 5.3)

(1) Supplementary Footnote: See ASME B31 Piping Codes for additional fabrication details.

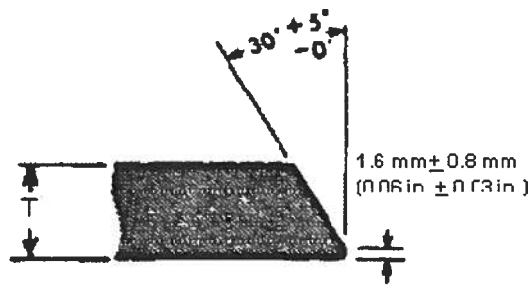


FIGURE 2 Bevel Detail for Wall Thickness (T), 22 mm (0.88 in.)^(a) or less

Note: (a) Flange sizes NPS 24 and smaller may be furnished with 37- ½ ° bevel at option of manufacturer.

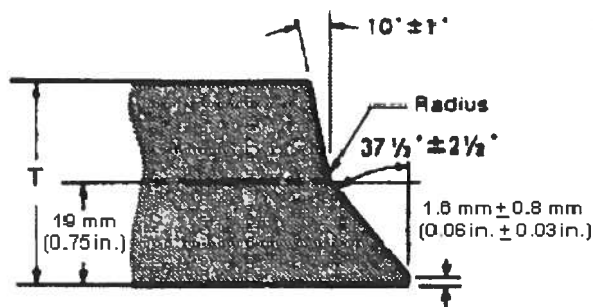


FIGURE 3 Bevel Detail for Wall Thickness (T), greater than 22 mm (0.88 in.)

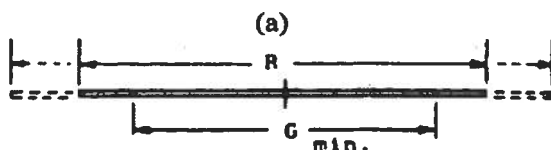


TABLE 4

Sheet Gasket Dimensions

Dimensions in mm

NOM. PIPE SIZE	O.D. GASKET R ^(a)	I. D. GASKET G MIN				
		Class 150	Class 300	Class 400	Class 600	Class 900
12	381.0	323.8	323.8	323.8	323.8	323.8
14	412.8	355.6	355.6	355.6	355.6	355.6
16	469.9	406.4	406.4	406.4	406.4	406.4
18	533.4	457.2	457.2	457.2	457.2	457.2
20	584.2	508.0	508.0	508.0	508.0	508.0
22	641.4	558.8	558.8	558.8	558.8	-
24	692.2	609.6	609.6	609.6	609.6	609.6
26	749.3	660.4	701.6	685.8	676.2	670.0
28	800.1	711.2	749.3	733.6	720.8	720.8
30	857.2	762.0	803.2	784.4	771.6	771.6
32	914.4	812.8	857.2	838.2	825.5	822.4
34	965.2	863.6	904.8	886.0	870.0	873.2
36	1022.4	914.4	955.6	936.8	920.8	924.0
38	Same as O.D. of Raised Face, R, In Tables 6, 7, 8, 9 & 10	965.2	965.2	958.8	952.5	939.8
40		1016.0	1016.0	1009.6	1003.3	990.6
42		1066.8	1066.8	1060.4	1054.1	1041.4
44		1117.6	1117.6	1111.2	1104.9	1092.2
46		1168.4	1168.4	1162.0	1155.7	1143.0
48		1219.2	1219.2	1212.8	1206.5	1193.8
50		1270.0	1270.0	1260.4	1251.0	-
52		1320.8	1320.8	1311.2	1301.8	-
54		1371.6	1371.6	1361.9	1352.6	-
56		1422.4	1422.4	1412.8	1403.4	-
58		1473.2	1473.2	1463.6	1454.2	-
60		1524.0	1524.0	1514.4	1505.0	-

Note: (a) Outside Diameter R may be made to fit the inside diameter of the bolts to act as a locating device when making a joint in the field, however, in no case should the contact area of the gasket be increased by changing the diameter of the raised face on the flange.

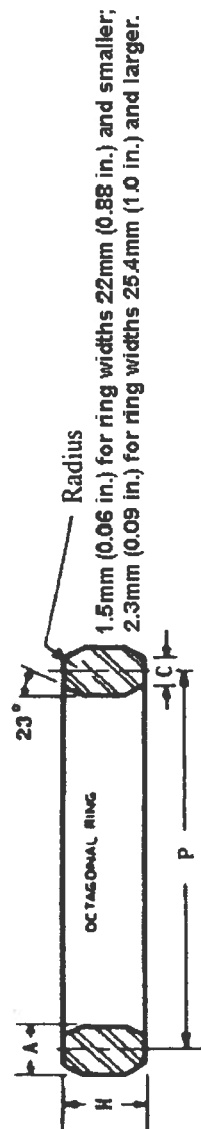


TABLE 5
Ring-Joint Gasket Dimensions ^(a)

Nom inal Pipe Size	CLASS 300, 400, AND 600						CLASS 900					Dimensions in mm		
	Pitch Dia. of Ring	Width of Ring	Height of Octagonal Ring	Oct Ring Flat	Ring No.	Pitch Dia. of Ring	Width of Ring	Height of Octagonal Ring	Oct Ring Flat	Ring No.				
	P	A	H	C		P	A	H	C					
12	381.00	11.12	15.9	7.75	R57	381.00	11.12	15.9	7.75	R57				
14	419.10	11.12	15.9	7.75	R61	419.10	15.88	20.6	10.49	R62				
16	469.90	11.12	15.9	7.75	R65	469.90	15.88	20.6	10.49	R66				
18	533.40	11.12	15.9	7.75	R69	533.40	19.05	23.8	12.32	R70				
20	584.20	12.70	17.5	8.66	R73	584.20	19.05	23.8	12.32	R74				
22	635.00	14.27	19.1	9.58	R81	—	—	—	—	—				
24	692.15	15.88	20.6	10.49	R77	692.15	25.40	31.8	17.30	R78				
26	749.30	19.05	23.8	12.32	R93	749.30	28.58	34.9	19.81	R100				
28	800.10	19.05	23.8	12.32	R94	800.10	31.75	38.1	22.33	R101				
30	857.25	19.05	23.8	12.32	R95	857.25	31.75	38.1	22.33	R102				
32	914.40	22.22	27.0	14.81	R96	914.40	31.75	38.1	22.33	R103				
34	965.20	22.22	27.0	14.81	R97	965.20	34.92	41.3	24.82	R104				
36	1022.35	22.22	27.0	14.81	R98	1022.35	34.92	41.3	24.82	R105				

Supplemental Information:

Note: (a) For matching tolerances of ring-joint gasket dimensions, see ASME B16.20.

Ring-Joint Gaskets are not contemplated for size 38, and larger flanges.

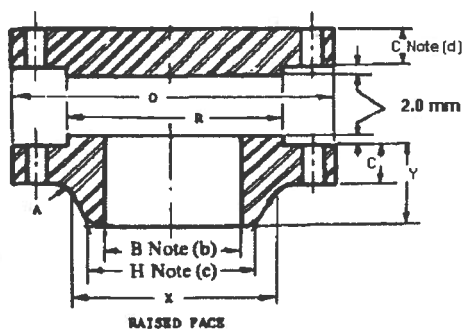


TABLE 6 Class 150, 19.6 bar at Atmospheric Temperature Raised Face ^(a)

Dimensions in mm except bolt holes

PIPE SIZE	FLANGE DIMENSIONS			HUB DIMENSIONS	DRILLING			Raised Face Dia.	Fillet Radius (MIN)
	OD Of Flange	Thick. Of Flange (MIN)	Length Thru Hub	OD Large End Hub	No. Of Bolt Holes	Dia. Of Bolt Holes	Dia. Of Bolt Circle		
	O	C	Y	X				R	A
12	485	30.2	113	365	12	1.00	431.8	381.0	10
14	535	33.4	125	400	12	1.12	476.3	412.8	10
16	595	35.0	125	457	16	1.12	539.8	469.9	10
18	635	38.1	138	505	16	1.25	577.9	533.4	10
20	700	41.3	143	559	20	1.25	635.0	584.2	10
22	750	44.5	148	610	20	1.38	692.2	641.4	10
24	815	46.1	151	663	20	1.38	749.3	692.2	10
26	870	66.7	119	676	24	1.38	806.4	749.3	10
28	925	69.9	124	727	28	1.38	863.6	800.1	11
30	985	73.1	135	781	28	1.38	914.4	857.2	11
32	1060	79.4	143	832	28	1.62	977.9	914.4	11
34	1110	81.0	148	883	32	1.62	1028.7	965.2	13
36	1170	88.9	156	933	32	1.62	1085.8	1022.4	13
38	1240	85.8	156	991	32	1.62	1149.4	1073.2	13
40	1290	88.9	162	1041	36	1.62	1200.2	1124.0	13
42	1345	95.3	170	1092	36	1.62	1257.3	1193.8	13
44	1405	100.1	176	1143	40	1.62	1314.4	1244.6	13
46	1455	101.6	184	1197	40	1.62	1365.2	1295.4	13
48	1510	106.4	190	1248	44	1.62	1422.4	1358.9	13
50	1570	109.6	202	1302	44	1.88	1479.6	1409.7	13
52	1625	114.3	208	1353	44	1.88	1536.7	1460.5	13
54	1685	119.1	214	1403	44	1.88	1593.8	1511.3	13
56	1745	122.3	227	1457	48	1.88	1651.0	1574.8	13
58	1805	127.0	233	1508	48	1.88	1708.2	1625.6	13
60	1855	130.2	238	1559	52	1.88	1759.0	1676.4	13

General Notes:

For machining tolerances see Section 10.
For welding end detail see Figures 1, 2 and 3.

Notes:

- (a) Rating for raised face flanges is predicated on the use of sheet gaskets shown in Table 4.
- (b) Dimensions to be specified by customer.
- (c) See Section 5.
- (d) Where calculated blind thickness is less than the mating welding neck, the thicknesses were made equal. See Section 5.5 for material requirements.

