# MSS SP-44-2010

# 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.



Originally Approved July, 1952

## 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 $100^{0}$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 $450^{0}$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 $250^{0}$F. De-rating above $250^{0}$F was accelerated such that the $450^{0}$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 $100^{0}$F and $450^{0}$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

# 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] ASTM Specification | Plates [a] 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$^0$C (20$^0$F) or at the minimum temperature for which the flange pressure temperature rating is listed, typically -29$^0$C (-20$^0$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 | | | Al93-B8 | CL1 | (g) |
| A193-B16 | | A193-B6 | | | Al93-B8C | CL1 | (g) |
| A320-L7 | (d) | Al93-B6X | | | Al93-B8M | CL1 | (g) |
| A320-L7A | (d) | Al93-B7M | | | Al93-B8T | CL1 | (g) |
| A320-L7B | (d) | Al 93-B8 | CL2 | (f) | Al93-B8A | | (g) |
| | | A193-B8 | CL2B | (f) | | | |
| A320-L7C | (d) | A193-B8C | CL2 | (f) | Al93-B8CA | | (g) |
| A320-L43 | (d) | A193-B8M | CL2 | (f) | Al93-B8MA | | (g) |
| | | A193-B8M | CL2B | (f) | | | |
| A354-BC | | A193-B8T | CL2 | (f) | Al93-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:

(a) These bolting materials may be used with all listed materials and gaskets.

(b) 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.

(c) 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.

(d) This ferritic material is intended for low temperature service, use Al94 Gr. 4 or Gr. 7 nuts.

(e) This special alloy is intended for high temperature service with austenitic stainless steel.

(f) This austenitic stainless steel has been carbide solution treated and strain hardened. Use A194 nuts of corresponding material.

(g) This austenitic stainless material has been carbide solution treated but not strain hardened. Use A194 nuts of corresponding material.

(h) This carbon steel fastener shall not be used above 205$^0$C (400$^0$F) or below -29$^0$C (-20$^0$F), see also Note (c). Bolts with drilled or undersized heads shall not be used.

(i) 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.

## TABLE 3

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

| | | | | | Pressure in bar (gage) |
|---|---|---|---|---|---|
| TEMP. $^0$C | CLASS 150 | CLASS 300 | CLASS 400 | CLASS 600 | CLASS 900 |
| -29 to 121 | 19.6 | 51.0 | 68.3 | 102.0 | 153.1 |
| 150 | 18.9 | 49.2 | 65.8 | 98.5 | 147.7 |
| 175 | 18.3 | 47.7 | 63.9 | 95.4 | 143.0 |
| 200 | 17.7 | 46.8 | 62.8 | 93.7 | 140.7 |
| 225 | 17.1 | 44.6 | 59.8 | 89.4 | 134.1 |
| 232 | 16.9 | 44.1 | 59.3 | 88.6 | 132.7 |
| | | | | | Pressure in psi (gage) |
| TEMP. $^0$F | CLASS 150 | CLASS 300 | CLASS 400 | CLASS 600 | CLASS 900 |
| -20 to 250 | 285 | 740 | 990 | 1480 | 2220 |
| 300 | 275 | 715 | 955 | 1430 | 2145 |
| 350 | 265 | 690 | 925 | 1380 | 2070 |
| 400 | 255 | 665 | 890 | 1330 | 2000 |
| 450 | 245 | 640 | 860 | 1285 | 1925 |

3.3 ***Gasket Material***

3.3.1 The user is responsible for selection of gasket materials which will withstand the expected bolt loading without injurious crushing, and which are suitable for the service conditions. Particular attention should be given to gasket selection if a system hydrostatic test will exceed the test pressure specified in Section 8.2. Such a test involves the risk of excessive flange distortion.

3.3.2 Gasket dimensions for 1.5mm (1/16 in.) sheet asbestos in Tables 4 and C1 are based on a contact area equal to approximately twice the bolt root area. Class 150 flanged joints should use these exclusively.

3.3.3 Ring joint gasket materials shall conform to ASME B16.20 with dimensions as given in Tables 5 and C2.

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

4. **HEAT TREATMENT**

4.1 The F42 and higher grades of flanges of all pressure classes and the class 400 and higher classes of Grade F36 flanges shall be normalized or quenched and tempered.

