

**ASME B16.5-2003**  
(Revision of ASME B16.5-1996)

# Pipe Flanges and Flanged Fittings

NPS 1/2 Through NPS 24 Metric/Inch  
Standard

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**AN AMERICAN NATIONAL STANDARD**



**The American Society of  
Mechanical Engineers**



The American Society of  
Mechanical Engineers

A N A M E R I C A N N A T I O N A L S T A N D A R D

# PIPE FLANGES AND FLANGED FITTINGS

NPS  $\frac{1}{2}$  Through NPS 24  
Metric/Inch Standard

**ASME B16.5-2003**  
(Revision of ASME B16.5-1996)

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The next edition of this Standard is scheduled for publication in 2007. There will be no addenda or written interpretations to the requirements of this Standard issued to this edition.

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# FOREWORD

In 1920, the American Engineering Standards Committee [later the American Standards Association (ASA)] organized Sectional Committee B16 to unify and further develop standards for pipe flanges and fittings (and later for valves and gaskets). Co-sponsors of the B16 Committee were the American Society of Mechanical Engineers (ASME), the Heating and Piping Contractors National Association [now Mechanical Contractors Association of America (MCAA)], and the Manufacturers Standardization Society of the Valves and Fittings Industry (MSS). Co-sponsors were later designated as co-secretariat organizations.

The Committee soon recognized the need for standardization of steel pipe flanges. In May, 1923, Subcommittee 3 was organized to develop such standards for pressures in the 250 psi to 3200 psi range and for elevated temperatures. Active work began in October, including steel flanged fittings. The first proposed standard was submitted to the Committee in April 1926 and approved by letter ballot in December. After favorable review by the three sponsor organizations, the Standard was approved as American Tentative Standard B16e in June 1927.

Experience in using the Standard showed the need for hub dimensions of companion flanges and for other changes, including rerating of 250 lb and 1350 lb flanges and development of flanged fittings with integral bases. An investigation was made into the factors determining stiffness of flanges and flange hubs. The revised edition was approved as ASA B16E-1932.

A revision was initiated in 1936, stimulated by suggestions from Committee members and industrial users. The resulting 1939 edition contained standards for welding neck flanges (completed in March 1937), 1500 lb flanges in the 14 in. through 24 in. range 2500 lb flanges and flanged fittings in the  $\frac{1}{2}$  in. through 12-in. range, and dimensions for a full line of ring joint flanges developed by the American Petroleum Institute. Pressure-temperature ratings for alloy steel flanges and fittings, developed by Subcommittee 4, were included for the first time.

In August 1942, the War Production Board requested a review of measures to conserve vital materials in piping components. A special War Committee of B16 was appointed and, operating under War Standard Procedure, developed revised pressure-temperature ratings for all materials and all pressure classes. The ratings were published as American War Standard B16e5-1943. In 1945, under normal procedures, Subcommittees 3 and 4 reviewed the 1939 standard and the 1943 ratings, and recommended adoption of the wartime ratings. Their report was approved as Supplement No. 1 to B16e-1939 and published as ASA B16e6-1949. In addition to ratings, the supplement updated material specification references and added a table of metal wall thickness for welding-end valves.

Subcommittee 3 then began a revision of the entire standard. Technically, the 1949 Supplement was absorbed, new materials were recognized, a general rating method was developed and added as an appendix, and welding end preparations were expanded. Editorially, a new style of presentation was worked out, including tables rearranged for easier use. Approval by Sectional Committee, cosponsors, and ASA resulted in publication of ASA B16.5-1953 (designation changed from B16e).

Work soon began on further revisions. Class B ratings were deleted and Class A ratings were clarified as the standard. An appendix defined qualifications for gaskets, other than ring joint, which would merit the ratings. Another appendix defined the method for calculating bolt lengths (including measurement of the length of stud bolts between thread ends instead of between points). Pressure-temperature ratings for several new materials were added, the table of welding end dimensions was expanded, and the temperatures used in determining ratings were redefined. The resulting new edition, after approval, was published as ASA B16.5-1957.

The more modest revision approved as ASA B16.5-1961 changed the text to clarify the intent or to make requirements easier to administer. The next revision began in 1963 with nearly 100 comments and suggestions. No fundamental changes were made, but the text was further clarified and wall thicknesses less than  $\frac{1}{4}$  in. for flanged fittings were recognized in the 1968 edition.

A new joint study of ratings between Subcommittees 3 and 4 was initiated before the next revision. Based on Subcommittee 4 report, the rating procedure was revised and a rating basis for Class 150 (150 lb) flanges was developed. New product forms, bar and plate, were added for special applications, including fabricated flanged valves and fittings. Reference to welding-end valves was not included because a separate standard for them was. Bolt length calculations based on worst case tolerances led to a revision of tabulated lengths. Testing of valve subsequently published by SC 15 closure members was added to the test requirements. Following final approval on October 23, the Standard was published as ANSI B16.5-1973.

Subcommittee N (formerly 15) was assigned responsibility for all valve standards in late 1973. Subcommittee C (formerly 3) continues to have responsibility for flange standards. A revision was accordingly initiated to remove all references to valves. At the same time, comments from users and changes in the ASME Boiler and Pressure Vessel Code led to significant revisions in the Class 150 rating basis, and, in the ratings of stainless steel and certain alloy steel flanges and flanged fittings in all rating classes. Extensive public review comments led to addition of considerations for flanged joints, for bolting and gaskets, and of marking requirements. To avoid frequent and confusing changes in ratings as further changes in Code allowable stresses are made, it was agreed with Subcommittee N to leave ratings alone unless the relevant Code stress values are changed by more than 10%. After final approval by Standards Committee, co-sponsors and ANSI, ANSI B16.5-1977, Steel Pipe Flanges and Flanged Fittings, was published on June 16, 1977.

In 1979, work began on another new edition. Materials coverage was expanded by the addition of nickel and nickel alloys. Bolting rules were revised to cover nickel alloy bolts. Bolt hole and bolting were changed to provide interchangeability between inch and metric dimensions. Metric dimensional tables were made informational rather than alternative requirements of the Standard. Final approval was granted for ANSI B16.5-1984, Pipe Flanges and Flanged Fittings on August 14.

In 1982, American National Standards Committee B16 was reorganized as an ASME Committee operating under procedures accredited by ANSI. The 1988 edition of the Standard extended nickel alloy ratings to higher temperatures, clarifying flat face flange requirements, and included other minor revisions. The Committee determined that any metric standard for flanges will stand alone, with metric bolting and gaskets; hence metric equivalents have been deleted. Following approval by the Standard Committee and ASME, approval as American National Standard was given by ANSI on April 7, 1988, with the new designation ASME/ANSI B16.5-1988.

The 1996 Edition allowed flanges marked with more than one material grade or specification, revised flange facing finish requirements, revised pressure-temperature ratings for several material groups, added a nonmandatory quality system annex, and included several other revisions. The 1996 Edition was approved by ANSI on October 3, 1996, with the new designation of ASME B16.5-1996.

The 2003 Edition includes metric units as the primary reference units while maintaining U.S. Customary units in either parenthetical or separate forms. The goal is to delete the U.S. customary units when the standard is next issued. New materials have been added while some materials have been shifted from one group to another and new material groups have been established.

All pressure-temperature ratings have been recalculated using data from the latest edition of the ASME Boiler and Pressure Vessel Code, Section II, Part D. Annex F has been added to cover pressure-temperature ratings and dimensional data for Class 150 through 2500 flanges and Class 150 and 300 flanged fittings in U.S. Customary units. Table and figure numbers in Annex F are prefixed by the letter F and correspond to table and figure numbers in the main text for metric version with the exception of some table and figure numbers that have not been used in Annex F. Of note, the flange thickness designations for Class 150 and 300 have been revised with reference to their raised faces. For these classes, the flange thickness dimensional reference planes have been altered, however, required flange thickness remains unchanged. The minimum flange thickness designation has been changed from C to  $t_f$  and it does not include 2.0 mm (0.06 in.) raised face for Class 150 and 300 raised face flanges and flanged fittings. Because of diminished interest, flanged end fittings conforming to ASME Class 400 and higher are listed only with U.S. Customary units in Annex G. In addition, straight hub welding flanges have been incorporated as a new set of flanges in Classes 150 through 2500. Also, there are numerous requirement clarifications and editorial revisions.



Following the approval of the Standards Committee and ASME, approval for the new edition was granted by the American National Standards Institute on July 9, 2003.

Requests for Interpretations or suggestion for revision should be sent to the secretary, B16 Committee, Three Park Avenue, New York, NY 10016-5990.

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**General.** ASME Standards are developed and maintained with the intent to represent the consensus of concerned interests. As such, users of this Standard may interact with the Committee by requesting interpretations, proposing revisions, and attending Committee meetings. Correspondence should be addressed to:

Secretary, B16 Standards Committee  
The American Society of Mechanical Engineers  
Three Park Avenue  
New York, NY 10016-5990

**Proposing Revisions.** Revisions are made periodically to the Standard to incorporate changes that appear necessary or desirable, as demonstrated by the experience gained from the application of the Standard. Approved revisions will be published periodically.

The Committee welcomes proposals for revisions to this Standard. Such proposals should be as specific as possible, citing the paragraph number(s), the proposed wording, and a detailed description of the reasons for the proposal, including any pertinent documentation.

**Interpretations.** Upon request, the B16 Committee will render an interpretation of any requirement of the Standard. Interpretations can only be rendered in response to a written request sent to the Secretary of the B16 Standards Committee.

The request for interpretation should be clear and unambiguous. It is further recommended that the inquirer submit his/her request in the following format:

|           |                                                                                                                                                                                                                                                                                                                                                                          |
|-----------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Subject:  | Cite the applicable paragraph number(s) and the topic of the inquiry.                                                                                                                                                                                                                                                                                                    |
| Edition:  | Cite the applicable edition of the Standard for which the interpretation is being requested.                                                                                                                                                                                                                                                                             |
| Question: | Phrase the question as a request for an interpretation of a specific requirement suitable for general understanding and use, not as a request for an approval of a proprietary design or situation. The inquirer may also include any plans or drawings, which are necessary to explain the question; however, they should not contain proprietary names or information. |

Requests that are not in this format will be rewritten in this format by the Committee prior to being answered, which may inadvertently change the intent of the original request.

ASME procedures provide for reconsideration of any interpretation when or if additional information that might affect an interpretation is available. Further, persons aggrieved by an interpretation may appeal to the cognizant ASME Committee or Subcommittee. ASME does not “approve,” “certify,” “rate,” or “endorse” any item, construction, proprietary device, or activity.

**Attending Committee Meetings.** The B16 Standards Committee regularly holds meetings, which are open to the public. Persons wishing to attend any meeting should contact the Secretary of the B16 Standards Committee.

# PIPE FLANGES AND FLANGED FITTINGS

## NPS 1/2 THROUGH NPS 24 METRIC/INCH STANDARD

### 1 SCOPE

#### 1.1 General

(a) This Standard covers pressure-temperature ratings, materials, dimensions, tolerances, marking, testing, and methods of designating openings for pipe flanges and flanged fittings. Included are

(1) flanges with rating class designations 150, 300, 400, 600, 900, 1500, and 2500 in sizes NPS 1/2 through NPS 24, with requirements given in both metric and U.S. Customary units with diameter of bolts and flange bolt holes expressed in inch units

(2) flanged fittings with rating class designation 150 and 300 in sizes NPS 1/2 through NPS 24, with requirements given in both metric and U.S. Customary units with diameter of bolts and flange bolt holes expressed in inch units

(3) flanged fittings with rating class designation 400, 600, 900, 1500, and 2500 in sizes NPS 1/2 through NPS 24 that are acknowledged in Annex G in which only U.S. Customary units are provided

(b) This Standard is limited to

(1) flanges and flanged fittings made from cast or forged materials

(2) blind flanges and certain reducing flanges made from cast, forged, or plate materials

Also included in this Standard are requirements and recommendations regarding flange bolting, flange gaskets, and flange joints.

#### 1.2 References

Codes, standards, and specifications, containing provisions to the extent referenced herein, constitute requirements of this Standard. These reference documents are listed in Annex H.

#### 1.3 Time of Purchase, Manufacture, or Installation

The pressure-temperature ratings in this Standard are applicable upon its publication to all flanges and flanged fittings within its scope which otherwise meet its requirements. For unused flanges or flanged fittings maintained in inventory, the manufacturer of the flange or flanged fittings may certify conformance to this Edition provided that it can be demonstrated that all requirements of this Edition have been met. Where such

components were installed in accordance with the pressure-temperature ratings of an earlier edition of this Standard, those ratings are applicable except as may be governed by the applicable code or regulation.

#### 1.4 User Accountability

This Standard cites duties and responsibilities that are to be assumed by the flange or flanged fitting user in the areas of, for example, application, installation, system hydrostatic testing, operation, and material selection.

#### 1.5 Quality Systems

Requirements relating to the product manufacturer's Quality System Program are described in Annex E.

#### 1.6 Relevant Units

This Standard 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 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.

#### 1.7 Service Conditions

Criteria for selection of materials suitable for particular fluid service are not within the scope of this Standard.

#### 1.8 Convention

For the purpose of determining conformance with this Standard, the convention for fixing significant digits where limits, maximum and minimum values are specified, shall be rounded as defined in ASTM Practice E 29. This requires that an observed or calculated value shall be rounded off to the nearest unit in the last right hand digit used for expressing the limit. Decimal values and tolerances do not imply a particular method of measurement.

## 1.9 Denotation

**1.9.1 Pressure Rating Designation.** Class, followed by a dimensionless number, is the designation for pressure-temperature ratings as follows:

Class    150    300    400    600    900    1500    2500

**1.9.2 Size.** NPS, followed by a dimensionless number, is the designation for nominal flange or flange fitting size. NPS is related to the reference *nominal diameter*, DN, used in international standards. The relationship is, typically, as follows:

| NPS            | DN  |
|----------------|-----|
| $\frac{1}{2}$  | 15  |
| $\frac{3}{4}$  | 20  |
| 1              | 25  |
| $1\frac{1}{4}$ | 32  |
| $1\frac{1}{2}$ | 40  |
| 2              | 50  |
| $2\frac{1}{2}$ | 65  |
| 3              | 80  |
| 4              | 100 |

GENERAL NOTE: For NPS  $\geq 4$ , the related DN is DN = 25 (NPS).

## 2 PRESSURE-TEMPERATURE RATINGS

### 2.1 General

Pressure-temperature ratings are maximum allowable working gage pressures in bar units at the temperatures in degrees Celsius shown in Tables 2-1.1 through 2-3.17 for the applicable material and class designation. Tables F2-1.1 through F2-3.17 of Annex F list pressure-temperature ratings using psi units for pressure at the temperature in degrees Fahrenheit. For intermediate temperatures, linear interpolation is permitted. Interpolation between class designations is not permitted.

### 2.2 Flanged Joints

A flanged joint is composed of separate and independent, although inter-related components: the flanges, the gasket, and the bolting, which are assembled by another influence, the assembler. Proper controls must be exercised in the selection and application for all these elements to attain a joint that has acceptable leak tightness. Special techniques, such as controlled bolt tightening are described in ASME PCC-1.

### 2.3 Ratings of Flanged Joints

**2.3.1 Basis.** Pressure-temperature ratings apply to flanged joints that conform to the limitations on bolting in para. 5.3 and on gaskets in para. 5.4, which are made up in accordance with good practice for alignment and assembly (see para. 2.2). Use of these ratings for flanged joints not conforming to these limitations is the responsibility of the user.

**2.3.2 Mixed Flanged Joints.** If the two flanges in a flanged joint do not have the same pressure-temperature rating, the rating of the joint at any temperature is the lower of the two flange ratings at that temperature.

### 2.4 Rating Temperature

The temperature shown for a corresponding pressure rating is the temperature of the pressure-containing shell of the component. In general, this temperature is the same as that of the contained fluid. Use of a pressure rating corresponding to a temperature other than that of the contained fluid is the responsibility of the user, subject to the requirements of applicable codes and regulations. For any temperature below  $-29^{\circ}\text{C}$  ( $-20^{\circ}\text{F}$ ), the rating shall be no greater than the rating shown for  $-29^{\circ}\text{C}$  ( $-20^{\circ}\text{F}$ ). See also paras. 2.5.3 and 5.1.2.

### 2.5 Temperature Considerations

**2.5.1 General.** Use of flanged joints at either high or low temperatures shall take into consideration the risk of joint leakage due to forces and moments developed in the connected piping or equipment. Provisions in paras. 2.5.2 and 2.5.3 are included as advisory with the aim of lessening these risks.

**2.5.2 High Temperature.** Application at temperatures in the creep range will result in decreasing bolt loads as relaxation of flanges, bolts, and gaskets takes place. Flanged joints subjected to thermal gradients may likewise be subject to decreasing bolt loads. Decreased bolt loads diminish the capacity of the flanged joint to sustain loads effectively without leakage. At temperatures above  $200^{\circ}\text{C}$  ( $400^{\circ}\text{F}$ ) for Class 150 and above  $400^{\circ}\text{C}$  ( $750^{\circ}\text{F}$ ) for other class designations, flanged joints may develop leakage problems unless care is taken to avoid imposing severe external loads, severe thermal gradients, or both.

**2.5.3 Low Temperature.** Some of the materials listed in Tables 1A and 1B, notably some carbon steels, may undergo a decrease in ductility when used at low temperatures to such an extent as to be unable to safely resist shock loading, sudden changes of stress, or high stress concentration. Some codes or regulations may require impact testing for applications even where temperatures are higher than  $-29^{\circ}\text{C}$  ( $-20^{\circ}\text{F}$ ). When such requirements apply, it is the responsibility of the user to ensure these requirements are communicated to the manufacturer prior to the time of purchase.

### 2.6 System Hydrostatic Testing

Flanged joints and flanged fittings may be subjected to system hydrostatic tests at a pressure of 1.5 times the  $38^{\circ}\text{C}$  ( $100^{\circ}\text{F}$ ) rating rounded off to the next higher 1 bar (25 psi) increment. Testing at any higher pressure is the responsibility of the user, taking into account the requirements of the applicable code or regulation.

## 2.7 Welding Neck Flanges

Ratings for welding neck flanges covered by this Standard are based upon their hubs at the welding end having thickness at least equal to that calculated for pipe having 276 MPa (40,000 psi) specified minimum yield strength.<sup>1</sup> In order to ensure adequate flange hub thickness for flange sizes NPS 2 and larger, the bore of a welding neck flange, dimension  $B$  in the various dimensional tables, shall not exceed  $B_{\max}$ , determined as follows:

$$B_{\max} = A \left( 1 - \frac{C_o p_c}{50,000} \right)$$

where:

- $A$  = tabulated hub diameter, beginning of chamfer as listed in the dimensional tables
- $B_{\max}$  = maximum permissible diameter for the bore of a welding neck flange
- $C_o$  = 14.5 when  $p_c$  is expressed in bar units or 1.0 when  $p_c$  is expressed in psi units
- $p_c$  = ceiling pressure value at 38°C (100°F), Tables B1 and B2 of Annex B

The resultant units for diameter  $B_{\max}$  are the same as those entered for diameter  $A$ .

The tabulated ratings for welding neck flanges are independent of components to which they may be attached and the pressure rating of the flange shall not be exceeded. Attachment welds should be made in accordance with the applicable code or regulation. See para. 6.7 and Figs. 12, 13, and 14 for weld end dimensional requirements.

## 2.8 Straight Hub Welding Flanges

Straight hub welding flanges are an extension of welding neck flanges and have straight hubs of uniform thickness. With the exception of the following, the straight hub welding flanges shall have dimensions of the welding neck flanges of the size and class set forth in Tables 8, 11, 14, 16, 18, 20, and 22 (Tables F8, F11, F14, F16, F18, F20, and F22 of Annex F). See Fig. 15.

**2.8.1 Length Through Hub.** The length through hub shall be 229 mm (9 in.) for NPS 4 and smaller and 305 mm (12 in.) for larger than NPS 4. Other lengths may be furnished by agreement between the end user and the manufacturer.

**2.8.2 Bore.** The bore diameter shall be equal to  $B$  dimension of the welding neck flange. Other bores may be furnished by agreement between the end user and the manufacturer. In no case shall the bore diameter exceed the bore of the same size and class lapped flange.

<sup>1</sup> For flanges to be attached to high strength pipe with large inside diameters resulting from thin wall sections, see MSS SP-44.

**2.8.3 Hub End.** The standard flange shall be provided with square cut end. The end user may specify welding end preparation in accordance with para. 6.7.

## 2.9 Multiple Material Grades

Material for flanges and flanged fittings may meet the requirements of more than one specification or the requirements of more than one grade of a specification listed in Table 1A. In either case, the pressure-temperature ratings for any of these specifications or grades may be used provided the material is marked in accordance with para. 4.2.8.

## 3 COMPONENT SIZE

### 3.1 Nominal Pipe Size

As applied in this Standard, the use of the phrase “nominal pipe size” or the designation NPS followed by a dimensionless number is for the purpose of pipe, flange, or flanged fitting end connection size identification. The number is not necessarily the same as the flange or flanged fitting inside diameter.

### 3.2 Reducing Fittings

Reducing fittings shall be designated by the NPS for the openings in the sequence indicated in the sketches of Fig. 2.

### 3.3 Reducing Flanges

Reducing flanges shall be designated by the NPS for each opening. See examples in Note (4) of Table 6 (Table F6 of Annex F).

## 4 MARKING

### 4.1 General

Except as modified herein, flanges and flanged fittings shall be marked as required in MSS SP-25, except as noted in para. 4.2.

### 4.2 Identification Markings

**4.2.1 Name.** The manufacturer's name or trademark shall be applied.

**4.2.2 Material.** Material shall be identified in the following way:

(a) Cast flanges and flanged fittings shall be marked with the ASTM specification,<sup>2</sup> grade identification symbol (letters and numbers), and the melt number or melt identification.

(b) Plate flanges, forged flanges, and flanged fittings shall be marked with the ASTM specification number and grade identification symbol.<sup>2</sup>

<sup>2</sup> An ASME Boiler and Pressure Vessel Code, Section II specification number may be substituted for an ASTM specification number provided the requirements of the ASME specification are identical to or more stringent than the ASTM specification for the Grade, Class, or type of material.

**Table 1A List of Material Specifications**

| Material Group | Nominal Designation                                 | Pressure–Temperature Rating Table | Applicable ASTM Specifications [Note (1)]                          |                                                                      |                                                            |
|----------------|-----------------------------------------------------|-----------------------------------|--------------------------------------------------------------------|----------------------------------------------------------------------|------------------------------------------------------------|
|                |                                                     |                                   | Forgings                                                           | Castings                                                             | Plates                                                     |
| 1.1            | C–Si<br>C–Mn–Si<br><br>C–Mn–Si–V<br>3½ Ni           | 2-1.1                             | A 105<br>A 350 Gr. LF2<br><br>A 350 Gr. LF6 Cl. 1<br>A 350 Gr. LF3 | A 216 Gr. WCB                                                        | A 515 Gr. 70<br>A 516 Gr. 70<br>A 537 Cl. 1                |
| 1.2            | C–Mn–Si<br><br>C–Mn–Si–V<br>2½Ni<br>3½Ni            | 2-1.2                             | A 350 Gr. LF6 Cl. 2                                                | A 216 Gr. WCC<br>A 352 Gr. LCC<br><br>A 352 Gr. LC2<br>A 352 Gr. LC3 | A 203 Gr. B<br>A 203 Gr. E                                 |
| 1.3            | C–Si<br>C–Mn–Si<br>2 ½Ni<br>3 ½Ni<br>C–½Mo          | 2-1.3                             |                                                                    | A 352 Gr. LCB<br><br><br>A 217 Gr. WC1<br>A 352 Gr. LC1              | A 515 Gr. 65<br>A 516 Gr. 65<br>A 203 Gr. A<br>A 203 Gr. D |
| 1.4            | C–Si<br>C–Mn–Si                                     | 2-1.4                             | A 350 Gr. LF1 Cl. 1                                                |                                                                      | A 515 Gr. 60<br>A 516 Gr. 60                               |
| 1.5            | C–½Mo                                               | 2-1.5                             | A 182 Gr. F1                                                       |                                                                      | A 204 Gr. A<br>A 204 Gr. B                                 |
| 1.7            | ½Cr–½Mo<br>Ni–½Cr–½Mo<br>¾Ni–¾Cr–1Mo                | 2-1.7                             | A 182 Gr. F2                                                       | A 217 Gr. WC4<br>A 217 Gr. WC5                                       |                                                            |
| 1.9            | 1¼Cr–½Mo<br>1¼Cr–½Mo–Si                             | 2-1.9                             | A 182 Gr. F11 CL.2                                                 | A 217 Gr. WC6                                                        | A 387 Gr. 11 Cl. 2                                         |
| 1.10           | 2 ¼Cr–1Mo                                           | 2-1.10                            | A 182 Gr. F22 Cl. 3                                                | A 217 Gr. WC9                                                        | A 387 Gr. 22 Cl. 2                                         |
| 1.11           | C–½Mo                                               | 2-1.11                            |                                                                    |                                                                      | A 204 Gr. C                                                |
| 1.13           | 5Cr–½Mo                                             | 2-1.13                            | A 182 Gr. F5a                                                      | A 217 Gr. C5                                                         |                                                            |
| 1.14           | 9Cr–1Mo                                             | 2-1.14                            | A 182 Gr. F9                                                       | A 217 Gr. C12                                                        |                                                            |
| 1.15           | 9Cr–1Mo–V                                           | 2-1.15                            | A 182 Gr. F91                                                      | A 217 Gr. C12A                                                       | A 387 Gr. 91 Cl. 2                                         |
| 1.17           | 1Cr–½Mo<br>5Cr–½Mo                                  | 2-1.17                            | A 182 Gr. F12 Cl. 2<br>A 182 Gr. F5                                |                                                                      |                                                            |
| 2.1            | 18Cr–8Ni                                            | 2-2.1                             | A 182 Gr. F304<br>A 182 Gr. F304H                                  | A 351 Gr. CF3<br>A 351 Gr. CF8                                       | A 240 Gr. 304<br>A 240 Gr. 304H                            |
| 2.2            | 16Cr–12Ni–2Mo<br><br>18Cr–13Ni–3Mo<br>19Cr–10Ni–3Mo | 2-2.2                             | A 182 Gr. F316<br>A 182 Gr. F316H<br>A 182 Gr. F317                | A 351 Gr. CF3M<br>A 351 Gr. CF8M<br><br>A 351 Gr. CG8M               | A 240 Gr. 316<br>A 240 Gr. 316H<br>A 240 Gr. 317           |
| 2.3            | 18Cr–8Ni<br>16Cr–12Ni–2Mo                           | 2-2.3                             | A 182 Gr. F304L<br>A 182 Gr. F316L                                 |                                                                      | A 240 Gr. 304L<br>A 240 Gr. 316L                           |

**Table 1A List of Material Specifications (Cont'd)**

| Material Group | Nominal Designation                                                                                                                                                | Pressure–<br>Temperature<br>Rating Table | Applicable ASTM Specifications [Note (1)]                                                                                                                    |                                                                                        |                                                                                                                                                              |
|----------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                |                                                                                                                                                                    |                                          | Forgings                                                                                                                                                     | Castings                                                                               | Plates                                                                                                                                                       |
| 2.4            | 18Cr–10Ni–Ti                                                                                                                                                       | 2-2.4                                    | A 182 Gr. F321<br>A 182 Gr. F321H                                                                                                                            |                                                                                        | A 240 Gr. 321<br>A 240 Gr. 321H                                                                                                                              |
| 2.5            | 18Cr–10Ni–Cb                                                                                                                                                       | 2-2.5                                    | A 182 Gr. F347<br>A 182 Gr. F347H<br>A 182 Gr. F348<br>A 182 Gr. F348H                                                                                       |                                                                                        | A 240 Gr. 347<br>A 240 Gr. 347H<br>A 240 Gr. 348<br>A 240 Gr. 348H                                                                                           |
| 2.6            | 23Cr–12Ni                                                                                                                                                          | 2-2.6                                    |                                                                                                                                                              |                                                                                        | A 240 Gr. 309H                                                                                                                                               |
| 2.7            | 25Cr–20Ni                                                                                                                                                          | 2-2.7                                    | A 182 Gr. F310                                                                                                                                               |                                                                                        | A 240 Gr. 310H                                                                                                                                               |
| 2.8            | 20Cr–18Ni–6Mo<br>22Cr–5Ni–3Mo–N<br>25Cr–7Ni–4Mo–N<br>24Cr–10Ni–4Mo–V<br>25Cr–5Ni–2Mo–3Cu<br>25Cr–7Ni–3.5Mo–W–Cb<br>25Cr–7Ni–3.5Mo–N–Cu–W                           | 2-2.8                                    | A 182 Gr. F44<br>A 182 Gr. F51<br>A 182 Gr. F53<br><br><br><br>A 182 Gr. F55                                                                                 | A 351 Gr. CK3MCuN<br><br><br>A 351 Gr. CE8MN<br>A 351 Gr. CD4MCu<br>A 351 Gr. CD3MWCuN | A 240 Gr. S31254<br>A 240 Gr. S31803<br>A 240 Gr. S32750<br><br><br>A 240 Gr. S32760                                                                         |
| 2.9            | 23Cr–12Ni<br>25Cr–20Ni                                                                                                                                             | 2-2.9                                    |                                                                                                                                                              |                                                                                        | A 240 Gr. 309S<br>A 240 Gr. 310S                                                                                                                             |
| 2.10           | 25Cr–12Ni                                                                                                                                                          | 2-2.10                                   |                                                                                                                                                              | A 351 Gr. CH8<br>A 351 Gr. CH20                                                        |                                                                                                                                                              |
| 2.11           | 18Cr–10Ni–Cb                                                                                                                                                       | 2-2.11                                   |                                                                                                                                                              | A 351 Gr. CF8C                                                                         |                                                                                                                                                              |
| 2.12           | 25Cr–20Ni                                                                                                                                                          | 2-2.12                                   |                                                                                                                                                              | A 351 Gr. CK20                                                                         |                                                                                                                                                              |
| 3.1            | 35Ni–35Fe–10Cr–Cb                                                                                                                                                  | 2-3.1                                    | B 462 Gr. N08020                                                                                                                                             |                                                                                        | B 463 Gr. N08020                                                                                                                                             |
| 3.2            | 99.0Ni                                                                                                                                                             | 2-3.2                                    | B 160 Gr. N02200                                                                                                                                             |                                                                                        | B 162 Gr. N02200                                                                                                                                             |
| 3.3            | 99.0Ni–Low C                                                                                                                                                       | 2-3.3                                    | B 160 Gr. N02201                                                                                                                                             |                                                                                        | B 162 Gr. N02201                                                                                                                                             |
| 3.4            | 67Ni–30Cu<br>67Ni–30Cu–S                                                                                                                                           | 2-3.4                                    | B 564 Gr. N04400<br>B 164 Gr. N04405                                                                                                                         |                                                                                        | B 127 Gr. N04400                                                                                                                                             |
| 3.5            | 72Ni–15Cr–8Fe                                                                                                                                                      | 2-3.5                                    | B 564 Gr. N06600                                                                                                                                             |                                                                                        | B 168 Gr. N06600                                                                                                                                             |
| 3.6            | 33Ni–42Fe–21Cr                                                                                                                                                     | 2-3.6                                    | B 564 Gr. N08800                                                                                                                                             |                                                                                        | B 409 Gr. N08800                                                                                                                                             |
| 3.7            | 65Ni–28Mo–2Fe<br>64Ni–29.5Mo–2Cr–2Fe–Mn–W                                                                                                                          | 2-3.7                                    | B 462 Gr. N10665<br>B 462 Gr. N10675                                                                                                                         |                                                                                        | B 333 Gr. N10665<br>B 333 Gr. N10675                                                                                                                         |
| 3.8            | 54Ni–16Mo–15Cr<br>60Ni–22Cr–9Mo–3.5Cb<br>62Ni–28Mo–5Fe<br>70Ni–16Mo–7Cr–5Fe<br>61Ni–16Mo–16Cr<br>42Ni–21.5Cr–3Mo–2.3Cu<br>55Ni–21Cr–13.5Mo<br>55Ni–23Cr–16Mo–1.6Cu | 2-3.8                                    | B 462 Gr. N10276<br>B 564 Gr. N06625<br>B 335 Gr. N10001<br>B 573 Gr. N10003<br>B 574 Gr. N06455<br>B 564 Gr. N08825<br>B 462 Gr. N06022<br>B 462 Gr. N06200 |                                                                                        | B 575 Gr. N10276<br>B 443 Gr. N06625<br>B 333 Gr. N10001<br>B 434 Gr. N10003<br>B 575 Gr. N06455<br>B 424 Gr. N08825<br>B 575 Gr. N06022<br>B 575 Gr. N06200 |
| 3.9            | 47Ni–22Cr–9Mo–18Fe                                                                                                                                                 | 2-3.9                                    | B 572 Gr. N06002                                                                                                                                             |                                                                                        | B 435 Gr. N06002                                                                                                                                             |
| 3.10           | 25Ni–46Fe–21Cr–5Mo                                                                                                                                                 | 2-3.10                                   | B 672 Gr. N08700                                                                                                                                             |                                                                                        | B 599 Gr. N08700                                                                                                                                             |



**Table 1A List of Material Specifications (Cont'd)**

| Material Group | Nominal Designation                                                 | Pressure–Temperature Rating Table | Applicable ASTM Specifications [Note (1)]                |                 |                                                          |
|----------------|---------------------------------------------------------------------|-----------------------------------|----------------------------------------------------------|-----------------|----------------------------------------------------------|
|                |                                                                     |                                   | Forgings                                                 | Castings        | Plates                                                   |
| 3.11           | 44Fe–25Ni–21Cr–Mo                                                   | 2-3.11                            | B 649 Gr. N08904                                         |                 | B 625 Gr. N08904                                         |
| 3.12           | 26Ni–43Fe–22Cr–5Mo<br>47Ni–22Cr–20Fe–7Mo<br>46Fe–24Ni–21Cr–6Mo–Cu–N | 2-3.12                            | B 621 Gr. N08320<br>B 581 Gr. N06985<br>B 462 Gr. N08367 | A 351 Gr. CN3MN | B 620 Gr. N08320<br>B 582 Gr. N06985<br>B 688 Gr. N08367 |
| 3.13           | 49Ni–25Cr–18Fe–6Mo<br>Ni–Fe–Cr–Mo–Cu–Low C                          | 2-3.13                            | B 581 Gr. N06975<br>B 564 Gr. N08031                     |                 | B 582 Gr. N06975<br>B 625 Gr. N08031                     |
| 3.14           | 47Ni–22Cr–19Fe–6Mo<br>40Ni–29Cr–15Fe–5Mo                            | 2-3.14                            | B 581 Gr. N06007<br>B 462 Gr. N06030                     |                 | B 582 Gr. N06007<br>B 582 Gr. N06030                     |
| 3.15           | 33Ni–42Fe–21Cr                                                      | 2-3.15                            | B 564 Gr. N08810                                         |                 | B 409 Gr. N08810                                         |
| 3.16           | 35Ni–19Cr–1 $\frac{1}{4}$ Si                                        | 2-3.16                            | B 511 Gr. N08330                                         |                 | B 536 Gr. N08330                                         |
| 3.17           | 29Ni–20.5Cr–3.5Cu–2.5Mo                                             | 2-3.17                            |                                                          | A 351 Gr. CN7M  |                                                          |

## GENERAL NOTES:

- (a) For temperature limitations, see notes in Tables 2-1.1 through 2-3.17 (Tables F2-1.1 through F2-3.17 of Annex F).  
 (b) Plate materials are listed only for use as blind flanges and reducing flanges without hubs (see para. 5.1). Additional plate materials listed in ASME B16.34 may also be used with corresponding B16.34 Standard Class ratings.

## NOTE:

- (1) ASME Boiler and Pressure Vessel Code, Section II materials may also be used provided the requirements of the ASME specification are identical to or more stringent than the corresponding ASTM specification for the Grade, Class, or Type listed.

(c) A manufacturer may supplement these mandatory material indications with his trade designation for the material grade, but confusion of symbols shall be avoided.

(d) For flanges and flanged fittings manufactured from material that meets the requirements of more than one specification or grade of a specification listed in Table 1A, see para. 4.2.8.

**4.2.3 Rating Designation.** The flange or flanged fitting shall be marked with the number that corresponds to its pressure rating class designation (i.e., 150, 300, 400, 600, 900, 1500, or 2500).

**4.2.4 Conformance.** The designation B16 or B16.5 shall be applied to the flange or flanged fitting, preferably located adjacent to the class designation, to indicate conformance to this Standard. The use of the prefix ASME is optional.

**4.2.5 Temperature.** Temperature markings are not required on flanges or flanged fittings, however, if marked, the temperature shall be shown with its corresponding tabulated pressure rating for the material.

**4.2.6 Size.** The NPS designation shall be marked on flanges and flanged fittings. Reducing flanges and reducing flanged fittings shall be marked with the applicable NPS designations as required by paras. 3.2 and 3.3.

**4.2.7 Ring Joint Flanges.** The edge (periphery) of each ring joint flange shall be marked with the letter R and the corresponding ring groove number.