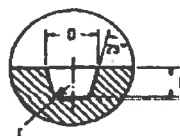
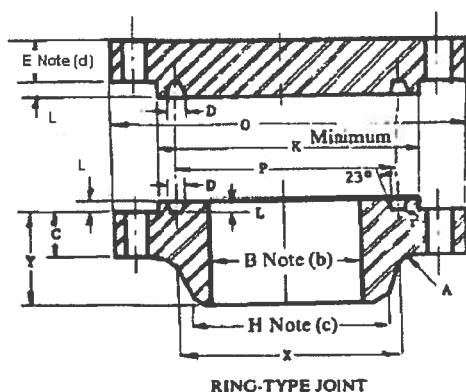


TABLE 7

Class 300, 51.0 bar at Atmospheric Temperature Raised Face ^(a)
and Ring-Type Joints

Dimensions in mm except bolt holes

Pipe Size	FLANGE DIMENSIONS				HUB DIM	DRILLING			FACING DIMENSIONS							Fillet Radius (min)	Groove Fillet Radius
	OD of Flange	Thick of Flange		Length Thru Hub	OD ^(c) Large End Hub	No. of Bolt Holes	Dia. of Bolt Holes	Dia. of Bolt Circle	Raised Face Dia.	Ring-Type Joint							
		Weld-Neck	(d) Bld. Fig.							Facing Dia.	Depth of Groove	Pitch Dia.	Width of Groove	Ring No.			
O	C	E	Y	X			R	K	L	P	D		A	r			
12	520	49.3	49.3	129	375	16	1.25	450.8	381.0	413	7.92	381.00	11.91	R57	10	0.8	
14	585	52.4	52.4	141	425	20	1.25	514.4	412.8	457	7.92	419.10	11.91	R61	10	0.8	
16	650	55.6	55.6	144	483	20	1.38	571.5	469.9	508	7.92	469.90	11.91	R65	10	0.8	
18	710	58.8	58.8	157	533	24	1.38	628.6	533.4	575	7.92	533.40	11.91	R69	10	0.8	
20	775	62.0	62.0	160	587	24	1.38	685.8	584.2	635	9.53	584.20	13.49	R73	10	1.5	
22	840	65.1	65.1	164	641	24	1.62	743.0	641.5	686	11.13	635.00	15.09	R81	10	1.5	
24	915	68.3	68.3	167	702	24	1.62	812.8	692.2	749	11.13	692.15	16.66	R77	10	1.5	
26	970	77.8	82.6	183	721	28	1.75	876.3	749.3	810	12.70	749.3	19.84	R93	10	1.5	
28	1035	84.2	88.9	195	775	28	1.75	939.8	800.1	861	12.70	800.1	19.84	R94	11	1.5	
30	1090	90.5	93.7	208	827	28	1.88	997.0	857.2	917	12.70	857.25	19.84	R95	11	1.5	
32	1150	96.9	98.5	221	881	28	2.00	1054.1	914.4	984	14.27	914.4	23.01	R96	11	1.5	
34	1205	100.1	103.2	230	937	28	2.00	1104.9	965.2	1035	14.27	965.20	23.01	R97	13	1.5	
36	1270	103.2	109.6	240	991	32	2.12	1168.4	1022.4	1092	14.27	1022.35	23.01	R98	13	1.5	
38	1170	106.4	106.4	179	994	32	1.62	1092.2	1028.7	—	—	—	—	—	13	—	
40	1240	112.8	112.8	192	1048	32	1.75	1155.7	1085.8	—	—	—	—	—	13	—	
42	1290	117.5	117.5	198	1099	32	1.75	1206.5	1136.6	—	—	—	—	—	13	—	
44	1355	122.3	122.3	205	1149	32	1.88	1263.6	1193.8	—	—	—	—	—	13	—	
46	1415	127.0	127.0	214	1203	28	2.00	1320.8	1244.6	—	—	—	—	—	13	—	
48	1465	131.8	131.8	222	1254	32	2.00	1371.6	1301.8	—	—	—	—	—	13	—	
50	1530	138.2	138.2	230	1305	32	2.12	1428.8	1358.9	—	—	—	—	—	13	—	
52	1580	142.9	142.9	237	1356	32	2.12	1479.6	1409.7	—	—	—	—	—	13	—	
54	1660	150.9	150.9	251	1410	28	2.38	1549.4	1466.8	—	—	—	—	—	13	—	
56	1710	152.4	152.4	259	1464	28	2.38	1600.2	1517.6	—	—	—	—	—	13	—	
58	1760	157.2	157.2	265	1514	32	2.38	1651.0	1574.8	—	—	—	—	—	13	—	
60	1810	162.0	162.0	271	1565	32	2.38	1701.8	1625.6	—	—	—	—	—	13	—	

General Notes:

For machining tolerances see Section 10.

For welding end detail see Figures 1, 2 and 3.

Notes:

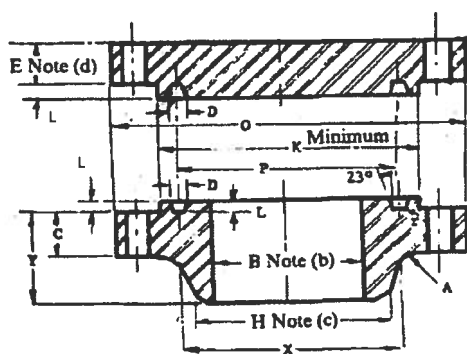
(a) Rating for raised face flanges is predicated on the use of sheet gaskets shown in Table 4.

(b) Dimensions to be specified by customer.

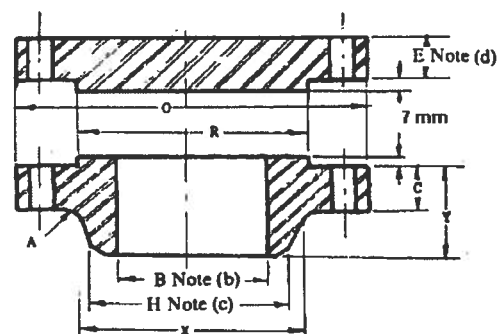
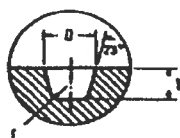
(c) See Section 5.

(d) Where calculated blind thickness is less than the mating welding neck, the thicknesses were made equal. See Section 5.5 for material requirements.

(e) Hub dimension for Size 24 and smaller flanges may vary as explained in Section 5.3.2.



RING-TYPE JOINT



RAISED FACE

TABLE 8

**Class 400, 68.3 bar at Atmospheric Temperature Raised Face^(a)
and Ring-Type Joints**

Dimensions in mm except bolt holes

Pipe Size	FLANGE DIMENSIONS				HUB DIM	DRILLING			FACING DIMENSIONS						Fillet Radius (min)	Groove Fillet Radius
	OD of Flange	Thick of Flange		Length Thru Hub	OD (c) Large End Hub	No. of Bolt Holes	Dia. of Bolt Holes	Dia. of Bolt Circle	Raised Face Dia.	Ring-Type Joint						
		Weld-Neck	(d)							Facing Dia.	Depth of Groove	Pitch Dia.	Width of Groove	Ring No.		
			Bld. Fig.													
	O	C	E	Y	X				R	K	L	P	D		A	r
12	520	57.2	57.2	137	375	16	1.38	450.8	381.0	413	7.92	381.00	11.91	R57	11	0.8
14	585	60.4	60.4	149	425	20	1.38	514.4	412.8	457	7.92	419.10	11.91	R61	11	0.8
16	650	63.5	63.5	152	483	20	1.50	571.5	469.9	508	7.92	469.90	11.91	R65	11	0.8
18	710	66.7	66.7	165	533	24	1.50	628.6	533.4	575	7.92	533.40	11.91	R69	11	0.8
20	775	69.9	69.9	168	587	24	1.62	685.8	584.2	635	9.53	584.20	13.49	R73	11	1.5
22	840	73.1	73.1	171	641	24	1.75	743.0	641.5	686	11.13	635.00	15.09	R81	11	1.5
24	915	76.2	76.2	175	702	24	1.88	812.8	692.2	749	11.13	692.15	16.66	R77	11	1.5
26	970	88.9	98.5	194	727	28	1.88	876.3	749.3	810	12.70	749.3	19.84	R93	11	1.5
28	1035	95.3	104.8	206	783	28	2.00	939.8	800.1	861	12.70	800.1	19.84	R94	13	1.5
30	1090	101.6	111.2	219	837	28	2.12	997.0	857.2	917	12.70	857.25	19.84	R95	13	1.5
32	1150	108.0	115.9	232	889	28	2.12	1054.1	914.4	984	14.27	914.4	23.01	R96	13	1.5
34	1205	111.2	122.3	241	945	28	2.12	1104.9	965.2	1035	14.27	965.20	23.01	R97	14	1.5
36	1270	114.3	128.6	251	1000	32	2.12	1168.4	1022.4	1092	14.27	1022.35	23.01	R98	14	1.5
38	1205	123.9	123.9	206	1003	32	1.88	1117.6	1035.0	-	-	-	-	-	14	-
40	1270	130.2	130.2	216	1054	32	2.00	1174.8	1092.2	-	-	-	-	-	14	-
42	1320	133.4	133.4	224	1108	32	2.00	1225.6	1143.0	-	-	-	-	-	14	-
44	1385	139.7	139.7	233	1159	32	2.12	1282.7	1200.2	-	-	-	-	-	14	-
46	1440	146.1	146.1	244	1213	36	2.12	1339.8	1257.3	-	-	-	-	-	14	-
48	1510	152.4	152.4	257	1267	28	2.38	1403.4	1308.1	-	-	-	-	-	14	-
50	1570	157.2	158.8	268	1321	32	2.38	1460.5	1362.1	-	-	-	-	-	14	-
52	1620	162.0	163.6	276	1372	32	2.38	1511.3	1412.9	-	-	-	-	-	14	-
54	1700	169.9	171.5	289	1426	28	2.62	1581.2	1470.0	-	-	-	-	-	14	-
56	1755	174.7	176.3	298	1480	32	2.62	1632.0	1527.2	-	-	-	-	-	14	-
58	1805	177.8	181.0	306	1530	32	2.62	1682.8	1578.0	-	-	-	-	-	14	-
60	1885	185.8	189.0	319	1584	32	2.88	1752.6	1635.1	-	-	-	-	-	14	-

General Notes:

For machining tolerances see Section 10.

For welding end detail see Figures 1, 2 and 3.