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 μin.) to 6.3 μm (250 μin.) 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 $38^0$C ($100^0$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 ¾ in. shall have square heads or heavy hex heads (ASME B18.2.1), and. shall have heavy hex nuts (ASME B18.2.2). Bolts ¾ 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 $1^1/_8$ 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:
$12 \leq$ NPS $\leq 24$ $\pm$1.0 mm ($\pm$0.03 in.)
NPS $\geq 26$ $\pm$2.0 mm ($\pm$0.08 in.)

Outside Diameter, 7.0 mm (0.25 in.) raised face:
$12 \leq$ NPS $\leq 24$ $\pm$0.5 mm ($\pm$0.02 in.)
NPS $\geq 26$ $\pm$1.0 mm ($\pm$0.04 in.)

10.2 ***Flange Thickness***

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

$12 \leq$ NPS $\leq 24$
+4.0 mm, -1.0 mm (+0.16 in., -0.03 in.)
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).

$12 \leq$ NPS $\leq 18$ $\pm$1.5 mm ($\pm$0.06 in.)
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***

$12 \leq$ NPS $\leq 24$
+3.0 mm, -5.0 mm (+0.12 in., -0.18 in.)
NPS $\geq 26$ $\pm$5.0 mm ($\pm$0.19 in.)

10.5 ***Drilling and Facing***

10.5.1 Bolt Circle Diameter, $\pm$1.5 mm ($\pm$0.06 in.)

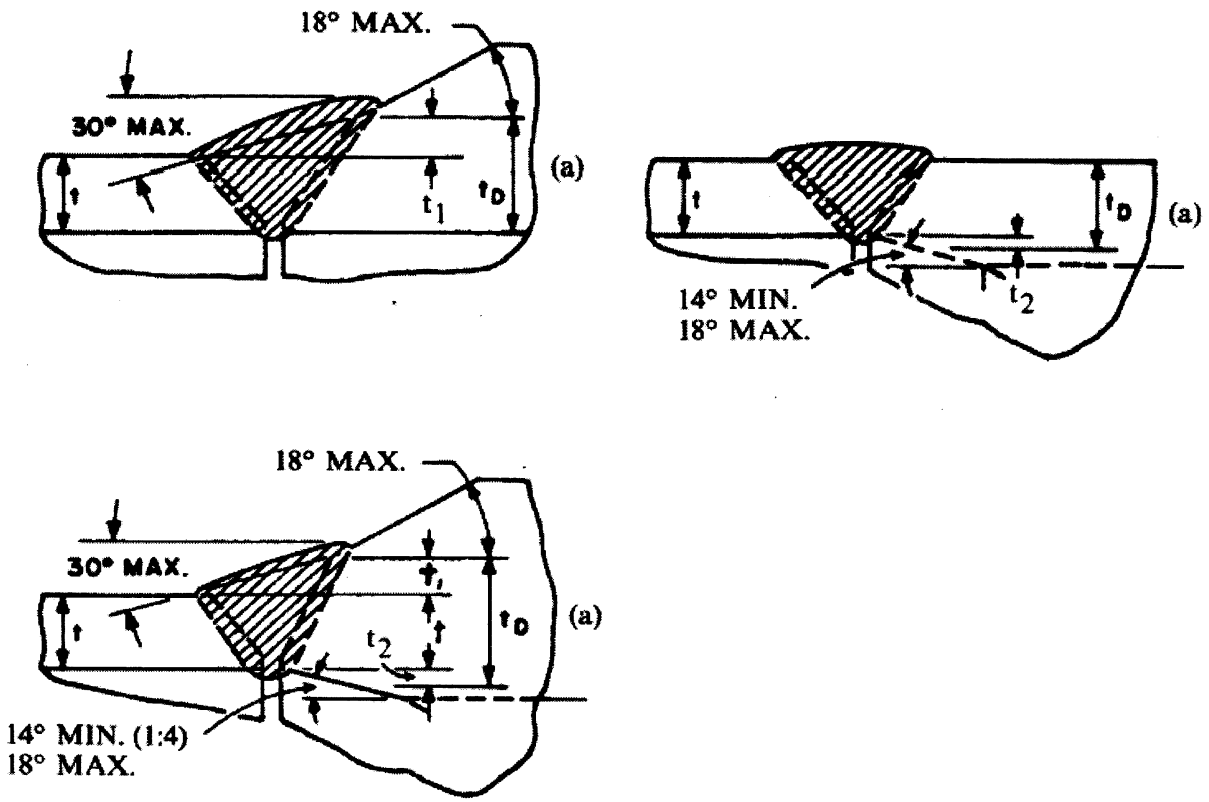
10.5.2 Center-to-Center of adjacent bolt holes, $\pm$0.8 mm ($\pm$0.03 in.)