**4.2.8 Multiple Material Marking.** Material for components that meet the requirements for more than one specification or grade of a specification listed in Table 1A may, at the manufacturer's option, be marked with more than one of the applicable specification or grade symbols. These identification markings shall be placed so as to avoid confusion in identification. The multiple marking shall be in accordance with the guidelines set out in ASME Boiler and Pressure Vessel Code, Section II, Part D, Appendix 7.

## 5 MATERIALS

### 5.1 General

Materials required for flanges and flanged fittings are listed in Table 1A with the restriction that plate materials shall be used only for blind flanges and reducing flanges without hubs. Recommended bolting materials are listed in Table 1B (See para. 5.3). Corresponding materials listed in Section II of the ASME Boiler and Pressure Vessel Code may be used provided that the requirements of the ASME specification are identical to or more stringent than the ASTM specification for the Grade, Class, or type of material.

**Table 1B List of Bolting Specifications  
Applicable ASTM Specifications**

| Bolting Materials [Note (1)] |       |       |                                     |           |       |                            |          |       |                                        |                  |            |
|------------------------------|-------|-------|-------------------------------------|-----------|-------|----------------------------|----------|-------|----------------------------------------|------------------|------------|
| High Strength<br>[Note (2)]  |       |       | Intermediate Strength<br>[Note (3)] |           |       | Low Strength<br>[Note (4)] |          |       | Nickel and Special Alloy<br>[Note (5)] |                  |            |
| Spec.<br>No.                 | Grade | Notes | Spec.<br>No.                        | Grade     | Notes | Spec.<br>No.               | Grade    | Notes | Spec.<br>No.                           | Grade            | Notes      |
| A 193                        | B7    | ...   | A 193                               | B5        | ...   | A 193                      | B8 Cl.1  | (6)   | B164                                   | ...              | (7)(8)(9)  |
| A 193                        | B16   | ...   | A 193                               | B6        | ...   | A 193                      | B8C Cl.1 | (6)   |                                        |                  |            |
|                              |       |       | A 193                               | B6X       | ...   | A 193                      | B8M Cl.1 | (6)   | B166                                   | ...              | (7)(8)(9)  |
| A 320                        | L7    | (10)  | A 193                               | B7M       | ...   | A 193                      | B8T Cl.1 | (6)   |                                        |                  |            |
| A 320                        | L7A   | (10)  |                                     |           |       |                            |          |       |                                        |                  |            |
| A 320                        | L7B   | (10)  | A 193                               | B8 Cl.2   | (11)  | A 193                      | B8A      | (6)   | B335                                   | N10665<br>N10675 | (7)<br>(7) |
|                              |       |       | A 193                               | B8 Cl.2B  | (11)  |                            |          |       |                                        |                  |            |
| A 320                        | L7C   | (10)  | A 193                               | B8C Cl.2  | (11)  | A 193                      | B8CA     | ...   |                                        |                  |            |
| A 320                        | L43   | (10)  | A 193                               | B8M Cl.2  | (11)  | A 193                      | B8MA     | ...   | B408                                   | ...              | (7)(8)(9)  |
|                              |       |       | A 193                               | B8M Cl.2B | (11)  |                            |          |       |                                        |                  |            |
|                              |       |       | A 193                               | B8T Cl.2  | (11)  | A 193                      | B8TA     | (6)   |                                        |                  |            |
| A 354                        | BC    | ...   |                                     |           |       |                            |          |       | B473                                   | ...              | (7)        |
| A 354                        | BD    | ...   | A 320                               | B8 Cl.2   | (11)  | A 307                      | B        | (12)  |                                        |                  |            |
|                              |       |       | A 320                               | B8C Cl.2  | (11)  |                            |          |       | B574                                   | ...              | (7)        |
| A 540                        | B21   | ...   | A 320                               | B8F Cl.2  | (11)  | A 320                      | B8 Cl.1  | (6)   |                                        |                  |            |
| A 540                        | B22   | ...   | A 320                               | B8M Cl.2  | (11)  | A 320                      | B8C Cl.1 | (6)   |                                        |                  |            |
| A 540                        | B23   | ...   | A 320                               | B8T Cl.2  | (11)  | A 320                      | B8M Cl.1 | (6)   |                                        |                  |            |
| A 540                        | B24   | ...   |                                     |           |       | A 320                      | B8T Cl.1 | (6)   |                                        |                  |            |
|                              |       |       | A 449                               |           | (13)  |                            |          |       |                                        |                  |            |
|                              |       |       | A 453                               | 651       | (14)  |                            |          |       |                                        |                  |            |
|                              |       |       | A 453                               | 660       | (14)  |                            |          |       |                                        |                  |            |

**GENERAL NOTES:**

- (a) Bolting material shall not be used beyond temperature limits specified in the governing code.
- (b) ASME Boiler and Pressure Vessel Code, Section II materials may also be used provided the requirements of the ASME specification are identical or more stringent than the corresponding ASTM specification for the Grade, Class, or Type listed.

**NOTES:**

- (1) Repair welding of bolting material is prohibited.
- (2) These bolting materials may be used with all listed materials and gaskets.
- (3) 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 working pressure and temperature.
- (4) These bolting materials may be used with all listed materials but are limited to Class 150 and Class 300 joints. See para. 5.3.4 for recommended gasket practices.
- (5) These materials may be used as bolting with comparable nickel and special alloy parts.
- (6) This austenitic stainless material has been carbide solution treated but not strain hardened. Use A 194 nuts of corresponding material.
- (7) Nuts may be machined from the same material or may be of a compatible grade of ASTM A 194.
- (8) Maximum operating temperature is arbitrarily set at 260°C (500°F) unless the material has been annealed, solution annealed, or hot finished because hard temper adversely affects design stress in the creep rupture range.
- (9) Forging quality is not permitted unless the producer last heating or working these parts tests them as required for other permitted conditions in the same specification and certifies their final tensile, yield, and elongation properties to equal or exceed the requirements for one of the other permitted conditions.
- (10) This ferritic material is intended for low temperature service. Use A 194 Gr. 4 or Gr. 7 nuts.
- (11) This austenitic stainless material has been carbide solution treated and strain hardened. Use A 194 nuts of corresponding material.
- (12) This carbon steel fastener shall not be used above 200°C (400°F) or below -29°C (-20°F). See also Note (4). Bolts with drilled or undersized heads shall not be used.
- (13) Acceptable nuts for use with quenched and tempered bolts are A 194 Gr. 2 or Gr. 2H Mechanical property requirements for studs shall be the same as those for bolts.
- (14) This special alloy is intended for high temperature service with austenitic stainless steel.

**5.1.1 Application.** Criteria for the selection of materials are not within the scope of this Standard. The possibility of material deterioration in service should be considered by the user. Carbide phase conversion to graphite and excessive oxidation of ferritic materials, susceptibility to intergranular corrosion of austenitic materials, or grain boundary attack of nickel base alloys are among those items requiring attention. A discussion of precautionary considerations can be found in ASME B31.3, Appendix F; Section II, Part D, Appendix 6; and Section III, Division 1, Appendix W of the ASME Boiler and Pressure Vessel Code.

**5.1.2 Toughness.** Some of the materials listed in Table 1A undergo a decrease in toughness when used at low temperatures, to the extent that Codes referencing the Standard may require impact tests for application even at temperatures higher than  $-7^{\circ}\text{C}$  ( $+20^{\circ}\text{F}$ ). It is the responsibility of the user to assure that such testing is performed.

**5.1.3 Responsibility.** When service conditions dictate the implementation of special material requirements [e.g., using a Group 2 material above  $538^{\circ}\text{C}$  ( $1000^{\circ}\text{F}$ )], it is the user's responsibility to so specify to the manufacturer in order to ensure compliance with metallurgical requirements listed in the notes in Tables 2-1.1 through 2-3.17 (Tables F2-1.1 through F2-3.17 of Annex F):

**5.1.4 Cast Surfaces.** Cast surfaces of component pressure boundaries shall be in accordance with MSS SP-55 except that all Type I defects are unacceptable and defects in excess of Plates "a" and "b" for Type II through Type XII are unacceptable.

## 5.2 Mechanical Properties

Mechanical properties shall be obtained from test specimens that represent the final heat treated condition of the material required by the material specification.

## 5.3 Bolting

**5.3.1 General.** Bolting listed in Table 1B is recommended for use in flanged joints covered by this Standard. Bolting of other material may be used if permitted by the applicable code or government regulation. Bolting materials are subject to the limitations given in paras. 5.3.2, 5.3.3, 5.3.4, and 5.3.5.

**5.3.2 High Strength Bolting.** Bolting materials having allowable stresses not less than those for ASTM A 193 Grade B7 are listed as high strength in Table 1B. These and other materials of comparable strength may be used in any flanged joint.

**5.3.3 Intermediate Strength Bolting.** Bolting materials listed as intermediate strength in Table 1B, 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 condition.

**5.3.4 Low Strength Bolting.** Bolting materials having no more than 206 MPa (30 ksi) specified minimum yield strength are listed as low strength in Table 1B. These materials and others of comparable strength are to be used only in Class 150 and 300 flanged joints and only with gaskets described in para. 5.4.2. Flanged assemblies using low strength carbon steel bolts should not be used above  $200^{\circ}\text{C}$  ( $400^{\circ}\text{F}$ ) or below  $-29^{\circ}\text{C}$  ( $-20^{\circ}\text{F}$ ).

**5.3.5 Bolting to Gray Cast Iron Flanges.** The following recommendations are made in recognition of the low ductility of gray cast iron.

(a) Alignment of flange faces is essential along with control of assembly bolt torque so as not to over-stress the cast iron flanges. Care must also be exercised to ensure that piping loads transmitted to cast iron flanges are controlled, taking into account its lack of ductility and recognizing that cast iron flanges should not be used where suddenly applied loads such as rapid pressure fluctuation may occur.

(b) Where Class 150 steel flanges are bolted to Class 125 cast iron flanges, the gaskets should be made of Annex C, Group No. 1a materials, the steel flanges should have flat faces, and

(1) low strength bolting within the limitations of para. 5.3.4 should be used with ring gaskets extending to the bolt holes, or

(2) bolting of low (para. 5.3.4), intermediate (para. 5.3.3), or high (para. 5.3.2) strength may be used with full face gaskets extending to the outside diameters of the flanges

(c) Where Class 300 steel flanges are bolted to Class 250 cast iron flanges, the gaskets should be made of Annex C, Group No. 1a materials, and

(1) low strength bolting within the limitations of para. 5.3.4 should be used with gaskets extending to the bolt holes and with the flanges having either raised or flat faces, or

(2) bolting of low (para. 5.3.4), intermediate (para. 5.3.3), or high (para. 5.3.2) strength may be used with full face gaskets extending to the outside diameters of the flanges and with both the Class 300, steel and Class 250 cast iron flanges having flat faces

## 5.4 Gaskets

**5.4.1 General.** Ring joint gasket materials shall conform to ASME B16.20. Materials for other gaskets are described in Annex C. 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 approaches or exceeds the test pressure specified in para. 2.6.

**5.4.2 Gaskets for Low Strength Bolting.** If bolting listed as low strength in Table 1B is used, gaskets shown in Annex C, Table C1, Group No. 1a, are recommended.

**5.4.3 Gaskets for Class 150 Flanged Joints.** It is recommended that only Annex C, Table C1, Group No. 1 gaskets be used for Class 150 flanged joints. When the ring joint or spiral wound gasket is selected, it is recommended that line flanges be of the welding neck or lapped joint type.

## 6 DIMENSIONS

### 6.1 Flanged Fittings Wall Thickness

**6.1.1 Minimum Wall Thickness.** For inspection purposes the minimum wall thickness  $t_m$  of flanged fittings at the time of manufacture shall be as shown in Tables 9 and 12 (Tables F9 and F12 of Annex F), except as provided in para. 6.1.2. Additional metal thickness needed to withstand installation bolt-up assembly stresses, shapes other than circular, and stress concentrations must be determined by the manufacturer, since these factors vary widely. In particular, 45-deg laterals, true Ys, and crosses may require additional reinforcement to compensate for inherent weaknesses in these shapes.

**6.1.2 Fitting Local Areas.** Local areas having less than minimum wall thickness are acceptable provided that all of the following conditions are satisfied:

(a) The area of sub-minimum thickness can be enclosed by a circle whose diameter is no greater than  $0.35 \sqrt{dt_m}$ , where  $d$  is the tabulated fitting inside diameter and  $t_m$  is the minimum wall thickness as shown in the tables listed in para. 6.1.1.

(b) Measured thickness is not less than  $0.75 t_m$ .

(c) Enclosure circles are separated from each other by an edge-to-edge distance of more than  $1.75 \sqrt{dt_m}$ .

### 6.2 Fitting Center-to-Contact Surface and Center-to-End

**6.2.1 Design.** A principle of design in this Standard is to maintain a fixed position for the flange edge with reference to the body of the fitting. In case of raised face flanged fittings, the outside edge of the flange includes the raised face (see para. 6.4).

**6.2.2 Standard Fittings.** Center-to-contact surface, center-to-flange edge, and center-to end (ring joint) dimensions are shown in Tables 9 and 12 (Tables F9 and F12 of Annex F).

**6.2.3 Reducing Fittings.** Center-to-contact surface or center-to-flange edge dimensions for all openings shall be the same as those of straight size fittings of the largest opening. The contact surface-to-contact surface or flange edge-to-flange edge dimensions for all combinations of

reducers and eccentric reducers shall be as listed for the larger opening.

**6.2.4 Side Outlet Fittings.** Side outlet elbows, side outlet tees, and side outlet crosses shall have all openings on intersecting centerlines, and the center-to-contact surface dimensions of the side outlet shall be the same as for the largest opening. Long radius elbows with one side outlet shall have the side outlet on the radial centerline of the elbow, and the center-to-contact surface dimension of the side outlet shall be the same as for the regular 90 deg elbow of the largest opening.

**6.2.5 Special Degree Elbows.** Special degree elbows ranging from 1 deg to 45 deg, inclusive, shall have the same center-to-contact surface dimensions as 45 deg elbows, and those over 45 deg and up to 90 deg, inclusive, shall have the same center-to-contact surface dimensions as 90 deg elbows. The angle designation of an elbow is its deflection from straight line flow and is also the angle between the flange faces.

### 6.3 Flat Face Flanges

**6.3.1 General.** This Standard permits flat face flanges in all classes.

**6.3.2 Conversion.** A raised face may be removed from a raised face flange to convert it to a flat face flange provided that the required dimension  $t_f$ , shown in Fig. 7 (Fig. F7 of Annex F) is maintained.

**6.3.3 Facing.** The flat face flange facing finish shall be in conformance with para. 6.4.5 for the full width of the seating surface for the gasket.

### 6.4 Flange Facings

**6.4.1 General.** Figure 7 (Fig. F7 of Annex F) shows dimensional relationships for various flange types and for pipe lap facings to be used with lap joints. Table 4 (Table F4 of Annex F) lists dimensions for facings other than ring joint. Table 5 (Table F5 of Annex F) lists dimensions for ring joint facings. Classes 150 and 300 pipe flanges and companion flanges of fittings are regularly furnished with 2 mm (0.06 in.) raised face, which is in addition to the minimum flange thickness,  $t_f$ . Classes 400, 600, 900, 1500, and 2500 pipe flanges and companion flanges of fittings are regularly furnished with 7 mm (0.25 in.) raised face, which is in addition to the minimum flange thickness,  $t_f$ .

**6.4.2 Other Than Lapped Joints.** For joints other than lapped joints, the requirements of paras. 6.4.2.1 and 6.4.2.2 shall apply.

**6.4.2.1 Raised Face and Tongue Face.** In the case of flanges having raised face, tongue or male face, the minimum flange thickness,  $t_f$ , shall be provided and then the raised face, tongue, or male face shall be added thereto.

**6.4.2.2 Grooves.** For flanges that have a ring joint, groove, or female face, the minimum flange thickness shall first be provided and then sufficient thickness added thereto so that the bottom of the ring joint groove, or the contact face of the groove or female face is in the same plane as the flange edge of a full thickness flange.

**6.4.3 Lapped Joint Flanges.** Lapped joint flanges shall be furnished with flat faces as illustrated in Tables 8, 11, 14, 16, 18, 20, and 22 (Tables F8, F11, F14, F16, F18, F20, and F22 of Annex F). Lap joint stub ends shall be in accordance with Fig. 7 (Fig. F7 of Annex F) and paras. 6.4.3.1 through 6.4.3.3.

**6.4.3.1 Raised Face.** The finished thickness of the lap shall be no less than nominal pipe wall thickness.

**6.4.3.2 Large Male and Female.** The finished height of the male face shall be the greater of the wall thickness of the pipe used or 7 mm (0.25 in.). The thickness of lap that remains after machining the female face shall be no less than the nominal wall thickness of pipe used.

**6.4.3.3 Tongue and Groove.** The thickness of the lap remaining after machining the tongue or groove face shall be no less than the nominal wall thickness of the pipe used.

**6.4.3.4 Ring Joint.** The thickness of the lap remaining after machining the ring groove shall be no less than the nominal wall thickness of pipe used.

**6.4.3.5 Lap Joint Facing Outside Diameters.** The outside diameters of the lap for ring joints are shown in Table 5 (Table F5 of Annex F), dimension K. The outside diameters of laps for large female, large tongue and groove, and small tongue and groove are shown in Table 4 (Table F4 of Annex F). Small male and female facings for lapped joints are not covered by this Standard.

**6.4.4 Blind Flanges.** Blind flanges need not be faced in the center if, when this center part is raised, its diameter is at least 25 mm (1 in.) smaller than the inside diameter of fittings of the corresponding pressure class, as given in Tables 9 and 12 (Tables F9 and F12) or 25 mm (1 in.) smaller than the mating pipe inside diameter. When the center part is depressed, its diameter shall not be greater than the inside diameter of the corresponding pressure class fittings, as given in Tables 9 and 12 (Tables F9 and F12). Machining of the depressed center is not required.

**6.4.5 Flange Facing Finish.** Flange facing finishes shall be in accordance with paras. 6.4.5.1 through 6.4.5.3, except that other finishes may be furnished by agreement between the user and the manufacturer. The finish of the gasket contact faces shall be judged by visual comparison with Ra standards (see ASME B46.1) and not by instruments having stylus tracers and electronic amplification.

**6.4.5.1 Tongue and Groove and Small Male and Female.** The gasket contact surface finish shall not exceed 3.2  $\mu\text{m}$  (125  $\mu\text{in.}$ ) roughness.

**6.4.5.2 Ring Joint.** The side wall surface finish of the gasket groove shall not exceed 1.6  $\mu\text{m}$  (63  $\mu\text{in.}$ ) roughness.

**6.4.5.3 Other Flange Facings.** Either a serrated concentric or serrated spiral finish having a resultant surface finish from 3.2 to 6.3  $\mu\text{m}$  (125 to 250  $\mu\text{in.}$ ) average roughness shall be furnished. The cutting tool employed should have an approximate 1.5 mm (0.06 in.) or larger radius, and there should be from 1.8 grooves/mm through 2.2 grooves/mm (45 grooves/in. through 55 grooves/in.).

**6.4.6 Flange Facing Finish Imperfections.** Imperfections in the flange facing finish shall not exceed the dimensions shown in Table 3 (Table F3 of Annex F). A distance of at least four times the maximum radial projection shall separate adjacent imperfections. A radial projection shall be measured by the difference between an outer radius and an inner radius encompassing the imperfection where the radii are struck from the centerline of the bore. Imperfections less than half the depth of the serrations shall not be considered cause for rejection. Protrusions above the serrations are not permitted.

## 6.5 Flange Bolt Holes

Bolt holes are in multiples of four. Bolt holes shall be equally spaced and pairs of bolt holes shall straddle fitting centerlines.

## 6.6 Bolting Bearing Surfaces

Flanges and flanged fittings shall have bearing surfaces for bolting that are parallel to the flange face within 1 deg. Any back facing or spot facing shall not reduce the flange thickness,  $t_f$  below the dimensions given in Tables 8, 9, 11, 12, 14, 16, 18, 20, and 22 (Tables F8, F9, F11, F12, F14, F16, F18, F20, and F22 of Annex F). Spot facing or back facing shall be in accordance with MSS SP-9.

## 6.7 Welding End Preparation for Welding Neck Flanges

**6.7.1 Illustrations.** Welding ends are illustrated in Figs. 8, 9, 10, 11 (Figs. F8, F9, F10, and F11 of Annex F) and Figs. 12, 13, and 14.

**6.7.2 Contours.** The contours of the outside of the welding neck beyond the welding groove are shown in Figs. 8 and 9 (Figs. F8 and F9 of Annex F) and Figs. 12 and 14.

**6.7.3 Bores.** Straight through bores shown in Figs. 8 and 9 (Figs. F8 and F9 of Annex F) are standard unless

specifically ordered to suit the special conditions illustrated in Figs. 10 and 11 (Figs. F10 and F11 of Annex F) and Figs. 13 and 14.

**6.7.4 Other Welding Ends.** Other welding end preparations furnished by agreement of purchaser and manufacturer do not invalidate compliance with this Standard.

## 6.8 Reducing Flanges

**6.8.1 Drilling, Outside Diameter, Thickness, and Facing Dimensions.** Flange drilling, outside diameter, thickness, and facing are the same as those of the standard flange of the size from which the reduction is being made.

### 6.8.2 Hub Dimensions

**6.8.2.1 Threaded, Socket Weld, and Slip-on Flanges.** The hub dimension shall be at least as large as those of the standard flange of the size to which the reduction is being made. The hub may be larger or omitted as detailed in Table 6 (Table F6 of Annex F).

**6.8.2.2 Welding Neck Flanges.** The hub dimensions shall be the same as those of the standard flange of the size to which the reduction is being made.

## 6.9 Threaded Flanges

**6.9.1 Thread Dimensions.** Except as provided in Notes (4) and (5) of Table 4 (Table F4 of Annex F), threaded flanges shall have a taper pipe thread conforming to ASME B1.20.1. The thread shall be concentric with the axis of the flange opening, and variations in alignment (perpendicularity with reference to the flange face) shall not exceed 5 mm/m (0.06 in./ft).

**6.9.2 Threads for Class 150 Flanges.** Class 150 flanges are made without a counterbore. The threads shall be chamfered approximately to the major diameter of the thread at the back of the flange at an angle of approximately 45 deg with the axis of the thread. The chamfer shall be concentric with the thread and shall be included in the measurement of the thread length.

**6.9.3 Threads for Class 300 and Higher Flanges.** Class 300 and higher pressure class flanges shall be made with a counterbore at the back of the flange. The threads shall be chamfered to the diameter of the counterbore at an angle of approximately 45 deg with the axis of the threads. The counterbore and chamfer shall be concentric with the thread.

**6.9.4 Reducing Flange Thread Length.** The minimum length of effective thread in reducing flanges shall be at least equal to dimension  $T$  of the corresponding class of threaded flange as shown in Tables 8, 9, 11, 12, 14, 16, 18, 20, and 22 (Tables F8, F9, F11, F12, F14, F16, F18, F20, and F22). Threads do not necessarily extend to the

face of the flange. See Table 6 (Table F6 of Annex F) for reducing threaded flanges.

**6.9.5 Thread Gaging.** The gaging notch of the working gage shall come flush with the bottom of the chamfer in all threaded flanges and shall be considered as being the intersection of the chamfer cone and the pitch cone of the thread. This depth of chamfer is approximately equal to one-half the pitch of the thread. The maximum allowable thread variation is one turn large or small from the gaging notch.

**6.9.6 Assembly Using Power Equipment.** For ASME B1.20.1 external pipe threads, Annex A specifies the distance and number of turns that external pipe threads may be made longer than regular for use with the higher pressure flanges to bring the small end of the thread close to the face of the flange when the parts are assembled by power equipment.

## 6.10 Flange Bolting Dimensions

**6.10.1 Dimensional Standards.** Stud bolts, threaded at both ends or threaded full length, or bolts may be used in flange joints. Dimensional recommendations for bolts, stud bolts, and nuts are shown in Table 1C. See para. 5.3 for bolting material recommendations.

**6.10.2 Bolt Lengths.** Stud bolt lengths, including the height of two heavy hexagon nuts, are shown as dimension  $L$  in Tables 7, 10, 13, 15, 17, 19, and 21 (Tables F7, F10, F13, F15, F17, F19, and F21 of Annex F). The tabulated stud bolt length  $L$  does not include the height of end points. An end point is defined as an unthreaded length, such as a chamfer, which extends beyond the thread. The method of calculating bolt lengths is explained in Annex D. The tabulated bolt lengths are reference dimensions. Users may select other bolting lengths.

**6.10.3 Bolting Recommendations.** For flange joints, stud bolts with a nut at each end are recommended for all applications and especially for high temperature service.

## 6.11 Gaskets for Line Flanges

**6.11.1 Ring Joint.** Ring joint gasket dimensions shall conform to ASME B16.20.

**6.11.2 Contact Width.** For flanges having large or small tongue-and-groove faces, all gaskets, except solid flat metal gaskets, shall cover the bottom of the groove with minimum clearance. [See para. 7.3(a) for tolerance applicable to groove.] Solid flat metal gaskets shall have contact width not greater than for Annex C, Group III gaskets.

**6.11.3 Bearing Surface.** For flanges with small male-and-female face, care must be taken to assure that adequate bearing surface is provided for the gaskets. In

**Table 1C Flange Bolting Dimensional Recommendations**

| Product                                         | Carbon Steel                           | Alloy Steel                                                                            |
|-------------------------------------------------|----------------------------------------|----------------------------------------------------------------------------------------|
| Stud Bolts                                      | ASME B18.2.1                           | ASME B18.2.1                                                                           |
| Bolts smaller than $\frac{3}{4}$ in.            | ASME B18.2.1, square or heavy hex head | ASME B18.2.1, heavy hex head                                                           |
| Bolts equal to or larger than $\frac{3}{4}$ in. | ASME B18.2.1, square or heavy hex head | ASME B18.2.1, heavy hex head                                                           |
| Nuts smaller than $\frac{3}{4}$ in.             | ASME B18.2.2, heavy hex                | ASME B18.2.2, heavy hex                                                                |
| Nuts equal to or larger than $\frac{3}{4}$ in.  | ASME B18.2.2, hex or heavy hex         | ASME B18.2.2, heavy hex                                                                |
| External threads                                | ASME B1.1, Cl. 2A course series        | ASME B1.1, Cl. 2A course series up through 1 in.; eight thread series for larger bolts |
| Internal threads                                | ASME B1.1, Cl. 2B course series        | ASME B1.1, Cl. 2B course series up through 1 in.; eight thread series for larger bolts |

particular, care is necessary when the joint is made on the end of pipe as shown in Fig. 7 (Fig. F7 of Annex F).

## 6.12 Auxiliary Connections

**6.12.1 General.** Auxiliary connections or openings for flanged fittings are not required unless specified by the purchaser. Welding to attach auxiliary connections to flanged fittings shall be made by a qualified welder using a qualified weld procedure in accordance with Section IX of the ASME Boiler and Pressure Vessel Code.

**6.12.2 Pipe Thread Tapping.** Holes may be tapped in the wall of a fitting if the metal is thick enough to allow the effective thread length specified in Fig. 3 (Fig. F3 of Annex F). Where thread length is insufficient or the tapped hole needs reinforcement, a boss shall be added.

**6.12.3 Sockets.** Sockets for socket welding connections may be provided in the wall of a fitting if the metal is thick enough to afford the depth of socket and retaining wall specified in Fig. 4 (Fig. F4 of Annex F). Where the wall thickness is insufficient, or the size of the connection requires opening reinforcement, a boss shall be added. See Fig. 6 (Fig. F6 of Annex F).

**6.12.4 Butt Welding.** Connections may be attached by butt welding directly to the wall of the fitting. See Fig. 5 (Fig. F5 of Annex F). Where the size of an opening requires reinforcement, a boss shall be added.

**6.12.5 Bosses.** Where bosses are required, the diameters shall be no less than those shown in Fig. 6 (Fig. F6 of Annex F), and the height shall provide lengths as specified in Fig. 3 or 4 (Fig. F3 or F4 of Annex F).

**6.12.6 Size.** Unless otherwise specified, auxiliary connections shall be of the pipe sizes given below.

| Fitting Size               | Connection Size (NPS) |
|----------------------------|-----------------------|
| $2 \leq \text{NPS} \leq 4$ | $\frac{1}{2}$         |
| $5 \leq \text{NPS} \leq 8$ | $\frac{3}{4}$         |
| $\text{NPS} \geq 10$       | 1                     |

**6.12.7 Designating Locations.** The designation of locations for auxiliary connections for flanged fittings is shown in Fig. 1. A letter is used to designate each location.

## 7 TOLERANCES

### 7.1 General

For the purpose of determining conformance with this Standard, the convention for fixing significant digits where limits, maximum or minimum values are specified, shall be rounded as defined in ASTM Practice E 29. This requires that an observed or calculated value shall be rounded to the nearest unit in the last right hand digit used for expressing the limit. The listing of decimal tolerances does not imply a particular method of measurement.

### 7.2 Center-to-Contact Surfaces and Center-to-End Tolerances

Required tolerances for various flanges and flanged fitting elements are as follows:

- (a) *Center-to-Contact Surfaces Other Than Ring Joint:*
- |                      |                                              |
|----------------------|----------------------------------------------|
| $\text{NPS} \leq 10$ | $\pm 1.0 \text{ mm } (\pm 0.03 \text{ in.})$ |
| $\text{NPS} \geq 12$ | $\pm 1.5 \text{ mm } (\pm 0.06 \text{ in.})$ |

*(b) Center-to-End (Ring Joint):*

|          |                     |
|----------|---------------------|
| NPS ≤ 10 | ±1.0 mm (±0.03 in.) |
| NPS ≥ 12 | ±1.5 mm (±0.06 in.) |

*(c) Contact Surface-to-Contact Surface Other Than Ring Joint:*

|          |                     |
|----------|---------------------|
| NPS ≤ 10 | ±2.0 mm (±0.06 in.) |
| NPS ≥ 12 | ±3.0 mm (±0.12 in.) |

*(d) End-to-End (Ring Joint):*

|          |                     |
|----------|---------------------|
| NPS ≤ 10 | ±2.0 mm (±0.06 in.) |
| NPS ≥ 12 | ±3.0 mm (±0.12 in.) |

**7.3 Facings**

Required tolerances for various flange and flanged fitting facings are as follows:

(a) Inside and outside diameter of large and small tongue and groove and female, ±0.5 mm (±0.02 in.).

(b) Outside diameter, 2.0 mm (0.06 in.) raised face, ±1.0 mm (±0.03 in.).

(c) Outside diameter, 7.0 mm (0.25 in.) raised face, ±0.5 mm (±0.02 in.).

(d) Ring joint groove tolerances are shown in Table 5 (Table F5 of Annex F).

**7.4 Flange Thickness**

Required tolerances for flange thickness are as follows.

|           |                                 |
|-----------|---------------------------------|
| NPS ≤ 18, | +3.0, -0.0 mm (+0.12, -0.0 in.) |
| NPS ≥ 20, | +5.0, -0.0 mm (+0.19, -0.0 in.) |

The plus tolerance is applicable to bolting bearing surfaces whether as-forged, as-cast, spot-faced or back-faced. See para. 6.6.

**7.5 Welding End Flange Ends and Hubs**

**7.5.1 Outside Diameter.** Required tolerances for the nominal outside diameter dimension *A* of Figs. 8 and 9 (Figs. F8 and F9 of Annex F) of welding ends of welding neck flanges are as follows:

|         |                                  |
|---------|----------------------------------|
| NPS ≤ 5 | +2.0, -1.0 mm (+0.09, -0.03 in.) |
| NPS ≥ 6 | +4.0, -1.0 mm (+0.16, -0.03 in.) |

**7.5.2 Inside Diameter.** Required tolerances for the nominal inside diameter of welding ends of welding neck flanges and smaller bore of socket welding flanges (dimension *B* in the referenced figures) are as follows:

For Figs. 8 and 9 (Figs. F8 and F9 of Annex F) the tolerances are

|               |                                  |
|---------------|----------------------------------|
| NPS ≤ 10      | ±1.0 mm (±0.03 in.)              |
| 12 ≤ NPS ≤ 18 | ±1.5 mm (±0.06 in.)              |
| NPS ≥ 20,     | +3.0, -1.5 mm (+0.12, -0.06 in.) |

For Fig. 10 (Fig. F10 of Annex F) the tolerances are

|          |                                 |
|----------|---------------------------------|
| NPS ≤ 10 | +0.0, -1.0 mm (+0.0, -0.03 in.) |
| NPS ≥ 12 | +0.0, -1.5 mm (+0.0, -0.06 in.) |

**7.5.3 Backing Ring Contact Surface.** Required tolerances for the bore of the backing ring contact surface of welding neck flanges, dimension *C* of Figs. 10 and 11 (Figs. F10 and F11 of Annex F) are as follows.

|              |                                  |
|--------------|----------------------------------|
| 2 ≤ NPS ≤ 24 | +0.25, -0.0 mm (+0.01, -0.0 in.) |
|--------------|----------------------------------|

**7.5.4 Hub Thickness.** Despite the tolerances specified for dimensions *A* and *B*, the thickness of the hub at the welding end shall not be less than 87½% of the nominal thickness of the pipe, having an under tolerance of 12.5% for the pipe wall thickness to which the flange is to be attached, or the minimum wall thickness as specified by the purchaser.

**7.6 Length Through Hub on Welding Neck Flanges**

The required tolerances for the length through hubs on welding neck flanges are as follows.

|              |                                  |
|--------------|----------------------------------|
| NPS ≤ 4      | ±1.5 mm (±0.06 in.)              |
| 5 ≤ NPS ≤ 10 | +1.5, -3.0 mm (+0.06, -0.12 in.) |
| NPS ≥ 12     | +3.0, -5.0 mm (+0.12, -0.18 in.) |

**7.7 Flange Bore**

**7.7.1 Lapped, Slip-on, and Socket Welding Flange Bores.** The required tolerances for lapped, slip-on, and socket welding flange bores are as follows.

|          |                                 |
|----------|---------------------------------|
| NPS ≤ 10 | +1.0, -0.0 mm (+0.03, -0.0 in.) |
| NPS ≥ 12 | +1.5, -0.0 mm (+0.06, -0.0 in.) |

**7.7.2 Counterbores, Threaded Flanges.** The required tolerances for threaded flange counterbores are as follows.

|          |                                 |
|----------|---------------------------------|
| NPS ≤ 10 | +1.0, -0.0 mm (+0.03, -0.0 in.) |
| NPS ≥ 12 | +1.5, -0.0 mm (+0.06, -0.0 in.) |

**7.7.3 Counterbores, Socket Welding Flanges.** The required tolerances for socket end counterbores are as follows.

|             |                       |
|-------------|-----------------------|
| ½ ≤ NPS ≤ 3 | ±0.25 mm (±0.010 in.) |
|-------------|-----------------------|

**7.8 Drilling and Facing**

**7.8.1 Bolt Circle Diameter.** The required tolerance for all bolt circle diameters is ±1.5 mm (±0.06 in.)

**7.8.2 Bolt Hole to Bolt Hole.** The required tolerance for the center-to-center of adjacent bolt holes is ±0.8 mm (±0.03 in.)

**7.8.3 Bolt Circle Concentricity.** The required tolerances for concentricity between the flange bolt circle diameter and machined facing diameters are as follows.

|          |                   |
|----------|-------------------|
| NPS ≤ 2½ | 0.8 mm (0.03 in.) |
| NPS ≥ 3  | 1.5 mm (0.06 in.) |



## 8 PRESSURE TESTING

### 8.1 Flange Test

Flanges are not required to be pressure tested.

### 8.2 Flanged Fitting Test

**8.2.1 Shell Pressure Test.** Each flanged fitting shall be given a shell pressure test.

**8.2.2 Test Conditions.** The shell pressure test for flanged fittings shall be at a pressure no less than 1.5 times the 38°C (100°F) pressure rating rounded off to the next higher 1 bar (25 psi) increment.