Notes:

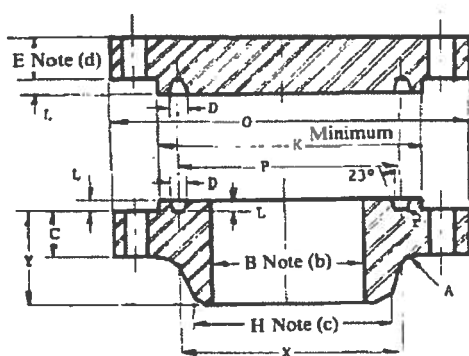
(a) Rating for raised face flanges is predicated on the use of sheet gaskets shown in Table 4.

(b) Dimensions to be specified by customer.

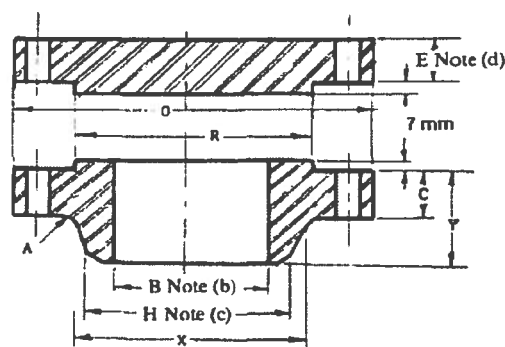
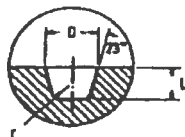
(c) See Section 5.

(d) Where calculated blind thickness is less than the mating welding neck, the thicknesses were made equal. See Section 5.5 for material requirements.

(e) Hub dimension for Size 24 and smaller flanges may vary as explained in Section 5.3.2.



RING-TYPE JOINT



RAISED FACE

TABLE 9

Class 600, 102.1 bar at Atmospheric Temperature Raised Face ^(a)
and Ring-Type Joints

Dimensions in mm except bolt holes

Pipe Size	FLANGE DIMENSIONS				HUB DIM	DRILLING			FACING DIMENSIONS						Fillet Radiu s (min)	Groove Fillet Radius
	OD of Flange	Thickness of Flange		Length Thru Hub	OD Large End Hub	No. of Bolt Holes	Dia. of Bolt Holes	Dia. of Bolt Circle	Raised Face Dia.	Ring-Type Joint						
		Weld- Neck	Bld. Fig. (d)							Facing Dia.	Depth of Groove	Pitch Dia.	Width of Groove	Ring No.		
O	C	E	Y	X				R	K	L	P	D	A	r		
12	560	66.7	66.7	156	400	20	1.38	489.0	381.0	413	7.92	381.00	11.91	R57	11	0.8
14	605	69.9	69.9	165	432	20	1.50	527.0	412.8	457	7.92	419.10	11.91	R61	11	0.8
16	685	76.2	76.2	178	495	20	1.62	603.2	469.9	508	7.92	469.90	11.91	R65	11	0.8
18	745	82.6	82.6	184	546	20	1.75	654.0	533.4	575	7.92	533.40	11.91	R69	11	0.8
20	815	88.9	88.9	190	610	24	1.75	723.9	584.2	635	9.53	584.20	13.49	R73	11	1.5
22	870	95.3	95.3	197	667	24	1.88	777.8	641.4	686	11.13	635.00	15.09	R81	11	1.5
24	940	101.6	101.6	203	718	24	2.00	838.2	692.2	749	11.13	692.15	16.66	R77	11	1.5
26	1015	108.0	125.5	222	748	28	2.00	914.4	749.3	810	12.70	749.30	19.84	R93	13	1.5
28	1075	111.2	131.8	235	803	28	2.12	965.2	800.1	861	12.70	800.10	19.84	R94	13	1.5
30	1130	114.3	139.7	248	862	28	2.12	1022.4	857.2	917	12.70	857.25	19.84	R95	13	1.5
32	1195	117.5	147.7	260	918	28	2.38	1079.5	914.4	984	14.27	914.40	23.01	R96	13	1.5
34	1245	120.7	154.0	270	973	28	2.38	1130.3	965.2	1035	14.27	965.20	23.01	R97	14	1.5
36	1315	123.9	162.0	283	1032	28	2.62	1193.8	1022.4	1092	14.27	1022.35	23.01	R98	14	1.5
38	1270	152.4	155.6	254	1022	28	2.38	1162.0	1054.1	-	-	-	-	-	14	-
40	1320	158.8	162.0	264	1073	32	2.38	1212.8	1111.2	-	-	-	-	-	14	-
42	1405	168.3	171.5	279	1127	28	2.62	1282.7	1168.4	-	-	-	-	-	14	-
44	1455	173.1	177.8	289	1181	32	2.62	1333.5	1225.6	-	-	-	-	-	14	-
46	1510	179.4	185.8	300	1235	32	2.62	1390.6	1276.4	-	-	-	-	-	14	-
48	1595	189.0	195.3	316	1289	32	2.88	1460.5	1333.5	-	-	-	-	-	14	-
50	1670	196.9	203.2	329	1343	28	3.12	1524.0	1384.3	-	-	-	-	-	14	-
52	1720	203.2	209.6	337	1394	32	3.12	1574.8	1435.1	-	-	-	-	-	14	-
54	1780	209.6	217.5	349	1448	32	3.12	1632.0	1492.2	-	-	-	-	-	14	-
56	1855	217.5	225.5	362	1502	32	3.38	1695.4	1543.0	-	-	-	-	-	16	-
58	1905	222.3	231.8	370	1553	32	3.38	1746.2	1600.2	-	-	-	-	-	16	-
60	1995	233.4	242.9	389	1610	28	3.62	1822.4	1657.4	-	-	-	-	-	17	-

General Notes:

For machining tolerances see Section 10.
For welding end detail see Figures 1, 2 and 3.

Notes

- (a) Rating for raised face flanges is predicated on the use of sheet gaskets shown in Table 4.
(b) Dimensions to be specified by customer.
(c) See Section 5.
(d) Where calculated blind thickness is less than the mating welding neck, the thicknesses were made equal. See Section 5.5 for material requirements.
(e) Hub dimension for Size 24 and smaller flanges may vary as explained in Section 5.3.2.

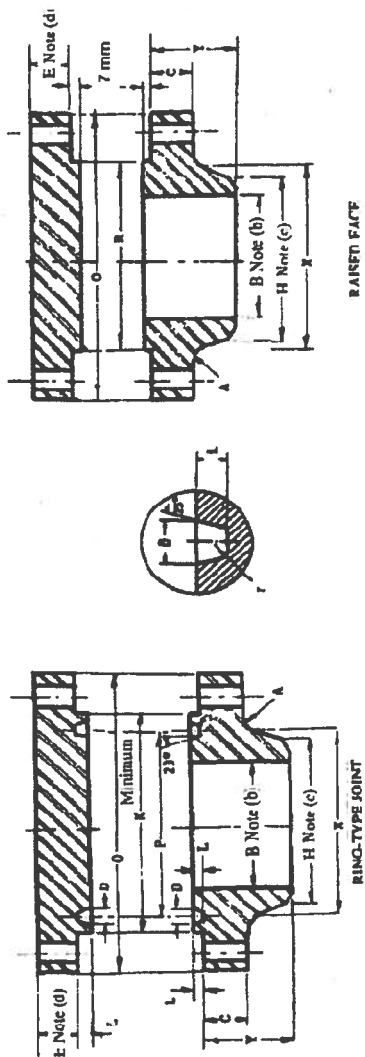


TABLE 10 Class 900, 153.1 bar at Atmospheric Temperature Raised Face ^(a) and Ring-Type Joints
Dimensions in mm except bolt holes

Pipe Size	FLANGE DIMENSIONS				HUB	DRILLING			FACING DIMENSIONS						Groove Fillet Radius		
	OD of Flange	THICK OF FLANGE		Length Thru Hub		OD Large End Hub	No. of Bolt Holes	Dia. of Bolt Holes	Dia. of Bolt Circle	Raised Face Dia.	RING-TYPE JOINT					Fillet Radius (min)	
		Weld-Neck	Bld.Fig. (d)								Facing Dia.	Depth of Groove	Pitch Dia.	Width of Groove			Ring No.
	O	C	E	Y	X				R	K	L	P	D		A	R	
12	610	79.4	79.4	200	419	20	1.50	533.4	381.0	419	7.92	381.00	11.91	R57	11	0.8	
14	640	85.8	85.8	213	451	20	1.62	558.8	412.8	467	11.13	419.10	16.66	R62	11	1.5	
16	705	88.9	88.9	216	508	20	1.75	616.0	469.9	524	11.13	469.90	16.66	R66	11	1.5	
18	785	101.6	101.6	229	565	20	2.00	685.8	533.4	594	12.70	533.40	19.84	R70	11	1.5	
20	855	108.0	108.0	248	622	20	2.12	749.3	584.2	648	12.70	584.20	19.84	R74	11	1.5	
24	1040	139.7	139.7	292	749	20	2.62	901.7	692.2	772	15.88	692.15	26.97	R78	11	2.3	
26	1085	139.7	160.4	286	775	20	2.88	952.5	749.3	832	17.48	749.30	30.18	R100	11	2.3	
28	1170	142.9	171.5	298	832	20	3.12	1022.4	800.1	889	17.48	800.10	33.32	R101	13	2.3	
30	1230	149.3	182.6	311	889	20	3.12	1085.8	857.2	946	17.48	857.25	33.32	R102	13	2.3	
32	1315	158.8	193.7	330	946	20	3.38	1155.7	914.4	1003	17.48	914.40	33.32	R103	13	2.3	
34	1395	165.1	204.8	349	1006	20	3.62	1225.6	965.2	1067	20.62	965.20	36.52	R104	14	2.3	
36	1460	171.5	214.4	362	1064	20	3.62	1289.0	1022.4	1124	20.62	1022.35	36.52	R105	14	2.3	
38	1460	190.5	215.9	352	1073	20	3.62	1289.0	1098.6	-	-	-	-	-	19	-	
40	1510	196.9	223.9	364	1127	24	3.62	1339.8	1162.8	-	-	-	-	-	21	-	
42	1560	206.4	231.8	371	1176	24	3.62	1390.6	1212.8	-	-	-	-	-	21	-	
44	1650	214.4	242.9	391	1235	24	3.88	1463.7	1270.0	-	-	-	-	-	22	-	
46	1735	225.5	255.6	411	1292	24	4.12	1536.7	1333.5	-	-	-	-	-	22	-	
48	1785	233.4	263.6	419	1343	24	4.12	1587.5	1384.3	-	-	-	-	-	24	-	

General Notes:
For machining tolerances see Section 10.
For welding end detail see Figures 1, 2 and 3.