10.5.3 Eccentricity between bolt circle diameter and machined facing diameters.

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




NOTES:
GENERAL:
When the minimum specified yield strengths of the sections to be joined are unequal, the deposited weld metal shall have mechanical properties at least equal to those of the section having the higher strength, and the minimum thickness, $t_D$, shall at least equal t times the ratio of minimum specified yield strength of pipe and flange, but not to exceed 1.5t.

(a) Neither $t_1$, $t_2$, nor $t_1 + t_2$ shall exceed 0.5t.

**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.

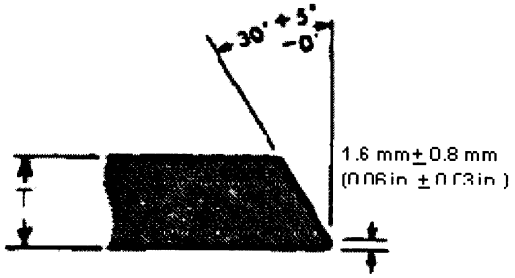



**FIGURE 2 Bevel Detail for Wall Thickness (T), 22 mm (0.88 in.) [a] or less**

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

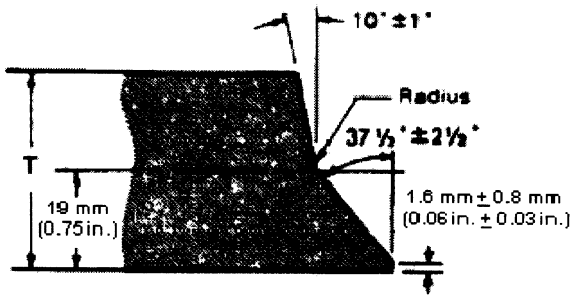
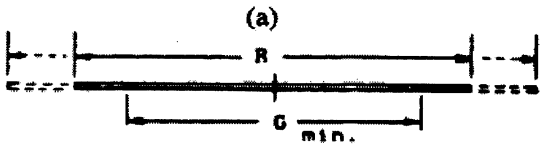



**FIGURE 3 Bevel Detail for Wall Thickness (T), greater than 22 mm (0.88 in.)**



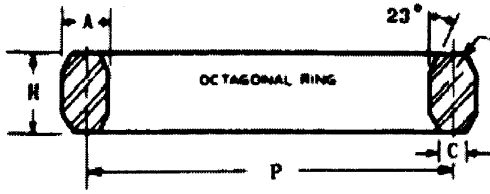

## TABLE 4

### 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.



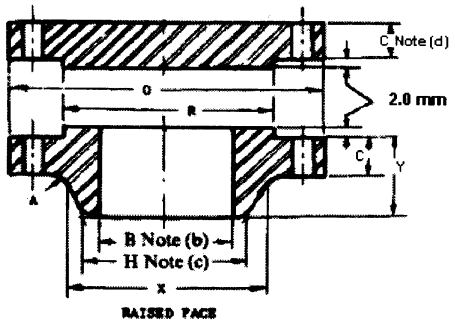

## TABLE 5
## Ring-Joint Gasket Dimensions [a]

Dimensions in mm

| 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 | 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.