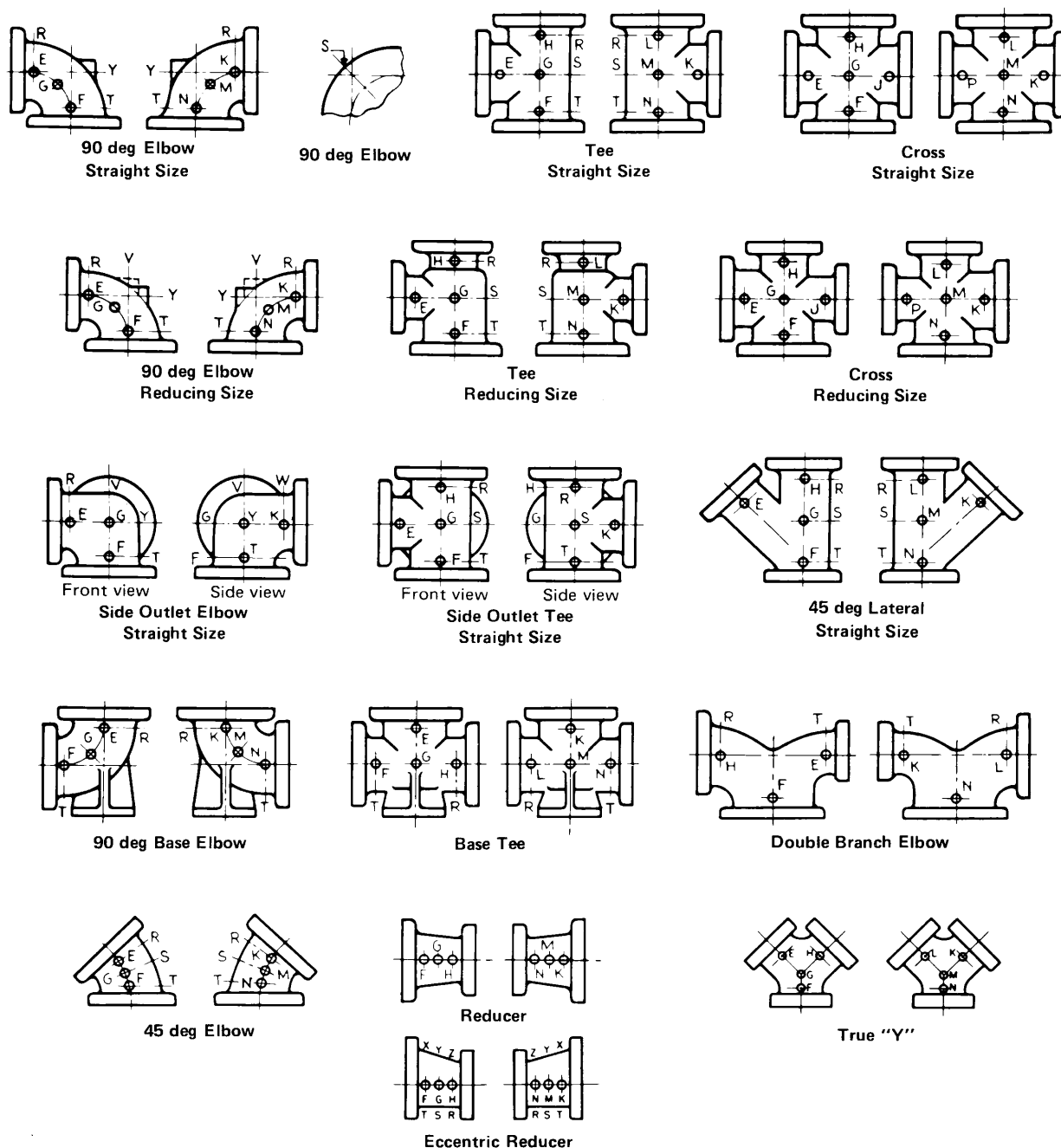
**8.2.3 Test Fluid.** The pressure test shall be made using water, which may contain a corrosion inhibitor or kerosene as the test fluid. Other suitable test fluids may be used provided their viscosity is no greater than that of water. The test fluid temperature shall not exceed 50°C (125°F).

**8.2.4 Test Duration.** The test duration shall be as follows.

| Fitting Size | Duration, sec |
|--------------|---------------|
| NPS ≤ 2      | 60            |
| 2½ ≤ NPS ≤ 8 | 120           |
| NPS ≥ 10     | 180           |

**8.2.5 Acceptance.** No visible leakage is permitted through the pressure boundary wall.

## FLANGED FITTINGS

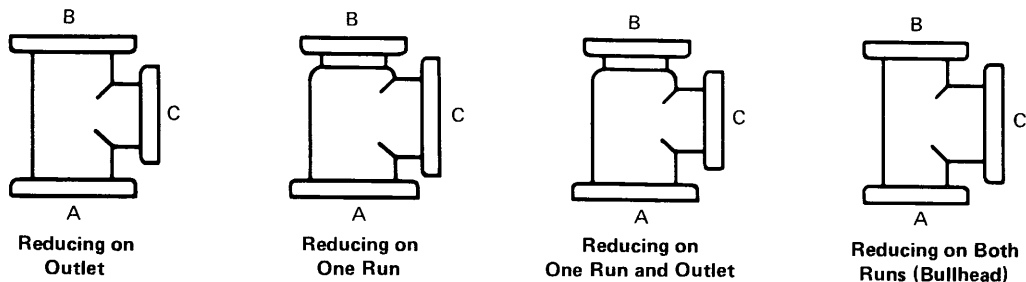


GENERAL NOTE: The above sketches show views of the same fitting and represent fittings with symmetrical shapes, with the exception of the side outlet elbow and the side outlet tee (straight sizes). Sketches are illustrative only, and do not imply required design (see para. 6.12).

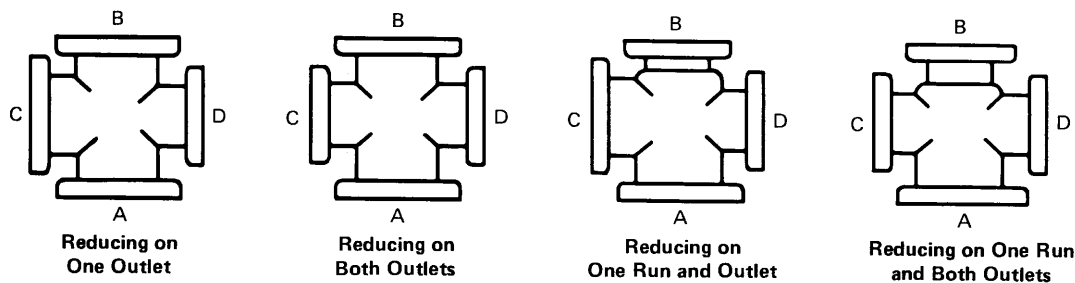
**Fig. 1 Method of Designating Location of Auxiliary Connections When Specified**

## FLANGED FITTINGS

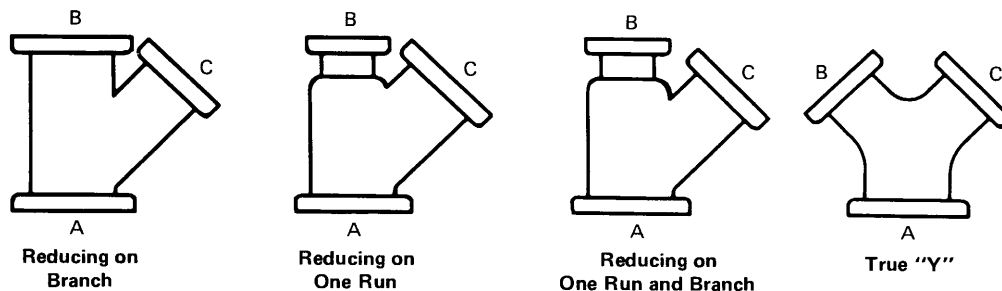
### Reducing Tees



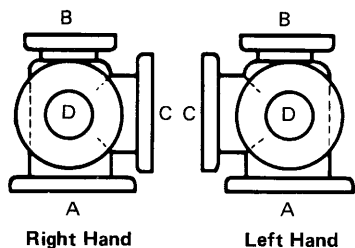
### Reducing Crosses



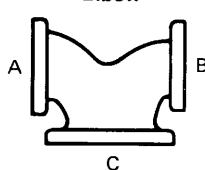
### Reducing Laterals



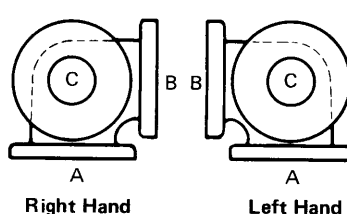
### Side Outlet Tee



### Double Branch Elbow



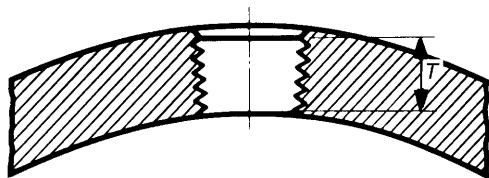
### Side Outlet Elbow



#### GENERAL NOTES:

- The largest opening establishes the basic size of a reducing fitting. The largest opening is named first, except that for bull head tees, which are reducing on both runs and for double branch elbows where both branches are reducing, the outlet is the largest opening and named last in both cases.
- In designating the openings of reducing fittings, they should be read in the order indicated by the sequence of the letters A, B, C, and D. In designating the outlets of side outlet reducing fittings, the side outlet is named last, and in the case of the cross, which is not shown, the side outlet is designated by the Letter E.
- Sketches are illustrative only, and do not imply required design. (See para. 3.2).

**Fig. 2 Method of Designating Outlets of Reducing Fittings in Specifications**



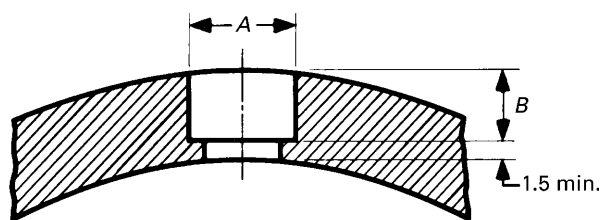
| Connection Size, NPS              | $\frac{3}{8}$ | $\frac{1}{2}$ | $\frac{3}{4}$ | 1    | $1\frac{1}{4}$ | $1\frac{1}{2}$ | 2    |
|-----------------------------------|---------------|---------------|---------------|------|----------------|----------------|------|
| Thread length $T$ , mm [Note (1)] | 10.5          | 13.5          | 14.0          | 17.5 | 18.1           | 18.3           | 19.4 |

GENERAL NOTE: See paras. 6.12.2, 6.12.5, and 6.12.6.

NOTE:

- (1) In no case shall the effective length of thread  $T$  be less than that shown in Table above. These lengths are equal to the effective thread length of external pipe threads (ASME B1.20.1).

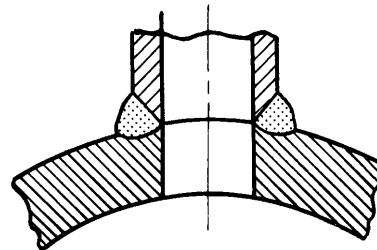
**Fig. 3 Thread Length for Connection Tapping**



| Connection Size, NPS                | $\frac{3}{8}$ | $\frac{1}{2}$ | $\frac{3}{4}$ | 1    | $1\frac{1}{4}$ | $1\frac{1}{2}$ | 2    |
|-------------------------------------|---------------|---------------|---------------|------|----------------|----------------|------|
| Minimum diameter of socket $A$ , mm | 17.5          | 21.8          | 26.9          | 33.8 | 42.7           | 48.8           | 61.2 |
| Minimum depth $B$ , mm              | 4.8           | 4.8           | 6.4           | 6.4  | 6.4            | 6.4            | 7.9  |

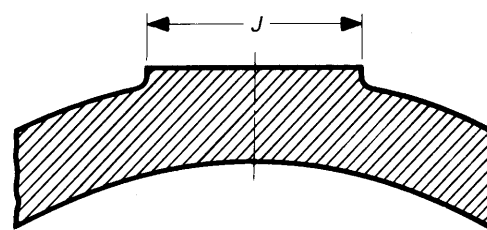
GENERAL NOTE: See paras. 6.12.3, 6.12.5, and 6.12.6.

**Fig. 4 Socket Welding for Connections**



GENERAL NOTE: See paras. 6.12.4 and 6.12.5.

**Fig. 5 Butt Welding for Connections**

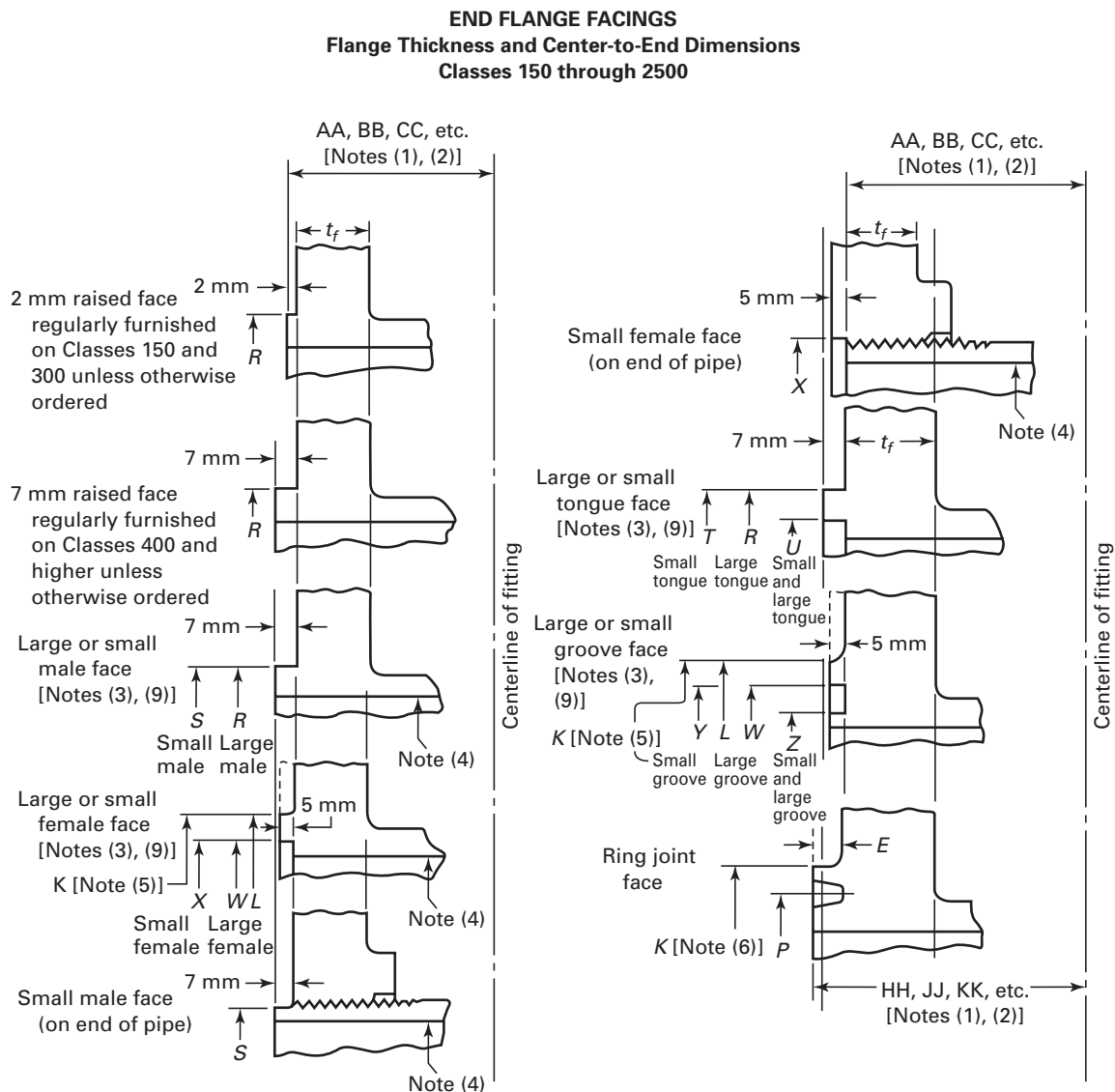


| Connection Size, NPS           | $\frac{3}{8}$ | $\frac{1}{2}$ | $\frac{3}{4}$ | 1    | $1\frac{1}{4}$ | $1\frac{1}{2}$ | 2    |
|--------------------------------|---------------|---------------|---------------|------|----------------|----------------|------|
| Minimum boss diameter $J$ , mm | 31.8          | 38.1          | 44.5          | 53.8 | 63.5           | 69.8           | 85.8 |

GENERAL NOTES:

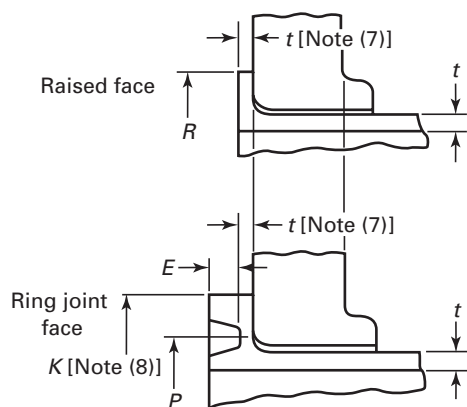
- (a) See para. 6.12.5.  
 (b) Dimensions are in millimeters. For dimensions in inches, refer to Annex F, Figs. F3, F4, F5, and F6.

**Fig. 6 Bosses for Connections**



**Fig. 7 End Flange Facings and Their Relationship to Flange Thickness and Center-to-End and End-to-End Dimensions**

**END FLANGE FACINGS**  
**Flange Thickness and End-to-End Dimensions**  
**Lapped Joints**

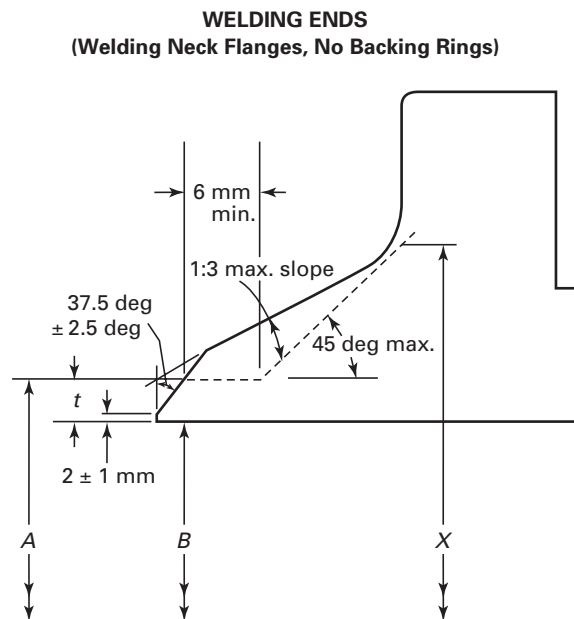


GENERAL NOTE: Dimensions are in millimeters. For dimensions in inches, refer to Annex F, Fig. F7.

NOTES:

- (1) See paras. 6.2 and 6.4.
- (2) See Tables 7 through 22.
- (3) See Table 4 for dimensions of facings (other than ring joint) and Table 5 for ring joint facing.
- (4) For small male and female joints, care should be taken in the use of these dimensions to insure that the inside diameter of fitting or pipe is small enough to permit sufficient bearing surface to prevent crushing of the gasket (See Table 4.). This applies particularly on lines where the joint is made on the end of the pipe. Threaded companion flanges for small male and female joints are furnished with plain face and are threaded with American National Standard Locknut Thread (NPSL).
- (5) See Table 4.
- (6) See Table 5.
- (7) See para. 6.4.3.
- (8) See para. 6.4.3.5 and Table 5.
- (9) Large male and female faces and large tongue and groove are not applicable to Class 150 because of potential dimensional conflicts.

**Fig. 7 End Flange Facings and Their Relationship  
to Flange Thickness and Center-to-End  
and End-to-End Dimensions (Cont'd)**

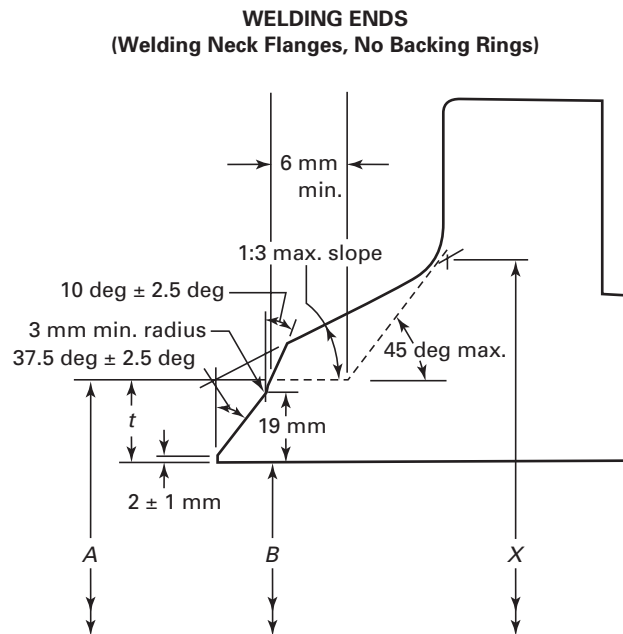


A = nominal outside diameter of pipe  
B = nominal inside diameter of pipe  
t = nominal wall thickness of pipe

## GENERAL NOTES:

- Dimensions are in millimeters. For dimensions in inches, refer to Annex F, Figs. F8 and F9.
- See paras. 6.7, 6.8, and 7.4 for details and tolerances.
- See Figs. 10 and 11 for additional details of welding ends.
- When the thickness of the hub at the bevel is greater than that of the pipe to which the flange is joined and the additional thickness is provided on the outside diameter, a taper weld having a slope not exceeding 1 to 3 may be employed or, alternatively, the greater outside diameter may be tapered at the same maximum slope or less, from a point on the welding bevel equal to the outside diameter of the mating pipe. Similarly, when the greater thickness is provided on the inside of the flange, it shall be taper-bored from the welding end at a slope not exceeding 1 to 3. When flanges covered by this Standard are intended for services with light wall, higher strength pipe, the thickness of the hub at the bevel may be greater than that of the pipe to which the flange is joined. Under these conditions, a single taper hub may be provided, and the outside diameter of the hub at the base (dimension X) may also be modified. The additional thickness may be provided on either inside or outside or partially on each side, but the total additional thickness shall not exceed one-half times the nominal wall thickness of intended mating pipe. See Figs. 12, 13, and 14.
- The hub transition from the A diameter to the X diameter shall fall within the maximum and minimum envelope outlined by the 1:3 max. slope and the dashed line.
- For welding end dimensions, refer to ASME B16.25.

**Fig. 8 Bevel for Wall Thicknesses  $t$  From 5 mm to 22 mm Inclusive**

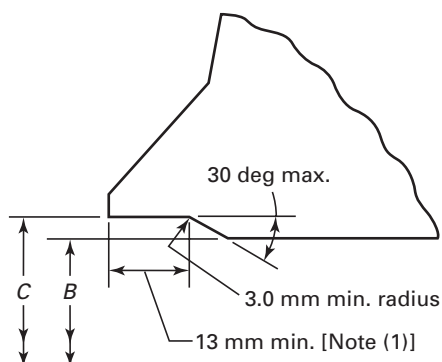


A = nominal outside diameter of pipe  
B = nominal inside diameter of pipe  
t = nominal wall thickness of pipe

GENERAL NOTE: Please see General Notes for Fig. 8.

**Fig. 9 Bevel for Wall Thicknesses  $t$  Greater Than 22 mm**

**WELDING ENDS**  
(Welding Neck Flanges)



- $A$  = nominal outside diameter of welding end, mm  
 $B$  = nominal inside diameter of pipe ( $= A - 2t$ ), mm  
 $C = A - 0.79 - 1.75t - 0.25$ , mm  
 $t$  = nominal wall thickness of pipe, mm  
 0.79 mm = minus tolerance on outside diameter of pipe to ASTM A 106, etc.  
 $1.75t$  =  $87\frac{1}{2}\%$  of nominal wall (permitted by ASTM A 106, etc.) multiplied by two to convert into terms of diameter  
 0.25 mm = plus tolerance on diameter  $C$ , mm. See para. 7.5.3.

**GENERAL NOTES:**

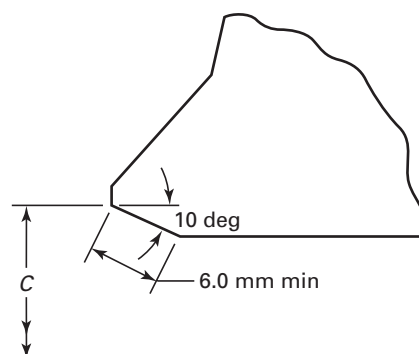
- (a) Dimensions are in millimeters. For dimensions in inches, refer to Annex F, Fig. F10.  
 (b) See paras. 6.7, 6.8, and 7.5 for details and tolerances.  
 (c) See Figs. 8 and 9 for welding end details of welding neck flanges.  
 (d) For dimensions, see ASME B16.25.

**NOTE:**

- (1) 13 mm depth based on use of 19-mm wide backing ring.

**Fig. 10 Inside Contour for Use With Rectangular Backing Ring**

**WELDING ENDS**  
(Welding Neck Flanges)



- $A$  = nominal outside diameter of welding end, mm  
 $B$  = nominal inside diameter of pipe ( $= A - 2t$ ), mm  
 $C = A - 0.79 - 1.75t - 0.25$ , mm  
 $t$  = nominal wall thickness of pipe, mm  
 0.79 mm = minus tolerance on outside diameter of pipe to ASTM A 106, etc.  
 $1.75t$  =  $87\frac{1}{2}\%$  of nominal wall (permitted by ASTM A 106, etc.) multiplied by two to convert into terms of diameter  
 0.25 mm = plus tolerance on diameter  $C$ , mm. See para. 7.5.3.

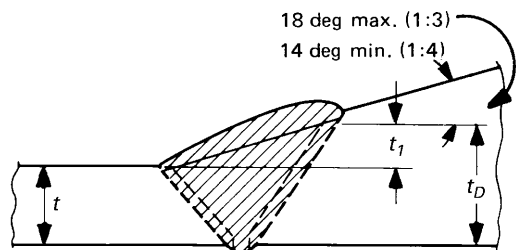
**GENERAL NOTES:**

- (a) Dimensions are in millimeters. For dimensions in inches, refer to Annex F, Fig. F11.  
 (b) See paras. 6.7, 6.8, and 7.5 for details and tolerances.  
 (c) See Figs. 8 and 9 for welding end details of welding neck flanges.  
 (d) For dimensions, see ASME B16.25.

**Fig. 11 Inside Contour for Use With Taper Backing Ring**



**WELDING ENDS**  
(Welding Neck Flanges)  
**ADDITIONAL THICKNESS FOR**  
**WELDING TO HIGHER STRENGTH PIPE**

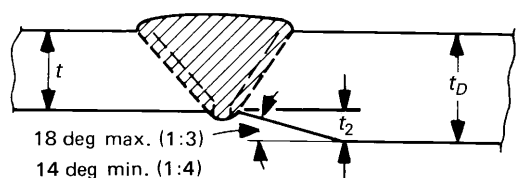


**GENERAL NOTES:**

- When the materials joined have equal minimum specified yield strength, there shall be no restriction on the minimum slope.
- Neither  $t_1$ ,  $t_2$ , nor their sum  $t_1 + t_2$  shall exceed  $0.5t$ .
- When the minimum specified yield strengths of the sections to be joined are unequal, the value of  $t_D$  shall at least equal the mating wall thickness times the ratio of minimum specified yield strength of the pipe to minimum specified yield strength of the flange.
- Welding shall be in accordance with the applicable code.

**Fig. 12 Bevel for Outside Thickness**

**WELDING ENDS**  
(Welding Neck Flanges)  
**ADDITIONAL THICKNESS FOR**  
**WELDING TO HIGHER STRENGTH PIPE**

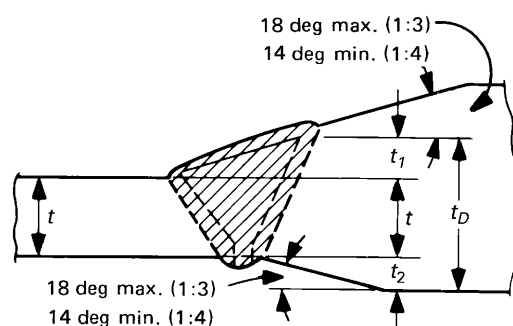


**GENERAL NOTES:**

- When the materials joined have equal minimum specified yield strength, there shall be no restriction on the minimum slope.
- Neither  $t_1$ ,  $t_2$ , nor their sum  $t_1 + t_2$  shall exceed  $0.5t$ .
- When the minimum specified yield strengths of the sections to be joined are unequal, the value of  $t_D$  shall at least equal the mating wall thickness times the ratio of minimum specified yield strength of the pipe to minimum specified yield strength of the flange.
- Welding shall be in accordance with the applicable code.

**Fig. 13 Bevel for Inside Thickness**

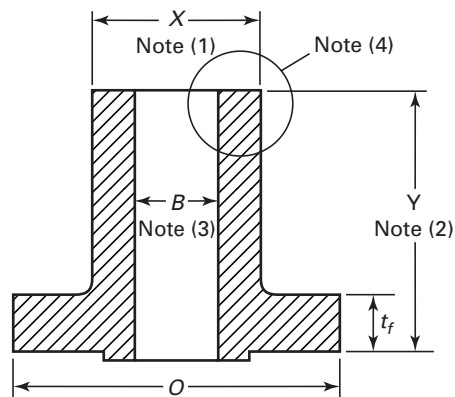
**WELDING ENDS**  
(Welding Neck Flanges)  
**ADDITIONAL THICKNESS FOR**  
**WELDING TO HIGHER STRENGTH PIPE**



**GENERAL NOTES:**

- When the materials joined have equal minimum specified yield strength, there shall be no restriction on the minimum slope.
- Neither  $t_1$ ,  $t_2$ , nor their sum  $t_1 + t_2$  shall exceed  $0.5t$ .
- When the minimum specified yield strengths of the sections to be joined are unequal, the value of  $t_D$  shall at least equal the mating wall thickness times the ratio of minimum specified yield strength of the pipe to minimum specified yield strength of the flange.
- Welding shall be in accordance with the applicable code.

**Fig. 14 Bevel for Combined Thickness**



**GENERAL NOTES:**

- $O$  = Outside diameter of flange. See para. 2.8.
- $t_f$  = Minimum thickness of flange. See para. 2.8.

**NOTES:**

- $X$  = Diameter of hub. See para. 2.8.
- $Y$  = Length through hub. See para. 2.8.1.
- $B$  = Bore. See para. 2.8.2.
- Hub end. See para. 2.8.3.

**Fig. 15 Straight Hub Welding Flanges**

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

| Nominal Designation              |      | Forgings              |      | Castings          |       | Plates                |       |
|----------------------------------|------|-----------------------|------|-------------------|-------|-----------------------|-------|
| C–Si                             |      | A 105 (1)             |      | A 216 Gr. WCB (1) |       | A 515 Gr. 70 (1)      |       |
| C–Mn–Si                          |      | A 350 Gr. LF2 (1)     |      |                   |       | A 516 Gr. 70 (1), (2) |       |
| C–Mn–Si–V                        |      | A 350 Gr. LF6 Cl. (4) |      |                   |       |                       |       |
| 3 <sup>1</sup> / <sub>2</sub> Ni |      | A 350 Gr. LF3         |      |                   |       | A 537 Cl. 1 (3)       |       |
| Working Pressure by Classes, bar |      |                       |      |                   |       |                       |       |
| Class                            |      |                       |      |                   |       |                       |       |
| Temp., °C                        | 150  | 300                   | 400  | 600               | 900   | 1500                  | 2500  |
| –29 to 38                        | 19.6 | 51.1                  | 68.1 | 102.1             | 153.2 | 255.3                 | 425.5 |
| 50                               | 19.2 | 50.1                  | 66.8 | 100.2             | 150.4 | 250.6                 | 417.7 |
| 100                              | 17.7 | 46.6                  | 62.1 | 93.2              | 139.8 | 233.0                 | 388.3 |
| 150                              | 15.8 | 45.1                  | 60.1 | 90.2              | 135.2 | 225.4                 | 375.6 |
| 200                              | 13.8 | 43.8                  | 58.4 | 87.6              | 131.4 | 219.0                 | 365.0 |
| 250                              | 12.1 | 41.9                  | 55.9 | 83.9              | 125.8 | 209.7                 | 349.5 |
| 300                              | 10.2 | 39.8                  | 53.1 | 79.6              | 119.5 | 199.1                 | 331.8 |
| 325                              | 9.3  | 38.7                  | 51.6 | 77.4              | 116.1 | 193.6                 | 322.6 |
| 350                              | 8.4  | 37.6                  | 50.1 | 75.1              | 112.7 | 187.8                 | 313.0 |
| 375                              | 7.4  | 36.4                  | 48.5 | 72.7              | 109.1 | 181.8                 | 303.1 |
| 400                              | 6.5  | 34.7                  | 46.3 | 69.4              | 104.2 | 173.6                 | 289.3 |
| 425                              | 5.5  | 28.8                  | 38.4 | 57.5              | 86.3  | 143.8                 | 239.7 |
| 450                              | 4.6  | 23.0                  | 30.7 | 46.0              | 69.0  | 115.0                 | 191.7 |
| 475                              | 3.7  | 17.4                  | 23.2 | 34.9              | 52.3  | 87.2                  | 145.3 |
| 500                              | 2.8  | 11.8                  | 15.7 | 23.5              | 35.3  | 58.8                  | 97.9  |
| 538                              | 1.4  | 5.9                   | 7.9  | 11.8              | 17.7  | 29.5                  | 49.2  |

## NOTES:

- (1) Upon prolonged exposure to temperatures above 425°C, the carbide phase of steel may be converted to graphite. Permissible but not recommended for prolonged use above 425°C.
- (2) Not to be used over 455°C.
- (3) Not to be used over 370°C.
- (4) Not to be used over 260°C.

**Table 2-1.2 Pressure–Temperature Ratings for Group 1.2 Materials**

| Nominal Designation              |      | Forgings               |      | Castings                               |       | Plates          |       |
|----------------------------------|------|------------------------|------|----------------------------------------|-------|-----------------|-------|
| C–Mn–Si                          |      |                        |      | A 216 Gr. WCC (1)<br>A 352 Gr. LCC (2) |       |                 |       |
| C–Mn–Si–V                        |      | A 350 Gr. LF6 Cl.2 (3) |      |                                        |       |                 |       |
| 2 <sup>1</sup> / <sub>2</sub> Ni |      |                        |      | A 352 Gr. LC2                          |       | A 203 Gr. B (1) |       |
| 3 <sup>1</sup> / <sub>2</sub> Ni |      |                        |      | A 352 Gr. LC3                          |       | A 203 Gr. E (1) |       |
| Working Pressure by Classes, bar |      |                        |      |                                        |       |                 |       |
| Class<br>Temp., °C               | 150  | 300                    | 400  | 600                                    | 900   | 1500            | 2500  |
| –29 to 38                        | 19.8 | 51.7                   | 68.9 | 103.4                                  | 155.1 | 258.6           | 430.9 |
| 50                               | 19.5 | 51.7                   | 68.9 | 103.4                                  | 155.1 | 258.6           | 430.9 |
| 100                              | 17.7 | 51.5                   | 68.7 | 103.0                                  | 154.6 | 257.6           | 429.4 |
| 150                              | 15.8 | 50.2                   | 66.8 | 100.3                                  | 150.5 | 250.8           | 418.1 |
| 200                              | 13.8 | 48.6                   | 64.8 | 97.2                                   | 145.8 | 243.2           | 405.4 |
| 250                              | 12.1 | 46.3                   | 61.7 | 92.7                                   | 139.0 | 231.8           | 386.2 |
| 300                              | 10.2 | 42.9                   | 57.0 | 85.7                                   | 128.6 | 214.4           | 357.1 |
| 325                              | 9.3  | 41.4                   | 55.0 | 82.6                                   | 124.0 | 206.6           | 344.3 |
| 350                              | 8.4  | 40.0                   | 53.4 | 80.0                                   | 120.1 | 200.1           | 333.5 |
| 375                              | 7.4  | 37.8                   | 50.4 | 75.7                                   | 113.5 | 189.2           | 315.3 |
| 400                              | 6.5  | 34.7                   | 46.3 | 69.4                                   | 104.2 | 173.6           | 289.3 |
| 425                              | 5.5  | 28.8                   | 38.4 | 57.5                                   | 86.3  | 143.8           | 239.7 |
| 450                              | 4.6  | 23.0                   | 30.7 | 46.0                                   | 69.0  | 115.0           | 191.7 |
| 475                              | 3.7  | 17.1                   | 22.8 | 34.2                                   | 51.3  | 85.4            | 142.4 |
| 500                              | 2.8  | 11.6                   | 15.4 | 23.2                                   | 34.7  | 57.9            | 96.5  |
| 538                              | 1.4  | 5.9                    | 7.9  | 11.8                                   | 17.7  | 29.5            | 49.2  |

## NOTES:

- (1) Upon prolonged exposure to temperatures above 425°C, the carbide phase of steel may be converted to graphite. Permissible, but not recommended for prolonged use above 425°C.
- (2) Not to be used over 340°C.
- (3) Not to be used over 260°C.