Notes: (a) Rating for raised face flanges is predicated on the use of sheet gaskets shown in Table 4.
(b) Dimensions to be specified by customer.
(c) See Section 5.
(d) Where calculated blind thickness is less than the mating welding neck, the thicknesses were made equal. See Section 5.5 for material requirements.
(e) Hub dimension for Size 24 and smaller flanges may vary as explained in Section 5.3.2.

TABLE 11**Permissible Imperfections in Flange Facing Finish ^(a)**

Metric and U.S. Customary

NPS	MAXIMUM RADIAL ^(b) PROJECTION OF IMPERFECTIONS THAT ARE NO DEEPER THAN THE BOTTOM OF THE SERRATIONS		MAXIMUM DEPTH AND RADIAL PROJECTION OF IMPERFECTIONS THAT ARE DEEPER THAN THE BOTTOM OF THE SERRATIONS	
	MM	INCH	MM	INCH
12 - 14	8.0	0.31	4.5	0.18
16	10.0	0.38	4.5	0.18
18 - 24	12.0	0.50	6.0	0.25
26 - 36	12.5	0.50	6.0	0.25
38 - 48	14.0	0.56	7.0	0.28
50 - 60	16.0	0.62	8.0	0.31

- NOTES: (a) Imperfections less than half the depth of the serrations shall not be cause for rejection. See Section 7.4.
- (b) A radial projection shall be measured by the difference between an inner radius and an outer radius encompassing the imperfection where the radius is struck from the center line of the bore.

ANNEX A

Design Criteria

This Annex is an integral part of this Standard Practice and is placed after the main text for convenience.

These flanges were designed in accordance with the formula of paragraphs UA 45 - UA 59 (inclusive) of Section VIII Unfired Pressure Vessel, Division 1 (1950 ed.). Currently, the equivalent paragraphs are found in Appendix 2, ASME Section VIII, Division 1. This Annex is presented as a description of the basis for this Standard Practice. Any deviations from the dimensions, material, or provisions of this Standard Practice are the responsibility of the User/ Designer. The maximum allowable stresses were established as follows.

	<u>SIZES 12-36 incl.</u>		<u>SIZES 38-60 incl.</u>	
	<u>MPa</u>	<u>ksi</u>	<u>MPa</u>	<u>ksi</u>
Longitudinal Hub Stress	205	30	205	30
Radial Flange Stress	140	20	170	25
Tangential Flange Stress	140	20	170	25
Average Stress	140	20	170	25
Bolt Stress (2½" and Smaller)	140	20	170	25
Bolt Stress (Larger than 2½ ")	140	20	160	23

1. The suggested ASME Section VIII, Division 1 values of 3700 and 2.75 for Y and M factors of 1.5mm (0.06 in.) thick, flat, asbestos ring gaskets were assumed.
2. The widths of the gaskets were established as those whose surface areas would be at least twice the new bolt area.
3. For the Class 300, 400, 600 and 900 flanges, the slope and the O.D. of the hub at the base are designed for welding ends having equivalent yield strength and thickness as those of the mating pipe. The wall thickness of the intended mating pipe was based upon API 5LX-52 with a 0.68 design factor for the NPS 26-36 sizes, and API 5LX-65 with 0.72 design factor for the NPS 38 and larger sizes. When the manufacturer of the NPS 26-36 sizes elects to utilize the alternative permitted in Section 5.3.1, or when the mating pipe has a minimum specified yield strength exceeding 450 MPa (65,000 psi), it will be necessary for him to recalculate the design in accordance with the requirements of Section 5.3.1.
4. The design of the 38 NPS and larger sizes of the 300 and higher classes of welding neck flanges is predicated upon the flange material having a minimum specified yield strength of at least 290 MPa (42,000 psi) in the ring section of the flange and a minimum yield at the welding end at least equal to that specified for the mating pipe. When the yield strength of the welding end of the flange is less than specified, compensation in accordance with Section 5.3.2 may be made, but the hub slope and diameter at larger end must be preserved.
5. The design of all sizes is predicated on the use of heat treated carbon steel bolt studs for Class 150 flanges and alloy steel bolt studs for Class 300, 400, 600, and 900 flanges. Bolt diameters shall be 1/8 in. less than the bolt hole sizes shown in the tables.

ANNEX B

Blind Flange Design Criteria

This Annex is an integral part of this Standard Practice and is placed after the main text for convenience.

Blind flanges were designed in accordance with the formula of Paragraph UG34 of Section VIII (Pressure Vessels, Division 1) of the ASME Boiler and Pressure Vessel Code. The thicknesses listed in Tables 6, 7, 8, 9, 10, C3, C4, C5, C6 and C7 were based on material having mechanical properties for Grade F36 of Table 1 with allowable stresses as listed below:

	SIZES 26-60	
	MPa	ksi
Blind Flange Stress	180 (1.5 x 120)	26 (1.5x17.5)

Where the calculated blind flange thickness is less than the mating welding neck, the thicknesses were made equal to the welding neck thicknesses.

Blind flanges may be produced using any of the higher strength grades of materials listed in Table 1. The thicknesses may then be reduced in accordance with the following formula, but in no case shall they be thinner than the corresponding welding neck flange thickness "C":

$$E' = E \sqrt{\frac{414}{UTS_F}} \quad (\text{Metric})$$

$$E' = E \sqrt{\frac{60}{UTS_F}} \quad (\text{U.S. Customary})$$

where E' = Reduced blind flange thicknesses based on higher grade material in mm or inch per applicable formulae.

E = Present blind thickness based on F36 grade material (See Tables 6-10 and C3-C7).

UTS_F = Tensile strength of higher grade material from Table 1 in MPa for metric or ksi for U.S. Customary.

Blinds produced to a thinner thickness from higher strength material should be identified in the marking with the higher grade material designation. All other marking required by Section 6 shall be included.

ANNEX C

Dimensional Data for Gaskets and Classes 150, 300, 400, 600, and 900 Flanges in U.S. Customary Units

This Annex is an integral and mandatory part of SP-44-2010 and is placed after the main text for convenience.

Tables included in this Annex provide dimensional data in U.S. Customary units for the following:

- (a) Sheet Gaskets
- (b) Ring Joint Gaskets
- (c) Classes 150, 300, 400, 600 and 900 flanges

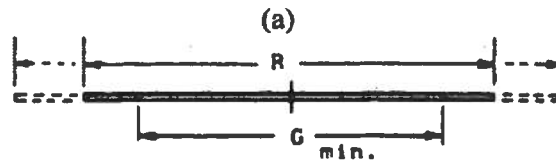


TABLE C1

Sheet Gasket Dimensions

Dimensions in inches

NOM. PIPE SIZE	O.D. GASKET $R^{(a)}$	I. D. GASKET G MIN				
		Class 150	Class 300	Class 400	Class 600	Class 900
12	15.00	12.75	12.75	12.75	12.75	12.75
14	16.25	14.00	14.00	14.00	14.00	14.00
16	18.50	16.00	16.00	16.00	16.00	16.00
18	21.00	18.00	18.00	18.00	18.00	18.00
20	23.00	20.00	20.00	20.00	20.00	20.00
22	25.25	22.00	22.00	22.00	22.00	-
24	27.25	24.00	24.00	24.00	24.00	24.00
26	29.50	26.00	27.62	27.00	26.62	26.38
28	31.50	28.00	29.50	28.88	28.38	28.38
30	33.75	30.00	31.62	30.88	30.38	30.38
32	36.00	32.00	33.75	33.00	32.50	32.38
34	38.00	34.00	35.62	34.88	34.25	34.38
36	40.25	36.00	37.62	36.88	36.25	36.38
38	Same as O.D. of Raised Face, R, In Tables C3, C4, C5, C6 & C7	38.00	38.00	37.75	37.50	37.00
40		40.00	40.00	39.75	39.50	39.00
42		42.00	42.00	41.75	41.50	41.00
44		44.00	44.00	43.75	43.50	43.00
46		46.00	46.00	45.75	45.50	45.00
48		48.00	48.00	47.75	47.50	47.00
50		50.00	50.00	49.62	49.25	-
52		52.00	52.00	51.62	51.25	-
54		54.00	54.00	53.62	53.25	-
56		56.00	56.00	55.62	55.25	-
58		58.00	58.00	57.62	57.25	-
60		60.00	60.00	59.62	59.25	-

Note: (a) Outside Diameter R may be made to fit the inside diameter of the bolts to act as a locating device when making a joint in the field, however, in no case should the contact area of the gasket be increased by changing the diameter of the raised face on the flange.