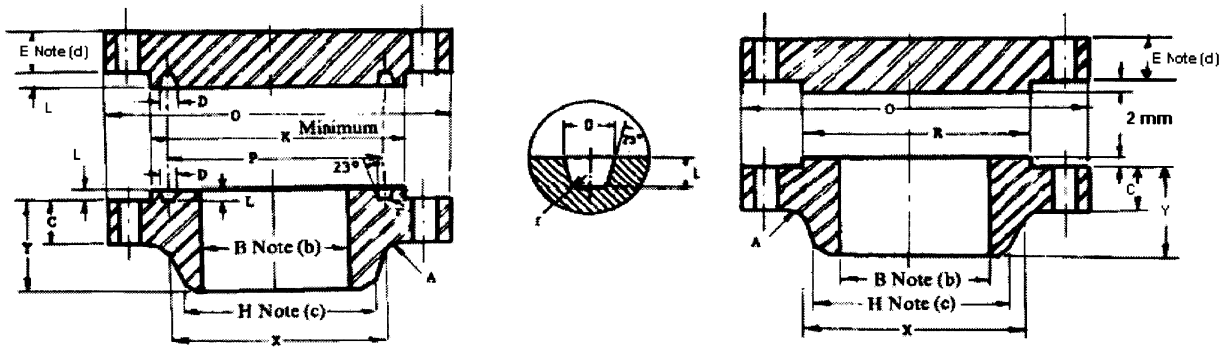

## TABLE 6 Class 150, 19.6 bar at Atmospheric Temperature Raised Face [a]

Dimensions in mm except bolt holes

| PIPE SIZE | FLANGE DIMENSIONS | | | HUB DIMEN-SIONS | 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

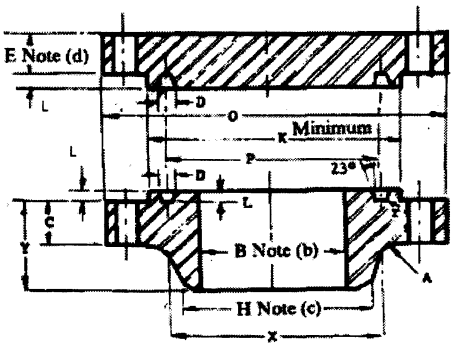
## Class 300, 51.0 bar at Atmospheric Temperature Raised Face [a] and Ring-Type Joints

Dimensions in mm except bolt holes

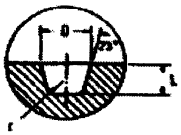
| Pipe Size | FLANGE DIMENSIONS | | | | HUB DIM | DRILLING | | | FACING DIMENSIONS | | | | | | Fillet Radius (min) | Groove Fillet Radius |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | OD of Flange | Thick of Flange | | Length Thru Hub | OD [e] Large End Hub | No. of Bolt 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 | 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 | — |

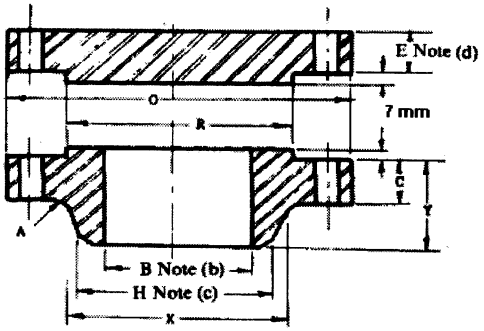
General Notes:
For machining tolerances see Section 10.
For welding end detail see Figures 1, 2 and 3.

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

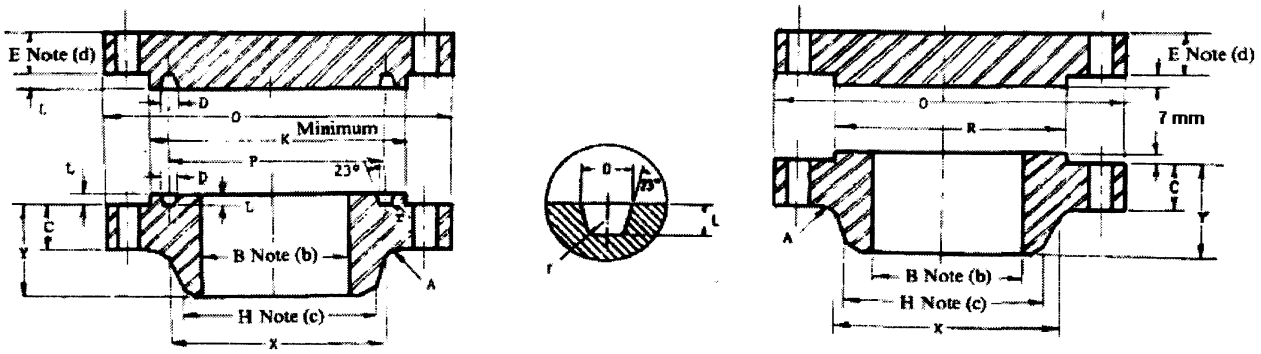
### Class 400, 68.3 bar at Atmospheric Temperature Raised Face [a] and Ring-Type Joints