**Table 2-1.3 Pressure–Temperature Ratings for Group 1.3 Materials**

| Nominal Designation               | Forgings |      | Castings                                    |      | Plates                |       |       |
|-----------------------------------|----------|------|---------------------------------------------|------|-----------------------|-------|-------|
| C–Si                              |          |      | A 352 LCB (3)                               |      | A 515 Gr. 65 (1)      |       |       |
| C–Mn–Si                           |          |      |                                             |      | A 516 Gr. 65 (1), (2) |       |       |
| C– $\frac{1}{2}$ Mo               |          |      | A 217 Gr. WC1 (4), (5)<br>A 352 Gr. LC1 (3) |      |                       |       |       |
| $2\frac{1}{2}$ Ni                 |          |      |                                             |      | A 203 Gr. A (1)       |       |       |
| $3\frac{1}{2}$ Ni                 |          |      |                                             |      | A 203 Gr. D (1)       |       |       |
| Working Pressures by Classes, bar |          |      |                                             |      |                       |       |       |
| Class<br>Temp., °C                | 150      | 300  | 400                                         | 600  | 900                   | 1500  | 2500  |
| –29 to 38                         | 18.4     | 48.0 | 64.0                                        | 96.0 | 144.1                 | 240.1 | 400.1 |
| 50                                | 18.2     | 47.5 | 63.3                                        | 94.9 | 142.4                 | 237.3 | 395.6 |
| 100                               | 17.4     | 45.3 | 60.5                                        | 90.7 | 136.0                 | 226.7 | 377.8 |
| 150                               | 15.8     | 43.9 | 58.6                                        | 87.9 | 131.8                 | 219.7 | 366.1 |
| 200                               | 13.8     | 42.5 | 56.7                                        | 85.1 | 127.6                 | 212.7 | 354.4 |
| 250                               | 12.1     | 40.8 | 54.4                                        | 81.6 | 122.3                 | 203.9 | 339.8 |
| 300                               | 10.2     | 38.7 | 51.6                                        | 77.4 | 116.1                 | 193.4 | 322.4 |
| 325                               | 9.3      | 37.6 | 50.1                                        | 75.2 | 112.7                 | 187.9 | 313.1 |
| 350                               | 8.4      | 36.4 | 48.5                                        | 72.8 | 109.2                 | 182.0 | 303.3 |
| 375                               | 7.4      | 35.0 | 46.6                                        | 69.9 | 104.9                 | 174.9 | 291.4 |
| 400                               | 6.5      | 32.6 | 43.5                                        | 65.2 | 97.9                  | 163.1 | 271.9 |
| 425                               | 5.5      | 27.3 | 36.4                                        | 54.6 | 81.9                  | 136.5 | 227.5 |
| 450                               | 4.6      | 21.6 | 28.8                                        | 43.2 | 64.8                  | 107.9 | 179.9 |
| 475                               | 3.7      | 15.7 | 20.9                                        | 31.3 | 47.0                  | 78.3  | 130.6 |
| 500                               | 2.8      | 11.1 | 14.8                                        | 22.1 | 33.2                  | 55.4  | 92.3  |
| 538                               | 1.4      | 5.9  | 7.9                                         | 11.8 | 17.7                  | 29.5  | 49.2  |

## NOTES:

- (1) Upon prolonged exposure to temperatures above 425°C, the carbide phase of steel may be converted to graphite. Permissible, but not recommended for prolonged use above 425°C.
- (2) Not to be used over 455°C.
- (3) Not to be used over 340°C.
- (4) Upon prolonged exposure to temperatures above 465°C, the carbide phase of steel may be converted to graphite. Permissible, but not recommended for prolonged use above 465°C.
- (5) Use normalized and tempered material only.

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

| Nominal Designation               | Forgings                 |      |      | Castings |       | Plates                |       |
|-----------------------------------|--------------------------|------|------|----------|-------|-----------------------|-------|
| C–Si                              |                          |      |      |          |       | A 515 Gr. 60 (1)      |       |
| C–Mn–Si                           | A 350 Gr. LF1, Cl. 1 (1) |      |      |          |       | A 516 Gr. 60 (1), (2) |       |
| Working Pressures by Classes, bar |                          |      |      |          |       |                       |       |
| Class<br>Temp., °C                | 150                      | 300  | 400  | 600      | 900   | 1500                  | 2500  |
| –29 to 38                         | 16.3                     | 42.6 | 56.7 | 85.1     | 127.7 | 212.8                 | 354.6 |
| 50                                | 16.0                     | 41.8 | 55.7 | 83.5     | 125.3 | 208.9                 | 348.1 |
| 100                               | 14.9                     | 38.8 | 51.8 | 77.7     | 116.5 | 194.2                 | 323.6 |
| 150                               | 14.4                     | 37.6 | 50.1 | 75.1     | 112.7 | 187.8                 | 313.0 |
| 200                               | 13.8                     | 36.4 | 48.5 | 72.8     | 109.2 | 182.1                 | 303.4 |
| 250                               | 12.1                     | 34.9 | 46.6 | 69.8     | 104.7 | 174.6                 | 291.0 |
| 300                               | 10.2                     | 33.2 | 44.2 | 66.4     | 99.5  | 165.9                 | 276.5 |
| 325                               | 9.3                      | 32.2 | 43.0 | 64.5     | 96.7  | 161.2                 | 268.6 |
| 350                               | 8.4                      | 31.2 | 41.7 | 62.5     | 93.7  | 156.2                 | 260.4 |
| 375                               | 7.4                      | 30.4 | 40.5 | 60.7     | 91.1  | 151.8                 | 253.0 |
| 400                               | 6.5                      | 29.3 | 39.1 | 58.7     | 88.0  | 146.7                 | 244.5 |
| 425                               | 5.5                      | 25.8 | 34.4 | 51.5     | 77.3  | 128.8                 | 214.7 |
| 450                               | 4.6                      | 21.4 | 28.5 | 42.7     | 64.1  | 106.8                 | 178.0 |
| 475                               | 3.7                      | 14.1 | 18.8 | 28.2     | 42.3  | 70.5                  | 117.4 |
| 500                               | 2.8                      | 10.3 | 13.7 | 20.6     | 30.9  | 51.5                  | 85.9  |
| 538                               | 1.4                      | 5.9  | 7.9  | 11.8     | 17.7  | 29.5                  | 49.2  |

## NOTES:

- (1) Upon prolonged exposure to temperatures above 425°C, the carbide phase of steel may be converted to graphite. Permissible, but not recommended for prolonged use above 425°C.
- (2) Not to be used over 455°C.

**Table 2-1.5 Pressure–Temperature Ratings for Group 1.5 Materials**

| Nominal Designation               | Forgings         |      |      | Castings |       | Plates          |                 |
|-----------------------------------|------------------|------|------|----------|-------|-----------------|-----------------|
| C- <sup>1</sup> / <sub>2</sub> Mo | A 182 Gr. F1 (1) |      |      |          |       | A 204 Gr. A (1) | A 204 Gr. B (1) |
| Working Pressures by Classes, bar |                  |      |      |          |       |                 |                 |
| Class<br>Temp., °C                | 150              | 300  | 400  | 600      | 900   | 1500            | 2500            |
| -29 to 38                         | 18.4             | 48.0 | 64.0 | 96.0     | 144.1 | 240.1           | 400.1           |
| 50                                | 18.4             | 48.0 | 64.0 | 96.0     | 144.1 | 240.1           | 400.1           |
| 100                               | 17.7             | 47.9 | 63.9 | 95.9     | 143.8 | 239.7           | 399.5           |
| 150                               | 15.8             | 47.3 | 63.1 | 94.7     | 142.0 | 236.7           | 394.5           |
| 200                               | 13.8             | 45.8 | 61.1 | 91.6     | 137.4 | 229.0           | 381.7           |
| 250                               | 12.1             | 44.5 | 59.3 | 89.0     | 133.5 | 222.5           | 370.9           |
| 300                               | 10.2             | 42.9 | 57.0 | 85.7     | 128.6 | 214.4           | 357.1           |
| 325                               | 9.3              | 41.4 | 55.0 | 82.6     | 124.0 | 206.6           | 344.3           |
| 350                               | 8.4              | 40.3 | 53.6 | 80.4     | 120.7 | 201.1           | 335.3           |
| 375                               | 7.4              | 38.9 | 51.6 | 77.6     | 116.5 | 194.1           | 323.2           |
| 400                               | 6.5              | 36.5 | 48.9 | 73.3     | 109.8 | 183.1           | 304.9           |
| 425                               | 5.5              | 35.2 | 46.5 | 70.0     | 105.1 | 175.1           | 291.6           |
| 450                               | 4.6              | 33.7 | 45.1 | 67.7     | 101.4 | 169.0           | 281.8           |
| 475                               | 3.7              | 31.7 | 42.3 | 63.4     | 95.1  | 158.2           | 263.9           |
| 500                               | 2.8              | 24.1 | 32.1 | 48.1     | 72.2  | 120.3           | 200.5           |
| 538                               | 1.4              | 11.3 | 15.1 | 22.7     | 34.0  | 56.7            | 94.6            |

## NOTE:

- (1) Upon prolonged exposure to temperatures above 465°C, the carbide phase of carbon-molybdenum steel may be converted to graphite. Permissible, but not recommended for prolonged use above 465°C.

**Table 2-1.7 Pressure–Temperature Ratings for Group 1.7 Materials**

| Nominal Designation                                    | Forgings         |      |      | Castings               |       | Plates |       |
|--------------------------------------------------------|------------------|------|------|------------------------|-------|--------|-------|
| $\frac{1}{2}\text{Cr}-\frac{1}{2}\text{Mo}$            | A 182 Gr. F2 (2) |      |      |                        |       |        |       |
| $\text{Ni}-\frac{1}{2}\text{Cr}-\frac{1}{2}\text{Mo}$  |                  |      |      | A 217 Gr. WC4 (1), (2) |       |        |       |
| $\frac{3}{4}\text{Ni}-\frac{3}{4}\text{Cr}-1\text{Mo}$ |                  |      |      | A 217 Gr. WC5 (1)      |       |        |       |
| Working Pressures By Classes, bar                      |                  |      |      |                        |       |        |       |
| Class<br>Temp., °C                                     | 150              | 300  | 400  | 600                    | 900   | 1500   | 2500  |
| −29 to 38                                              | 19.8             | 51.7 | 68.9 | 103.4                  | 155.1 | 258.6  | 430.9 |
| 50                                                     | 19.5             | 51.7 | 68.9 | 103.4                  | 155.1 | 258.6  | 430.9 |
| 100                                                    | 17.7             | 51.5 | 68.7 | 103.0                  | 154.6 | 257.6  | 429.4 |
| 150                                                    | 15.8             | 50.3 | 66.8 | 100.3                  | 150.6 | 250.8  | 418.2 |
| 200                                                    | 13.8             | 48.6 | 64.8 | 97.2                   | 145.8 | 243.4  | 405.4 |
| 250                                                    | 12.1             | 46.3 | 61.7 | 92.7                   | 139.0 | 231.8  | 386.2 |
| 300                                                    | 10.2             | 42.9 | 57.0 | 85.7                   | 128.6 | 214.4  | 357.1 |
| 325                                                    | 9.3              | 41.4 | 55.0 | 82.6                   | 124.0 | 206.6  | 344.3 |
| 350                                                    | 8.4              | 40.3 | 53.6 | 80.4                   | 120.7 | 201.1  | 335.3 |
| 375                                                    | 7.4              | 38.9 | 51.6 | 77.6                   | 116.5 | 194.1  | 323.2 |
| 400                                                    | 6.5              | 36.5 | 48.9 | 73.3                   | 109.8 | 183.1  | 304.9 |
| 425                                                    | 5.5              | 35.2 | 46.5 | 70.0                   | 105.1 | 175.1  | 291.6 |
| 450                                                    | 4.6              | 33.7 | 45.1 | 67.7                   | 101.4 | 169.0  | 281.8 |
| 475                                                    | 3.7              | 31.7 | 42.3 | 63.4                   | 95.1  | 158.2  | 263.9 |
| 500                                                    | 2.8              | 26.7 | 35.6 | 53.4                   | 80.1  | 133.4  | 222.4 |
| 538                                                    | 1.4              | 13.9 | 18.6 | 27.9                   | 41.8  | 69.7   | 116.2 |
| 550                                                    | ...              | 12.6 | 16.8 | 25.2                   | 37.8  | 63.0   | 105.0 |
| 575                                                    | ...              | 7.2  | 9.6  | 14.4                   | 21.5  | 35.9   | 59.8  |

## NOTES:

- (1) Use normalized and tempered material only.  
 (2) Not to be used over 538°C.

**Table 2-1.9 Pressure–Temperature Ratings for Group 1.9 Materials**

| Nominal Designation               | Forgings                     |      |      | Castings |                        | Plates |       |
|-----------------------------------|------------------------------|------|------|----------|------------------------|--------|-------|
| 1¼Cr–½Mo                          | A 217 Gr. WC6 (1), (3)       |      |      |          |                        |        |       |
| 1¼Cr–½Mo–Si                       | A 182 Gr. F11 Cl. 2 (1), (2) |      |      |          | A 387 Gr. 11 Cl. 2 (2) |        |       |
| Working Pressures by Classes, bar |                              |      |      |          |                        |        |       |
| Class<br>Temp., °C                | 150                          | 300  | 400  | 600      | 900                    | 1500   | 2500  |
| –29 to 38                         | 19.8                         | 51.7 | 68.9 | 103.4    | 155.1                  | 258.6  | 430.9 |
| 50                                | 19.5                         | 51.7 | 68.9 | 103.4    | 155.1                  | 258.6  | 430.9 |
| 100                               | 17.7                         | 51.5 | 68.6 | 103.0    | 154.4                  | 257.4  | 429.0 |
| 150                               | 15.8                         | 49.7 | 66.3 | 99.5     | 149.2                  | 248.7  | 414.5 |
| 200                               | 13.8                         | 48.0 | 63.9 | 95.9     | 143.9                  | 239.8  | 399.6 |
| 250                               | 12.1                         | 46.3 | 61.7 | 92.7     | 139.0                  | 231.8  | 386.2 |
| 300                               | 10.2                         | 42.9 | 57.0 | 85.7     | 128.6                  | 214.4  | 357.1 |
| 325                               | 9.3                          | 41.4 | 55.0 | 82.6     | 124.0                  | 206.6  | 344.3 |
| 350                               | 8.4                          | 40.3 | 53.6 | 80.4     | 120.7                  | 201.1  | 335.3 |
| 375                               | 7.4                          | 38.9 | 51.6 | 77.6     | 116.5                  | 194.1  | 323.2 |
| 400                               | 6.5                          | 36.5 | 48.9 | 73.3     | 109.8                  | 183.1  | 304.9 |
| 425                               | 5.5                          | 35.2 | 46.5 | 70.0     | 105.1                  | 175.1  | 291.6 |
| 450                               | 4.6                          | 33.7 | 45.1 | 67.7     | 101.4                  | 169.0  | 281.8 |
| 475                               | 3.7                          | 31.7 | 42.3 | 63.4     | 95.1                   | 158.2  | 263.9 |
| 500                               | 2.8                          | 25.7 | 34.3 | 51.5     | 77.2                   | 128.6  | 214.4 |
| 538                               | 1.4                          | 14.9 | 19.9 | 29.8     | 44.7                   | 74.5   | 124.1 |
| 550                               | ...                          | 12.7 | 16.9 | 25.4     | 38.1                   | 63.5   | 105.9 |
| 575                               | ...                          | 8.8  | 11.7 | 17.6     | 26.4                   | 44.0   | 73.4  |
| 600                               | ...                          | 6.1  | 8.1  | 12.2     | 18.3                   | 30.5   | 50.9  |
| 625                               | ...                          | 4.3  | 5.7  | 8.5      | 12.8                   | 21.3   | 35.5  |
| 650                               | ...                          | 2.8  | 3.8  | 5.7      | 8.5                    | 14.2   | 23.6  |

## NOTES:

- (1) Use normalized and tempered material only.
- (2) Permissible, but not recommended for prolonged use above 590°C.
- (3) Not to be used over 590°C.



**Table 2-1.10 Pressure–Temperature Ratings for Group 1.10 Materials**

| Nominal Designation                  | Forgings                |      |      | Castings               |       | Plates                 |       |
|--------------------------------------|-------------------------|------|------|------------------------|-------|------------------------|-------|
| 2 <sup>1</sup> / <sub>4</sub> Cr–1Mo | A 182 Gr. F22 Cl. 3 (2) |      |      | A 217 Gr. WC9 (1), (3) |       | A 387 Gr. 22 Cl. 2 (2) |       |
| Working Pressures by Classes, bar    |                         |      |      |                        |       |                        |       |
| Class<br>Temp., °C                   | 150                     | 300  | 400  | 600                    | 900   | 1500                   | 2500  |
| –29 to 38                            | 19.8                    | 51.7 | 68.9 | 103.4                  | 155.1 | 258.6                  | 430.9 |
| 50                                   | 19.5                    | 51.7 | 68.9 | 103.4                  | 155.1 | 258.6                  | 430.9 |
| 100                                  | 17.7                    | 51.5 | 68.7 | 103.0                  | 154.6 | 257.6                  | 429.4 |
| 150                                  | 15.8                    | 50.3 | 66.8 | 100.3                  | 150.6 | 250.8                  | 418.2 |
| 200                                  | 13.8                    | 48.6 | 64.8 | 97.2                   | 145.8 | 243.4                  | 405.4 |
| 250                                  | 12.1                    | 46.3 | 61.7 | 92.7                   | 139.0 | 231.8                  | 386.2 |
| 300                                  | 10.2                    | 42.9 | 57.0 | 85.7                   | 128.6 | 214.4                  | 357.1 |
| 325                                  | 9.3                     | 41.4 | 55.0 | 82.6                   | 124.0 | 206.6                  | 344.3 |
| 350                                  | 8.4                     | 40.3 | 53.6 | 80.4                   | 120.7 | 201.1                  | 335.3 |
| 375                                  | 7.4                     | 38.9 | 51.6 | 77.6                   | 116.5 | 194.1                  | 323.2 |
| 400                                  | 6.5                     | 36.5 | 48.9 | 73.3                   | 109.8 | 183.1                  | 304.9 |
| 425                                  | 5.5                     | 35.2 | 46.5 | 70.0                   | 105.1 | 175.1                  | 291.6 |
| 450                                  | 4.6                     | 33.7 | 45.1 | 67.7                   | 101.4 | 169.0                  | 281.8 |
| 475                                  | 3.7                     | 31.7 | 42.3 | 63.4                   | 95.1  | 158.2                  | 263.9 |
| 500                                  | 2.8                     | 28.2 | 37.6 | 56.5                   | 84.7  | 140.9                  | 235.0 |
| 538                                  | 1.4                     | 18.4 | 24.6 | 36.9                   | 55.3  | 92.2                   | 153.7 |
| 550                                  | ...                     | 15.6 | 20.8 | 31.3                   | 46.9  | 78.2                   | 130.3 |
| 575                                  | ...                     | 10.5 | 14.0 | 21.1                   | 31.6  | 52.6                   | 87.7  |
| 600                                  | ...                     | 6.9  | 9.2  | 13.8                   | 20.7  | 34.4                   | 57.4  |
| 625                                  | ...                     | 4.5  | 6.0  | 8.9                    | 13.4  | 22.3                   | 37.2  |
| 650                                  | ...                     | 2.8  | 3.8  | 5.7                    | 8.5   | 14.2                   | 23.6  |

## NOTES:

- (1) Use normalized and tempered material only.
- (2) Permissible, but not recommended for prolonged use above 590°C.
- (3) Not to be used over 590°C.

**Table 2-1.11 Pressure–Temperature Ratings for Group 1.11 Materials**

| Nominal Designation               | Forgings         |      |      | Castings |       | Plates |       |
|-----------------------------------|------------------|------|------|----------|-------|--------|-------|
| C— <sup>1</sup> / <sub>2</sub> Mo | A 204, Gr. C (1) |      |      |          |       |        |       |
| Working Pressures by Classes, bar |                  |      |      |          |       |        |       |
| Class<br>Temp., °C                | 150              | 300  | 400  | 600      | 900   | 1500   | 2500  |
| –29 to 38                         | 20.0             | 51.7 | 68.9 | 103.4    | 155.1 | 258.6  | 430.9 |
| 50                                | 19.5             | 51.7 | 68.9 | 103.4    | 155.1 | 258.6  | 430.9 |
| 100                               | 17.7             | 51.5 | 68.7 | 103.0    | 154.6 | 257.6  | 429.4 |
| 150                               | 15.8             | 50.3 | 66.8 | 100.3    | 150.6 | 250.8  | 418.2 |
| 200                               | 13.8             | 48.6 | 64.8 | 97.2     | 145.8 | 243.4  | 405.4 |
| 250                               | 12.1             | 46.3 | 61.7 | 92.7     | 139.0 | 231.8  | 386.2 |
| 300                               | 10.2             | 42.9 | 57.0 | 85.7     | 128.6 | 214.4  | 357.1 |
| 325                               | 9.3              | 41.4 | 55.0 | 82.6     | 124.0 | 206.6  | 344.3 |
| 350                               | 8.4              | 40.3 | 53.6 | 80.4     | 120.7 | 201.1  | 335.3 |
| 375                               | 7.4              | 38.9 | 51.6 | 77.6     | 116.5 | 194.1  | 323.2 |
| 400                               | 6.5              | 36.5 | 48.9 | 73.3     | 109.8 | 183.1  | 304.9 |
| 425                               | 5.5              | 35.2 | 46.5 | 70.0     | 105.1 | 175.1  | 291.6 |
| 450                               | 4.6              | 33.7 | 45.1 | 67.7     | 101.4 | 169.0  | 281.8 |
| 475                               | 3.7              | 31.7 | 42.3 | 63.4     | 95.1  | 158.2  | 263.9 |
| 500                               | 2.8              | 23.6 | 31.4 | 47.1     | 70.7  | 117.8  | 196.3 |
| 538                               | 1.4              | 11.3 | 15.3 | 22.7     | 34.4  | 56.7   | 94.6  |
| 550                               | ...              | 11.3 | 15.3 | 22.7     | 34.4  | 56.7   | 94.6  |
| 575                               | ...              | 10.1 | 13.6 | 20.1     | 30.2  | 50.3   | 83.8  |
| 600                               | ...              | 7.1  | 9.5  | 14.2     | 21.3  | 35.6   | 59.3  |
| 625                               | ...              | 5.3  | 7.1  | 10.6     | 15.9  | 26.5   | 44.2  |
| 650                               | ...              | 3.1  | 4.1  | 6.1      | 9.2   | 15.4   | 25.6  |

**NOTE:**

- (1) Upon prolonged exposure to temperatures above 465°C, the carbide phase of carbon–molybdenum steel may be converted to graphite. Permissible, but not recommended for prolonged use above 465°C.

**Table 2-1.13 Pressure–Temperature Ratings for Group 1.13 Materials**

| Nominal Designation                 | Forgings      |      |      | Castings         |       |       | Plates |
|-------------------------------------|---------------|------|------|------------------|-------|-------|--------|
| 5Cr– <sup>1</sup> / <sub>2</sub> Mo | A 182 Gr. F5a |      |      | A 217 Gr. C5 (1) |       |       |        |
| Working Pressures by Classes, bar   |               |      |      |                  |       |       |        |
| Class<br>Temp., °C                  | 150           | 300  | 400  | 600              | 900   | 1500  | 2500   |
| –29 to 38                           | 20.0          | 51.7 | 68.9 | 103.4            | 155.1 | 258.6 | 430.9  |
| 50                                  | 19.5          | 51.7 | 68.9 | 103.4            | 155.1 | 258.6 | 430.9  |
| 100                                 | 17.7          | 51.5 | 68.7 | 103.0            | 154.6 | 257.6 | 429.4  |
| 150                                 | 15.8          | 50.3 | 66.8 | 100.3            | 150.6 | 250.8 | 418.2  |
| 200                                 | 13.8          | 48.6 | 64.8 | 97.2             | 145.8 | 243.4 | 405.4  |
| 250                                 | 12.1          | 46.3 | 61.7 | 92.7             | 139.0 | 231.8 | 386.2  |
| 300                                 | 10.2          | 42.9 | 57.0 | 85.7             | 128.6 | 214.4 | 357.1  |
| 325                                 | 9.3           | 41.4 | 55.0 | 82.6             | 124.0 | 206.6 | 344.3  |
| 350                                 | 8.4           | 40.3 | 53.6 | 80.4             | 120.7 | 201.1 | 335.3  |
| 375                                 | 7.4           | 38.9 | 51.6 | 77.6             | 116.5 | 194.1 | 323.2  |
| 400                                 | 6.5           | 36.5 | 48.9 | 73.3             | 109.8 | 183.1 | 304.9  |
| 425                                 | 5.5           | 35.2 | 46.5 | 70.0             | 105.1 | 175.1 | 291.6  |
| 450                                 | 4.6           | 33.7 | 45.1 | 67.7             | 101.4 | 169.0 | 281.8  |
| 475                                 | 3.7           | 27.9 | 37.1 | 55.7             | 83.6  | 139.3 | 232.1  |
| 500                                 | 2.8           | 21.4 | 28.5 | 42.8             | 64.1  | 106.9 | 178.2  |
| 538                                 | 1.4           | 13.7 | 18.3 | 27.4             | 41.1  | 68.6  | 114.3  |
| 550                                 | ...           | 12.0 | 16.1 | 24.1             | 36.1  | 60.2  | 100.4  |
| 575                                 | ...           | 8.9  | 11.8 | 17.8             | 26.7  | 44.4  | 74.0   |
| 600                                 | ...           | 6.2  | 8.3  | 12.5             | 18.7  | 31.2  | 51.9   |
| 625                                 | ...           | 4.0  | 5.3  | 8.0              | 12.0  | 20.0  | 33.3   |
| 650                                 | ...           | 2.4  | 3.2  | 4.7              | 7.1   | 11.8  | 19.7   |

NOTE:

(1) Use normalized and tempered material only.

**Table 2-1.14 Pressure–Temperature Ratings for Group 1.14 Materials**

| Nominal Designation               |      | Forgings     |      |       | Castings          |       | Plates |
|-----------------------------------|------|--------------|------|-------|-------------------|-------|--------|
| 9Cr–1Mo                           |      | A 182 Gr. F9 |      |       | A 217 Gr. C12 (1) |       |        |
| Working Pressures by Classes, bar |      |              |      |       |                   |       |        |
| Class<br>Temp., °C                | 150  | 300          | 400  | 600   | 900               | 1500  | 2500   |
| –29 to 38                         | 20.0 | 51.7         | 68.9 | 103.4 | 155.1             | 258.6 | 430.9  |
| 50                                | 19.5 | 51.7         | 68.9 | 103.4 | 155.1             | 258.6 | 430.9  |
| 100                               | 17.7 | 51.5         | 68.7 | 103.0 | 154.6             | 257.6 | 429.4  |
| 150                               | 15.8 | 50.3         | 66.8 | 100.3 | 150.6             | 250.8 | 418.2  |
| 200                               | 13.8 | 48.6         | 64.8 | 97.2  | 145.8             | 243.4 | 405.4  |
| 250                               | 12.1 | 46.3         | 61.7 | 92.7  | 139.0             | 231.8 | 386.2  |
| 300                               | 10.2 | 42.9         | 57.0 | 85.7  | 128.6             | 214.4 | 357.1  |
| 325                               | 9.3  | 41.4         | 55.0 | 82.6  | 124.0             | 206.6 | 344.3  |
| 350                               | 8.4  | 40.3         | 53.6 | 80.4  | 120.7             | 201.1 | 335.3  |
| 375                               | 7.4  | 38.9         | 51.6 | 77.6  | 116.5             | 194.1 | 323.2  |
| 400                               | 6.5  | 36.5         | 48.9 | 73.3  | 109.8             | 183.1 | 304.9  |
| 425                               | 5.5  | 35.2         | 46.5 | 70.0  | 105.1             | 175.1 | 291.6  |
| 450                               | 4.6  | 33.7         | 45.1 | 67.7  | 101.4             | 169.0 | 281.8  |
| 475                               | 3.7  | 31.7         | 42.3 | 63.4  | 95.1              | 158.2 | 263.9  |
| 500                               | 2.8  | 28.2         | 37.6 | 56.5  | 84.7              | 140.9 | 235.0  |
| 538                               | 1.4  | 17.5         | 23.3 | 35.0  | 52.5              | 87.5  | 145.8  |
| 550                               | ...  | 15.0         | 20.0 | 30.0  | 45.0              | 75.0  | 125.0  |
| 575                               | ...  | 10.5         | 13.9 | 20.9  | 31.4              | 52.3  | 87.1   |
| 600                               | ...  | 7.2          | 9.6  | 14.4  | 21.5              | 35.9  | 59.8   |
| 625                               | ...  | 5.0          | 6.6  | 9.9   | 14.9              | 24.8  | 41.4   |
| 650                               | ...  | 3.5          | 4.7  | 7.1   | 10.6              | 17.7  | 29.5   |

NOTE:

(1) Use normalized and tempered material only.

**Table 2-1.15 Pressure–Temperature Ratings for Group 1.15 Materials**

| Nominal Designation               |      | Forgings      |      | Castings       |       | Plates             |       |
|-----------------------------------|------|---------------|------|----------------|-------|--------------------|-------|
| 9Cr–1Mo–V                         |      | A 182 Gr. F91 |      | A 217 Gr. C12A |       | A 387 Gr. 91 Cl. 2 |       |
| Working Pressures by Classes, bar |      |               |      |                |       |                    |       |
| Class<br>Temp., °C                | 150  | 300           | 400  | 600            | 900   | 1500               | 2500  |
| –29 to 38                         | 20.0 | 51.7          | 68.9 | 103.4          | 155.1 | 258.6              | 430.9 |
| 50                                | 19.5 | 51.7          | 68.9 | 103.4          | 155.1 | 258.6              | 430.9 |
| 100                               | 17.7 | 51.5          | 68.7 | 103.0          | 154.6 | 257.6              | 429.4 |
| 150                               | 15.8 | 50.3          | 66.8 | 100.3          | 150.6 | 250.8              | 418.2 |
| 200                               | 13.8 | 48.6          | 64.8 | 97.2           | 145.8 | 243.4              | 405.4 |
| 250                               | 12.1 | 46.3          | 61.7 | 92.7           | 139.0 | 231.8              | 386.2 |
| 300                               | 10.2 | 42.9          | 57.0 | 85.7           | 128.6 | 214.4              | 357.1 |
| 325                               | 9.3  | 41.4          | 55.0 | 82.6           | 124.0 | 206.6              | 344.3 |
| 350                               | 8.4  | 40.3          | 53.6 | 80.4           | 120.7 | 201.1              | 335.3 |
| 375                               | 7.4  | 38.9          | 51.6 | 77.6           | 116.5 | 194.1              | 323.2 |
| 400                               | 6.5  | 36.5          | 48.9 | 73.3           | 109.8 | 183.1              | 304.9 |
| 425                               | 5.5  | 35.2          | 46.5 | 70.0           | 105.1 | 175.1              | 291.6 |
| 450                               | 4.6  | 33.7          | 45.1 | 67.7           | 101.4 | 169.0              | 281.8 |
| 475                               | 3.7  | 31.7          | 42.3 | 63.4           | 95.1  | 158.2              | 263.9 |
| 500                               | 2.8  | 28.2          | 37.6 | 56.5           | 84.7  | 140.9              | 235.0 |
| 538                               | 1.4  | 25.2          | 33.4 | 50.0           | 75.2  | 125.5              | 208.9 |
| 550                               | ...  | 25.0          | 33.3 | 49.8           | 74.8  | 124.9              | 208.0 |
| 575                               | ...  | 24.0          | 31.9 | 47.9           | 71.8  | 119.7              | 199.5 |
| 600                               | ...  | 19.5          | 26.0 | 39.0           | 58.5  | 97.5               | 162.5 |
| 625                               | ...  | 14.6          | 19.5 | 29.2           | 43.8  | 73.0               | 121.7 |
| 650                               | ...  | 9.9           | 13.2 | 19.9           | 29.8  | 49.6               | 82.7  |

**Table 2-1.17 Pressure–Temperature Ratings for Group 1.17 Materials**

| Nominal Designation               |      | Forgings                     |      |       | Castings |       | Plates |
|-----------------------------------|------|------------------------------|------|-------|----------|-------|--------|
| 1Cr– $\frac{1}{2}$ Mo             |      | A 182 Gr. F12 Cl. 2 (1), (2) |      |       |          |       |        |
| 5Cr– $\frac{1}{2}$ Mo             |      | A 182 Gr. F5                 |      |       |          |       |        |
| Working Pressures by Classes, bar |      |                              |      |       |          |       |        |
| Class<br>Temp., °C                | 150  | 300                          | 400  | 600   | 900      | 1500  | 2500   |
| –29 to 38                         | 19.8 | 51.7                         | 68.9 | 103.4 | 155.1    | 258.6 | 430.9  |
| 50                                | 19.5 | 51.5                         | 68.7 | 103.0 | 154.5    | 257.5 | 429.2  |
| 100                               | 17.7 | 50.4                         | 67.3 | 100.9 | 151.3    | 252.2 | 420.4  |
| 150                               | 15.8 | 48.2                         | 64.2 | 96.4  | 144.5    | 240.9 | 401.5  |
| 200                               | 13.8 | 46.3                         | 61.7 | 92.5  | 138.8    | 231.3 | 385.6  |
| 250                               | 12.1 | 44.8                         | 59.8 | 89.6  | 134.5    | 224.1 | 373.5  |
| 300                               | 10.2 | 42.9                         | 57.0 | 85.7  | 128.6    | 214.4 | 357.1  |
| 325                               | 9.3  | 41.4                         | 55.0 | 82.6  | 124.0    | 206.6 | 344.3  |
| 350                               | 8.4  | 40.3                         | 53.6 | 80.4  | 120.7    | 201.1 | 335.3  |
| 375                               | 7.4  | 38.9                         | 51.6 | 77.6  | 116.5    | 194.1 | 323.2  |
| 400                               | 6.5  | 36.5                         | 48.9 | 73.3  | 109.8    | 183.1 | 304.9  |
| 425                               | 5.5  | 35.2                         | 46.5 | 70.0  | 105.1    | 175.1 | 291.6  |
| 450                               | 4.6  | 33.7                         | 45.1 | 67.7  | 101.4    | 169.0 | 281.8  |
| 475                               | 3.7  | 27.9                         | 37.1 | 55.7  | 83.6     | 139.3 | 232.1  |
| 500                               | 2.8  | 21.4                         | 28.5 | 42.8  | 64.1     | 106.9 | 178.2  |
| 538                               | 1.4  | 13.7                         | 18.3 | 27.4  | 41.1     | 68.6  | 114.3  |
| 550                               | ...  | 12.0                         | 16.1 | 24.1  | 36.1     | 60.2  | 100.4  |
| 575                               | ...  | 8.8                          | 11.7 | 17.6  | 26.4     | 44.0  | 73.4   |
| 600                               | ...  | 6.1                          | 8.1  | 12.1  | 18.2     | 30.3  | 50.4   |
| 625                               | ...  | 4.0                          | 5.3  | 8.0   | 12.0     | 20.0  | 33.3   |
| 650                               | ...  | 2.4                          | 3.2  | 4.7   | 7.1      | 11.8  | 19.7   |

## NOTES:

- (1) Use normalized and tempered material only.
- (2) Permissible, but not recommended for prolonged use above 590°C.

**Table 2-2.1 Pressure–Temperature Ratings for Group 2.1 Materials**

| Nominal Designation               |      | Forgings           |      | Castings          |       | Plates            |       |
|-----------------------------------|------|--------------------|------|-------------------|-------|-------------------|-------|
| 18Cr–8Ni                          |      | A 182 Gr. F304 (1) |      | A 351 Gr. CF3 (2) |       | A 240 Gr. 304 (1) |       |
|                                   |      | A 182 Gr. F304H    |      | A 351 Gr. CF8 (1) |       | A 240 Gr. 304H    |       |
| Working Pressures by Classes, bar |      |                    |      |                   |       |                   |       |
| Class<br>Temp., °C                | 150  | 300                | 400  | 600               | 900   | 1500              | 2500  |
| –29 to 38                         | 19.0 | 49.6               | 66.2 | 99.3              | 148.9 | 248.2             | 413.7 |
| 50                                | 18.3 | 47.8               | 63.8 | 95.6              | 143.5 | 239.1             | 398.5 |
| 100                               | 15.7 | 40.9               | 54.5 | 81.7              | 122.6 | 204.3             | 340.4 |
| 150                               | 14.2 | 37.0               | 49.3 | 74.0              | 111.0 | 185.0             | 308.4 |
| 200                               | 13.2 | 34.5               | 46.0 | 69.0              | 103.4 | 172.4             | 287.3 |
| 250                               | 12.1 | 32.5               | 43.3 | 65.0              | 97.5  | 162.4             | 270.7 |
| 300                               | 10.2 | 30.9               | 41.2 | 61.8              | 92.7  | 154.6             | 257.6 |
| 325                               | 9.3  | 30.2               | 40.3 | 60.4              | 90.7  | 151.1             | 251.9 |
| 350                               | 8.4  | 29.6               | 39.5 | 59.3              | 88.9  | 148.1             | 246.9 |
| 375                               | 7.4  | 29.0               | 38.7 | 58.1              | 87.1  | 145.2             | 241.9 |
| 400                               | 6.5  | 28.4               | 37.9 | 56.9              | 85.3  | 142.2             | 237.0 |
| 425                               | 5.5  | 28.0               | 37.3 | 56.0              | 84.0  | 140.0             | 233.3 |
| 450                               | 4.6  | 27.4               | 36.5 | 54.8              | 82.2  | 137.0             | 228.4 |
| 475                               | 3.7  | 26.9               | 35.9 | 53.9              | 80.8  | 134.7             | 224.5 |
| 500                               | 2.8  | 26.5               | 35.3 | 53.0              | 79.5  | 132.4             | 220.7 |
| 538                               | 1.4  | 24.4               | 32.6 | 48.9              | 73.3  | 122.1             | 203.6 |
| 550                               | ...  | 23.6               | 31.4 | 47.1              | 70.7  | 117.8             | 196.3 |
| 575                               | ...  | 20.8               | 27.8 | 41.7              | 62.5  | 104.2             | 173.7 |
| 600                               | ...  | 16.9               | 22.5 | 33.8              | 50.6  | 84.4              | 140.7 |
| 625                               | ...  | 13.8               | 18.4 | 27.6              | 41.4  | 68.9              | 114.9 |
| 650                               | ...  | 11.3               | 15.0 | 22.5              | 33.8  | 56.3              | 93.8  |
| 675                               | ...  | 9.3                | 12.5 | 18.7              | 28.0  | 46.7              | 77.9  |
| 700                               | ...  | 8.0                | 10.7 | 16.1              | 24.1  | 40.1              | 66.9  |
| 725                               | ...  | 6.8                | 9.0  | 13.5              | 20.3  | 33.8              | 56.3  |
| 750                               | ...  | 5.8                | 7.7  | 11.6              | 17.3  | 28.9              | 48.1  |
| 775                               | ...  | 4.6                | 6.2  | 9.0               | 13.7  | 22.8              | 38.0  |
| 800                               | ...  | 3.5                | 4.8  | 7.0               | 10.5  | 17.4              | 29.2  |
| 816                               | ...  | 2.8                | 3.8  | 5.9               | 8.6   | 14.1              | 23.8  |

## NOTES:

- (1) At temperatures over 538°C, use only when the carbon content is 0.04% or higher.  
 (2) Not to be used over 425°C.