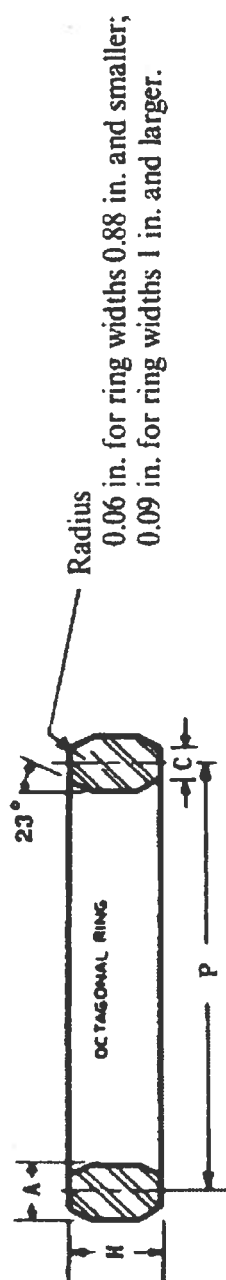


TABLE C2
Ring-Joint Gasket Dimensions ^(a)

Dimensions in inches										
CLASS 300, 400, AND 600						CLASS 900				
Nominal Pipe Size	Pitch Dia. of Ring	Width of Ring	Height of Octagonal Ring	Oct Ring Flat	Ring No.	Pitch Dia. of Ring	Width of Ring	Height of Octagonal Ring	Oct Ring Flat	Ring No.
	P	A	H	C		P	A	H	C	
12	15.000	0.438	0.625	0.305	R57	15.000	0.438	0.625	0.305	R57
14	16.500	0.438	0.625	0.305	R61	16.500	0.625	0.812	0.413	R62
16	18.500	0.438	0.625	0.305	R65	18.500	0.625	0.812	0.413	R66
18	21.000	0.438	0.625	0.305	R69	21.000	0.750	0.938	0.485	R70
20	23.000	0.500	0.688	0.341	R73	23.000	0.750	0.938	0.485	R74
22	25.000	0.562	0.750	0.377	R81	—	—	—	—	—
24	27.250	0.625	0.812	0.413	R77	27.250	1.000	1.250	0.681	R78
26	29.500	0.750	0.938	0.485	R93	29.500	1.125	1.375	0.780	R100
28	31.500	0.750	0.938	0.485	R94	31.500	1.250	1.500	0.879	R101
30	33.750	0.750	0.938	0.485	R95	33.750	1.250	1.500	0.879	R102
32	36.000	0.875	1.062	0.583	R96	36.000	1.250	1.500	0.879	R103
34	38.000	0.875	1.062	0.583	R97	38.000	1.375	1.625	0.977	R104
36	40.250	0.875	1.062	0.583	R98	40.250	1.375	1.625	0.977	R105

Supplemental Information

Note: (a) For machining tolerances of ring-joint gasket dimensions, see ASME B16.20.

Ring-Joint Gaskets are not contemplated for size 38, and larger flanges.

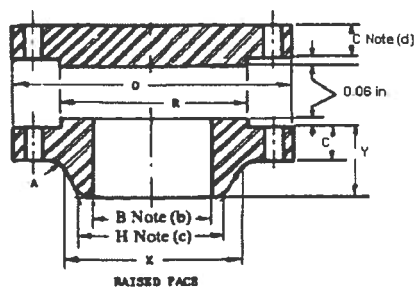


TABLE C3

Class 150, 285 psi at Atmospheric Temperature Raised Face ^(a)

Dimensions in inches

PIPE SIZE	FLANGE DIMENSIONS			HUB DIMENSIONS	DRILLING			Raised Face Dia.	Fillet Radius (MIN)
	OD of Flange	Thick. of Flange (MIN)	Length Thru Hub	OD Large End Hub	No. of Bolt Holes	Dia. of Bolt Holes	Dia. of Bolt Circle		
	O	C	Y	X				R	A
12	19.00	1.19	4.44	14.38	12	1.00	17.00	15.00	0.38
14	21.00	1.31	4.94	15.75	12	1.12	18.75	16.25	0.38
16	23.50	1.38	4.94	18.00	16	1.12	21.25	18.50	0.38
18	25.00	1.50	5.44	19.88	16	1.25	22.75	21.00	0.38
20	27.50	1.62	5.62	22.00	20	1.25	25.00	23.00	0.38
22	29.50	1.75	5.82	24.00	20	1.38	27.25	25.25	0.38
24	32.00	1.81	5.94	26.12	20	1.38	29.50	27.25	0.38
26	34.25	2.63	4.69	26.62	24	1.38	31.75	29.50	0.38
28	36.50	2.75	4.88	28.62	28	1.38	34.00	31.50	0.44
30	38.75	2.88	5.32	30.75	28	1.38	36.00	33.75	0.44
32	41.75	3.13	5.63	32.75	28	1.62	38.50	36.00	0.44
34	43.75	3.19	5.82	34.75	32	1.62	40.50	38.00	0.50
36	46.00	3.50	6.13	36.75	32	1.62	42.75	40.25	0.50
38	48.75	3.38	6.13	39.00	32	1.62	45.25	42.25	0.50
40	50.75	3.50	6.38	41.00	36	1.62	47.25	44.25	0.50
42	53.00	3.75	6.69	43.00	36	1.62	49.50	47.00	0.50
44	55.25	3.94	6.94	45.00	40	1.62	51.75	49.00	0.50
46	57.25	4.00	7.25	47.12	40	1.62	53.75	51.00	0.50
48	59.50	4.19	7.50	49.12	44	1.62	56.00	53.50	0.50
50	61.75	4.32	7.94	51.25	44	1.88	58.25	55.50	0.50
52	64.00	4.50	8.19	53.25	44	1.88	60.50	57.50	0.50
54	66.25	4.69	8.44	55.25	44	1.88	62.75	59.50	0.50
56	68.75	4.82	8.94	57.38	48	1.88	65.00	62.00	0.50
58	71.00	5.00	9.19	59.38	48	1.88	67.25	64.00	0.50
60	73.00	5.13	9.38	61.38	52	1.88	69.25	66.00	0.50

General Notes:

For machining tolerances see Section 10.

For welding end detail see Figures 1, 2 and 3.

Notes:

(a) Rating for raised face flanges is predicated on the use of sheet gaskets shown in Table C1.

(b) Dimensions to be specified by customer.

(c) See Section 5.

(d) Where calculated blind thickness is less than the mating welding neck, the thicknesses were made equal. See Section 5.5 for material requirements.

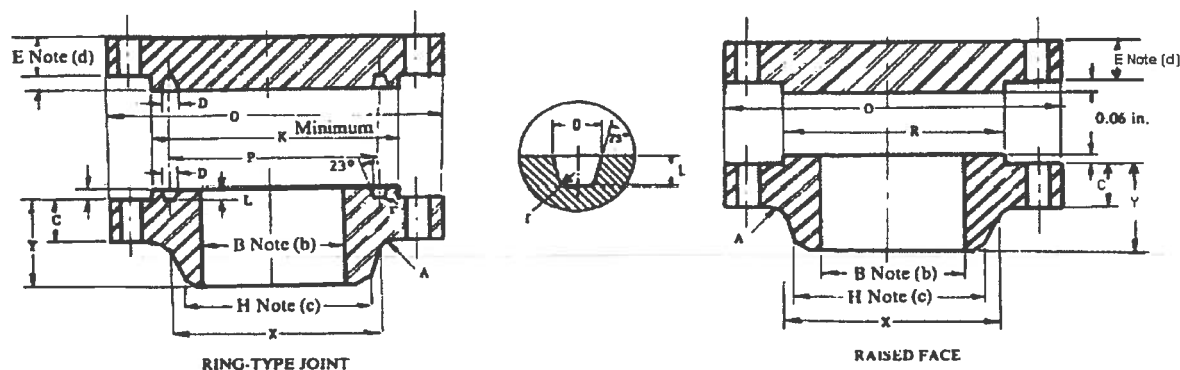


TABLE C4

Class 300, 740 psi at Atmospheric Temperature Raised Face ^(a)
and Ring-Type Joints

Dimensions in inches

Pipe Size	FLANGE DIMENSIONS				HUB DIM	DRILLING			FACING DIMENSIONS							Fillet Radius (min)	Groove Fillet Radius
	OD of Flange	Thick of Flange		Length Thru Hub	OD ^(e) Large End Hub	No. of Bolt Holes	Dia. of Bolt Holes	Dia. of Bolt Circle	Raised Face Dia.	Ring-Type Joint							
		Weld-Neck	(d)							Facing Dia.	Depth of Groove	Pitch Dia.	Width of Groove	Ring No.			
			Bld. Fig.														
	O	C	E	Y	X				R	K	L	P	D		A	r	
12	20.50	1.94	1.94	5.06	14.75	16	1.25	17.75	15.00	16.25	0.312	15.000	0.469	R57	0.38	0.03	
14	23.00	2.06	2.06	5.56	16.75	20	1.25	20.25	16.25	18.00	0.312	16.500	0.469	R61	0.38	0.03	
16	25.50	2.19	2.19	5.69	19.00	20	1.38	22.50	18.50	20.00	0.312	18.500	0.469	R65	0.38	0.03	
18	28.00	2.31	2.31	6.19	21.00	24	1.38	24.75	21.00	22.62	0.312	21.000	0.469	R69	0.38	0.03	
20	30.50	2.44	2.44	6.32	23.12	24	1.38	27.00	23.00	25.00	0.375	23.000	0.531	R73	0.38	0.06	
22	33.00	2.56	2.56	6.44	25.25	24	1.62	29.25	25.25	27.00	0.438	25.000	0.594	R81	0.38	0.06	
24	36.00	2.69	2.69	6.56	27.62	24	1.62	32.00	27.25	29.50	0.438	27.250	0.656	R77	0.38	0.06	
26	38.25	3.06	3.25	7.19	28.38	28	1.75	34.50	29.50	31.88	0.500	29.500	0.781	R93	0.38	0.06	
28	40.75	3.32	3.50	7.69	30.50	28	1.75	37.00	31.50	33.88	0.500	31.500	0.781	R94	0.44	0.06	
30	43.00	3.56	3.69	8.19	32.56	28	1.88	39.25	33.75	36.12	0.500	33.750	0.781	R95	0.44	0.06	
32	45.25	3.82	3.88	8.69	34.69	28	2.00	41.50	36.00	38.75	0.562	36.000	0.906	R96	0.44	0.06	
34	47.50	3.94	4.06	9.06	36.88	28	2.00	43.50	38.00	40.75	0.562	38.000	0.906	R97	0.50	0.06	
36	50.00	4.06	4.32	9.44	39.00	32	2.12	46.00	40.25	43.00	0.562	40.250	0.906	R98	0.50	0.06	
38	46.00	4.19	4.19	7.06	39.12	32	1.62	43.00	40.50	—	—	—	—	—	0.50	—	
40	48.75	4.44	4.44	7.56	41.25	32	1.75	45.50	42.75	—	—	—	—	—	0.50	—	
42	50.75	4.63	4.63	7.82	43.25	28	1.75	47.50	44.75	—	—	—	—	—	0.50	—	
44	53.25	4.82	4.82	8.06	45.25	32	1.88	49.75	47.00	—	—	—	—	—	0.50	—	
46	55.75	5.00	5.00	8.44	47.38	28	2.00	52.00	49.00	—	—	—	—	—	0.50	—	
48	57.75	5.19	5.19	8.75	49.38	32	2.00	54.00	51.25	—	—	—	—	—	0.50	—	
50	60.25	5.44	5.44	9.06	51.38	32	2.12	56.25	53.50	—	—	—	—	—	0.50	—	
52	62.25	5.63	5.63	9.32	53.38	32	2.12	58.25	55.50	—	—	—	—	—	0.50	—	
54	65.25	5.94	5.94	9.88	55.50	28	2.38	61.00	57.75	—	—	—	—	—	0.50	—	
56	67.25	6.00	6.00	10.19	57.62	28	2.38	63.00	59.75	—	—	—	—	—	0.50	—	
58	69.25	6.19	6.19	10.44	59.62	32	2.38	65.00	62.00	—	—	—	—	—	0.50	—	
60	71.25	6.38	6.38	10.69	61.62	32	2.38	67.00	64.00	—	—	—	—	—	0.50	—	

General Notes:

For machining tolerances see Section 10.