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 [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 | 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

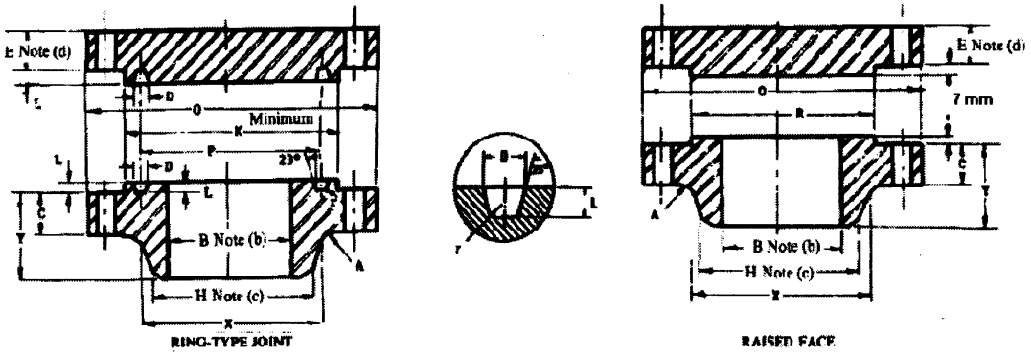
### Class 600, 102.1 bar at Atmospheric Temperature Raised Face [a] and Ring-Type Joints

Dimensions in mm except bolt holes

| Pipe Size | FLANGE DIMENSIONS | | | | HUB DIM | DRILLING | | | FACING DIMENSIONS | | | | | | Fillet Radius (min) | Groove Fillet Radius |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | OD of Flange | Thickness 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 | 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 | | | | | | Fillet Radius (min) | Groove Fillet Radius |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | OD of Flange | THICK OF FLANGE | | Length Thru Hub | OD Large [c] End Hub | No. of Bolt Holes | Dia. of Bolt Holes | Dia. of Bolt Circle | Raised Face Dia. | RING-TYPE JOINT | | | | | | |
| | | Weld-Neck | Bld.Flg. [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

| | 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 | |
|---|---|---|---|---|
| NPS | 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.

| | SIZES 12-36 incl. | | SIZES 38-60 incl. | |
|---|---|---|---|---|
| | MPa | ksi | MPa | ksi |
| 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":

$$E' = E\sqrt{\frac{414}{UTS_F}} \text{ (Metric)} \qquad E' = E\sqrt{\frac{60}{UTS_F}} \text{ (U.S. Customary)}$$

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

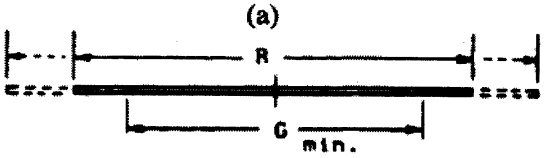
This Annex is an integral and mandatory part of SP-44-2010 and is placed after the main text for convenience.

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



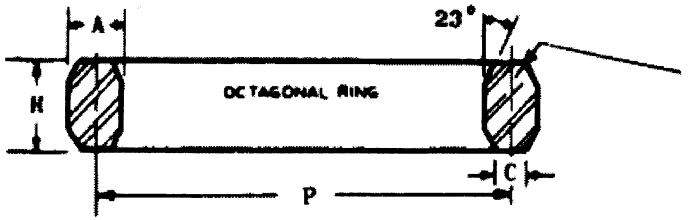

## TABLE C1

### 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.




Radius
0.06 in. for ring widths 0.88 in. and smaller;
0.09 in. for ring widths 1 in. and larger.