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

| Nominal Designation               | Forgings           |      | Castings           |      | Plates            |       |       |
|-----------------------------------|--------------------|------|--------------------|------|-------------------|-------|-------|
| 16Cr–12Ni–2Mo                     | A 182 Gr. F316 (1) |      | A 351 Gr. CF3M (2) |      | A 240 Gr. 316 (1) |       |       |
|                                   | A 182 Gr. F316H    |      | A 351 Gr. CF8M (1) |      | A 240 Gr. 316H    |       |       |
| 18Cr–13Ni–3Mo                     | A182Gr. F317 (1)   |      |                    |      | A 240 Gr. 317 (1) |       |       |
| 19Cr–10Ni–3Mo                     |                    |      | A 351 Gr. CG8M (3) |      |                   |       |       |
| Working Pressures by Classes, bar |                    |      |                    |      |                   |       |       |
| Class<br>Temp., °C                | 150                | 300  | 400                | 600  | 900               | 1500  | 2500  |
| –29 to 38                         | 19.0               | 49.6 | 66.2               | 99.3 | 148.9             | 248.2 | 413.7 |
| 50                                | 18.4               | 48.1 | 64.2               | 96.2 | 144.3             | 240.6 | 400.9 |
| 100                               | 16.2               | 42.2 | 56.3               | 84.4 | 126.6             | 211.0 | 351.6 |
| 150                               | 14.8               | 38.5 | 51.3               | 77.0 | 115.5             | 192.5 | 320.8 |
| 200                               | 13.7               | 35.7 | 47.6               | 71.3 | 107.0             | 178.3 | 297.2 |
| 250                               | 12.1               | 33.4 | 44.5               | 66.8 | 100.1             | 166.9 | 278.1 |
| 300                               | 10.2               | 31.6 | 42.2               | 63.2 | 94.9              | 158.1 | 263.5 |
| 325                               | 9.3                | 30.9 | 41.2               | 61.8 | 92.7              | 154.4 | 257.4 |
| 350                               | 8.4                | 30.3 | 40.4               | 60.7 | 91.0              | 151.6 | 252.7 |
| 375                               | 7.4                | 29.9 | 39.8               | 59.8 | 89.6              | 149.4 | 249.0 |
| 400                               | 6.5                | 29.4 | 39.3               | 58.9 | 88.3              | 147.2 | 245.3 |
| 425                               | 5.5                | 29.1 | 38.9               | 58.3 | 87.4              | 145.7 | 242.9 |
| 450                               | 4.6                | 28.8 | 38.5               | 57.7 | 86.5              | 144.2 | 240.4 |
| 475                               | 3.7                | 28.7 | 38.2               | 57.3 | 86.0              | 143.4 | 238.9 |
| 500                               | 2.8                | 28.2 | 37.6               | 56.5 | 84.7              | 140.9 | 235.0 |
| 538                               | 1.4                | 25.2 | 33.4               | 50.0 | 75.2              | 125.5 | 208.9 |
| 550                               | ...                | 25.0 | 33.3               | 49.8 | 74.8              | 124.9 | 208.0 |
| 575                               | ...                | 24.0 | 31.9               | 47.9 | 71.8              | 119.7 | 199.5 |
| 600                               | ...                | 19.9 | 26.5               | 39.8 | 59.7              | 99.5  | 165.9 |
| 625                               | ...                | 15.8 | 21.1               | 31.6 | 47.4              | 79.1  | 131.8 |
| 650                               | ...                | 12.7 | 16.9               | 25.3 | 38.0              | 63.3  | 105.5 |
| 675                               | ...                | 10.3 | 13.8               | 20.6 | 31.0              | 51.6  | 86.0  |
| 700                               | ...                | 8.4  | 11.2               | 16.8 | 25.1              | 41.9  | 69.8  |
| 725                               | ...                | 7.0  | 9.3                | 14.0 | 21.0              | 34.9  | 58.2  |
| 750                               | ...                | 5.9  | 7.8                | 11.7 | 17.6              | 29.3  | 48.9  |
| 775                               | ...                | 4.6  | 6.2                | 9.0  | 13.7              | 22.8  | 38.0  |
| 800                               | ...                | 3.5  | 4.8                | 7.0  | 10.5              | 17.4  | 29.2  |
| 816                               | ...                | 2.8  | 3.8                | 5.9  | 8.6               | 14.1  | 23.8  |

## NOTES:

- (1) At temperatures over 538°C, use only when the carbon content is 0.04% or higher.
- (2) Not to be used over 455°C.
- (3) Not to be used over 538°C.



**Table 2-2.3 Pressure-Temperature Ratings for Group 2.3 Materials**

| Nominal Designation               | Forgings            |      |      | Castings |       | Plates             |       |
|-----------------------------------|---------------------|------|------|----------|-------|--------------------|-------|
| 16Cr–12Ni–2Mo                     | A 182 Gr. F316L     |      |      |          |       | A 240 Gr. 316L     |       |
| 18Cr–8Ni                          | A 182 Gr. F304L (1) |      |      |          |       | A 240 Gr. 304L (1) |       |
| Working Pressures by Classes, bar |                     |      |      |          |       |                    |       |
| Class<br>Temp., °C                | 150                 | 300  | 400  | 600      | 900   | 1500               | 2500  |
| –29 to 38                         | 15.9                | 41.4 | 55.2 | 82.7     | 124.1 | 206.8              | 344.7 |
| 50                                | 15.3                | 40.0 | 53.4 | 80.0     | 120.1 | 200.1              | 333.5 |
| 100                               | 13.3                | 34.8 | 46.4 | 69.6     | 104.4 | 173.9              | 289.9 |
| 150                               | 12.0                | 31.4 | 41.9 | 62.8     | 94.2  | 157.0              | 261.6 |
| 200                               | 11.2                | 29.2 | 38.9 | 58.3     | 87.5  | 145.8              | 243.0 |
| 250                               | 10.5                | 27.5 | 36.6 | 54.9     | 82.4  | 137.3              | 228.9 |
| 300                               | 10.0                | 26.1 | 34.8 | 52.1     | 78.2  | 130.3              | 217.2 |
| 325                               | 9.3                 | 25.5 | 34.0 | 51.0     | 76.4  | 127.4              | 212.3 |
| 350                               | 8.4                 | 25.1 | 33.4 | 50.1     | 75.2  | 125.4              | 208.9 |
| 375                               | 7.4                 | 24.8 | 33.0 | 49.5     | 74.3  | 123.8              | 206.3 |
| 400                               | 6.5                 | 24.3 | 32.4 | 48.6     | 72.9  | 121.5              | 202.5 |
| 425                               | 5.5                 | 23.9 | 31.8 | 47.7     | 71.6  | 119.3              | 198.8 |
| 450                               | 4.6                 | 23.4 | 31.2 | 46.8     | 70.2  | 117.1              | 195.1 |

NOTE:

(1) Not to be used over 425°C.

**Table 2-2.4 Pressure–Temperature Ratings for Group 2.4 Materials**

| Nominal Designation               | Forgings                                  |      |      | Castings |                                         | Plates |       |
|-----------------------------------|-------------------------------------------|------|------|----------|-----------------------------------------|--------|-------|
| 18Cr–10Ni–Ti                      | A 182 Gr. F321 (1)<br>A 182 Gr. F321H (2) |      |      |          | A 240 Gr. 321 (1)<br>A 240 Gr. 321H (2) |        |       |
| Working Pressures by Classes, bar |                                           |      |      |          |                                         |        |       |
| Class<br>Temp., °C                | 150                                       | 300  | 400  | 600      | 900                                     | 1500   | 2500  |
| –29 to 38                         | 19.0                                      | 49.6 | 66.2 | 99.3     | 148.9                                   | 248.2  | 413.7 |
| 50                                | 18.6                                      | 48.6 | 64.7 | 97.1     | 145.7                                   | 242.8  | 404.6 |
| 100                               | 17.0                                      | 44.2 | 59.0 | 88.5     | 132.7                                   | 221.2  | 368.7 |
| 150                               | 15.7                                      | 41.0 | 54.6 | 82.0     | 122.9                                   | 204.9  | 341.5 |
| 200                               | 13.8                                      | 38.3 | 51.1 | 76.6     | 114.9                                   | 191.5  | 319.1 |
| 250                               | 12.1                                      | 36.0 | 48.0 | 72.0     | 108.1                                   | 180.1  | 300.2 |
| 300                               | 10.2                                      | 34.1 | 45.5 | 68.3     | 102.4                                   | 170.7  | 284.6 |
| 325                               | 9.3                                       | 33.3 | 44.4 | 66.6     | 99.9                                    | 166.5  | 277.6 |
| 350                               | 8.4                                       | 32.6 | 43.5 | 65.2     | 97.8                                    | 163.0  | 271.7 |
| 375                               | 7.4                                       | 32.0 | 42.7 | 64.1     | 96.1                                    | 160.2  | 266.9 |
| 400                               | 6.5                                       | 31.6 | 42.1 | 63.2     | 94.8                                    | 157.9  | 263.2 |
| 425                               | 5.5                                       | 31.1 | 41.5 | 62.3     | 93.4                                    | 155.7  | 259.5 |
| 450                               | 4.6                                       | 30.8 | 41.1 | 61.7     | 92.5                                    | 154.2  | 256.9 |
| 475                               | 3.7                                       | 30.5 | 40.7 | 61.1     | 91.6                                    | 152.7  | 254.4 |
| 500                               | 2.8                                       | 28.2 | 37.6 | 56.5     | 84.7                                    | 140.9  | 235.0 |
| 538                               | 1.4                                       | 25.2 | 33.4 | 50.0     | 75.2                                    | 125.5  | 208.9 |
| 550                               | ...                                       | 25.0 | 33.3 | 49.8     | 74.8                                    | 124.9  | 208.0 |
| 575                               | ...                                       | 24.0 | 31.9 | 47.9     | 71.8                                    | 119.7  | 199.5 |
| 600                               | ...                                       | 20.3 | 27.0 | 40.5     | 60.8                                    | 101.3  | 168.9 |
| 625                               | ...                                       | 15.8 | 21.1 | 31.6     | 47.4                                    | 79.1   | 131.8 |
| 650                               | ...                                       | 12.6 | 16.9 | 25.3     | 37.9                                    | 63.2   | 105.4 |
| 675                               | ...                                       | 9.9  | 13.2 | 19.8     | 29.6                                    | 49.4   | 82.3  |
| 700                               | ...                                       | 7.9  | 10.5 | 15.8     | 23.7                                    | 39.5   | 65.9  |
| 725                               | ...                                       | 6.3  | 8.5  | 12.7     | 19.0                                    | 31.7   | 52.8  |
| 750                               | ...                                       | 5.0  | 6.7  | 10.0     | 15.0                                    | 25.0   | 41.7  |
| 775                               | ...                                       | 4.0  | 5.3  | 8.0      | 11.9                                    | 19.9   | 33.2  |
| 800                               | ...                                       | 3.1  | 4.2  | 6.3      | 9.4                                     | 15.6   | 26.1  |
| 816                               | ...                                       | 2.6  | 3.5  | 5.2      | 7.8                                     | 13.0   | 21.7  |

## NOTES:

- (1) Not to be used over 538°C.  
 (2) At temperatures over 538°C, use only if the material is heat treated by heating to a minimum temperature of 1095°C.

**Table 2-2.5 Pressure–Temperature Ratings for Group 2.5 Materials**

| Nominal Designation               |      | Forgings            |      | Castings |       | Plates             |       |
|-----------------------------------|------|---------------------|------|----------|-------|--------------------|-------|
| 18Cr–10Ni–Cb                      |      | A 182 Gr. F347 (1)  |      |          |       | A 240 Gr. 347 (1)  |       |
|                                   |      | A 182 Gr. F347H (2) |      |          |       | A 240 Gr. 347H (2) |       |
|                                   |      | A 182 Gr. F348 (1)  |      |          |       | A 240 Gr. 348 (1)  |       |
|                                   |      | A 182 Gr. F348H (2) |      |          |       | A 240 Gr. 348H (2) |       |
| Working Pressures by Classes, bar |      |                     |      |          |       |                    |       |
| Class<br>Temp., °C                | 150  | 300                 | 400  | 600      | 900   | 1500               | 2500  |
| –29 to 38                         | 19.0 | 49.6                | 66.2 | 99.3     | 148.9 | 248.2              | 413.7 |
| 50                                | 18.7 | 48.8                | 65.0 | 97.5     | 146.3 | 243.8              | 406.4 |
| 100                               | 17.4 | 45.3                | 60.4 | 90.6     | 135.9 | 226.5              | 377.4 |
| 150                               | 15.8 | 42.5                | 56.6 | 84.9     | 127.4 | 212.4              | 353.9 |
| 200                               | 13.8 | 39.9                | 53.3 | 79.9     | 119.8 | 199.7              | 332.8 |
| 250                               | 12.1 | 37.8                | 50.4 | 75.6     | 113.4 | 189.1              | 315.1 |
| 300                               | 10.2 | 36.1                | 48.1 | 72.2     | 108.3 | 180.4              | 300.7 |
| 325                               | 9.3  | 35.4                | 47.1 | 70.7     | 106.1 | 176.8              | 294.6 |
| 350                               | 8.4  | 34.8                | 46.3 | 69.5     | 104.3 | 173.8              | 289.6 |
| 375                               | 7.4  | 34.2                | 45.6 | 68.4     | 102.6 | 171.0              | 285.1 |
| 400                               | 6.5  | 33.9                | 45.2 | 67.8     | 101.7 | 169.5              | 282.6 |
| 425                               | 5.5  | 33.6                | 44.8 | 67.2     | 100.8 | 168.1              | 280.1 |
| 450                               | 4.6  | 33.5                | 44.6 | 66.9     | 100.4 | 167.3              | 278.8 |
| 475                               | 3.7  | 31.7                | 42.3 | 63.4     | 95.1  | 158.2              | 263.9 |
| 500                               | 2.8  | 28.2                | 37.6 | 56.5     | 84.7  | 140.9              | 235.0 |
| 538                               | 1.4  | 25.2                | 33.4 | 50.0     | 75.2  | 125.5              | 208.9 |
| 550                               | ...  | 25.0                | 33.3 | 49.8     | 74.8  | 124.9              | 208.0 |
| 575                               | ...  | 24.0                | 31.9 | 47.9     | 71.8  | 119.7              | 199.5 |
| 600                               | ...  | 21.6                | 28.6 | 42.9     | 64.2  | 107.0              | 178.5 |
| 625                               | ...  | 18.3                | 24.3 | 36.6     | 54.9  | 91.2               | 152.0 |
| 650                               | ...  | 14.1                | 18.9 | 28.1     | 42.5  | 70.7               | 117.7 |
| 675                               | ...  | 12.4                | 16.9 | 25.2     | 37.6  | 62.7               | 104.5 |
| 700                               | ...  | 10.1                | 13.4 | 20.0     | 29.8  | 49.7               | 83.0  |
| 725                               | ...  | 7.9                 | 10.5 | 15.4     | 23.2  | 38.6               | 64.4  |
| 750                               | ...  | 5.9                 | 7.9  | 11.7     | 17.6  | 29.6               | 49.1  |
| 775                               | ...  | 4.6                 | 6.2  | 9.0      | 13.7  | 22.8               | 38.0  |
| 800                               | ...  | 3.5                 | 4.8  | 7.0      | 10.5  | 17.4               | 29.2  |
| 816                               | ...  | 2.8                 | 3.8  | 5.9      | 8.6   | 14.1               | 23.8  |

## NOTES:

(1) Not to be used over 538°C.

(2) For temperatures over 538°C, use only if the material is heat treated by heating to a minimum temperature of 1095°C.

**Table 2-2.6 Pressure–Temperature Ratings for Group 2.6 Materials**

| Nominal Designation               | Forgings       |      |      | Castings |       | Plates |       |
|-----------------------------------|----------------|------|------|----------|-------|--------|-------|
| 23Cr–12Ni                         | A 240 Gr. 309H |      |      |          |       |        |       |
| Working Pressures by Classes, bar |                |      |      |          |       |        |       |
| Class<br>Temp., °C                | 150            | 300  | 400  | 600      | 900   | 1500   | 2500  |
| –29 to 38                         | 19.0           | 49.6 | 66.2 | 99.3     | 148.9 | 248.2  | 413.7 |
| 50                                | 18.5           | 48.3 | 64.4 | 96.6     | 144.9 | 241.5  | 402.5 |
| 100                               | 16.5           | 43.1 | 57.5 | 86.2     | 129.3 | 215.5  | 359.2 |
| 150                               | 15.3           | 40.0 | 53.3 | 80.0     | 120.0 | 200.0  | 333.3 |
| 200                               | 13.8           | 37.8 | 50.3 | 75.5     | 113.3 | 188.8  | 314.7 |
| 250                               | 12.1           | 36.1 | 48.1 | 72.1     | 108.2 | 180.4  | 300.6 |
| 300                               | 10.2           | 34.8 | 46.4 | 69.6     | 104.4 | 173.9  | 289.9 |
| 325                               | 9.3            | 34.2 | 45.7 | 68.5     | 102.7 | 171.2  | 285.4 |
| 350                               | 8.4            | 33.8 | 45.1 | 67.6     | 101.4 | 169.0  | 281.7 |
| 375                               | 7.4            | 33.4 | 44.5 | 66.8     | 100.1 | 166.9  | 278.2 |
| 400                               | 6.5            | 33.1 | 44.1 | 66.1     | 99.2  | 165.4  | 275.6 |
| 425                               | 5.5            | 32.6 | 43.5 | 65.3     | 97.9  | 163.1  | 271.9 |
| 450                               | 4.6            | 32.2 | 42.9 | 64.4     | 96.5  | 160.9  | 268.2 |
| 475                               | 3.7            | 31.7 | 42.3 | 63.4     | 95.1  | 158.2  | 263.9 |
| 500                               | 2.8            | 28.2 | 37.6 | 56.5     | 84.7  | 140.9  | 235.0 |
| 538                               | 1.4            | 25.2 | 33.4 | 50.0     | 75.2  | 125.5  | 208.9 |
| 550                               | ...            | 25.0 | 33.3 | 49.8     | 74.8  | 124.9  | 208.0 |
| 575                               | ...            | 22.2 | 29.6 | 44.4     | 66.5  | 110.9  | 184.8 |
| 600                               | ...            | 16.8 | 22.4 | 33.5     | 50.3  | 83.9   | 139.8 |
| 625                               | ...            | 12.5 | 16.7 | 25.0     | 37.5  | 62.5   | 104.2 |
| 650                               | ...            | 9.4  | 12.5 | 18.7     | 28.1  | 46.8   | 78.0  |
| 675                               | ...            | 7.2  | 9.6  | 14.5     | 21.7  | 36.2   | 60.3  |
| 700                               | ...            | 5.5  | 7.3  | 11.0     | 16.5  | 27.5   | 45.9  |
| 725                               | ...            | 4.3  | 5.8  | 8.7      | 13.0  | 21.6   | 36.0  |
| 750                               | ...            | 3.4  | 4.6  | 6.8      | 10.2  | 17.1   | 28.4  |
| 775                               | ...            | 2.7  | 3.6  | 5.4      | 8.1   | 13.5   | 22.4  |
| 800                               | ...            | 2.1  | 2.8  | 4.2      | 6.3   | 10.5   | 17.5  |
| 816                               | ...            | 1.8  | 2.4  | 3.5      | 5.3   | 8.9    | 14.8  |

**Table 2-2.7 Pressure–Temperature Ratings for Group 2.7 Materials**

| Nominal Designation               | Forgings                |      |      | Castings |                | Plates |       |
|-----------------------------------|-------------------------|------|------|----------|----------------|--------|-------|
| 25Cr–20Ni                         | A 182 Gr. F310 (1), (2) |      |      |          | A 240 Gr. 310H |        |       |
| Working Pressures by Classes, bar |                         |      |      |          |                |        |       |
| Class<br>Temp., °C                | 150                     | 300  | 400  | 600      | 900            | 1500   | 2500  |
| –29 to 38                         | 19.0                    | 49.6 | 66.2 | 99.3     | 148.9          | 248.2  | 413.7 |
| 50                                | 18.5                    | 48.4 | 64.5 | 96.7     | 145.1          | 241.8  | 403.1 |
| 100                               | 16.6                    | 43.4 | 57.9 | 86.8     | 130.2          | 217.0  | 361.6 |
| 150                               | 15.3                    | 40.0 | 53.3 | 80.0     | 120.0          | 200.0  | 333.3 |
| 200                               | 13.8                    | 37.6 | 50.1 | 75.2     | 112.8          | 188.0  | 313.4 |
| 250                               | 12.1                    | 35.8 | 47.7 | 71.5     | 107.3          | 178.8  | 298.1 |
| 300                               | 10.2                    | 34.5 | 45.9 | 68.9     | 103.4          | 172.3  | 287.2 |
| 325                               | 9.3                     | 33.9 | 45.2 | 67.7     | 101.6          | 169.3  | 282.2 |
| 350                               | 8.4                     | 33.3 | 44.4 | 66.6     | 99.9           | 166.5  | 277.6 |
| 375                               | 7.4                     | 32.9 | 43.8 | 65.7     | 98.6           | 164.3  | 273.8 |
| 400                               | 6.5                     | 32.4 | 43.2 | 64.8     | 97.3           | 162.1  | 270.2 |
| 425                               | 5.5                     | 32.1 | 42.8 | 64.2     | 96.4           | 160.6  | 267.7 |
| 450                               | 4.6                     | 31.7 | 42.2 | 63.4     | 95.1           | 158.4  | 264.0 |
| 475                               | 3.7                     | 31.2 | 41.7 | 62.5     | 93.7           | 156.2  | 260.3 |
| 500                               | 2.8                     | 28.2 | 37.6 | 56.5     | 84.7           | 140.9  | 235.0 |
| 538                               | 1.4                     | 25.2 | 33.4 | 50.0     | 75.2           | 125.5  | 208.9 |
| 550                               | ...                     | 25.0 | 33.3 | 49.8     | 74.8           | 124.9  | 208.0 |
| 575                               | ...                     | 22.2 | 29.6 | 44.4     | 66.5           | 110.9  | 184.8 |
| 600                               | ...                     | 16.8 | 22.4 | 33.5     | 50.3           | 83.9   | 139.8 |
| 625                               | ...                     | 12.5 | 16.7 | 25.0     | 37.5           | 62.5   | 104.2 |
| 650                               | ...                     | 9.4  | 12.5 | 18.7     | 28.1           | 46.8   | 78.0  |
| 675                               | ...                     | 7.2  | 9.6  | 14.5     | 21.7           | 36.2   | 60.3  |
| 700                               | ...                     | 5.5  | 7.3  | 11.0     | 16.5           | 27.5   | 45.9  |
| 725                               | ...                     | 4.3  | 5.8  | 8.7      | 13.0           | 21.6   | 36.0  |
| 750                               | ...                     | 3.4  | 4.6  | 6.8      | 10.2           | 17.1   | 28.4  |
| 775                               | ...                     | 2.7  | 3.5  | 5.3      | 8.0            | 13.3   | 22.1  |
| 800                               | ...                     | 2.1  | 2.8  | 4.1      | 6.2            | 10.3   | 17.2  |
| 816                               | ...                     | 1.8  | 2.4  | 3.5      | 5.3            | 8.9    | 14.8  |

**NOTES:**

- (1) At temperatures over 538°C, use only when the carbon content is 0.04% or higher.
- (2) Service temperatures of 565°C and above should be used only when assurance is provided that grain size is not finer than ASTM 6.

**Table 2-2.8 Pressure–Temperature Ratings for Group 2.8 Materials**

| Nominal Designation               | Forgings          | Castings               | Plates               |       |       |       |       |
|-----------------------------------|-------------------|------------------------|----------------------|-------|-------|-------|-------|
| 20Cr–18Ni–6Mo                     | A 182 Gr. F44     | A 351 Gr. CK3MCuN      | A 240 Gr. S31254     |       |       |       |       |
| 22Cr–5Ni–3Mo–N                    | A 182 Gr. F51 (1) |                        | A 240 Gr. S31803 (1) |       |       |       |       |
| 25Cr–7Ni–4Mo–N                    | A 182 Gr. F53 (1) |                        | A 240 Gr. S32750 (1) |       |       |       |       |
| 24Cr–10Ni–4Mo–V                   |                   | A 351 Gr. CE8MN (1)    |                      |       |       |       |       |
| 25Cr–5Ni–2Mo–3Cu                  |                   | A 351 Gr. CD4MCu (1)   |                      |       |       |       |       |
| 25Cr–7Ni–3.5Mo–W–Cb               |                   | A 351 Gr. CD3MWCuN (1) |                      |       |       |       |       |
| 25Cr–7Ni–3.5Mo–N–Cu–W             | A 182 Gr. F55 (1) |                        | A 240 Gr. S32760 (1) |       |       |       |       |
| Working Pressures by Classes, bar |                   |                        |                      |       |       |       |       |
| Class<br>Temp., °C                | 150               | 300                    | 400                  | 600   | 900   | 1500  | 2500  |
| –29 to 38                         | 20.0              | 51.7                   | 68.9                 | 103.4 | 155.1 | 258.6 | 430.9 |
| 50                                | 19.5              | 51.7                   | 68.9                 | 103.4 | 155.1 | 258.6 | 430.9 |
| 100                               | 17.7              | 50.7                   | 67.5                 | 101.3 | 152.0 | 253.3 | 422.2 |
| 150                               | 15.8              | 45.9                   | 61.2                 | 91.9  | 137.8 | 229.6 | 382.7 |
| 200                               | 13.8              | 42.7                   | 56.9                 | 85.3  | 128.0 | 213.3 | 355.4 |
| 250                               | 12.1              | 40.5                   | 53.9                 | 80.9  | 121.4 | 202.3 | 337.2 |
| 300                               | 10.2              | 38.9                   | 51.8                 | 77.7  | 116.6 | 194.3 | 323.8 |
| 325                               | 9.3               | 38.2                   | 50.9                 | 76.3  | 114.5 | 190.8 | 318.0 |
| 350                               | 8.4               | 37.6                   | 50.2                 | 75.3  | 112.9 | 188.2 | 313.7 |
| 375                               | 7.4               | 37.4                   | 49.8                 | 74.7  | 112.1 | 186.8 | 311.3 |
| 400                               | 6.5               | 36.5                   | 48.9                 | 73.3  | 109.8 | 183.1 | 304.9 |

## NOTE:

- (1) This steel may become brittle after service at moderately elevated temperatures. Not to be used over 315°C.

**Table 2-2.9 Pressure–Temperature Ratings for Group 2.9 Materials**

| Nominal Designation               | Forgings |      | Castings |      |       | Plates                       |       |
|-----------------------------------|----------|------|----------|------|-------|------------------------------|-------|
| 23Cr–12Ni                         |          |      |          |      |       | A 240 Gr. 309S (1), (2), (3) |       |
| 25Cr–20Ni                         |          |      |          |      |       | A 240 Gr. 310S (1), (2), (3) |       |
| Working Pressures by Classes, bar |          |      |          |      |       |                              |       |
| Class<br>Temp., °C                | 150      | 300  | 400      | 600  | 900   | 1500                         | 2500  |
| –29 to 38                         | 19.0     | 49.6 | 66.2     | 99.3 | 148.9 | 248.2                        | 413.7 |
| 50                                | 18.5     | 48.3 | 64.4     | 96.6 | 144.9 | 241.5                        | 402.5 |
| 100                               | 16.5     | 43.1 | 57.5     | 86.2 | 129.3 | 215.5                        | 359.2 |
| 150                               | 15.3     | 40.0 | 53.3     | 80.0 | 120.0 | 200.0                        | 333.3 |
| 200                               | 13.8     | 37.6 | 50.1     | 75.2 | 112.8 | 188.0                        | 313.4 |
| 250                               | 12.1     | 35.8 | 47.7     | 71.5 | 107.3 | 178.8                        | 298.1 |
| 300                               | 10.2     | 34.5 | 45.9     | 68.9 | 103.4 | 172.3                        | 287.2 |
| 325                               | 9.3      | 33.9 | 45.2     | 67.7 | 101.6 | 169.3                        | 282.2 |
| 350                               | 8.4      | 33.3 | 44.4     | 66.6 | 99.9  | 166.5                        | 277.6 |
| 375                               | 7.4      | 32.9 | 43.8     | 65.7 | 98.6  | 164.3                        | 273.8 |
| 400                               | 6.5      | 32.4 | 43.2     | 64.8 | 97.3  | 162.1                        | 270.2 |
| 425                               | 5.5      | 32.1 | 42.8     | 64.2 | 96.4  | 160.6                        | 267.7 |
| 450                               | 4.6      | 31.7 | 42.2     | 63.4 | 95.1  | 158.4                        | 264.0 |
| 475                               | 3.7      | 31.2 | 41.7     | 62.5 | 93.7  | 156.2                        | 260.3 |
| 500                               | 2.8      | 28.2 | 37.6     | 56.5 | 84.7  | 140.9                        | 235.0 |
| 538                               | 1.4      | 23.4 | 31.2     | 46.8 | 70.2  | 117.0                        | 195.0 |
| 550                               | ...      | 20.5 | 27.3     | 41.0 | 61.5  | 102.5                        | 170.8 |
| 575                               | ...      | 15.1 | 20.1     | 30.2 | 45.3  | 75.5                         | 125.8 |
| 600                               | ...      | 11.0 | 14.7     | 22.1 | 33.1  | 55.1                         | 91.9  |
| 625                               | ...      | 8.1  | 10.9     | 16.3 | 24.4  | 40.7                         | 67.9  |
| 650                               | ...      | 5.8  | 7.8      | 11.6 | 17.4  | 29.1                         | 48.5  |
| 675                               | ...      | 3.7  | 4.9      | 7.4  | 11.1  | 18.4                         | 30.7  |
| 700                               | ...      | 2.2  | 2.9      | 4.3  | 6.5   | 10.8                         | 18.0  |
| 725                               | ...      | 1.4  | 1.8      | 2.7  | 4.1   | 6.8                          | 11.4  |
| 750                               | ...      | 1.0  | 1.4      | 2.1  | 3.1   | 5.2                          | 8.6   |
| 775                               | ...      | 0.8  | 1.1      | 1.6  | 2.5   | 4.1                          | 6.8   |
| 800                               | ...      | 0.6  | 0.8      | 1.2  | 1.8   | 3.0                          | 5.0   |
| 816                               | ...      | 0.5  | 0.6      | 0.9  | 1.4   | 2.4                          | 3.9   |

## NOTES:

- (1) At temperatures over 538°C, use only when the carbon content is 0.04% or higher.
- (2) At temperatures above 538°C, use only if the material is solution heat treated to the minimum temperature specified in the specification but not lower than 1035°C, and quenching in water or rapidly cooling by other means.
- (3) This material should be used for service temperatures 565°C and above only when assurance is provided that grain size is not finer than ASTM 6.

**Table 2-2.10 Pressure–Temperature Ratings for Group 2.10 Materials**

| Nominal Designation               | Forgings |      |      | Castings                                |       |       | Plates |
|-----------------------------------|----------|------|------|-----------------------------------------|-------|-------|--------|
| 25Cr–12Ni                         |          |      |      | A 351 Gr. CH8 (1)<br>A 351 Gr. CH20 (1) |       |       |        |
| Working Pressures by Classes, bar |          |      |      |                                         |       |       |        |
| Class<br>Temp., °C                | 150      | 300  | 400  | 600                                     | 900   | 1500  | 2500   |
| –29 to 38                         | 17.8     | 46.3 | 61.8 | 92.7                                    | 139.0 | 231.7 | 386.1  |
| 50                                | 17.0     | 44.5 | 59.3 | 89.0                                    | 133.4 | 222.4 | 370.6  |
| 100                               | 14.4     | 37.5 | 50.0 | 75.1                                    | 112.6 | 187.7 | 312.8  |
| 150                               | 13.4     | 34.9 | 46.5 | 69.8                                    | 104.7 | 174.4 | 290.7  |
| 200                               | 12.9     | 33.5 | 44.7 | 67.1                                    | 100.6 | 167.7 | 279.5  |
| 250                               | 12.1     | 32.6 | 43.5 | 65.2                                    | 97.8  | 163.1 | 271.8  |
| 300                               | 10.2     | 31.7 | 42.3 | 63.4                                    | 95.2  | 158.6 | 264.3  |
| 325                               | 9.3      | 31.2 | 41.6 | 62.4                                    | 93.6  | 156.1 | 260.1  |
| 350                               | 8.4      | 30.6 | 40.8 | 61.2                                    | 91.7  | 152.9 | 254.8  |
| 375                               | 7.4      | 29.8 | 39.8 | 59.7                                    | 89.5  | 149.2 | 248.6  |
| 400                               | 6.5      | 29.1 | 38.8 | 58.2                                    | 87.3  | 145.5 | 242.4  |
| 425                               | 5.5      | 28.3 | 37.8 | 56.7                                    | 85.0  | 141.7 | 236.2  |
| 450                               | 4.6      | 27.6 | 36.8 | 55.2                                    | 82.8  | 138.0 | 230.0  |
| 475                               | 3.7      | 26.7 | 35.6 | 53.5                                    | 80.2  | 133.7 | 222.8  |
| 500                               | 2.8      | 25.8 | 34.5 | 51.7                                    | 77.5  | 129.2 | 215.3  |
| 538                               | 1.4      | 23.3 | 31.1 | 46.6                                    | 70.0  | 116.6 | 194.4  |
| 550                               | ...      | 21.9 | 29.2 | 43.8                                    | 65.7  | 109.5 | 182.5  |
| 575                               | ...      | 18.5 | 24.6 | 37.0                                    | 55.5  | 92.4  | 154.0  |
| 600                               | ...      | 14.5 | 19.4 | 29.0                                    | 43.5  | 72.6  | 121.0  |
| 625                               | ...      | 11.4 | 15.2 | 22.8                                    | 34.3  | 57.1  | 95.2   |
| 650                               | ...      | 8.9  | 11.9 | 17.8                                    | 26.7  | 44.5  | 74.1   |
| 675                               | ...      | 7.0  | 9.3  | 14.0                                    | 20.9  | 34.9  | 58.2   |
| 700                               | ...      | 5.7  | 7.6  | 11.3                                    | 17.0  | 28.3  | 47.2   |
| 725                               | ...      | 4.6  | 6.1  | 9.1                                     | 13.7  | 22.8  | 38.0   |
| 750                               | ...      | 3.5  | 4.7  | 7.0                                     | 10.5  | 17.5  | 29.2   |
| 775                               | ...      | 2.6  | 3.4  | 5.1                                     | 7.7   | 12.8  | 21.4   |
| 800                               | ...      | 2.0  | 2.7  | 4.0                                     | 6.1   | 10.1  | 16.9   |
| 816                               | ...      | 1.9  | 2.5  | 3.8                                     | 5.7   | 9.5   | 15.8   |

## NOTE:

(1) At temperatures over 538°C, use only when the carbon content is 0.04% or higher.