For welding end detail see Figures 1, 2 and 3.

Notes:

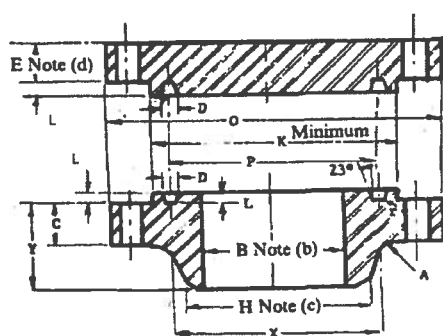
(a) Rating for raised face flanges is predicated on the use of sheet gaskets shown in Table C1.

(b) Dimensions to be specified by customer.

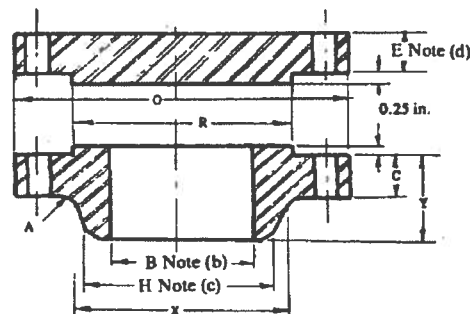
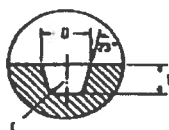
(c) See Section 5.

(d) Where calculated blind thickness is less than the mating welding neck, the thickness were made equal. See Section 5.5 for material requirements.

(e) Hub dimension for Size 24 and smaller flanges may vary as explained in Section 5.3.2.



RING-TYPE JOINT



RAISED FACE

TABLE C5

Class 400, 990 psi at Atmospheric Temperature Raised Face ^(a)
and Ring-Type Joints

Dimensions in inches

Pipe Size	FLANGE DIMENSIONS				HUB DIM		DRILLING			FACING DIMENSIONS						Fillet Radius (min)	Groove Fillet Radius
	OD of Flange	Thick of Flange		Length Thru Hub	OD (e) Large End Hub	No. of Bolt Holes	Dia. of Bolt Holes	Dia. of Bolt Circle	Raised Face Dia.	Ring-Type Joint							
		Weld-Neck	(d) Bld. Fig.							Facing Dia.	Depth of Groove	Pitch Dia.	Width of Groove	Ring No.			
O	C	E	Y	X				R	K	L	P	D		A	r		
12	20.50	2.25	2.25	5.38	14.75	16	1.38	17.75	15.00	16.25	0.312	15.000	0.469	R57	0.44	0.03	
14	23.00	2.38	2.38	5.88	16.75	20	1.38	20.25	16.25	18.00	0.312	16.500	0.469	R61	0.44	0.03	
16	25.50	2.50	2.50	6.00	19.00	20	1.50	22.50	18.50	20.00	0.312	18.500	0.469	R65	0.44	0.03	
18	28.00	2.62	2.62	6.50	21.00	24	1.50	24.75	21.00	22.62	0.312	21.000	0.469	R69	0.44	0.03	
20	30.50	2.75	2.75	6.62	23.12	24	1.62	27.00	23.00	25.00	0.375	23.000	0.531	R73	0.44	0.06	
22	33.00	2.88	2.88	6.75	25.25	24	1.75	29.25	25.25	27.00	0.438	25.000	0.594	R81	0.44	0.06	
24	36.00	3.00	3.00	6.88	27.62	24	1.88	32.00	27.25	29.50	0.438	27.250	0.656	R77	0.44	0.06	
26	38.25	3.50	3.88	7.62	28.62	28	1.88	34.50	29.50	31.88	0.500	29.500	0.781	R93	0.44	0.06	
28	40.75	3.75	4.12	8.12	30.81	28	2.00	37.00	31.50	33.88	0.500	31.500	0.781	R94	0.50	0.06	
30	43.00	4.00	4.38	8.62	32.94	28	2.12	39.25	33.75	36.12	0.500	33.750	0.781	R95	0.50	0.06	
32	45.25	4.25	4.56	9.12	35.00	28	2.12	41.50	36.00	38.75	0.562	36.000	0.906	R96	0.50	0.06	
34	47.50	4.38	4.81	9.50	37.19	28	2.12	43.50	38.00	40.75	0.562	38.000	0.906	R97	0.56	0.06	
36	50.00	4.50	5.06	9.88	39.38	32	2.12	46.00	40.25	43.00	0.562	40.250	0.906	R98	0.56	0.06	
38	47.50	4.88	4.88	8.12	39.50	32	1.88	44.00	40.75	-	-	-	-	-	0.56	-	
40	50.00	5.12	5.12	8.50	41.50	32	2.00	46.25	43.00	-	-	-	-	-	0.56	-	
42	52.00	5.25	5.25	8.81	43.62	32	2.00	48.25	45.00	-	-	-	-	-	0.56	-	
44	54.50	5.50	5.50	9.18	45.62	32	2.12	50.50	47.25	-	-	-	-	-	0.56	-	
46	56.75	5.75	5.75	9.62	47.75	36	2.12	52.75	49.50	-	-	-	-	-	0.56	-	
48	59.50	6.00	6.00	10.12	49.88	28	2.38	55.25	51.50	-	-	-	-	-	0.56	-	
50	61.75	6.19	6.25	10.56	52.00	32	2.38	57.50	53.62	-	-	-	-	-	0.56	-	
52	63.75	6.38	6.44	10.88	54.00	32	2.38	59.50	55.62	-	-	-	-	-	0.56	-	
54	67.00	6.69	6.75	11.38	56.12	28	2.62	62.25	57.88	-	-	-	-	-	0.56	-	
56	69.00	6.88	6.94	11.75	58.25	32	2.62	64.25	60.12	-	-	-	-	-	0.56	-	
58	71.00	7.00	7.12	12.06	60.25	32	2.62	66.25	62.12	-	-	-	-	-	0.56	-	
60	74.25	7.31	7.44	12.56	62.38	32	2.88	69.00	64.38	-	-	-	-	-	0.56	-	

General Notes:

For machining tolerances see Section 10.

For welding end detail see Figures 1, 2 and 3.

Notes:

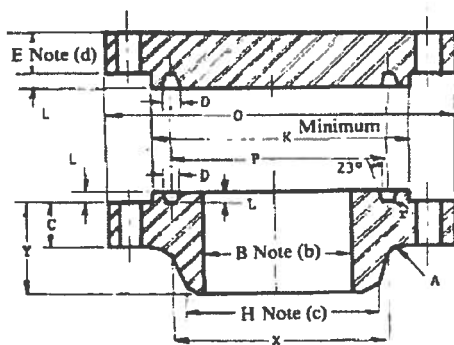
(a) Rating for raised face flanges is predicated on the use of sheet gaskets shown in Table C1.

(b) Dimensions to be specified by customer.

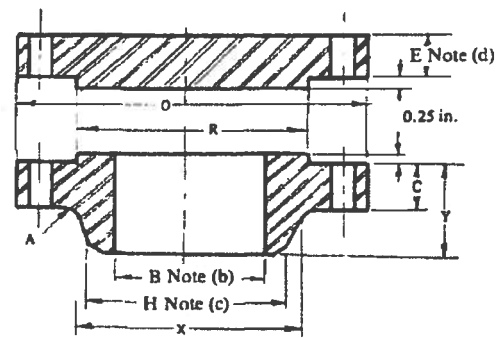
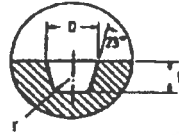
(c) See Section 5.

(d) Where calculated blind thickness is less than the mating welding neck, the thickness were made equal. See Section 5.5 for material requirements.

(e) Hub dimension for Size 24 and smaller flanges may vary as explained in Section 5.3.2.