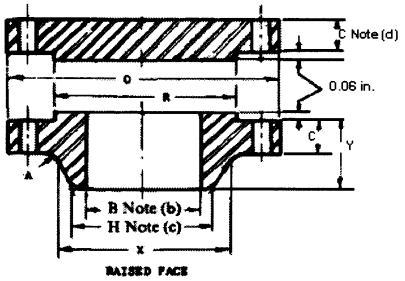
## TABLE C2
### Ring-Joint Gasket Dimensions [a]

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

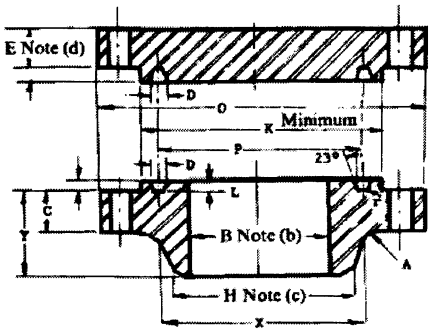
### Class 150, 285 psi at Atmospheric Temperature Raised Face [a]

Dimensions in inches

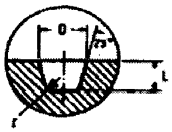
| PIPE SIZE | FLANGE DIMENSIONS | | | HUB DIMEN-SIONS | DRILLING | | | Raised Face Dia. | Fillet Radius (MIN) |
|---|---|---|---|---|---|---|---|---|---|
| | OD of Flange | Thick. of Flange (MIN) | Length Thru Hub | OD Large End Hub | No. of Bolt Holes | Dia. of Bolt Holes | Dia. of Bolt Circle | | |
| | 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 |

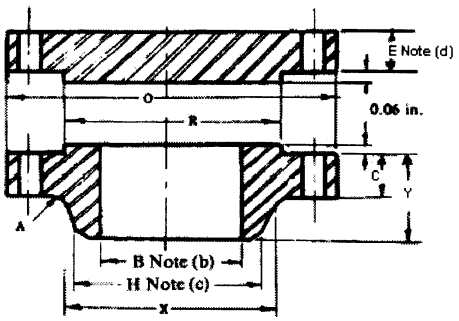
General Notes:
For machining tolerances see Section 10.
For welding end detail see Figures 1, 2 and 3.

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.




RING-TYPE JOINT




RAISED FACE

## TABLE C4

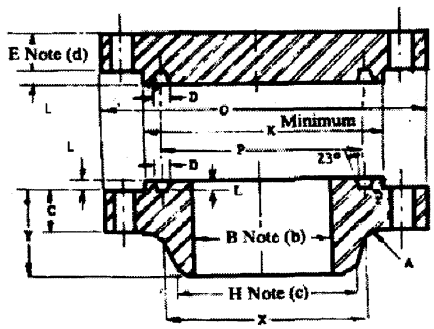
### Class 300, 740 psi at Atmospheric Temperature Raised Face [a] and Ring-Type Joints

Dimensions in inches

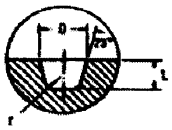
| Pipe Size | FLANGE DIMENSIONS | | | | HUB DIM | DRILLING | | | FACING DIMENSIONS | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | OD of Flange | Thick of Flange | | Length Thru Hub | OD [e] Large End Hub | No. of Bolt Holes | Dia. of Bolt Holes | Dia. of Bolt Circle | Raised Face Dia. | Ring-Type Joint | | | | | Fillet Radius (min) | Groove Fillet Radius |
| | | 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 | 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 | — |

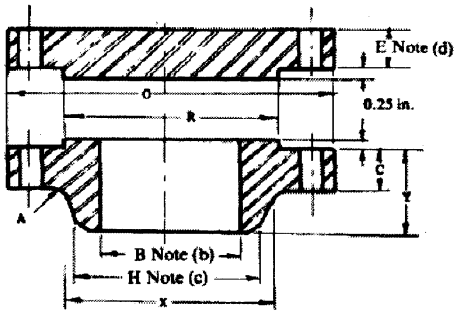
General Notes:
For machining tolerances see Section 10.
For welding end detail see Figures 1, 2 and 3.