**Table 2-2.11 Pressure–Temperature Ratings for Group 2.11 Materials**

| Nominal Designation               | Forgings           |      |      | Castings |       |       | Plates |
|-----------------------------------|--------------------|------|------|----------|-------|-------|--------|
| 18Cr–10Ni–Cb                      | A 351 Gr. CF8C (1) |      |      |          |       |       |        |
| Working Pressures by Classes, bar |                    |      |      |          |       |       |        |
| Class<br>Temp., °C                | 150                | 300  | 400  | 600      | 900   | 1500  | 2500   |
| –29 to 38                         | 19.0               | 49.6 | 66.2 | 99.3     | 148.9 | 248.2 | 413.7  |
| 50                                | 18.7               | 48.8 | 65.0 | 97.5     | 146.3 | 243.8 | 406.4  |
| 100                               | 17.4               | 45.3 | 60.4 | 90.6     | 135.9 | 226.5 | 377.4  |
| 150                               | 15.8               | 42.5 | 56.6 | 84.9     | 127.4 | 212.4 | 353.9  |
| 200                               | 13.8               | 39.9 | 53.3 | 79.9     | 119.8 | 199.7 | 332.8  |
| 250                               | 12.1               | 37.8 | 50.4 | 75.6     | 113.4 | 189.1 | 315.1  |
| 300                               | 10.2               | 36.1 | 48.1 | 72.2     | 108.3 | 180.4 | 300.7  |
| 325                               | 9.3                | 35.4 | 47.1 | 70.7     | 106.1 | 176.8 | 294.6  |
| 350                               | 8.4                | 34.8 | 46.3 | 69.5     | 104.3 | 173.8 | 289.6  |
| 375                               | 7.4                | 34.2 | 45.6 | 68.4     | 102.6 | 171.0 | 285.1  |
| 400                               | 6.5                | 33.9 | 45.2 | 67.8     | 101.7 | 169.5 | 282.6  |
| 425                               | 5.5                | 33.6 | 44.8 | 67.2     | 100.8 | 168.1 | 280.1  |
| 450                               | 4.6                | 33.5 | 44.6 | 66.9     | 100.4 | 167.3 | 278.8  |
| 475                               | 3.7                | 31.7 | 42.3 | 63.4     | 95.1  | 158.2 | 263.9  |
| 500                               | 2.8                | 28.2 | 37.6 | 56.5     | 84.7  | 140.9 | 235.0  |
| 538                               | 1.4                | 25.2 | 33.4 | 50.0     | 75.2  | 125.5 | 208.9  |
| 550                               | ...                | 25.0 | 33.3 | 49.8     | 74.8  | 124.9 | 208.0  |
| 575                               | ...                | 24.0 | 31.9 | 47.9     | 71.8  | 119.7 | 199.5  |
| 600                               | ...                | 19.8 | 26.4 | 39.6     | 59.4  | 99.0  | 165.1  |
| 625                               | ...                | 13.9 | 18.5 | 27.7     | 41.6  | 69.3  | 115.5  |
| 650                               | ...                | 10.3 | 13.7 | 20.6     | 30.9  | 51.5  | 85.8   |
| 675                               | ...                | 8.0  | 10.6 | 15.9     | 23.9  | 39.8  | 66.3   |
| 700                               | ...                | 5.6  | 7.5  | 11.2     | 16.8  | 28.1  | 46.8   |
| 725                               | ...                | 4.0  | 5.3  | 8.0      | 11.9  | 19.9  | 33.1   |
| 750                               | ...                | 3.1  | 4.1  | 6.2      | 9.3   | 15.5  | 25.8   |
| 775                               | ...                | 2.5  | 3.3  | 4.9      | 7.4   | 12.3  | 20.4   |
| 800                               | ...                | 2.0  | 2.7  | 4.0      | 6.1   | 10.1  | 16.9   |
| 816                               | ...                | 1.9  | 2.5  | 3.8      | 5.7   | 9.5   | 15.8   |

**NOTE:**

(1) At temperatures over 538°C, use only when the carbon content is 0.04% or higher.

**Table 2-2.12 Pressure–Temperature Ratings for Group 2.12 Materials**

| Nominal Designation               | Forgings          |      |      | Castings |       |       | Plates |
|-----------------------------------|-------------------|------|------|----------|-------|-------|--------|
| 25Cr–20Ni                         | A351 Gr. CK20 (1) |      |      |          |       |       |        |
| Working Pressures by Classes, bar |                   |      |      |          |       |       |        |
| Class<br>Temp., °C                | 150               | 300  | 400  | 600      | 900   | 1500  | 2500   |
| –29 to 38                         | 17.8              | 46.3 | 61.8 | 92.7     | 139.0 | 231.7 | 386.1  |
| 50                                | 17.0              | 44.5 | 59.3 | 89.0     | 133.4 | 222.4 | 370.6  |
| 100                               | 14.4              | 37.5 | 50.0 | 75.1     | 112.6 | 187.7 | 312.8  |
| 150                               | 13.4              | 34.9 | 46.5 | 69.8     | 104.7 | 174.4 | 290.7  |
| 200                               | 12.9              | 33.5 | 44.7 | 67.1     | 100.6 | 167.7 | 279.5  |
| 250                               | 12.1              | 32.6 | 43.5 | 65.2     | 97.8  | 163.1 | 271.8  |
| 300                               | 10.2              | 31.7 | 42.3 | 63.4     | 95.2  | 158.6 | 264.3  |
| 325                               | 9.3               | 31.2 | 41.6 | 62.4     | 93.6  | 156.1 | 260.1  |
| 350                               | 8.4               | 30.6 | 40.8 | 61.2     | 91.7  | 152.9 | 254.8  |
| 375                               | 7.4               | 29.8 | 39.8 | 59.7     | 89.5  | 149.2 | 248.6  |
| 400                               | 6.5               | 29.1 | 38.8 | 58.2     | 87.3  | 145.5 | 242.4  |
| 425                               | 5.5               | 28.3 | 37.8 | 56.7     | 85.0  | 141.7 | 236.2  |
| 450                               | 4.6               | 27.6 | 36.8 | 55.2     | 82.8  | 138.0 | 230.0  |
| 475                               | 3.7               | 26.7 | 35.6 | 53.5     | 80.2  | 133.7 | 222.8  |
| 500                               | 2.8               | 25.8 | 34.5 | 51.7     | 77.5  | 129.2 | 215.3  |
| 538                               | 1.4               | 23.3 | 31.1 | 46.6     | 70.0  | 116.6 | 194.4  |
| 550                               | ...               | 22.9 | 30.6 | 45.9     | 68.8  | 114.7 | 191.2  |
| 575                               | ...               | 21.7 | 28.9 | 43.3     | 65.0  | 108.3 | 180.4  |
| 600                               | ...               | 19.4 | 25.9 | 38.8     | 58.2  | 97.1  | 161.8  |
| 625                               | ...               | 16.8 | 22.4 | 33.7     | 50.5  | 84.1  | 140.2  |
| 650                               | ...               | 14.1 | 18.8 | 28.1     | 42.2  | 70.4  | 117.3  |
| 675                               | ...               | 11.5 | 15.4 | 23.0     | 34.6  | 57.6  | 96.0   |
| 700                               | ...               | 8.8  | 11.7 | 17.5     | 26.3  | 43.8  | 73.0   |
| 725                               | ...               | 6.3  | 8.5  | 12.7     | 19.0  | 31.7  | 52.9   |
| 750                               | ...               | 4.5  | 6.0  | 8.9      | 13.4  | 22.3  | 37.2   |
| 775                               | ...               | 3.1  | 4.2  | 6.3      | 9.4   | 15.7  | 26.2   |
| 800                               | ...               | 2.3  | 3.1  | 4.6      | 6.9   | 11.4  | 19.1   |
| 816                               | ...               | 1.9  | 2.5  | 3.8      | 5.7   | 9.5   | 15.8   |

## NOTE:

(1) At temperatures over 538°C, use only when the carbon content is 0.04% or higher.

**Table 2-3.1 Pressure–Temperature Ratings for Group 3.1 Materials**

| Nominal Designation               | Forgings             |      |      | Castings |                      | Plates |       |
|-----------------------------------|----------------------|------|------|----------|----------------------|--------|-------|
| 35Ni–35Fe–10Cr–Cb                 | B 462 Gr. N08020 (1) |      |      |          | B 463 Gr. N08020 (1) |        |       |
| Working Pressures by Classes, bar |                      |      |      |          |                      |        |       |
| Class<br>Temp., °C                | 150                  | 300  | 400  | 600      | 900                  | 1500   | 2500  |
| –29 to 38                         | 20.0                 | 51.7 | 68.9 | 103.4    | 155.1                | 258.6  | 430.9 |
| 50                                | 19.5                 | 51.7 | 68.9 | 103.4    | 155.1                | 258.6  | 430.9 |
| 100                               | 17.7                 | 50.9 | 67.8 | 101.7    | 152.6                | 254.4  | 423.9 |
| 150                               | 15.8                 | 48.9 | 65.3 | 97.9     | 146.8                | 244.7  | 407.8 |
| 200                               | 13.8                 | 47.2 | 62.9 | 94.3     | 141.5                | 235.8  | 392.9 |
| 250                               | 12.1                 | 45.5 | 60.7 | 91.0     | 136.5                | 227.5  | 379.2 |
| 300                               | 10.2                 | 42.9 | 57.0 | 85.7     | 128.6                | 214.4  | 357.1 |
| 325                               | 9.3                  | 41.4 | 55.0 | 82.6     | 124.0                | 206.6  | 344.3 |
| 350                               | 8.4                  | 40.3 | 53.6 | 80.4     | 120.7                | 201.1  | 335.3 |
| 375                               | 7.4                  | 38.9 | 51.6 | 77.6     | 116.5                | 194.1  | 323.2 |
| 400                               | 6.5                  | 36.5 | 48.9 | 73.3     | 109.8                | 183.1  | 304.9 |
| 425                               | 5.5                  | 35.2 | 46.5 | 70.0     | 105.1                | 175.1  | 291.6 |

NOTE:

(1) Use annealed material only.

**Table 2-3.2 Pressure–Temperature Ratings for Group 3.2 Materials**

| Nominal Designation               | Forgings                  |      |      | Castings |                      | Plates |       |
|-----------------------------------|---------------------------|------|------|----------|----------------------|--------|-------|
| 99.0Ni                            | B 160 Gr. N02200 (1), (2) |      |      |          | B 162 Gr. N02200 (1) |        |       |
| Working Pressures by Classes, bar |                           |      |      |          |                      |        |       |
| Class<br>Temp., °C                | 150                       | 300  | 400  | 600      | 900                  | 1500   | 2500  |
| −29 to 38                         | 12.7                      | 33.1 | 44.1 | 66.2     | 99.3                 | 165.5  | 275.8 |
| 50                                | 12.7                      | 33.1 | 44.1 | 66.2     | 99.3                 | 165.5  | 275.8 |
| 100                               | 12.7                      | 33.1 | 44.1 | 66.2     | 99.3                 | 165.5  | 275.8 |
| 150                               | 12.7                      | 33.1 | 44.1 | 66.2     | 99.3                 | 165.5  | 275.8 |
| 200                               | 12.7                      | 33.1 | 44.1 | 66.2     | 99.3                 | 165.5  | 275.8 |
| 250                               | 12.1                      | 31.6 | 42.1 | 63.2     | 94.8                 | 158.0  | 263.4 |
| 300                               | 10.2                      | 29.2 | 39.0 | 58.5     | 87.7                 | 146.2  | 243.7 |
| 325                               | 7.2                       | 18.8 | 25.0 | 37.6     | 56.4                 | 93.9   | 156.5 |

NOTES:

(1) Use annealed material only.

(2) The chemical composition, mechanical properties, heat treating requirements, and grain size requirements shall conform to the applicable ASTM specification. The manufacturing procedures tolerances, tests, certification, and markings shall be in accordance with ASTM B 564.

**Table 2-3.3 Pressure–Temperature Ratings for Group 3.3 Materials**

| Nominal Designation               |     | Forgings                  |      |      | Castings |                      | Plates |  |
|-----------------------------------|-----|---------------------------|------|------|----------|----------------------|--------|--|
| 99.0Ni–Low C                      |     | B 160 Gr. N02201 (1), (2) |      |      |          | B 162 Gr. N02201 (1) |        |  |
| Working Pressures by Classes, bar |     |                           |      |      |          |                      |        |  |
| Class<br>Temp., °C                | 150 | 300                       | 400  | 600  | 900      | 1500                 | 2500   |  |
| –29 to 38                         | 6.3 | 16.5                      | 22.1 | 33.1 | 49.6     | 82.7                 | 137.9  |  |
| 50                                | 6.3 | 16.4                      | 21.9 | 32.8 | 49.2     | 82.0                 | 136.7  |  |
| 100                               | 6.1 | 15.8                      | 21.1 | 31.7 | 47.5     | 79.2                 | 132.0  |  |
| 150                               | 6.0 | 15.6                      | 20.7 | 31.1 | 46.7     | 77.8                 | 129.6  |  |
| 200                               | 6.0 | 15.6                      | 20.7 | 31.1 | 46.7     | 77.8                 | 129.6  |  |
| 250                               | 6.0 | 15.6                      | 20.7 | 31.1 | 46.7     | 77.8                 | 129.6  |  |
| 300                               | 6.0 | 15.6                      | 20.7 | 31.1 | 46.7     | 77.8                 | 129.6  |  |
| 325                               | 5.9 | 15.5                      | 20.7 | 31.0 | 46.5     | 77.5                 | 129.2  |  |
| 350                               | 5.9 | 15.4                      | 20.5 | 30.8 | 46.2     | 76.9                 | 128.2  |  |
| 375                               | 5.9 | 15.4                      | 20.5 | 30.7 | 46.1     | 76.8                 | 128.0  |  |
| 400                               | 5.8 | 15.2                      | 20.3 | 30.4 | 45.6     | 76.1                 | 126.8  |  |
| 425                               | 5.5 | 14.9                      | 19.9 | 29.8 | 44.7     | 74.6                 | 124.3  |  |
| 450                               | 4.6 | 14.6                      | 19.5 | 29.2 | 43.8     | 73.1                 | 121.8  |  |
| 475                               | 3.7 | 14.3                      | 19.1 | 28.6 | 43.0     | 71.6                 | 119.3  |  |
| 500                               | 2.8 | 13.8                      | 18.4 | 27.6 | 41.4     | 69.0                 | 115.1  |  |
| 538                               | 1.4 | 13.1                      | 17.4 | 26.1 | 39.2     | 65.4                 | 108.9  |  |
| 550                               | ... | 9.8                       | 13.1 | 19.6 | 29.5     | 49.1                 | 81.8   |  |
| 575                               | ... | 5.4                       | 7.1  | 10.7 | 16.1     | 26.8                 | 44.6   |  |
| 600                               | ... | 4.4                       | 5.9  | 8.9  | 13.3     | 22.2                 | 37.0   |  |
| 625                               | ... | 3.4                       | 4.6  | 6.9  | 10.3     | 17.2                 | 28.7   |  |
| 650                               | ... | 2.8                       | 3.8  | 5.7  | 8.5      | 14.2                 | 23.6   |  |

## NOTES:

- (1) Use annealed material only.
- (2) The chemical composition, mechanical properties, heat treating requirements, and grain size requirements shall conform to the applicable ASTM specification. The manufacturing procedures, tolerances, tests, certification, and markings shall be in accordance with ASTM B 564.

**Table 2-3.4 Pressure–Temperature Ratings for Group 3.4 Materials**

| Nominal Designation               |      | Forgings                  |      |      | Castings |       | Plates               |  |
|-----------------------------------|------|---------------------------|------|------|----------|-------|----------------------|--|
| 67Ni–30Cu                         |      | B 564 Gr. N04400 (1)      |      |      |          |       | B 127 Gr. N04400 (1) |  |
| 67Ni–30Cu–S                       |      | B 164 Gr. N04405 (1), (2) |      |      |          |       |                      |  |
| Working Pressures by Classes, bar |      |                           |      |      |          |       |                      |  |
| Class<br>Temp., °C                | 150  | 300                       | 400  | 600  | 900      | 1500  | 2500                 |  |
| –29 to 38                         | 15.9 | 41.4                      | 55.2 | 82.7 | 124.1    | 206.8 | 344.7                |  |
| 50                                | 15.4 | 40.2                      | 53.7 | 80.5 | 120.7    | 201.2 | 335.3                |  |
| 100                               | 13.8 | 35.9                      | 47.9 | 71.9 | 107.8    | 179.7 | 299.5                |  |
| 150                               | 12.9 | 33.7                      | 45.0 | 67.5 | 101.2    | 168.7 | 281.1                |  |
| 200                               | 12.5 | 32.7                      | 43.6 | 65.4 | 98.1     | 163.5 | 272.4                |  |
| 250                               | 12.1 | 32.6                      | 43.5 | 65.2 | 97.8     | 163.0 | 271.7                |  |
| 300                               | 10.2 | 32.6                      | 43.5 | 65.2 | 97.8     | 163.0 | 271.7                |  |
| 325                               | 9.3  | 32.6                      | 43.5 | 65.2 | 97.8     | 163.0 | 271.7                |  |
| 350                               | 8.4  | 32.6                      | 43.4 | 65.1 | 97.7     | 162.8 | 271.3                |  |
| 375                               | 7.4  | 32.4                      | 43.2 | 64.8 | 97.2     | 161.9 | 269.9                |  |
| 400                               | 6.5  | 32.1                      | 42.8 | 64.2 | 96.2     | 160.4 | 267.4                |  |
| 425                               | 5.5  | 31.6                      | 42.2 | 63.3 | 94.9     | 158.2 | 263.6                |  |
| 450                               | 4.6  | 26.9                      | 35.9 | 53.8 | 80.7     | 134.5 | 224.2                |  |
| 475                               | 3.7  | 20.8                      | 27.7 | 41.5 | 62.3     | 103.8 | 173.0                |  |

## NOTES:

- (1) Use annealed material only.
- (2) The chemical composition, mechanical properties, heat treating requirements, and grain size requirements shall conform to the applicable ASTM specification. The manufacturing procedures, tolerances, tests, certification, and markings shall be in accordance with ASTM B 564.

**Table 2-3.5 Pressure–Temperature Ratings for Group 3.5 Materials**

| Nominal Designation               | Forgings             |      |      | Castings             |       | Plates |       |
|-----------------------------------|----------------------|------|------|----------------------|-------|--------|-------|
| 72Ni–15Cr–8Fe                     | B 564 Gr. N06600 (1) |      |      | B 168 Gr. N06600 (1) |       |        |       |
| Working Pressures by Classes, bar |                      |      |      |                      |       |        |       |
| Class<br>Temp., °C                | 150                  | 300  | 400  | 600                  | 900   | 1500   | 2500  |
| –29 to 38                         | 20.0                 | 51.7 | 68.9 | 103.4                | 155.1 | 258.6  | 430.9 |
| 50                                | 19.5                 | 51.7 | 68.9 | 103.4                | 155.1 | 258.6  | 430.9 |
| 100                               | 17.7                 | 51.5 | 68.7 | 103.0                | 154.6 | 257.6  | 429.4 |
| 150                               | 15.8                 | 50.3 | 66.8 | 100.3                | 150.6 | 250.8  | 418.2 |
| 200                               | 13.8                 | 48.6 | 64.8 | 97.2                 | 145.8 | 243.4  | 405.4 |
| 250                               | 12.1                 | 46.3 | 61.7 | 92.7                 | 139.0 | 231.8  | 386.2 |
| 300                               | 10.2                 | 42.9 | 57.0 | 85.7                 | 128.6 | 214.4  | 357.1 |
| 325                               | 9.3                  | 41.4 | 55.0 | 82.6                 | 124.0 | 206.6  | 344.3 |
| 350                               | 8.4                  | 40.3 | 53.6 | 80.4                 | 120.7 | 201.1  | 335.3 |
| 375                               | 7.4                  | 38.9 | 51.6 | 77.6                 | 116.5 | 194.1  | 323.2 |
| 400                               | 6.5                  | 36.5 | 48.9 | 73.3                 | 109.8 | 183.1  | 304.9 |
| 425                               | 5.5                  | 35.2 | 46.5 | 70.0                 | 105.1 | 175.1  | 291.6 |
| 450                               | 4.6                  | 33.7 | 45.1 | 67.7                 | 101.4 | 169.0  | 281.8 |
| 475                               | 3.7                  | 31.7 | 42.3 | 63.4                 | 95.1  | 158.2  | 263.9 |
| 500                               | 2.8                  | 28.2 | 37.6 | 56.5                 | 84.7  | 140.9  | 235.0 |
| 538                               | 1.4                  | 16.5 | 22.1 | 33.1                 | 49.6  | 82.7   | 137.9 |
| 550                               | ...                  | 13.9 | 18.6 | 27.9                 | 41.8  | 69.7   | 116.2 |
| 575                               | ...                  | 9.4  | 12.6 | 18.9                 | 28.3  | 47.2   | 78.6  |
| 600                               | ...                  | 6.6  | 8.9  | 13.3                 | 19.9  | 33.2   | 55.3  |
| 625                               | ...                  | 5.1  | 6.8  | 10.3                 | 15.4  | 25.7   | 42.8  |
| 650                               | ...                  | 4.7  | 6.3  | 9.5                  | 14.2  | 23.6   | 39.4  |

NOTE:

(1) Use annealed material only.

**Table 2-3.6 Pressure–Temperature Ratings for Group 3.6 Materials**

| Nominal Designation               | Forgings             |      |      | Castings |                      | Plates |       |
|-----------------------------------|----------------------|------|------|----------|----------------------|--------|-------|
| 33Ni–42Fe–21Cr                    | B 564 Gr. N08800 (1) |      |      |          | B 409 Gr. N08800 (1) |        |       |
| Working Pressures by Classes, bar |                      |      |      |          |                      |        |       |
| Class<br>Temp., °C                | 150                  | 300  | 400  | 600      | 900                  | 1500   | 2500  |
| –29 to 38                         | 19.0                 | 49.6 | 66.2 | 99.3     | 148.9                | 248.2  | 413.7 |
| 50                                | 18.7                 | 48.8 | 65.1 | 97.6     | 146.4                | 244.0  | 406.7 |
| 100                               | 17.5                 | 45.6 | 60.8 | 91.2     | 136.9                | 228.1  | 380.1 |
| 150                               | 15.8                 | 44.0 | 58.7 | 88.0     | 132.0                | 219.9  | 366.6 |
| 200                               | 13.8                 | 42.8 | 57.1 | 85.6     | 128.4                | 214.0  | 356.7 |
| 250                               | 12.1                 | 41.7 | 55.7 | 83.5     | 125.2                | 208.7  | 347.9 |
| 300                               | 10.2                 | 40.8 | 54.4 | 81.6     | 122.5                | 204.1  | 340.2 |
| 325                               | 9.3                  | 40.3 | 53.8 | 80.6     | 120.9                | 201.6  | 336.0 |
| 350                               | 8.4                  | 39.8 | 53.0 | 79.5     | 119.3                | 198.8  | 331.3 |
| 375                               | 7.4                  | 38.9 | 51.6 | 77.6     | 116.5                | 194.1  | 323.2 |
| 400                               | 6.5                  | 36.5 | 48.9 | 73.3     | 109.8                | 183.1  | 304.9 |
| 425                               | 5.5                  | 35.2 | 46.5 | 70.0     | 105.1                | 175.1  | 291.6 |
| 450                               | 4.6                  | 33.7 | 45.1 | 67.7     | 101.4                | 169.0  | 281.8 |
| 475                               | 3.7                  | 31.7 | 42.3 | 63.4     | 95.1                 | 158.2  | 263.9 |
| 500                               | 2.8                  | 28.2 | 37.6 | 56.5     | 84.7                 | 140.9  | 235.0 |
| 538                               | 1.4                  | 25.2 | 33.4 | 50.0     | 75.2                 | 125.5  | 208.9 |
| 550                               | ...                  | 25.0 | 33.3 | 49.8     | 74.8                 | 124.9  | 208.0 |
| 575                               | ...                  | 24.0 | 31.9 | 47.9     | 71.8                 | 119.7  | 199.5 |
| 600                               | ...                  | 21.6 | 28.6 | 42.9     | 64.2                 | 107.0  | 178.5 |
| 625                               | ...                  | 18.3 | 24.3 | 36.6     | 54.9                 | 91.2   | 152.0 |
| 650                               | ...                  | 14.1 | 18.9 | 28.1     | 42.5                 | 70.7   | 117.7 |
| 675                               | ...                  | 10.3 | 13.7 | 20.5     | 30.8                 | 51.3   | 85.6  |
| 700                               | ...                  | 5.6  | 7.4  | 11.1     | 16.7                 | 27.8   | 46.3  |
| 725                               | ...                  | 4.0  | 5.4  | 8.1      | 12.1                 | 20.1   | 33.6  |
| 750                               | ...                  | 3.0  | 4.0  | 6.1      | 9.1                  | 15.1   | 25.2  |
| 775                               | ...                  | 2.5  | 3.3  | 4.9      | 7.4                  | 12.4   | 20.6  |
| 800                               | ...                  | 2.2  | 2.9  | 4.3      | 6.5                  | 10.8   | 18.0  |
| 816                               | ...                  | 1.9  | 2.5  | 3.8      | 5.7                  | 9.5    | 15.8  |

NOTE:

(1) Use annealed material only.

**Table 2-3.7 Pressure–Temperature Ratings for Group 3.7 Materials**

| Nominal Designation               |      |      | Forgings             |       | Castings |       | Plates               |  |
|-----------------------------------|------|------|----------------------|-------|----------|-------|----------------------|--|
| 65Ni–28Mo–2Fe                     |      |      | B 462 Gr. N10665 (1) |       |          |       | B 333 Gr. N10665 (1) |  |
| 64Ni–29.5Mo–2Cr–2Fe–Mn–W          |      |      | B 462 Gr. N10675 (1) |       |          |       | B 333 Gr. N10675 (1) |  |
| Working Pressures by Classes, bar |      |      |                      |       |          |       |                      |  |
| Class                             |      |      |                      |       |          |       |                      |  |
| Temp., °C                         | 150  | 300  | 400                  | 600   | 900      | 1500  | 2500                 |  |
| –29 to 38                         | 20.0 | 51.7 | 68.9                 | 103.4 | 155.1    | 258.6 | 430.9                |  |
| 50                                | 19.5 | 51.7 | 68.9                 | 103.4 | 155.1    | 258.6 | 430.9                |  |
| 100                               | 17.7 | 51.5 | 68.7                 | 103.0 | 154.6    | 257.6 | 429.4                |  |
| 150                               | 15.8 | 50.3 | 66.8                 | 100.3 | 150.6    | 250.8 | 418.2                |  |
| 200                               | 13.8 | 48.6 | 64.8                 | 97.2  | 145.8    | 243.4 | 405.4                |  |
| 250                               | 12.1 | 46.3 | 61.7                 | 92.7  | 139.0    | 231.8 | 386.2                |  |
| 300                               | 10.2 | 42.9 | 57.0                 | 85.7  | 128.6    | 214.4 | 357.1                |  |
| 325                               | 9.3  | 41.4 | 55.0                 | 82.6  | 124.0    | 206.6 | 344.3                |  |
| 350                               | 8.4  | 40.3 | 53.6                 | 80.4  | 120.7    | 201.1 | 335.3                |  |
| 375                               | 7.4  | 38.9 | 51.6                 | 77.6  | 116.5    | 194.1 | 323.2                |  |
| 400                               | 6.5  | 36.5 | 48.9                 | 73.3  | 109.8    | 183.1 | 304.9                |  |
| 425                               | 5.5  | 35.2 | 46.5                 | 70.0  | 105.1    | 175.1 | 291.6                |  |

NOTE:

(1) Use solution annealed material only.



**Table 2-3.8 Pressure–Temperature Ratings for Group 3.8 Materials**

| Nominal Designation               | Forgings                       |      |      | Castings |                                | Plates |       |
|-----------------------------------|--------------------------------|------|------|----------|--------------------------------|--------|-------|
| 54Ni–16Mo–15Cr                    | B 462 Gr. N10276 (1), (2)      |      |      |          | B 575 Gr. N10276 (1), (2)      |        |       |
| 60Ni–22Cr–9Mo–3.5Cb               | B 564 Gr. N06625 (3), (4)      |      |      |          | B 443 Gr. N06625 (3), (4)      |        |       |
| 62Ni–28Mo–5Fe                     | B 335 Gr. N10001 (1), (2), (5) |      |      |          | B 333 Gr. N10001 (1), (5)      |        |       |
| 70Ni–16Mo–7Cr–5Fe                 | B 573 Gr. N10003 (6), (3)      |      |      |          | 8 434 Gr. N10003 (3)           |        |       |
| 61Ni–16Mo–16Cr                    | B 574 Gr. N06455 (1), (6), (5) |      |      |          | B 575 Gr. N06455 (1), (5)      |        |       |
| 42Ni–21.5Cr–3Mo–2.3Cu             | B 564 Gr. N08825 (3), (7)      |      |      |          | B 424 Gr. N08825 (3), (7)      |        |       |
| 55Ni–21Cr–13.5Mo                  | B 462 Gr. N06022 (1), (2), (8) |      |      |          | B 575 Gr. N06022 (1), (2), (8) |        |       |
| 55Ni–23Cr–16Mo–1.6Cu              | B 462 Gr. N06200 (1), (5)      |      |      |          | B 575 Gr. N06200 (1), (5)      |        |       |
| Working Pressures by Classes, bar |                                |      |      |          |                                |        |       |
| Class<br>Temp., °C                | 150                            | 300  | 400  | 600      | 900                            | 1500   | 2500  |
| –29 to 38                         | 20.0                           | 51.7 | 68.9 | 103.4    | 155.1                          | 258.6  | 430.9 |
| 50                                | 19.5                           | 51.7 | 68.9 | 103.4    | 155.1                          | 258.6  | 430.9 |
| 100                               | 17.7                           | 51.5 | 68.7 | 103.0    | 154.6                          | 257.6  | 429.4 |
| 150                               | 15.8                           | 50.3 | 66.8 | 100.3    | 150.6                          | 250.8  | 418.2 |
| 200                               | 13.8                           | 48.3 | 64.5 | 96.7     | 145.0                          | 241.7  | 402.8 |
| 250                               | 12.1                           | 46.3 | 61.7 | 92.7     | 139.0                          | 231.8  | 386.2 |
| 300                               | 10.2                           | 42.9 | 57.0 | 85.7     | 128.6                          | 214.4  | 357.1 |
| 325                               | 9.3                            | 41.4 | 55.0 | 82.6     | 124.0                          | 206.6  | 344.3 |
| 350                               | 8.4                            | 40.3 | 53.6 | 80.4     | 120.7                          | 201.1  | 335.3 |
| 375                               | 7.4                            | 38.9 | 51.6 | 77.6     | 116.5                          | 194.1  | 323.2 |
| 400                               | 6.5                            | 36.5 | 48.9 | 73.3     | 109.8                          | 183.1  | 304.9 |
| 425                               | 5.5                            | 35.2 | 46.5 | 70.0     | 105.1                          | 175.1  | 291.6 |
| 450                               | 4.6                            | 33.7 | 45.1 | 67.7     | 101.4                          | 169.0  | 281.8 |
| 475                               | 3.7                            | 31.7 | 42.3 | 63.4     | 95.1                           | 158.2  | 263.9 |
| 500                               | 2.8                            | 28.2 | 37.6 | 56.5     | 84.7                           | 140.9  | 235.0 |
| 538                               | 1.4                            | 25.2 | 33.4 | 50.0     | 75.2                           | 125.5  | 208.9 |
| 550                               | ...                            | 25.0 | 33.3 | 49.8     | 74.8                           | 124.9  | 208.0 |
| 575                               | ...                            | 24.0 | 31.9 | 47.9     | 71.8                           | 119.7  | 199.5 |
| 600                               | ...                            | 21.6 | 28.6 | 42.9     | 64.2                           | 107.0  | 178.5 |
| 625                               | ...                            | 18.3 | 24.3 | 36.6     | 54.9                           | 91.2   | 152.0 |
| 650                               | ...                            | 14.1 | 18.8 | 28.1     | 42.2                           | 70.4   | 117.3 |
| 675                               | ...                            | 11.5 | 15.4 | 23.0     | 34.6                           | 57.6   | 96.0  |
| 700                               | ...                            | 8.8  | 11.7 | 17.5     | 26.3                           | 43.8   | 73.0  |

## NOTES:

- (1) Use solution annealed material only.
- (2) Not to be used over 675°C.
- (3) Use annealed material only.
- (4) Not to be used over 645°C. Alloy N06625 in the annealed condition is subject to severe loss of impact strength at room temperatures after exposure in the range of 538°C to 760°C.
- (5) Not to be used over 425°C.
- (6) The chemical composition, mechanical properties, heat treating requirements, and grain size requirements shall conform to the applicable ASTM specification. The manufacturing procedures, tolerances, tests, certification, and markings shall be in accordance with ASTM B 564.
- (7) Not to be used over 538°C.
- (8) Alloy N06022 in the solution annealed condition is subject to severe loss of impact strength at room temperature after exposure to temperatures in the range of 538°C to 675°C.

**Table 2-3.9 Pressure–Temperature Ratings for Group 3.9 Materials**

| Nominal Designation               | Forgings                  |      |      | Castings |                      | Plates |       |
|-----------------------------------|---------------------------|------|------|----------|----------------------|--------|-------|
| 47Ni–22Cr–9Mo–18Fe                | B 572 Gr. N06002 (1), (2) |      |      |          | B 435 Gr. N06002 (1) |        |       |
| Working Pressures by Classes, bar |                           |      |      |          |                      |        |       |
| Class<br>Temp., °C                | 150                       | 300  | 400  | 600      | 900                  | 1500   | 2500  |
| –29 to 38                         | 20.0                      | 51.7 | 68.9 | 103.4    | 155.1                | 258.6  | 430.9 |
| 50                                | 19.5                      | 51.7 | 68.9 | 103.4    | 155.1                | 258.6  | 430.9 |
| 100                               | 17.7                      | 51.5 | 68.7 | 103.0    | 154.6                | 257.6  | 429.4 |
| 150                               | 15.8                      | 47.6 | 63.4 | 95.2     | 142.8                | 237.9  | 396.5 |
| 200                               | 13.8                      | 44.3 | 59.1 | 88.6     | 132.9                | 221.5  | 369.2 |
| 250                               | 12.1                      | 41.6 | 55.4 | 83.1     | 124.7                | 207.9  | 346.4 |
| 300                               | 10.2                      | 39.5 | 52.7 | 79.0     | 118.5                | 197.4  | 329.1 |
| 325                               | 9.3                       | 38.6 | 51.5 | 77.2     | 115.8                | 193.0  | 321.7 |
| 350                               | 8.4                       | 37.9 | 50.5 | 75.8     | 113.7                | 189.5  | 315.8 |
| 375                               | 7.4                       | 37.3 | 49.8 | 74.7     | 112.0                | 186.6  | 311.1 |
| 400                               | 6.5                       | 36.5 | 48.9 | 73.3     | 109.8                | 183.1  | 304.9 |
| 425                               | 5.5                       | 35.2 | 46.5 | 70.0     | 105.1                | 175.1  | 291.6 |
| 450                               | 4.6                       | 33.7 | 45.1 | 67.7     | 101.4                | 169.0  | 281.8 |
| 475                               | 3.7                       | 31.7 | 42.3 | 63.4     | 95.1                 | 158.2  | 263.9 |
| 500                               | 2.8                       | 28.2 | 37.6 | 56.5     | 84.7                 | 140.9  | 235.0 |
| 538                               | 1.4                       | 25.2 | 33.4 | 50.0     | 75.2                 | 125.5  | 208.9 |
| 550                               | ...                       | 25.0 | 33.3 | 49.8     | 74.8                 | 124.9  | 208.0 |
| 575                               | ...                       | 24.0 | 31.9 | 47.9     | 71.8                 | 119.7  | 199.5 |
| 600                               | ...                       | 21.6 | 28.6 | 42.9     | 64.2                 | 107.0  | 178.5 |
| 625                               | ...                       | 18.3 | 24.3 | 36.6     | 54.9                 | 91.2   | 152.0 |
| 650                               | ...                       | 14.1 | 18.9 | 28.1     | 42.5                 | 70.7   | 117.7 |
| 675                               | ...                       | 12.4 | 16.9 | 25.2     | 37.6                 | 62.7   | 104.5 |
| 700                               | ...                       | 10.1 | 13.4 | 20.0     | 29.8                 | 49.7   | 83.0  |
| 725                               | ...                       | 7.9  | 10.5 | 15.4     | 23.2                 | 38.6   | 64.4  |
| 750                               | ...                       | 5.9  | 7.9  | 11.7     | 17.6                 | 29.6   | 49.1  |
| 775                               | ...                       | 4.6  | 6.2  | 9.0      | 13.7                 | 22.8   | 38.0  |
| 800                               | ...                       | 3.5  | 4.8  | 7.0      | 10.5                 | 17.4   | 29.2  |
| 816                               | ...                       | 2.8  | 3.8  | 5.9      | 8.6                  | 14.1   | 23.8  |

## NOTES:

- (1) Use solution annealed material only.
- (2) The chemical composition, mechanical properties, heat treating requirements, and grain size requirements shall conform to the applicable ASTM specification. The manufacturing procedures, tolerances, tests, certification, and markings shall be in accordance with ASTM B 564.

**Table 2-3.10 Pressure–Temperature Ratings for Group 3.10 Materials**

| Nominal Designation               | Forgings                  |      |      | Castings |                      | Plates |       |
|-----------------------------------|---------------------------|------|------|----------|----------------------|--------|-------|
| 25Ni–46Fe–21Cr–5Mo                | B 672 Gr. N08700 (1), (2) |      |      |          | B 599 Gr. N08700 (1) |        |       |
| Working Pressures by Classes, bar |                           |      |      |          |                      |        |       |
| Class<br>Temp., °C                | 150                       | 300  | 400  | 600      | 900                  | 1500   | 2500  |
| –29 to 38                         | 20.0                      | 51.7 | 68.9 | 103.4    | 155.1                | 258.6  | 430.9 |
| 50                                | 19.5                      | 51.7 | 68.9 | 103.4    | 155.1                | 258.6  | 430.9 |
| 100                               | 17.7                      | 51.5 | 68.7 | 103.0    | 154.6                | 257.6  | 429.4 |
| 150                               | 15.8                      | 47.1 | 62.8 | 94.2     | 141.3                | 235.5  | 392.5 |
| 200                               | 13.8                      | 44.3 | 59.0 | 88.5     | 132.8                | 221.3  | 368.9 |
| 250                               | 12.1                      | 42.8 | 57.1 | 85.6     | 128.4                | 214.0  | 356.6 |
| 300                               | 10.2                      | 41.3 | 55.1 | 82.7     | 124.0                | 206.7  | 344.5 |
| 325                               | 9.3                       | 40.4 | 53.8 | 80.7     | 121.1                | 201.8  | 336.4 |
| 350                               | 8.4                       | 38.9 | 51.9 | 77.8     | 116.7                | 194.5  | 324.2 |

## NOTES:

- (1) Use solution annealed material only.
- (2) The chemical composition, mechanical properties, heat treating requirements, and grain size requirements shall conform to the applicable ASTM specification. The manufacturing procedures, tolerances, tests, certification, and markings shall be in accordance with ASTM B 564.