RING-TYPE JOINT



RAISED FACE

TABLE C6

**Class 600, 1480psi at Atmospheric Temperature Raised Face ^(a)
and Ring-Type Joints**

Dimensions in inches

Pipe Size	FLANGE DIMENSIONS				HUB DIM	DRILLING			FACING DIMENSIONS						Fillet Radius (min)	Groove Fillet Radius
	OD of Flange	Thick of Flange		Length Thru Hub	OD Large (e) End Hub	No. of Bolt Holes	Dia. of Bolt Holes	Dia. of Bolt Circle	Raised Face Dia.	Ring-Type Joint						
		Weld-Neck	(d) Bld. Fig.							Facing Dia.	Depth of Groove	Pitch Dia.	Width of Groove	Ring No.		
O	C	E	Y	X				R	K	L	P	D	A	r		
12	22.00	2.62	2.62	6.12	15.75	20	1.38	19.25	15.00	16.25	0.312	15.000	0.469	R57	0.44	0.03
14	23.75	2.75	2.75	6.50	17.00	20	1.50	20.75	16.25	18.00	0.312	16.500	0.469	R61	0.44	0.03
16	27.00	3.00	3.00	7.00	19.50	20	1.62	23.75	18.50	20.00	0.312	18.500	0.469	R65	0.44	0.03
18	29.25	3.25	3.25	7.25	21.50	20	1.75	25.75	21.00	22.62	0.312	21.000	0.469	R69	0.44	0.03
20	32.00	3.50	3.50	7.50	24.00	24	1.75	28.50	23.00	25.00	0.375	23.000	0.531	R73	0.44	0.06
22	34.25	3.75	3.75	7.75	26.25	24	1.88	30.62	25.25	27.00	0.438	25.000	0.594	R81	0.44	0.06
24	37.00	4.00	4.00	8.00	28.25	24	2.00	33.00	27.25	29.50	0.438	27.250	0.656	R77	0.44	0.06
26	40.00	4.25	4.94	8.75	29.44	28	2.00	36.00	29.50	31.88	0.500	29.500	0.781	R93	0.50	0.06
28	42.25	4.38	5.19	9.25	31.62	28	2.12	38.00	31.50	33.88	0.500	31.500	0.781	R94	0.50	0.06
30	44.50	4.50	5.50	9.75	33.94	28	2.12	40.25	33.75	36.12	0.500	33.750	0.781	R95	0.50	0.06
32	47.00	4.62	5.81	10.25	36.12	28	2.38	42.50	36.00	38.75	0.562	36.000	0.906	R96	0.50	0.06
34	49.00	4.75	6.06	10.62	38.31	28	2.38	44.50	38.00	40.75	0.562	38.000	0.906	R97	0.56	0.06
36	51.75	4.88	6.38	11.12	40.62	28	2.62	47.00	40.25	43.00	0.562	40.250	0.906	R98	0.56	0.06
38	50.00	6.00	6.12	10.00	40.25	28	2.38	45.75	41.50	-	-	-	-	-	0.56	-
40	52.00	6.25	6.38	10.38	42.25	32	2.38	47.75	43.75	-	-	-	-	-	0.56	-
42	55.25	6.62	6.75	11.00	44.38	28	2.62	50.50	46.00	-	-	-	-	-	0.56	-
44	57.25	6.81	7.00	11.38	46.50	32	2.62	52.50	48.25	-	-	-	-	-	0.56	-
46	59.50	7.06	7.31	11.81	48.62	32	2.62	54.75	50.25	-	-	-	-	-	0.56	-
48	62.75	7.44	7.69	12.44	50.75	32	2.88	57.50	52.50	-	-	-	-	-	0.56	-
50	65.75	7.75	8.00	12.94	52.88	28	3.12	60.00	54.50	-	-	-	-	-	0.56	-
52	67.75	8.00	8.25	13.25	54.88	32	3.12	62.00	56.50	-	-	-	-	-	0.56	-
54	70.00	8.25	8.56	13.75	57.00	32	3.12	64.25	58.75	-	-	-	-	-	0.56	-
56	73.00	8.56	8.88	14.25	59.12	32	3.38	66.75	60.75	-	-	-	-	-	0.62	-
58	75.00	8.75	9.12	14.56	61.12	32	3.38	68.75	63.00	-	-	-	-	-	0.62	-
60	78.50	9.19	9.56	15.31	63.38	28	3.62	71.75	65.25	-	-	-	-	-	0.69	-

General Notes:

For machining tolerances see Section 10.
For welding end detail see Figures 1, 2 and 3.

Notes:

- (a) Rating for raised face flanges is predicated on the use of sheet gaskets shown in Table C1.
(b) Dimensions to be specified by customer.
(c) See Section 5.
(d) Where calculated blind thickness is less than the mating welding neck, the thickness were made equal. See Section 5.5 for material requirements.
(e) Hub dimension for Size 24 and smaller flanges may vary as explained in Section 5.3.2.

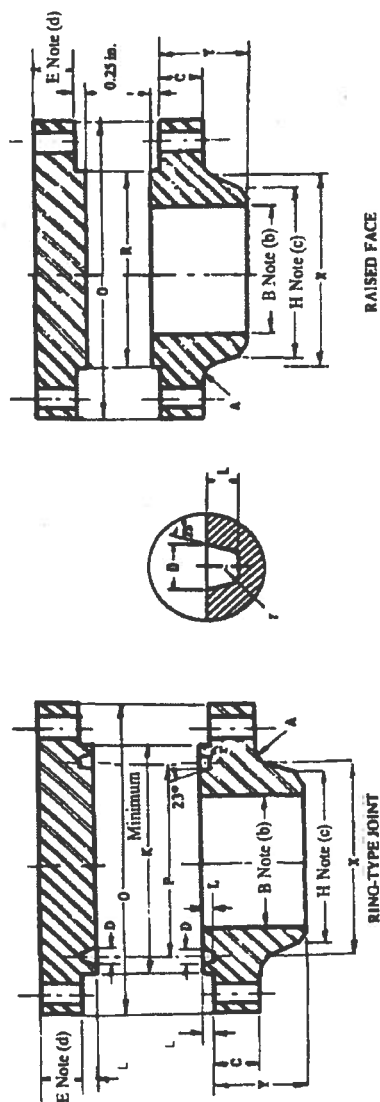


TABLE C7 Class 900, 2220 psi at Atmospheric Temperature Raised Face ^(a) and Ring-Type Joints
Dimensions in inches

Pipe Size	FLANGE DIMENSIONS				HUB	DRILLING			FACING DIMENSIONS						Fillet Radius (mm)	Groove Fillet Radius	
	OD of Flange	THICK OF FLANGE		Length Thru Hub		OD Large End Hub	No. of Bolt Holes	Dia. of Bolt Holes	Dia. of Bolt Circle	Raised Face Dia.	RING-TYPE JOINT						
		Weld-Neck	Bld.Fig. ^(a)								Facing Dia.	Depth of Groove	Pitch Dia.	Width of Groove			Ring No.
O	C	E	Y	X				R	K	L	P	D		A	R		
12	24.00	3.12	3.12	7.88	16.50	20	1.50	21.00	15.00	16.50	0.312	15.000	0.469	R57	0.44	0.03	
14	25.25	3.38	3.38	8.38	17.75	20	1.62	22.00	16.25	18.38	0.438	16.500	0.656	R62	0.44	0.06	
16	27.75	3.50	3.50	8.50	20.00	20	1.75	24.25	18.50	20.62	0.438	18.500	0.656	R66	0.44	0.06	
18	31.00	4.00	4.00	9.00	22.25	20	2.00	27.00	21.00	23.38	0.500	21.000	0.781	R70	0.44	0.06	
20	33.75	4.25	4.25	9.75	24.50	20	2.12	29.50	23.00	25.50	0.500	23.000	0.781	R74	0.44	0.06	
24	41.00	5.50	5.50	11.50	29.50	20	2.62	35.50	27.25	30.38	0.625	27.250	1.062	R78	0.44	0.09	
26	42.75	5.50	6.31	11.25	30.50	20	2.88	37.50	29.50	32.75	0.688	29.500	1.188	R100	0.44	0.09	
28	46.00	5.62	6.75	11.75	32.75	20	3.12	40.25	31.50	35.00	0.688	31.500	1.312	R101	0.50	0.09	
30	48.50	5.88	7.18	12.25	35.00	20	3.12	42.75	33.75	37.25	0.688	33.750	1.312	R102	0.50	0.09	
32	51.75	6.25	7.62	13.00	37.25	20	3.38	45.50	36.00	39.50	0.688	36.000	1.312	R103	0.50	0.09	
34	55.00	6.50	8.06	13.75	39.62	20	3.62	48.25	38.00	42.00	0.812	38.000	1.438	R104	0.56	0.09	
36	57.50	6.75	8.44	14.25	41.88	20	3.62	50.75	40.25	44.25	0.812	40.250	1.438	R105	0.56	0.09	
38	57.50	7.50	8.50	13.88	42.25	20	3.62	50.75	43.25	-	-	-	-	-	0.75	-	
40	59.50	7.75	8.81	14.31	44.38	24	3.62	52.75	45.75	-	-	-	-	-	0.81	-	
42	61.50	8.12	9.12	14.62	46.31	24	3.62	54.75	47.75	-	-	-	-	-	0.81	-	
44	64.88	8.44	9.56	15.38	48.62	24	3.88	57.62	50.00	-	-	-	-	-	0.88	-	
46	68.25	8.88	10.06	16.18	50.88	24	4.12	60.50	52.50	-	-	-	-	-	0.88	-	
48	70.25	9.19	10.38	16.50	52.88	24	4.12	62.50	54.50	-	-	-	-	-	0.94	-	

General Notes:

For machining tolerances see Section 10.

For welding end detail see Figures 1, 2 and 3.

Notes: (a) Rating for raised face flanges is predicated on the use of sheet gaskets shown in Table C1.

(b) Dimensions to be specified by customer.

(c) See Section 5.

(d) Where calculated blind thickness is less than the mating welding neck, the thicknesses were made equal. See Section 5.5 for material requirements.

(e) Hub dimension for Size 24 and smaller flanges may vary as explained in Section 5.3.2.

ANNEX D

Referenced Standards and Applicable Dates

This Annex is an integral part of this Standard Practice and is placed after the main text for convenience.

Standard Name	Description
---------------	-------------

ANSI/ASME; ASME

B1.1-2003	Unified Inch Screw Threads, (UN & UNR Thread Form)
B16.1-2005	Cast Iron Pipe Flanges and Flanged Fittings
B16.5-2003	Pipe Flanges and Flanged Fittings; NPS ½ through NPS 24 Metric/Inch Standard
B16.20-2007	Metallic Gaskets for Pipe Flanges, Ring-Joint, Spiral-Wound, and Jacketed
B16.47-2006	Large Diameter Steel Flanges; NPS 26 Through NPS 60 Metric/Inch Standard
B18.2.1-1996	Square and Hex Bolts and Screws (Inch Series)
B18.2.2-1987	Square and Hex Nuts (Inch Series)
B31.1-B31.8	Code for Pressure Piping
B46.1-2002	Surface Texture, Surface Roughness; Waviness, and Lay
ASME Boiler and Pressure Vessel Code, Section VIII, Division 1, 2007 Edition (including addendum)	

ASTM

A 53/A 53M-07	Pipe, Steel, Black and Hot-Dipped, Zinc Coated, Welded and Seamless
A 105/A 105M-05	Carbon Steel Forgings for Piping Components
A 106/A 106M-08	Seamless Carbon Steel Pipe for High-Temperature Service
A 193/A 193M-08b	Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature or High Pressure Service and Other Special Purpose Applications
A 194/A 194M-08b	Carbon and Alloy Steel Nuts for Bolts for High-Pressure, High Temperature or Both
A 307-07b	Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength
A 320/A 320M-08	Alloy Steel or Stainless Steel Bolting Materials for Low Temperature Service
A 350/A 350M-07	Carbon and Low Alloy Steel Forgings, Requiring Notch Toughness Testing for Piping Components
A 354-07a	Quenched and Tempered Alloy Steel Bolts, Studs, and Other Externally Threaded Fasteners
A 370-09	Test Methods and Definitions for Mechanical Testing of Steel Products

ANNEX D

Referenced Standards and Applicable Dates (Continued)

This Annex is an integral part of this Standard Practice and is placed after the main text for convenience.