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

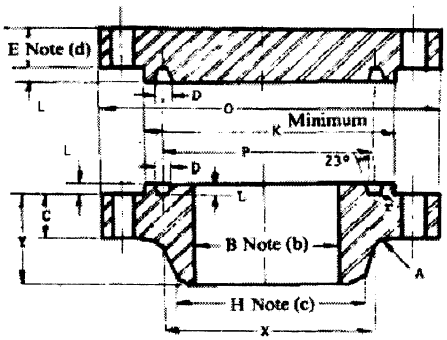
### Class 400, 990 psi at Atmospheric Temperature Raised Face [a] and Ring-Type Joints

Dimensions in inches

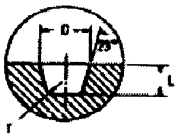
| Pipe Size | FLANGE DIMENSIONS | | | | HUB DIM | DRILLING | | | FACING DIMENSIONS | | | | | | Fillet Radius (min) | Groove Fillet Radius |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | OD of Flange | Thick of Flange | | Length Thru Hub | OD [e] Large End Hub | No. of Bolt 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 | - |

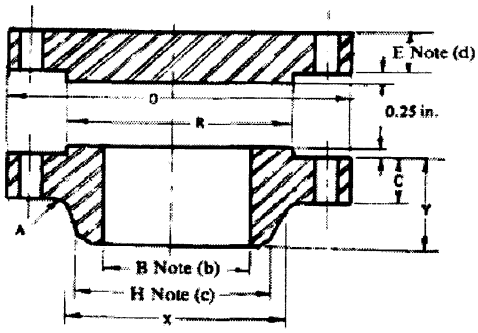
General Notes:
For machining tolerances see Section 10.
For welding end detail see Figures 1, 2 and 3.

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

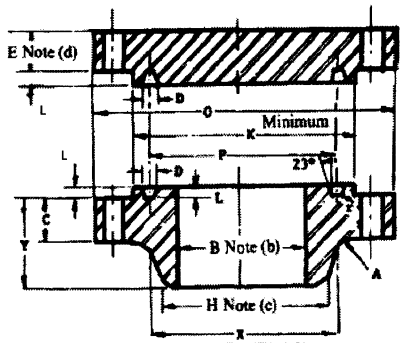
### Class 600, 1480psi at Atmospheric Temperature Raised Face [a] and Ring-Type Joints

Dimensions in inches

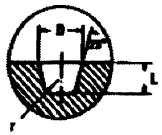
| Pipe Size | FLANGE DIMENSIONS | | | | HUB DIM | DRILLING | | | FACING DIMENSIONS | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | OD of Flange | Thick of Flange | | Length Thru Hub | OD Large [e] End Hub | No. of Bolt Holes | Dia. of Bolt Holes | Dia. of Bolt Circle | Raised Face Dia. | Ring-Type Joint | | | | | Fillet Radius (min) | Groove Fillet Radius |
| | | 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 | 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 | - |

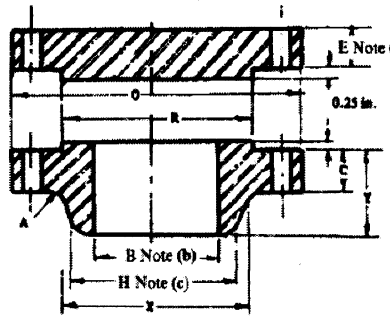
General Notes:
For machining tolerances see Section 10.
For welding end detail see Figures 1, 2 and 3.

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.




RING-TYPE JOINT




RAISED FACE

## 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 (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 | Bld.Flg.[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 | 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 |
|---|---|
| **ASTM** | |
| 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 |
| **API** | |
| 5L | Line Pipe, Thirty-Ninth Edition, Jan. 2000 |
| **MSS** | |
| 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.<br>25 West 43rd Street<br>Fourth floor<br>New York, NY 10036 |
| API | American Petroleum Institute<br>1220 L Street, N.W.<br>Washington, D.C. 20005-8029 |
| ASME | American Society of Mechanical Engineers<br>Three Park Ave.<br>New York, NY 10016-5990 |
| ASTM | ASTM International<br>100 Barr Harbor Drive<br>West Conshohoken, PA 19428-2959 |
| MSS | Manufacturers Standardization Society of the Valve and Fittings Industry, Inc.<br>127 Park Street, N.E<br>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, Glove, 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**