**Table 2-3.11 Pressure–Temperature Ratings for Group 3.11 Materials**

| Nominal Designation               | Forgings                  |      |      | Castings |                      | Plates |       |
|-----------------------------------|---------------------------|------|------|----------|----------------------|--------|-------|
| 44Fe–25Ni–21Cr–Mo                 | B 649 Gr. N08904 (1), (2) |      |      |          | B 625 Gr. N08904 (1) |        |       |
| Working Pressures by Classes, bar |                           |      |      |          |                      |        |       |
| Class<br>Temp., °C                | 150                       | 300  | 400  | 600      | 900                  | 1500   | 2500  |
| –29 to 38                         | 19.7                      | 51.3 | 68.4 | 102.6    | 153.9                | 256.5  | 427.5 |
| 50                                | 18.8                      | 49.1 | 65.5 | 98.3     | 147.4                | 245.7  | 409.6 |
| 100                               | 15.7                      | 41.1 | 54.7 | 82.1     | 123.2                | 205.3  | 342.1 |
| 150                               | 14.4                      | 37.5 | 50.0 | 75.0     | 112.5                | 187.5  | 312.5 |
| 200                               | 13.3                      | 34.7 | 46.2 | 69.3     | 104.0                | 173.4  | 288.9 |
| 250                               | 12.1                      | 32.0 | 42.6 | 64.0     | 95.9                 | 159.9  | 266.5 |
| 300                               | 10.2                      | 30.0 | 40.0 | 60.0     | 90.0                 | 150.1  | 250.1 |
| 325                               | 9.3                       | 29.2 | 39.0 | 58.5     | 87.7                 | 146.1  | 243.6 |
| 350                               | 8.4                       | 28.7 | 38.2 | 57.3     | 86.0                 | 143.4  | 238.9 |
| 375                               | 7.4                       | 28.2 | 37.7 | 56.5     | 84.7                 | 141.2  | 235.4 |

## NOTES:

- (1) Use annealed material only.
- (2) The chemical composition, mechanical properties, heat treating requirements, and grain size requirements shall conform to the applicable ASTM specification. The manufacturing procedures, tolerances, tests, certification, and markings shall be in accordance with ASTM B 564.

**Table 2-3.12 Pressure–Temperature Ratings for Group 3.12 Materials**

| Nominal Designation               |      | Forgings                  |      | Castings            |       | Plates               |       |
|-----------------------------------|------|---------------------------|------|---------------------|-------|----------------------|-------|
| 26Ni–43Fe–22Cr–5Mo                |      | B 621 Gr. N08320 (1), (2) |      |                     |       | B 620 Gr. N08320 (1) |       |
| 47Ni–22Cr–20Fe–7Mo                |      | B 581 Gr. N06985 (1), (2) |      |                     |       | B 582 Gr. N06985 (1) |       |
| 46Fe–24Ni–21Cr–6Mo–Cu–N           |      | B 462 Gr. N08367 (1)      |      | A 351 Gr. CN3MN (1) |       | B 688 Gr. N08367 (1) |       |
| Working Pressures by Classes, bar |      |                           |      |                     |       |                      |       |
| Class<br>Temp., °C                | 150  | 300                       | 400  | 600                 | 900   | 1500                 | 2500  |
| –29 to 38                         | 17.8 | 46.3                      | 61.8 | 92.7                | 139.0 | 231.7                | 386.1 |
| 50                                | 17.5 | 45.6                      | 60.8 | 91.1                | 136.7 | 227.8                | 379.7 |
| 100                               | 16.3 | 42.5                      | 56.7 | 85.1                | 127.6 | 212.7                | 354.5 |
| 150                               | 15.4 | 40.1                      | 53.5 | 80.3                | 120.4 | 200.7                | 334.6 |
| 200                               | 13.8 | 37.3                      | 49.8 | 74.6                | 112.0 | 186.6                | 311.0 |
| 250                               | 12.1 | 34.9                      | 46.5 | 69.8                | 104.7 | 174.5                | 290.8 |
| 300                               | 10.2 | 33.1                      | 44.1 | 66.2                | 99.3  | 165.5                | 275.9 |
| 325                               | 9.3  | 32.3                      | 43.1 | 64.6                | 97.0  | 161.6                | 269.3 |
| 350                               | 8.4  | 31.6                      | 42.1 | 63.2                | 94.8  | 158.1                | 263.4 |
| 375                               | 7.4  | 31.0                      | 41.4 | 62.0                | 93.0  | 155.1                | 258.5 |
| 400                               | 6.5  | 30.4                      | 40.6 | 60.8                | 91.3  | 152.1                | 253.5 |
| 425                               | 5.5  | 29.8                      | 39.8 | 59.7                | 89.5  | 149.1                | 248.5 |

## NOTES:

- (1) Use solution annealed material only.
- (2) The chemical composition, mechanical properties, heat treating requirements, and grain size requirements shall conform to the applicable ASTM specification. The manufacturing procedures, tolerances, tests, certification, and markings shall be in accordance with ASTM B 564.

**Table 2-3.13 Pressure–Temperature Ratings for Group 3.13 Materials**

| Nominal Designation               | Forgings                  |      |      | Castings |                      | Plates |       |
|-----------------------------------|---------------------------|------|------|----------|----------------------|--------|-------|
| 49Ni–25Cr–18Fe–6Mo                | B 581 Gr. N06975 (1), (2) |      |      |          | B 582 Gr. N06975 (1) |        |       |
| Ni–Fe–Cr–Mo–Cu–Low C              | B 564 Gr. N08031 (3)      |      |      |          | B 625 Gr. N08031 (3) |        |       |
| Working Pressures by Classes, bar |                           |      |      |          |                      |        |       |
| Class<br>Temp., °C                | 150                       | 300  | 400  | 600      | 900                  | 1500   | 2500  |
| –29 to 38                         | 20.0                      | 51.7 | 68.9 | 103.4    | 155.1                | 258.6  | 430.9 |
| 50                                | 19.5                      | 51.7 | 68.9 | 103.4    | 155.1                | 258.6  | 430.9 |
| 100                               | 17.7                      | 48.2 | 64.2 | 96.3     | 144.5                | 240.8  | 401.4 |
| 150                               | 15.8                      | 45.8 | 61.0 | 91.6     | 137.4                | 228.9  | 381.6 |
| 200                               | 13.8                      | 43.6 | 58.1 | 87.1     | 130.7                | 217.8  | 362.9 |
| 250                               | 12.1                      | 41.5 | 55.3 | 82.9     | 124.4                | 207.3  | 345.5 |
| 300                               | 10.2                      | 39.4 | 52.5 | 78.7     | 118.1                | 196.8  | 328.1 |
| 325                               | 9.3                       | 38.4 | 51.3 | 76.9     | 115.3                | 192.2  | 320.3 |
| 350                               | 8.4                       | 37.7 | 50.3 | 75.5     | 113.2                | 188.7  | 314.5 |
| 375                               | 7.4                       | 37.2 | 49.5 | 74.3     | 111.5                | 185.8  | 309.7 |
| 400                               | 6.5                       | 36.5 | 48.9 | 73.3     | 109.8                | 183.1  | 304.9 |
| 425                               | 5.5                       | 35.2 | 46.5 | 70.0     | 105.1                | 175.1  | 291.6 |

## NOTES:

- (1) Use solution annealed material only.
- (2) The chemical composition, mechanical properties, heat treating requirements, and grain size requirements shall conform to the applicable ASTM specification. The manufacturing procedures, tolerances, tests, certification, and markings shall be in accordance with ASTM B 564.
- (3) Use annealed material only.

**Table 2-3.14 Pressure–Temperature Ratings for Group 3.14 Materials**

| Nominal Designation               | Forgings                  |      |      | Castings |                           | Plates |       |
|-----------------------------------|---------------------------|------|------|----------|---------------------------|--------|-------|
| 47Ni–22Cr–19Fe–6Mo                | B 581 Gr. N06007 (1), (2) |      |      |          | B 582 Gr. N06007 (1)      |        |       |
| 40Ni–29Cr–15Fe–5Mo                | B 462 Gr. N06030 (1), (3) |      |      |          | B 582 Gr. N06030 (1), (3) |        |       |
| Working Pressures by Classes, bar |                           |      |      |          |                           |        |       |
| Class<br>Temp., °C                | 150                       | 300  | 400  | 600      | 900                       | 1500   | 2500  |
| –29 to 38                         | 19.0                      | 49.6 | 66.2 | 99.3     | 148.9                     | 248.2  | 413.7 |
| 50                                | 18.6                      | 48.6 | 64.7 | 97.1     | 145.7                     | 242.8  | 404.6 |
| 100                               | 17.0                      | 44.3 | 59.0 | 88.6     | 132.8                     | 221.4  | 369.0 |
| 150                               | 15.8                      | 41.3 | 55.1 | 82.6     | 124.0                     | 206.6  | 344.3 |
| 200                               | 13.8                      | 39.1 | 52.1 | 78.2     | 117.3                     | 195.4  | 325.7 |
| 250                               | 12.1                      | 37.4 | 49.9 | 74.8     | 112.2                     | 187.0  | 311.6 |
| 300                               | 10.2                      | 36.1 | 48.2 | 72.2     | 108.3                     | 180.6  | 300.9 |
| 325                               | 9.3                       | 35.6 | 47.4 | 71.1     | 106.7                     | 177.9  | 296.4 |
| 350                               | 8.4                       | 35.2 | 46.9 | 70.3     | 105.5                     | 175.8  | 293.1 |
| 375                               | 7.4                       | 34.9 | 46.5 | 69.7     | 104.6                     | 174.3  | 290.6 |
| 400                               | 6.5                       | 34.6 | 46.1 | 69.2     | 103.7                     | 172.9  | 288.1 |
| 425                               | 5.5                       | 34.4 | 45.9 | 68.9     | 103.3                     | 172.1  | 286.9 |
| 450                               | 4.6                       | 33.7 | 45.1 | 67.7     | 101.4                     | 169.0  | 281.8 |
| 475                               | 3.7                       | 31.7 | 42.3 | 63.4     | 95.1                      | 158.2  | 263.9 |
| 500                               | 2.8                       | 28.2 | 37.6 | 56.5     | 84.7                      | 140.9  | 235.0 |
| 538                               | 1.4                       | 25.2 | 33.4 | 50.0     | 75.2                      | 125.5  | 208.9 |

## NOTES:

- (1) Use solution annealed material only.
- (2) The chemical composition, mechanical properties, heat treating requirements, and grain size requirements shall conform to the applicable ASTM specification. The manufacturing procedures, tolerances, tests, certification, and markings shall be in accordance with ASTM B 564.
- (3) Not to be used over 425°C.

**Table 2-3.15 Pressure–Temperature Ratings for Group 3.15 Materials**

| Nominal Designation               |      | Forgings             |      | Castings |       | Plates               |       |
|-----------------------------------|------|----------------------|------|----------|-------|----------------------|-------|
| 33Ni–42Fe–21Cr                    |      | B 564 Gr. N08810 (1) |      |          |       | B 409 Gr. N08810 (1) |       |
| Working Pressures by Classes, bar |      |                      |      |          |       |                      |       |
| Class<br>Temp., °C                | 150  | 300                  | 400  | 600      | 900   | 1500                 | 2500  |
| –29 to 38                         | 15.9 | 41.4                 | 55.2 | 82.7     | 124.1 | 206.8                | 344.7 |
| 50                                | 15.6 | 40.6                 | 54.2 | 81.3     | 121.9 | 203.2                | 338.7 |
| 100                               | 14.5 | 37.8                 | 50.4 | 75.6     | 113.4 | 189.0                | 315.0 |
| 150                               | 13.7 | 35.9                 | 47.8 | 71.7     | 107.6 | 179.3                | 298.9 |
| 200                               | 13.0 | 33.9                 | 45.2 | 67.9     | 101.8 | 169.6                | 282.7 |
| 250                               | 12.1 | 32.3                 | 43.0 | 64.5     | 96.8  | 161.3                | 268.9 |
| 300                               | 10.2 | 30.7                 | 41.0 | 61.5     | 92.2  | 153.7                | 256.2 |
| 325                               | 9.3  | 30.1                 | 40.1 | 60.1     | 90.2  | 150.3                | 250.5 |
| 350                               | 8.4  | 29.4                 | 39.2 | 58.8     | 88.3  | 147.1                | 245.2 |
| 375                               | 7.4  | 28.7                 | 38.3 | 57.4     | 86.2  | 143.6                | 239.4 |
| 400                               | 6.5  | 28.3                 | 37.7 | 56.5     | 84.8  | 141.3                | 235.6 |
| 425                               | 5.5  | 27.7                 | 36.9 | 55.3     | 83.0  | 138.4                | 230.6 |
| 450                               | 4.6  | 27.2                 | 36.3 | 54.4     | 81.7  | 136.1                | 226.8 |
| 475                               | 3.7  | 26.8                 | 35.7 | 53.5     | 80.3  | 133.9                | 223.1 |
| 500                               | 2.8  | 26.3                 | 35.1 | 52.6     | 79.0  | 131.6                | 219.4 |
| 538                               | 1.4  | 25.2                 | 33.4 | 50.0     | 75.2  | 125.5                | 208.9 |
| 550                               | ...  | 25.0                 | 33.3 | 49.8     | 74.8  | 124.9                | 208.0 |
| 575                               | ...  | 24.0                 | 31.9 | 47.9     | 71.8  | 119.7                | 199.5 |
| 600                               | ...  | 21.6                 | 28.6 | 42.9     | 64.2  | 107.0                | 178.5 |
| 625                               | ...  | 18.3                 | 24.3 | 36.6     | 54.9  | 91.2                 | 152.0 |
| 650                               | ...  | 14.1                 | 18.9 | 28.1     | 42.5  | 70.7                 | 117.7 |
| 675                               | ...  | 12.4                 | 16.9 | 25.2     | 37.6  | 62.7                 | 104.5 |
| 700                               | ...  | 10.1                 | 13.4 | 20.0     | 29.8  | 49.7                 | 83.0  |
| 725                               | ...  | 7.9                  | 10.5 | 15.4     | 23.2  | 38.6                 | 64.4  |
| 750                               | ...  | 5.9                  | 7.9  | 11.7     | 17.6  | 29.6                 | 49.1  |
| 775                               | ...  | 4.6                  | 6.2  | 9.0      | 13.7  | 22.8                 | 38.0  |
| 800                               | ...  | 3.5                  | 4.8  | 7.0      | 10.5  | 17.4                 | 29.2  |
| 816                               | ...  | 2.8                  | 3.8  | 5.9      | 8.6   | 14.1                 | 23.8  |

NOTE:

(1) Use solution annealed material only.

**Table 2-3.16 Pressure–Temperature Ratings for Group 3.16 Materials**

| Nominal Designation               | Forgings                  |      |      | Castings |                      | Plates |       |
|-----------------------------------|---------------------------|------|------|----------|----------------------|--------|-------|
| 35Ni–19Cr–1¼Si                    | B 511 Gr. N08330 (1), (2) |      |      |          | B 536 Gr. N08330 (1) |        |       |
| Working Pressures by Classes, bar |                           |      |      |          |                      |        |       |
| Class<br>Temp., °C                | 150                       | 300  | 400  | 600      | 900                  | 1500   | 2500  |
| –29 to 38                         | 19.0                      | 49.6 | 66.2 | 99.3     | 148.9                | 248.2  | 413.7 |
| 50                                | 18.5                      | 48.4 | 64.5 | 96.7     | 145.1                | 241.8  | 403.1 |
| 100                               | 16.7                      | 43.5 | 58.0 | 87.0     | 130.5                | 217.5  | 362.4 |
| 150                               | 15.6                      | 40.8 | 54.4 | 81.6     | 122.5                | 204.1  | 340.2 |
| 200                               | 13.8                      | 38.6 | 51.5 | 77.2     | 115.8                | 192.9  | 321.6 |
| 250                               | 12.1                      | 36.8 | 49.0 | 73.5     | 110.3                | 183.8  | 306.3 |
| 300                               | 10.2                      | 35.2 | 47.0 | 70.4     | 105.6                | 176.1  | 293.4 |
| 325                               | 9.3                       | 34.5 | 46.0 | 69.0     | 103.6                | 172.6  | 287.7 |
| 350                               | 8.4                       | 33.9 | 45.2 | 67.8     | 101.7                | 169.4  | 282.4 |
| 375                               | 7.4                       | 33.2 | 44.2 | 66.3     | 99.5                 | 165.8  | 276.4 |
| 400                               | 6.5                       | 32.6 | 43.4 | 65.1     | 97.7                 | 162.9  | 271.4 |
| 425                               | 5.5                       | 32.0 | 42.6 | 64.0     | 95.9                 | 159.9  | 266.5 |
| 450                               | 4.6                       | 31.4 | 41.8 | 62.8     | 94.1                 | 156.9  | 261.5 |
| 475                               | 3.7                       | 30.8 | 41.0 | 61.6     | 92.4                 | 153.9  | 256.5 |
| 500                               | 2.8                       | 28.2 | 37.6 | 56.5     | 84.7                 | 140.9  | 235.0 |
| 538                               | 1.4                       | 25.2 | 33.4 | 50.0     | 75.2                 | 125.5  | 208.9 |
| 550                               | ...                       | 25.0 | 33.3 | 49.8     | 74.8                 | 124.9  | 208.0 |
| 575                               | ...                       | 21.9 | 29.2 | 43.7     | 65.6                 | 109.4  | 182.3 |
| 600                               | ...                       | 17.4 | 23.2 | 34.8     | 52.3                 | 87.1   | 145.1 |
| 625                               | ...                       | 13.8 | 18.3 | 27.5     | 41.3                 | 68.8   | 114.6 |
| 650                               | ...                       | 11.0 | 14.7 | 22.1     | 33.1                 | 55.1   | 91.9  |
| 675                               | ...                       | 9.1  | 12.1 | 18.2     | 27.3                 | 45.6   | 75.9  |
| 700                               | ...                       | 7.6  | 10.1 | 15.2     | 22.8                 | 38.0   | 63.3  |
| 725                               | ...                       | 6.1  | 8.1  | 12.2     | 18.3                 | 30.5   | 50.9  |
| 750                               | ...                       | 4.8  | 6.4  | 9.5      | 14.3                 | 23.8   | 39.7  |
| 775                               | ...                       | 3.9  | 5.2  | 7.7      | 11.6                 | 19.4   | 32.3  |
| 800                               | ...                       | 3.1  | 4.2  | 6.3      | 9.4                  | 15.6   | 26.1  |
| 816                               | ...                       | 2.6  | 3.5  | 5.2      | 7.8                  | 13.0   | 21.7  |

**NOTES:**

- (1) Use solution annealed material only.
- (2) The chemical composition, mechanical properties, heat treating requirements, and grain size requirements shall conform to the applicable ASTM specification. The manufacturing procedures, tolerances, tests, certification, and markings shall be in accordance with ASTM B 564.

**Table 2-3.17 Pressure–Temperature Ratings for Group 3.17 Materials**

| Nominal Designation               |      | Forgings |      |                    | Castings |       | Plates |
|-----------------------------------|------|----------|------|--------------------|----------|-------|--------|
| 29Ni–20.5Cr–3.5Cu–2.5Mo           |      |          |      | A 351 Gr. CN7M (1) |          |       |        |
| Working Pressures by Classes, bar |      |          |      |                    |          |       |        |
| Class<br>Temp., °C                | 150  | 300      | 400  | 600                | 900      | 1500  | 2500   |
| –29 to 38                         | 15.9 | 41.4     | 55.2 | 82.7               | 124.1    | 206.8 | 344.7  |
| 50                                | 15.4 | 40.1     | 53.5 | 80.3               | 120.4    | 200.7 | 334.4  |
| 100                               | 13.5 | 35.3     | 47.1 | 70.6               | 105.9    | 176.5 | 294.2  |
| 150                               | 12.3 | 32.0     | 42.7 | 64.1               | 96.1     | 160.2 | 267.0  |
| 200                               | 11.3 | 29.4     | 39.1 | 58.7               | 88.1     | 146.8 | 244.7  |
| 250                               | 10.4 | 27.2     | 36.3 | 54.4               | 81.7     | 136.1 | 226.9  |
| 300                               | 9.7  | 25.4     | 33.8 | 50.8               | 76.1     | 126.9 | 211.5  |
| 325                               | 9.3  | 24.4     | 32.6 | 48.8               | 73.3     | 122.1 | 203.5  |

NOTE:

(1) Use solution annealed material only.

**Table 3 Permissible Imperfections in Flange Facing Finish for Raised Face and Large Male and Female Flanges**

| NPS   | Maximum Radial Projection of Imperfections<br>Which Are No Deeper Than the Bottom of<br>the Serrations, mm | Maximum Depth and Radial Projection of<br>Imperfections Which Are Deeper Than the<br>Bottom of the Serrations, mm |
|-------|------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------|
| 1/2   | 3.0                                                                                                        | 1.5                                                                                                               |
| 3/4   | 3.0                                                                                                        | 1.5                                                                                                               |
| 1     | 3.0                                                                                                        | 1.5                                                                                                               |
| 1 1/4 | 3.0                                                                                                        | 1.5                                                                                                               |
| 1 1/2 | 3.0                                                                                                        | 1.5                                                                                                               |
| 2     | 3.0                                                                                                        | 1.5                                                                                                               |
| 2 1/2 | 3.0                                                                                                        | 1.5                                                                                                               |
| 3     | 4.5                                                                                                        | 1.5                                                                                                               |
| 3 1/2 | 6.0                                                                                                        | 3.0                                                                                                               |
| 4     | 6.0                                                                                                        | 3.0                                                                                                               |
| 5     | 6.0                                                                                                        | 3.0                                                                                                               |
| 6     | 6.0                                                                                                        | 3.0                                                                                                               |
| 8     | 8.0                                                                                                        | 4.5                                                                                                               |
| 10    | 8.0                                                                                                        | 4.5                                                                                                               |
| 12    | 8.0                                                                                                        | 4.5                                                                                                               |
| 14    | 8.0                                                                                                        | 4.5                                                                                                               |
| 16    | 10.0                                                                                                       | 4.5                                                                                                               |
| 18    | 12.0                                                                                                       | 6.0                                                                                                               |
| 20    | 12.0                                                                                                       | 6.0                                                                                                               |
| 24    | 12.0                                                                                                       | 6.0                                                                                                               |

GENERAL NOTE: For permissible imperfections in inch units, refer to Annex F, Table F3.



Table 4 Dimensions of Facings (Other Than Ring Joints, All Pressure Rating Classes)

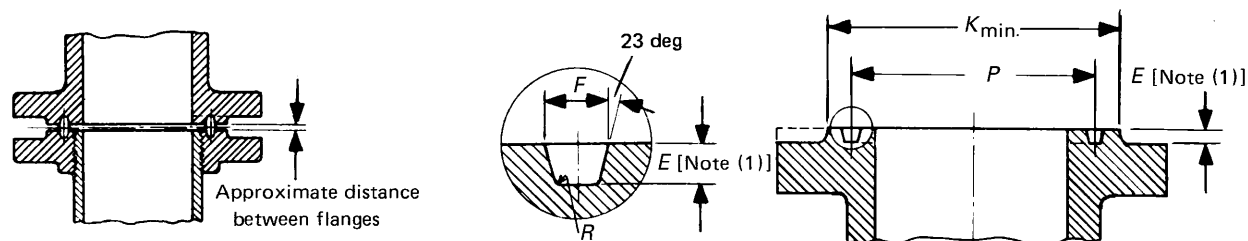
| 1                       | 2                                             | 3                                 | 4                     | 5                                                              | 6                                                         | 7                                               | 8                                               | 9                                   | 10                    | 11                                                   | 12                                    | 13                                                           | 14                                     | 15                                                        | 1     |                         |
|-------------------------|-----------------------------------------------|-----------------------------------|-----------------------|----------------------------------------------------------------|-----------------------------------------------------------|-------------------------------------------------|-------------------------------------------------|-------------------------------------|-----------------------|------------------------------------------------------|---------------------------------------|--------------------------------------------------------------|----------------------------------------|-----------------------------------------------------------|-------|-------------------------|
| Nominal<br>Size,<br>NPS | Outside Diameter                              |                                   |                       |                                                                |                                                           | Outside Diameter                                |                                                 |                                     |                       |                                                      | Height                                |                                                              |                                        | Minimum<br>Outside Diameter<br>of Raised Portion          |       | Nominal<br>Size,<br>NPS |
|                         | Large<br>Male<br>and<br>Large<br>Tongue,<br>R | Small<br>Male,<br>S<br>[Note (1)] | Small<br>Tongue,<br>T | Inside<br>Diameter<br>of Large<br>and<br>Small<br>Tongue,<br>U | Inside<br>Diameter<br>of Small<br>Tongue<br>[Note<br>(1)] | Outside Diameter                                |                                                 | Small<br>Female,<br>X<br>[Note (1)] | Small<br>Groove,<br>Y | Diameter<br>of Large<br>and<br>Small<br>Groove,<br>Z | Raised<br>Face<br>[Notes<br>(4), (5)] | Height                                                       |                                        | Depth of<br>Groove<br>or<br>Female<br>[Notes<br>(1), (7)] |       |                         |
|                         |                                               |                                   |                       |                                                                |                                                           | Large<br>Female<br>and<br>Large<br>Groove,<br>W | Large<br>Female<br>and<br>Small<br>Groove,<br>Z |                                     |                       |                                                      |                                       | Large<br>and<br>Male<br>and<br>Tongue<br>[Notes<br>(4), (6)] | Small<br>Female<br>and<br>Groove,<br>K | Large<br>Female<br>and<br>Groove,<br>L                    |       |                         |
| 1/2                     | 34.9                                          | 18.3                              | 35.1                  | 25.4                                                           | ...                                                       | 36.5                                            | 19.9                                            | 36.5                                | 23.8                  | ...                                                  | ...                                   | ...                                                          | 44                                     | 46                                                        | 1/2   |                         |
| 3/4                     | 42.9                                          | 23.8                              | 42.9                  | 33.3                                                           | ...                                                       | 44.4                                            | 25.4                                            | 44.4                                | 31.8                  | ...                                                  | ...                                   | ...                                                          | 52                                     | 54                                                        | 3/4   |                         |
| 1                       | 50.8                                          | 30.2                              | 47.8                  | 38.1                                                           | ...                                                       | 52.4                                            | 31.8                                            | 49.2                                | 36.5                  | ...                                                  | ...                                   | ...                                                          | 57                                     | 62                                                        | 1     |                         |
| 1 1/4                   | 63.5                                          | 38.1                              | 57.2                  | 47.6                                                           | ...                                                       | 65.1                                            | 39.7                                            | 58.7                                | 46.0                  | ...                                                  | ...                                   | ...                                                          | 67                                     | 75                                                        | 1 1/4 |                         |
| 1 1/2                   | 73.0                                          | 44.4                              | 63.5                  | 54.0                                                           | ...                                                       | 74.6                                            | 46.0                                            | 65.1                                | 52.4                  | ...                                                  | ...                                   | ...                                                          | 73                                     | 84                                                        | 1 1/2 |                         |
| 2                       | 92.1                                          | 57.2                              | 82.6                  | 73.0                                                           | ...                                                       | 93.7                                            | 58.8                                            | 84.1                                | 71.4                  | ...                                                  | ...                                   | ...                                                          | 92                                     | 103                                                       | 2     |                         |
| 2 1/2                   | 104.8                                         | 68.3                              | 95.2                  | 85.7                                                           | ...                                                       | 106.4                                           | 69.8                                            | 96.8                                | 84.1                  | ...                                                  | ...                                   | ...                                                          | 105                                    | 116                                                       | 2 1/2 |                         |
| 3                       | 127.0                                         | 84.1                              | 117.5                 | 108.0                                                          | ...                                                       | 128.6                                           | 85.7                                            | 119.1                               | 106.4                 | ...                                                  | ...                                   | ...                                                          | 127                                    | 138                                                       | 3     |                         |
| 3 1/2                   | 139.7                                         | 96.8                              | 130.2                 | 120.6                                                          | ...                                                       | 141.3                                           | 98.4                                            | 131.8                               | 119.1                 | ...                                                  | ...                                   | ...                                                          | 140                                    | 151                                                       | 3 1/2 |                         |
| 4                       | 157.2                                         | 109.5                             | 144.5                 | 131.8                                                          | ...                                                       | 158.8                                           | 111.1                                           | 146.0                               | 130.2                 | ...                                                  | ...                                   | ...                                                          | 157                                    | 168                                                       | 4     |                         |
| 5                       | 185.7                                         | 136.5                             | 173.0                 | 160.3                                                          | ...                                                       | 187.3                                           | 138.1                                           | 174.6                               | 158.8                 | ...                                                  | ...                                   | ...                                                          | 186                                    | 197                                                       | 5     |                         |
| 6                       | 215.9                                         | 161.9                             | 203.2                 | 190.5                                                          | ...                                                       | 217.5                                           | 163.5                                           | 204.8                               | 188.9                 | ...                                                  | ...                                   | ...                                                          | 216                                    | 227                                                       | 6     |                         |
| 8                       | 269.9                                         | 212.7                             | 254.0                 | 238.1                                                          | ...                                                       | 271.5                                           | 214.3                                           | 255.6                               | 236.5                 | ...                                                  | ...                                   | ...                                                          | 270                                    | 281                                                       | 8     |                         |
| 10                      | 323.8                                         | 266.7                             | 304.8                 | 285.8                                                          | ...                                                       | 325.4                                           | 268.3                                           | 306.4                               | 284.2                 | ...                                                  | ...                                   | ...                                                          | 324                                    | 335                                                       | 10    |                         |
| 12                      | 381.0                                         | 317.5                             | 362.0                 | 342.9                                                          | ...                                                       | 382.6                                           | 319.1                                           | 363.5                               | 341.3                 | ...                                                  | ...                                   | ...                                                          | 381                                    | 392                                                       | 12    |                         |
| 14                      | 412.8                                         | 349.2                             | 393.7                 | 374.6                                                          | ...                                                       | 414.3                                           | 350.8                                           | 395.3                               | 373.1                 | ...                                                  | ...                                   | ...                                                          | 413                                    | 424                                                       | 14    |                         |
| 16                      | 469.9                                         | 400.0                             | 447.5                 | 425.4                                                          | ...                                                       | 471.5                                           | 401.6                                           | 449.3                               | 423.9                 | ...                                                  | ...                                   | ...                                                          | 470                                    | 481                                                       | 16    |                         |
| 18                      | 533.4                                         | 450.8                             | 511.2                 | 489.0                                                          | ...                                                       | 535.0                                           | 452.4                                           | 512.8                               | 487.4                 | ...                                                  | ...                                   | ...                                                          | 533                                    | 544                                                       | 18    |                         |
| 20                      | 584.2                                         | 501.6                             | 558.8                 | 533.4                                                          | ...                                                       | 585.8                                           | 503.2                                           | 560.4                               | 531.8                 | ...                                                  | ...                                   | ...                                                          | 584                                    | 595                                                       | 20    |                         |
| 24                      | 692.2                                         | 603.2                             | 666.8                 | 641.4                                                          | ...                                                       | 693.7                                           | 604.8                                           | 668.3                               | 639.8                 | ...                                                  | ...                                   | ...                                                          | 692                                    | 703                                                       | 24    |                         |

**Notes to Table 4****GENERAL NOTES:**

- (a) Dimensions are in millimeters. For dimensions in inch units, refer to Table F4 of Annex F.
- (b) For facing requirements for flanges and flanged fittings, see paras. 6.3 and 6.4 and Fig. 7.
- (c) For facing requirements for lapped joints, see para. 6.4.3 and Fig. 7.
- (d) For facing tolerances, see para. 7.3.