Standard Name	Description
<u>ASTM</u>	
A 381-05	Metal-Arc-Welded Steel Pipe for Use with High-Pressure Transmission Systems
A 449-07b	Hex Caps Screws, Bolts, and Studs, Heat Treated, 120/105/90 ksi Minimum Tensile Strength, General Use
A 453/A 453M-08	High-Temperature Bolting Materials with Expansion Coefficients Comparable to Austenetic Steels
A 515/A 515M-03(2007)	Pressure Vessel Plates, Carbon Steel, for Intermediate-and Higher-Temperature Service
A 516/A 516M-06	Pressure Vessel Plates, Carbon Steel, for Moderate- and Lower-Temperature Service
A 537/a 537M-08	Pressure Vessel Plates, Heat-Treated, Carbon-Manganese-Silicon Steel
A 540/A 540M-06	Alloy-Steel Bolting Materials for Special Applications
A 694/A 694M-08	Carbon and Alloy Steel Forgings for Pipe Flanges, Fittings, Valves, and Parts for High-Pressure Transmission Service
A 707/A 707M-07	Forged Carbon and Alloy Steel Flanges for Low-Temperature Service
<u>API</u>	
5L	Line Pipe, Thirty-Ninth Edition, Jan. 2000
<u>MSS</u>	
SP-9-2008	Spot Facing for Bronze, Iron and Steel Flanges
SP-25-2008	Standard Marking System for Valves, Fittings, Flanges and Unions

ANNEX D**Referenced Standards and Applicable Dates (Continued)**

Publications of the following organizations appear on the previous page:

ANSI	American National Standards Institute, Inc. 25 West 43rd Street Fourth floor New York, NY 10036
API	American Petroleum Institute 1220 L Street, N.W. Washington, D.C. 20005-8029
ASME	American Society of Mechanical Engineers Three Park Ave. New York, NY 10016-5990
ASTM	ASTM International 100 Barr Harbor Drive West Conshohocken, PA 19428-2959
MSS	Manufacturers Standardization Society of the Valve and Fittings Industry, Inc. 127 Park Street, N.E Vienna, VA 22180-4602

Listing of MSS Standard Practices

TITLE

SP-6-2007	Standard Finishes for Contact Faces of Pipe Flanges and Connecting-End Flanges of Valves and Fittings
SP-9-2008	Spot Facing for Bronze, Iron and Steel Flanges
SP-25-2008	Standard Marking System for Valves, Fittings, Flanges and Unions
SP-42-2009	Class 150 Corrosion Resistant Gate, Globe, Angle and Check Valves with Flanged and Butt Weld Ends
SP-43-2008	Wrought and Fabricated Butt-Welding Fittings for Low Pressure, Corrosion Resistant Applications
SP-44-2010	Steel Pipeline Flanges
SP-45-2003	(R 2008) Bypass and Drain Connections
SP-51-2007	Class 150LW Corrosion Resistant Flanges and Cast Flanged Fittings
SP-53-1999	(R 2007) Quality Standard for Steel Castings and Forgings for Valves, Flanges and Fittings and Other Piping Components - Magnetic Particle Examination Method
SP-54-1999	(R 2007) Quality Standard for Steel Castings for Valves, Flanges, and Fittings and Other Piping Components - Radiographic Examination Method
SP-55-2006	Quality Standard for Steel Castings for Valves, Flanges and Fittings and Other Piping Components - Visual Method for Evaluation of Surface Irregularities
SP-58-2009	Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation
SP-60-2004	Connecting Flange Joint Between Tapping Sleeves and Tapping Valves
SP-61-2009	Pressure Testing of Valves
SP-65-2008	High Pressure Chemical Industry Flanges and Threaded Stubs for Use with Lens Gaskets
SP-67-2002a	Butterfly Valves
SP-68-1997	(R 2004) High Pressure Butterfly Valves with Offset Design
SP-69-2003	Pipe Hangers and Supports - Selection and Application (ANSI-approved American National Standard)
SP-70-2006	Gray Iron Gate Valves, Flanged and Threaded Ends
SP-71-2005	Gray Iron Swing Check Valves, Flanged and Threaded Ends
SP-72-1999	Ball Valves with Flanged or Butt-welding Ends for General Service
SP-75-2008	Specification for High Test Wrought Butt Welding Fittings
SP-78-2005a	Gray Iron Plug Valves, Flanged and Threaded Ends
SP-79-2009	Socket-Welding Reducer Inserts
SP-80-2008	Bronze Gate, Globe, Angle and Check Valves
SP-81-2006a	Stainless Steel, Bonnetless, Flanged, Knife Gate Valves
SP-83-2006	Class 3000 Steel Pipe Unions, Socket-Welding and Threaded
SP-85-2002	Gray Iron Globe & Angle Valves, Flanged and Threaded Ends
SP-86-2009	Guidelines for Metric Data in Standards for Valves, Flanges, Fittings, and Actuators
SP-88-1993	(R 2001) Diaphragm Valves
SP-91-2009	Guidelines for Manual Operation of Valves
SP-92-1999	MSS Valve User Guide
SP-93-2008	Quality Standard for Steel Castings and Forgings for Valves, Flanges, and Fittings and Other Piping Components - Liquid Penetrant Examination Method
SP-94-2008	Quality Standard for Ferritic and Martensitic Steel Castings for Valves, Flanges, and Fittings and Other Piping Components - Ultrasonic Examination Method
SP-95-2006	Swage(d) Nipples and Bull Plugs
SP-96-2001	(R 2005) Guidelines on Terminology for Valves and Fittings
SP-97-2006	Integrally Reinforced Forged Branch Outlet Fittings - Socket Welding, Threaded and Buttwelding Ends
SP-98-2001	(R 2005) Protective Coatings for the Interior of Valves, Hydrants, and Fittings
SP-99-1994	(R 2005) Instrument Valves
SP-100-2009	Qualification Requirements for Elastomer Diaphragms for Nuclear Service Diaphragm Valves
SP-101-1989	(R 2001) Part-Turn Valve Actuator Attachment - Flange and Driving Component Dimensions and Performance Characteristics
SP-102-1989	(R 2001) Multi-Turn Valve Actuator Attachment - Flange and Driving Component Dimensions and Performance Characteristics
SP-104-2003	Wrought Copper Solder Joint Pressure Fittings
SP-105-1996	(R 2005) Instrument Valves for Code Applications
SP-106-2003	Cast Copper Alloy Flanges and Flanged Fittings, Class 125, 150 and 300
SP-108-2002	Resilient-Seated Cast-Iron Eccentric Plug Valves
SP-109-1997	(R 2006) Welded Fabricated Copper Solder Joint Pressure Fittings
SP-110-1996	Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends
SP-111-2001	(R 2005) Gray-Iron and Ductile-Iron Tapping Sleeves
SP-112-1999	(R 2004) Quality Standard for Evaluation of Cast Surface Finishes -Visual and Tactile Method. This SP must be sold with a 10-surface, three dimensional Cast Surface Comparator, which is a necessary part of the standard. Additional Comparators may be sold separately.
SP-113-2001	(R 2007) Connecting Joint between Tapping Machines and Tapping Valves
SP-114-2007	Corrosion Resistant Pipe Fittings Threaded and Socket Welding, Class 150 and 1000
SP-115-2006	Excess Flow Valves, 1 1/4 NPS and Smaller, for Fuel Gas Service
SP-116-2003	Service Line Valves and Fittings for Drinking Water Systems
SP-117-2006	Bellows Seals for Globe and Gate Valves
SP-118-2007	Compact Steel Globe & Check Valves - Flanged, Flangeless, Threaded & Welding Ends (Chemical & Petroleum Refinery Service)
SP-119-2003	Factory-Made Belled End Socket Welding Fittings
SP-120-2006	Flexible Graphite Packing System for Rising Stem Steel Valves (Design Requirements)
SP-121-2006	Qualification Testing Methods for Stem Packing for Rising Stem Steel Valves
SP-122-2005	Plastic Industrial Ball Valves
SP-123-1998	(R 2006) Non-Ferrous Threaded and Solder-Joint Unions for Use with Copper Water Tube
SP-124-2001	Fabricated Tapping Sleeves
SP-125-2000	Gray Iron and Ductile Iron In-Line, Spring-Loaded, Center-Guided Check Valves
SP-126-2007	Steel In-Line Spring-Assisted Center Guided Check Valves
SP-127-2001	Bracing for Piping Systems Seismic-Wind-Dynamic Design, Selection, Application
SP-128-2006	Ductile Iron Gate Valves
SP-129-2003	(R 2007) Copper-Nickel Socket-Welding Fittings and Unions
SP-130-2003	Bellows Seals for Instrument Valves
SP-131-2004	Metallic Manually Operated Gas Distribution Valves
SP-132-2004	Compression Packing Systems for Instrument Valves
SP-133-2005	Excess Flow Valves for Low Pressure Fuel Gas Appliances
SP-134-2006a	Valves for Cryogenic Service Including Requirements for Body/Bonnet Extensions
SP-135-2006	High Pressure Steel Knife Gate Valves
SP-136-2007	Ductile Iron Swing Check Valves
SP-137-2007	Quality Standard for Positive Material Identification of Metal Valves, Flanges, Fittings, and Other Piping Components
SP-138-2009	Quality Standard Practice for Oxygen Cleaning of Valves & Fittings

(R YEAR) Indicates year standard reaffirmed without substantive changes • Price List Available Upon Request

MSS is an ANSI-accredited American National Standards developer. A number of former MSS Standard Practices have been adopted and published by other developers as American National Standards. In order to maintain a single source of authoritative information, MSS has withdrawn its Standard Practices in such cases.

Manufacturers Standardization Society of the Valve and Fittings Industry, Inc.
127 Park Street, N.E., Vienna, VA 22180-4620 • (703) 281-6613 • Fax # (703) 281-6671

MSS-IHS SP-44-2010