**NOTES:**

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

**Table 5 Dimensions of Ring-Joint Facings (All Pressure Rating Classes)**

| Nominal Size  |               |               |               |               |                |                | Groove Dimensions |                   |                     |          | Radius at Bottom, R |
|---------------|---------------|---------------|---------------|---------------|----------------|----------------|-------------------|-------------------|---------------------|----------|---------------------|
| Class 150 NPS | Class 300 NPS | Class 400 NPS | Class 600 NPS | Class 900 NPS | Class 1500 NPS | Class 2500 NPS | Groove Number     | Pitch Diameter, P | Depth, E [Note (1)] | Width, F |                     |
| ...           | 1/2           | ...           | 1/2           | ...           | ...            | ...            | R11               | 34.14             | 5.54                | 7.14     | 0.8                 |
| ...           | ...           | ...           | ...           | ...           | 1/2            | ...            | 12                | 39.67             | 6.35                | 8.74     | 0.8                 |
| ...           | 3/4           | ...           | 3/4           | ...           | ...            | 1/2            | 13                | 42.88             | 6.35                | 8.74     | 0.8                 |
| ...           | ...           | ...           | ...           | ...           | 3/4            | ...            | 14                | 44.45             | 6.35                | 8.74     | 0.8                 |
| 1             | ...           | ...           | ...           | ...           | ...            | ...            | 15                | 47.63             | 6.35                | 8.74     | 0.8                 |
| ...           | 1             | ...           | 1             | ...           | 1              | 3/4            | 16                | 50.80             | 6.35                | 8.74     | 0.8                 |
| 1 1/4         | ...           | ...           | ...           | ...           | ...            | ...            | 17                | 57.15             | 6.35                | 8.74     | 0.8                 |
| ...           | 1 1/4         | ...           | 1 1/4         | ...           | 1 1/4          | 1              | 18                | 60.33             | 6.35                | 8.74     | 0.8                 |
| 1 1/2         | ...           | ...           | ...           | ...           | ...            | ...            | 19                | 65.07             | 6.35                | 8.74     | 0.8                 |
| ...           | 1 1/2         | ...           | 1 1/2         | ...           | 1 1/2          | ...            | 20                | 68.27             | 6.35                | 8.74     | 0.8                 |
| ...           | ...           | ...           | ...           | ...           | ...            | 1 1/4          | 21                | 72.23             | 7.92                | 11.91    | 0.8                 |
| 2             | ...           | ...           | ...           | ...           | ...            | ...            | 22                | 82.55             | 6.35                | 8.74     | 0.8                 |
| ...           | 2             | ...           | 2             | ...           | ...            | 1 1/2          | 23                | 82.55             | 7.92                | 11.91    | 0.8                 |
| ...           | ...           | ...           | ...           | ...           | 2              | ...            | 24                | 95.25             | 7.92                | 11.91    | 0.8                 |
| 2 1/2         | ...           | ...           | ...           | ...           | ...            | ...            | 25                | 101.60            | 6.35                | 8.74     | 0.8                 |
| ...           | 2 1/2         | ...           | 2 1/2         | ...           | ...            | 2              | 26                | 101.60            | 7.92                | 11.91    | 0.8                 |
| ...           | ...           | ...           | ...           | ...           | 2 1/2          | ...            | 27                | 107.95            | 7.92                | 11.91    | 0.8                 |
| ...           | ...           | ...           | ...           | ...           | ...            | 2 1/2          | 28                | 111.13            | 9.52                | 13.49    | 0.8                 |
| 3             | ...           | ...           | ...           | ...           | ...            | ...            | 29                | 114.30            | 6.35                | 8.74     | 0.8                 |
| ...           | (2)           | ...           | (2)           | ...           | ...            | ...            | 30                | 117.48            | 7.92                | 11.91    | 0.8                 |
| ...           | 3 (2)         | ...           | 3 (2)         | 3             | ...            | ...            | 31                | 123.83            | 7.92                | 11.91    | 0.8                 |
| ...           | ...           | ...           | ...           | ...           | ...            | 3              | 32                | 127.00            | 9.53                | 13.49    | 1.5                 |
| 3 1/2         | ...           | ...           | ...           | ...           | ...            | ...            | 33                | 131.78            | 6.35                | 8.74     | 0.8                 |
| ...           | 3 1/2         | ...           | 3 1/2         | ...           | ...            | ...            | 34                | 131.78            | 7.92                | 11.91    | 0.8                 |
| ...           | ...           | ...           | ...           | ...           | 3              | ...            | 35                | 136.53            | 7.92                | 11.91    | 0.8                 |
| 4             | ...           | ...           | ...           | ...           | ...            | ...            | 36                | 149.23            | 6.35                | 8.74     | 0.8                 |
| ...           | 4             | 4             | 4             | 4             | ...            | ...            | 37                | 149.23            | 7.92                | 11.91    | 0.8                 |
| ...           | ...           | ...           | ...           | ...           | ...            | 4              | 38                | 157.18            | 11.13               | 16.66    | 1.5                 |
| ...           | ...           | ...           | ...           | ...           | 4              | ...            | 39                | 161.93            | 7.92                | 11.91    | 0.8                 |
| 5             | ...           | ...           | ...           | ...           | ...            | ...            | 40                | 171.45            | 6.35                | 8.74     | 0.8                 |
| ...           | 5             | 5             | 5             | 5             | ...            | ...            | 41                | 180.98            | 7.92                | 11.91    | 0.8                 |
| ...           | ...           | ...           | ...           | ...           | ...            | 5              | 42                | 190.50            | 12.70               | 19.84    | 1.5                 |
| 6             | ...           | ...           | ...           | ...           | ...            | ...            | 43                | 193.68            | 6.35                | 8.74     | 0.8                 |
| ...           | ...           | ...           | ...           | ...           | 5              | ...            | 44                | 193.68            | 7.92                | 11.91    | 0.8                 |
| ...           | 6             | 6             | 6             | 6             | ...            | ...            | 45                | 211.12            | 7.92                | 11.91    | 0.8                 |
| ...           | ...           | ...           | ...           | ...           | 6              | ...            | 46                | 211.14            | 9.53                | 13.49    | 1.5                 |
| ...           | ...           | ...           | ...           | ...           | ...            | 6              | 47                | 228.60            | 12.70               | 19.84    | 1.5                 |
| 8             | ...           | ...           | ...           | ...           | ...            | ...            | 48                | 247.65            | 6.35                | 8.74     | 0.8                 |
| ...           | 8             | 8             | 8             | 8             | ...            | ...            | 49                | 269.88            | 7.92                | 11.91    | 0.8                 |

**Table 5 Dimensions of Ring-Joint Facings (All Pressure Rating Classes) (Cont'd)**

| 13                            | 14                         | 15           | 16            | 17            | 18                                   | 19           | 20           | 21           | 22           | 23            | 24            |
|-------------------------------|----------------------------|--------------|---------------|---------------|--------------------------------------|--------------|--------------|--------------|--------------|---------------|---------------|
| Diameter of Raised Portion, K |                            |              |               |               | Approximate Distance Between Flanges |              |              |              |              |               |               |
| Class<br>150                  | Class<br>300<br>400<br>600 | Class<br>900 | Class<br>1500 | Class<br>2500 | Class<br>150                         | Class<br>300 | Class<br>400 | Class<br>600 | Class<br>900 | Class<br>1500 | Class<br>2500 |
| ...                           | 51.0                       | ...          | ...           | ...           | ...                                  | 3            | ...          | 3            | ...          | ...           | ...           |
| ...                           | ...                        | ...          | 60.5          | ...           | ...                                  | ...          | ...          | ...          | ...          | 4             | ...           |
| ...                           | 63.5                       | ...          | ...           | 65.0          | ...                                  | 4            | ...          | 4            | ...          | ...           | 4             |
| ...                           | ...                        | ...          | 66.5          | ...           | ...                                  | ...          | ...          | ...          | ...          | 4             | ...           |
| 63.5                          | ...                        | ...          | ...           | ...           | 4                                    | ...          | ...          | ...          | ...          | ...           | ...           |
| ...                           | 70.0                       | ...          | 71.5          | 73.0          | ...                                  | 4            | ...          | 4            | ...          | 4             | 4             |
| 73.0                          | ...                        | ...          | ...           | ...           | 4                                    | ...          | ...          | ...          | ...          | ...           | ...           |
| ...                           | 79.5                       | ...          | 81.0          | 82.5          | ...                                  | 4            | ...          | 4            | ...          | 4             | 4             |
| 82.5                          | ...                        | ...          | ...           | ...           | 4                                    | ...          | ...          | ...          | ...          | ...           | ...           |
| ...                           | 90.5                       | ...          | 92.0          | ...           | ...                                  | 4            | ...          | 4            | ...          | 4             | ...           |
| ...                           | ...                        | ...          | ...           | 102           | ...                                  | ...          | ...          | ...          | ...          | ...           | 3             |
| 102                           | ...                        | ...          | ...           | ...           | 4                                    | ...          | ...          | ...          | ...          | ...           | ...           |
| ...                           | 108                        | ...          | ...           | 114           | ...                                  | 6            | ...          | 5            | ...          | ...           | 3             |
| ...                           | ...                        | ...          | 124           | ...           | ...                                  | ...          | ...          | ...          | ...          | 3             | ...           |
| 121                           | ...                        | ...          | ...           | ...           | 4                                    | ...          | ...          | ...          | ...          | ...           | ...           |
| ...                           | 127                        | ...          | ...           | 133           | ...                                  | 6            | ...          | 5            | ...          | ...           | 3             |
| ...                           | ...                        | ...          | 137           | ...           | ...                                  | ...          | ...          | ...          | ...          | 3             | ...           |
| ...                           | ...                        | ...          | ...           | 149           | ...                                  | ...          | ...          | ...          | ...          | ...           | 3             |
| 133                           | ...                        | ...          | ...           | ...           | 4                                    | ...          | ...          | ...          | ...          | ...           | ...           |
| ...                           | ...                        | ...          | ...           | ...           | ...                                  | ...          | ...          | ...          | ...          | ...           | ...           |
| ...                           | 146                        | 156          | ...           | ...           | ...                                  | 6            | ...          | 5            | 4            | ...           | ...           |
| ...                           | ...                        | ...          | ...           | 168           | ...                                  | ...          | ...          | ...          | ...          | ...           | 3             |
| 154                           | ...                        | ...          | ...           | ...           | 4                                    | ...          | ...          | ...          | ...          | ...           | ...           |
| ...                           | 159                        | ...          | ...           | ...           | ...                                  | 6            | ...          | 5            | ...          | ...           | ...           |
| ...                           | ...                        | ...          | 168           | ...           | ...                                  | ...          | ...          | ...          | ...          | 3             | ...           |
| 171                           | ...                        | ...          | ...           | ...           | 4                                    | ...          | ...          | ...          | ...          | ...           | ...           |
| ...                           | 175                        | 181          | ...           | ...           | ...                                  | 6            | 6            | 5            | 4            | ...           | ...           |
| ...                           | ...                        | ...          | ...           | 203           | ...                                  | ...          | ...          | ...          | ...          | ...           | 4             |
| ...                           | ...                        | ...          | 194           | ...           | ...                                  | ...          | ...          | ...          | ...          | 3             | ...           |
| 194                           | ...                        | ...          | ...           | ...           | 4                                    | ...          | ...          | ...          | ...          | ...           | ...           |
| ...                           | 210                        | 216          | ...           | ...           | ...                                  | 6            | 6            | 5            | 4            | ...           | ...           |
| ...                           | ...                        | ...          | ...           | 241           | ...                                  | ...          | ...          | ...          | ...          | ...           | 4             |
| 219                           | ...                        | ...          | ...           | ...           | 4                                    | ...          | ...          | ...          | ...          | ...           | ...           |
| ...                           | ...                        | ...          | 229           | ...           | ...                                  | ...          | ...          | ...          | ...          | 3             | ...           |
| ...                           | 241                        | 241          | ...           | ...           | ...                                  | 6            | 6            | 5            | 4            | ...           | ...           |
| ...                           | ...                        | ...          | 248           | ...           | ...                                  | ...          | ...          | ...          | ...          | 3             | ...           |
| ...                           | ...                        | ...          | ...           | 279           | ...                                  | ...          | ...          | ...          | ...          | ...           | 4             |
| 273                           | ...                        | ...          | ...           | ...           | 4                                    | ...          | ...          | ...          | ...          | ...           | ...           |
| ...                           | 302                        | 308          | ...           | ...           | ...                                  | 6            | 6            | 5            | 4            | ...           | ...           |

**Table 5 Dimensions of Ring-Joint Facings (All Pressure Rating Classes) (Cont'd)**

| 1                   | 2                   | 3                   | 4                   | 5                   | 6                    | 7                    | 8                 | 9                              | 10                 | 11                 | 12                                  |
|---------------------|---------------------|---------------------|---------------------|---------------------|----------------------|----------------------|-------------------|--------------------------------|--------------------|--------------------|-------------------------------------|
| Nominal Size        |                     |                     |                     |                     |                      |                      | Groove Dimensions |                                |                    |                    | Radius<br>at<br>Bottom,<br><i>R</i> |
| Class<br>150<br>NPS | Class<br>300<br>NPS | Class<br>400<br>NPS | Class<br>600<br>NPS | Class<br>900<br>NPS | Class<br>1500<br>NPS | Class<br>2500<br>NPS | Groove<br>Number  | Pitch<br>Diameter,<br><i>P</i> | Depth,<br><i>E</i> | Width,<br><i>F</i> |                                     |
| ...                 | ...                 | ...                 | ...                 | ...                 | 8                    | ...                  | 50                | 269.88                         | 11.13              | 16.66              | 1.5                                 |
| ...                 | ...                 | ...                 | ...                 | ...                 | ...                  | 8                    | 51                | 279.40                         | 14.27              | 23.01              | 1.5                                 |
| 10                  | ...                 | ...                 | ...                 | ...                 | ...                  | ...                  | 52                | 304.80                         | 6.35               | 8.74               | 0.8                                 |
| ...                 | 10                  | 10                  | 10                  | 10                  | ...                  | ...                  | 53                | 323.85                         | 7.92               | 11.91              | 0.8                                 |
| ...                 | ...                 | ...                 | ...                 | ...                 | 10                   | ...                  | 54                | 323.85                         | 11.13              | 16.66              | 1.5                                 |
| ...                 | ...                 | ...                 | ...                 | ...                 | ...                  | 10                   | 55                | 342.90                         | 17.48              | 30.18              | 2.4                                 |
| 12                  | ...                 | ...                 | ...                 | ...                 | ...                  | ...                  | 56                | 381.00                         | 6.35               | 8.74               | 0.8                                 |
| ...                 | 12                  | 12                  | 12                  | 12                  | ...                  | ...                  | 57                | 381.00                         | 7.92               | 11.91              | 0.8                                 |
| ...                 | ...                 | ...                 | ...                 | ...                 | 12                   | ...                  | 58                | 381.00                         | 14.27              | 23.01              | 1.5                                 |
| 14                  | ...                 | ...                 | ...                 | ...                 | ...                  | ...                  | 59                | 396.88                         | 6.35               | 8.74               | 0.8                                 |
| ...                 | ...                 | ...                 | ...                 | ...                 | ...                  | 12                   | 60                | 406.40                         | 17.48              | 33.32              | 2.4                                 |
| ...                 | 14                  | 14                  | 14                  | ...                 | ...                  | ...                  | 61                | 419.10                         | 7.92               | 11.91              | 0.8                                 |
| ...                 | ...                 | ...                 | ...                 | 14                  | ...                  | ...                  | 62                | 419.10                         | 11.13              | 16.66              | 1.5                                 |
| ...                 | ...                 | ...                 | ...                 | ...                 | 14                   | ...                  | 63                | 419.10                         | 15.88              | 26.97              | 2.4                                 |
| 16                  | ...                 | ...                 | ...                 | ...                 | ...                  | ...                  | 64                | 454.03                         | 6.35               | 8.74               | 0.8                                 |
| ...                 | 16                  | 16                  | 16                  | ...                 | ...                  | ...                  | 65                | 469.90                         | 7.92               | 11.91              | 0.8                                 |
| ...                 | ...                 | ...                 | ...                 | 16                  | ...                  | ...                  | 66                | 469.90                         | 11.13              | 16.66              | 1.5                                 |
| ...                 | ...                 | ...                 | ...                 | ...                 | 16                   | ...                  | 67                | 469.90                         | 17.48              | 30.18              | 2.4                                 |
| 18                  | ...                 | ...                 | ...                 | ...                 | ...                  | ...                  | 68                | 517.53                         | 6.35               | 8.74               | 0.8                                 |
| ...                 | 18                  | 18                  | 18                  | ...                 | ...                  | ...                  | 69                | 533.40                         | 7.92               | 11.91              | 0.8                                 |
| ...                 | ...                 | ...                 | ...                 | 18                  | ...                  | ...                  | 70                | 533.40                         | 12.70              | 19.84              | 1.5                                 |
| ...                 | ...                 | ...                 | ...                 | ...                 | 18                   | ...                  | 71                | 533.40                         | 17.48              | 30.18              | 2.4                                 |
| 20                  | ...                 | ...                 | ...                 | ...                 | ...                  | ...                  | 72                | 558.80                         | 6.35               | 8.74               | 0.8                                 |
| ...                 | 20                  | 20                  | 20                  | ...                 | ...                  | ...                  | 73                | 584.20                         | 9.53               | 13.49              | 1.5                                 |
| ...                 | ...                 | ...                 | ...                 | 20                  | ...                  | ...                  | 74                | 584.20                         | 12.70              | 19.84              | 1.5                                 |
| ...                 | ...                 | ...                 | ...                 | ...                 | 20                   | ...                  | 75                | 584.20                         | 17.48              | 33.32              | 2.4                                 |
| 24                  | ...                 | ...                 | ...                 | ...                 | ...                  | ...                  | 76                | 673.10                         | 6.35               | 8.74               | 0.8                                 |
| ...                 | 24                  | 24                  | 24                  | ...                 | ...                  | ...                  | 77                | 692.15                         | 11.13              | 16.66              | 1.5                                 |
| ...                 | ...                 | ...                 | ...                 | 24                  | ...                  | ...                  | 78                | 692.15                         | 15.88              | 26.97              | 2.4                                 |
| ...                 | ...                 | ...                 | ...                 | ...                 | 24                   | ...                  | 79                | 692.15                         | 20.62              | 36.53              | 2.4                                 |

**Table 5 Dimensions of Ring-Joint Facings (All Pressure Rating Classes) (Cont'd)**

| 13                                   | 14                         | 15           | 16            | 17            | 18                                   | 19           | 20           | 21           | 22           | 23            | 24            |
|--------------------------------------|----------------------------|--------------|---------------|---------------|--------------------------------------|--------------|--------------|--------------|--------------|---------------|---------------|
| Diameter of Raised Portion, <i>K</i> |                            |              |               |               | Approximate Distance Between Flanges |              |              |              |              |               |               |
| Class<br>150                         | Class<br>300<br>400<br>600 | Class<br>900 | Class<br>1500 | Class<br>2500 | Class<br>150                         | Class<br>300 | Class<br>400 | Class<br>600 | Class<br>900 | Class<br>1500 | Class<br>2500 |
| ...                                  | ...                        | ...          | 318           | ...           | ...                                  | ...          | ...          | ...          | ...          | 4             | ...           |
| ...                                  | ...                        | ...          | ...           | 340           | ...                                  | ...          | ...          | ...          | ...          | ...           | 5             |
| 330                                  | ...                        | ...          | ...           | ...           | 4                                    | ...          | ...          | ...          | ...          | ...           | ...           |
| ...                                  | 356                        | 362          | ...           | ...           | ...                                  | 6            | 6            | 5            | 4            | ...           | ...           |
| ...                                  | ...                        | ...          | 371           | ...           | ...                                  | ...          | ...          | ...          | ...          | 4             | ...           |
| ...                                  | ...                        | ...          | ...           | 425           | ...                                  | ...          | ...          | ...          | ...          | ...           | 6             |
| 406                                  | ...                        | ...          | ...           | ...           | 4                                    | ...          | ...          | ...          | ...          | ...           | ...           |
| ...                                  | 413                        | 419          | ...           | ...           | ...                                  | 6            | 6            | 5            | 4            | ...           | ...           |
| ...                                  | ...                        | ...          | 438           | ...           | ...                                  | ...          | ...          | ...          | ...          | 5             | ...           |
| 425                                  | ...                        | ...          | ...           | ...           | 3                                    | ...          | ...          | ...          | ...          | ...           | ...           |
| ...                                  | ...                        | ...          | ...           | 495           | ...                                  | ...          | ...          | ...          | ...          | ...           | 8             |
| ...                                  | 457                        | ...          | ...           | ...           | ...                                  | 6            | 6            | 5            | ...          | ...           | ...           |
| ...                                  | ...                        | 467          | ...           | ...           | ...                                  | ...          | ...          | ...          | 4            | ...           | ...           |
| ...                                  | ...                        | ...          | 489           | ...           | ...                                  | ...          | ...          | ...          | ...          | 6             | ...           |
| 483                                  | ...                        | ...          | ...           | ...           | 3                                    | ...          | ...          | ...          | ...          | ...           | ...           |
| ...                                  | 508                        | ...          | ...           | ...           | ...                                  | 6            | 6            | 5            | ...          | ...           | ...           |
| ...                                  | ...                        | 524          | ...           | ...           | ...                                  | ...          | ...          | ...          | 4            | ...           | ...           |
| ...                                  | ...                        | ...          | 546           | ...           | ...                                  | ...          | ...          | ...          | ...          | 8             | ...           |
| 546                                  | ...                        | ...          | ...           | ...           | 3                                    | ...          | ...          | ...          | ...          | ...           | ...           |
| ...                                  | 575                        | ...          | ...           | ...           | ...                                  | 6            | 6            | 5            | ...          | ...           | ...           |
| ...                                  | ...                        | 594          | ...           | ...           | ...                                  | ...          | ...          | ...          | 5            | ...           | ...           |
| ...                                  | ...                        | ...          | 613           | ...           | ...                                  | ...          | ...          | ...          | ...          | 8             | ...           |
| 597                                  | ...                        | ...          | ...           | ...           | 3                                    | ...          | ...          | ...          | ...          | ...           | ...           |
| ...                                  | 635                        | ...          | ...           | ...           | ...                                  | 6            | 6            | 5            | ...          | ...           | ...           |
| ...                                  | ...                        | 648          | ...           | ...           | ...                                  | ...          | ...          | ...          | 5            | ...           | ...           |
| ...                                  | ...                        | ...          | 673           | ...           | ...                                  | ...          | ...          | ...          | ...          | 10            | ...           |
| 711                                  | ...                        | ...          | ...           | ...           | 3                                    | ...          | ...          | ...          | ...          | ...           | ...           |
| ...                                  | 749                        | ...          | ...           | ...           | ...                                  | 6            | 6            | 6            | ...          | ...           | ...           |
| ...                                  | ...                        | 772          | ...           | ...           | ...                                  | ...          | ...          | ...          | 6            | ...           | ...           |
| ...                                  | ...                        | ...          | 794           | ...           | ...                                  | ...          | ...          | ...          | ...          | 11            | ...           |

## GENERAL NOTES:

- (a) Dimensions are in millimeters. For dimensions in inch units, refer to Annex F, Table F5.  
 (b) For facing requirements for flanges and flanged fitting, see para. 6.4.1 and Fig. 7.  
 (c) For facing requirements for lapped joints, see para. 6.4.3 and Fig. 7.  
 (d) See para. 4.2.7 for marking requirements.  
 (e) Use Class 600 sizes NPS  $\frac{1}{2}$  to NPS  $3\frac{1}{2}$  for Class 400.  
 (f) Use Class 1500 in sizes NPS  $\frac{1}{2}$  to NPS  $2\frac{1}{2}$  for Class 900.

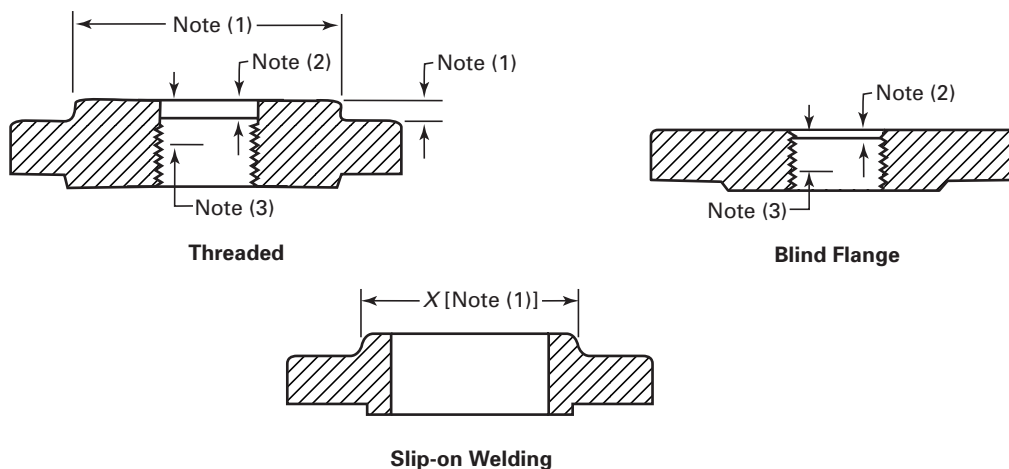
## NOTES:

- (1) Height of raised portion is equal to the depth of groove dimension *E*, but is not subjected to the tolerances for *E*. Former full-face contour may be used.  
 (2) For ring joints with lapped flanges in Classes 300 and 600, ring and groove number R30 is used instead of R31.

## TOLERANCES:

- E* (depth) +0.4, -0.0  
*F* (width) ±0.2  
*P* (pitch diameter) ±0.13  
*R* (radius at bottom)  
 $R \leq 2$  +0.8, -0.0  
 $R > 2$  ±0.8  
 23 deg (angle) ±  $\frac{1}{2}$  deg

## REDUCING THREADED AND SLIP-ON PIPE FLANGES

**Table 6 Reducing Threaded and Slip-On Flanges for Classes 150 Through 2500**

| 1                                  | 2                                                                                | 3                                  | 4                                                                                | 5                                  | 6                                                                                |
|------------------------------------|----------------------------------------------------------------------------------|------------------------------------|----------------------------------------------------------------------------------|------------------------------------|----------------------------------------------------------------------------------|
| Nominal<br>Pipe Size<br>[Note (4)] | Smallest Size<br>of Reducing<br>Outlet<br>Requiring Hub<br>Flanges<br>[Note (1)] | Nominal<br>Pipe Size<br>[Note (4)] | Smallest Size<br>of Reducing<br>Outlet<br>Requiring Hub<br>Flanges<br>[Note (1)] | Nominal<br>Pipe Size<br>[Note (4)] | Smallest Size<br>of Reducing<br>Outlet<br>Requiring Hub<br>Flanges<br>[Note (1)] |
| NPS                                | NPS                                                                              | NPS                                | NPS                                                                              | NPS                                | NPS                                                                              |
| 1                                  | $\frac{1}{2}$                                                                    | $3\frac{1}{2}$                     | $1\frac{1}{2}$                                                                   | 12                                 | $3\frac{1}{2}$                                                                   |
| $1\frac{1}{4}$                     | $\frac{1}{2}$                                                                    | 4                                  | $1\frac{1}{2}$                                                                   | 14                                 | $3\frac{1}{2}$                                                                   |
| $1\frac{1}{2}$                     | $\frac{1}{2}$                                                                    | 5                                  | $1\frac{1}{2}$                                                                   | 16                                 | 4                                                                                |
| 2                                  | 1                                                                                | 6                                  | $2\frac{1}{2}$                                                                   | 18                                 | 4                                                                                |
| $2\frac{1}{2}$                     | $1\frac{1}{4}$                                                                   | 8                                  | 3                                                                                | 20                                 | 4                                                                                |
| 3                                  | $1\frac{1}{4}$                                                                   | 10                                 | $3\frac{1}{2}$                                                                   | 24                                 | 4                                                                                |

GENERAL NOTE: Dimensions are in millimeters. For dimensions in inches, refer to Annex F, Table F6.

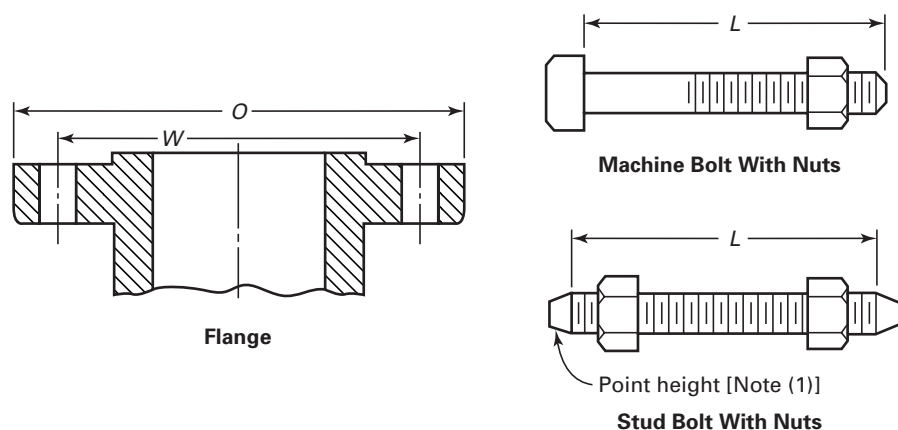
## NOTES:

- (1) The hub dimensions shall be at least as large as those of the standard flanges of the size to which the reduction is being machined, except flanges reducing to a size smaller than those of Columns 2, 4, and 6 may be made from blind flanges. See Example.
- (2) Class 150 flanges do not have a counterbore. Class 300 and higher pressure flanges will have depth of counterbore  $Q$  of 7 mm for NPS 2 and smaller tapping and 9.50 mm for NPS  $2\frac{1}{2}$  and larger. The diameter  $Q$  of counterbore is the same as that given in the tables of threaded flanges for the corresponding tapping.
- (3) Minimum length of effective threads shall be at least equal dimension  $T$  of the corresponding pressure class threaded flange as shown in tables but does not necessarily extend for the face of the flange. For thread of threaded flanges, see para. 6.9.
- (4) For method of designating reducing threaded and reducing slip-on flanges, see para. 3.3 and Examples below.

## EXAMPLES:

- A. The size designation is NPS  $6 \times 2\frac{1}{2}$  — Class 300 reducing threaded flange. This flange has the following dimensions:
  - NPS  $2\frac{1}{2}$  = taper pipe thread tapping (ASME B1.20.1)
  - 320 mm = diameter of regular NPS 6 Class 300 threaded flange
  - 35 mm = thickness of regular NPS 6 Class 300 threaded flange
  - 178 mm = diameter of hub for regular NPS 5 Class 300 threaded flange. Hub diameter may be one size small to reduce machining. In this example a hub diameter of NPS  $2\frac{1}{2}$  would be the smallest acceptable.
  - 15.5 mm = height of hub for regular NPS 5 Class 300 threaded flange.
- B. The size designation is NPS  $6 \times 2$  — Class 300 reducing threaded flange. Use regular NPS 6 Class 300 blind flange tapped with NPS 2 taper pipe thread (ASME B1.20.1).

## CLASS 150 PIPE FLANGES AND FLANGED FITTINGS

**Table 7 Templates for Drilling Class 150 Flanges**

| 1                               | 2                                         | 3                                   | 4                                    | 5                     | 6                            | 7                                      | 8             | 9                      |
|---------------------------------|-------------------------------------------|-------------------------------------|--------------------------------------|-----------------------|------------------------------|----------------------------------------|---------------|------------------------|
| Drilling [Notes (2), (3)]       |                                           |                                     |                                      |                       |                              | Length of Bolts, L<br>[Notes (1), (4)] |               |                        |
| Nominal<br>Pipe<br>Size,<br>NPS | Outside<br>Diameter<br>of<br>Flange,<br>O | Diameter<br>of Bolt<br>Circle,<br>W | Diameter<br>of Bolt<br>Holes,<br>in. | Number<br>of<br>Bolts | Diameter<br>of Bolts,<br>in. | Stud Bolts<br>[Note (1)]               |               | Machine<br>Bolts       |
|                                 |                                           |                                     |                                      |                       |                              | 2 mm<br>Raised<br>Face                 | Ring<br>Joint | 2 mm<br>Raised<br>Face |
| 1/2                             | 90                                        | 60.3                                | 5/8                                  | 4                     | 1/2                          | 55                                     | ...           | 50                     |
| 3/4                             | 100                                       | 69.9                                | 5/8                                  | 4                     | 1/2                          | 65                                     | ...           | 50                     |
| 1                               | 110                                       | 79.4                                | 5/8                                  | 4                     | 1/2                          | 65                                     | 75            | 55                     |
| 1 1/4                           | 115                                       | 88.9                                | 5/8                                  | 4                     | 1/2                          | 70                                     | 85            | 55                     |
| 1 1/2                           | 125                                       | 98.4                                | 5/8                                  | 4                     | 1/2                          | 70                                     | 85            | 65                     |
| 2                               | 150                                       | 120.7                               | 3/4                                  | 4                     | 5/8                          | 85                                     | 95            | 70                     |
| 2 1/2                           | 180                                       | 139.7                               | 3/4                                  | 4                     | 5/8                          | 90                                     | 100           | 75                     |
| 3                               | 190                                       | 152.4                               | 3/4                                  | 4                     | 5/8                          | 90                                     | 100           | 75                     |
| 3 1/2                           | 215                                       | 177.8                               | 3/4                                  | 8                     | 5/8                          | 90                                     | 100           | 75                     |
| 4                               | 230                                       | 190.5                               | 3/4                                  | 8                     | 5/8                          | 90                                     | 100           | 75                     |
| 5                               | 255                                       | 215.9                               | 7/8                                  | 8                     | 3/4                          | 95                                     | 110           | 85                     |
| 6                               | 280                                       | 241.3                               | 7/8                                  | 8                     | 3/4                          | 100                                    | 115           | 85                     |
| 8                               | 345                                       | 298.5                               | 7/8                                  | 8                     | 3/4                          | 110                                    | 120           | 90                     |
| 10                              | 405                                       | 362.0                               | 1                                    | 12                    | 7/8                          | 115                                    | 125           | 100                    |
| 12                              | 485                                       | 431.8                               | 1                                    | 12                    | 7/8                          | 120                                    | 135           | 100                    |
| 14                              | 535                                       | 476.3                               | 1 1/8                                | 12                    | 1                            | 135                                    | 145           | 115                    |
| 16                              | 595                                       | 539.8                               | 1 1/8                                | 16                    | 1                            | 135                                    | 145           | 115                    |
| 18                              | 635                                       | 577.9                               | 1 1/4                                | 16                    | 1 1/8                        | 145                                    | 160           | 125                    |
| 20                              | 700                                       | 635.0                               | 1 1/4                                | 20                    | 1 1/8                        | 160                                    | 170           | 140                    |
| 24                              | 815                                       | 749.3                               | 1 3/8                                | 20                    | 1 1/4                        | 170                                    | 185           | 150                    |

## GENERAL NOTES:

(a) Dimensions of Table 7 are in millimeters, except for diameters of bolts and bolt holes, which are in inch units. For dimensions in inch units, refer to Annex F, Table F7.

(b) For other dimensions, see Tables 8 and 9.

## NOTES:

(1) Length of stud bolt does not include the height of the points. See para. 6.10.2.

(2) For flange bolt holes, see para. 6.5.

(3) For spot facing, see para. 6.6.

(4) Bolt lengths not shown in table may be determined in accordance with Annex D. See para. 6.10.2.



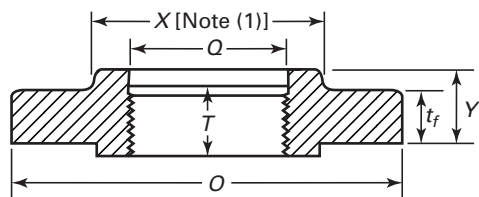
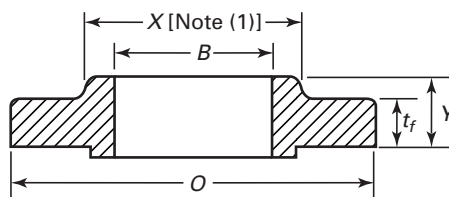
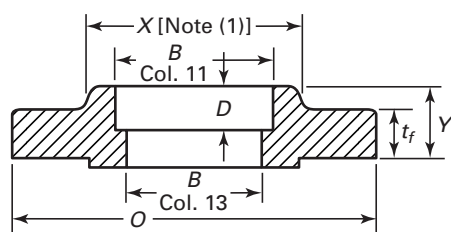
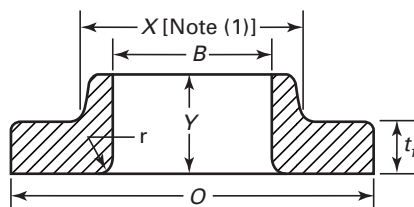
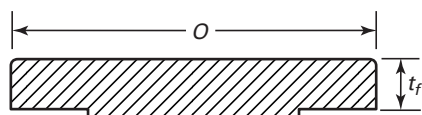
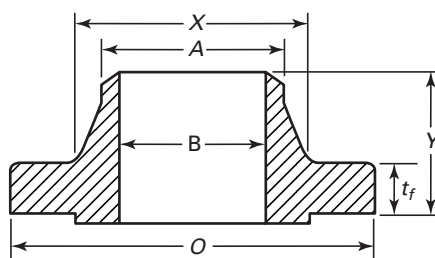
**Threaded****Slip-on Welding****Socket Welding (NPS 1/2 to 3 Only)****Lapped****Blind****Welding Neck****Table 8 Dimensions of Class 150 Flanges**

Table 8 Dimensions of Class 150 Flanges (Cont'd)

| 1                              | 2                                         | 3                                                            | 4                                                 | 5                        | 6                                                                                    | 7                                                | 8            | 9                     | 10                                                       | 11                                              | 12                   | 13                                               | 14 | 15                                                                            |                             |
|--------------------------------|-------------------------------------------|--------------------------------------------------------------|---------------------------------------------------|--------------------------|--------------------------------------------------------------------------------------|--------------------------------------------------|--------------|-----------------------|----------------------------------------------------------|-------------------------------------------------|----------------------|--------------------------------------------------|----|-------------------------------------------------------------------------------|-----------------------------|
| Nominal<br>Pipe<br>Size<br>NPS | Outside<br>Diameter<br>of<br>Flange,<br>O | Thickness<br>of Flange,<br>t <sub>f</sub><br>[Notes (2)-(4)] | Thickness<br>Lap Joint<br>Min.,<br>t <sub>l</sub> | Diameter<br>of Hub,<br>X | Hub<br>Diameter<br>Beginning<br>of<br>Chamfer<br>Welding<br>Neck,<br>A<br>[Note (5)] | Length Through Hub                               |              |                       |                                                          | Bore                                            |                      |                                                  |    | Corner<br>Radius<br>of<br>Bore<br>of<br>Lapped<br>Flange<br>and<br>Pipe,<br>r | Depth<br>of<br>Socket,<br>D |
|                                |                                           |                                                              |                                                   |                          |                                                                                      | Threaded/<br>Slip-on/<br>Socket<br>Welding,<br>Y | Lapped,<br>Y | Welding<br>Neck,<br>Y | Thread<br>Length<br>Threaded<br>Min.,<br>T<br>[Note (6)] | Slip-<br>on/<br>Socket<br>Welding,<br>Min.<br>B | Lapped<br>Min.,<br>B | Welding<br>Socket<br>Welding,<br>B<br>[Note (7)] |    |                                                                               |                             |
|                                |                                           |                                                              |                                                   |                          |                                                                                      |                                                  |              |                       |                                                          |                                                 |                      |                                                  |    |                                                                               |                             |
| 1½                             | 90                                        | 9.6                                                          | 11.2                                              | 30                       | 21.3                                                                                 | 14                                               | 16           | 46                    | 16                                                       | 22.2                                            | 22.9                 | 15.8                                             | 3  | 10                                                                            |                             |
| ¾                              | 100                                       | 11.2                                                         | 12.7                                              | 38                       | 26.7                                                                                 | 14                                               | 16           | 51                    | 16                                                       | 27.7                                            | 28.2                 | 20.9                                             | 3  | 11                                                                            |                             |
| 1                              | 110                                       | 12.7                                                         | 14.3                                              | 49                       | 33.4                                                                                 | 16                                               | 17           | 54                    | 17                                                       | 34.5                                            | 34.9                 | 26.6                                             | 3  | 13                                                                            |                             |
| 1¼                             | 115                                       | 14.3                                                         | 15.9                                              | 59                       | 42.2                                                                                 | 19                                               | 21           | 56                    | 21                                                       | 43.2                                            | 43.7                 | 35.1                                             | 5  | 14                                                                            |                             |
| 1½                             | 125                                       | 15.9                                                         | 17.5                                              | 65                       | 48.3                                                                                 | 21                                               | 22           | 60                    | 22                                                       | 49.5                                            | 50.0                 | 40.9                                             | 6  | 16                                                                            |                             |
| 2                              | 150                                       | 17.5                                                         | 19.1                                              | 78                       | 60.3                                                                                 | 24                                               | 25           | 62                    | 25                                                       | 61.9                                            | 62.5                 | 52.5                                             | 8  | 17                                                                            |                             |
| 2½                             | 180                                       | 20.7                                                         | 22.3                                              | 90                       | 73.0                                                                                 | 27                                               | 29           | 68                    | 29                                                       | 74.6                                            | 75.4                 | 62.7                                             | 8  | 19                                                                            |                             |
| 3                              | 190                                       | 22.3                                                         | 23.9                                              | 108                      | 88.9                                                                                 | 29                                               | 30           | 68                    | 30                                                       | 90.7                                            | 91.4                 | 77.9                                             | 10 | 21                                                                            |                             |
| 3½                             | 215                                       | 22.3                                                         | 23.9                                              | 122                      | 101.6                                                                                | 30                                               | 32           | 70                    | 32                                                       | 103.4                                           | 104.1                | 90.1                                             | 10 | ...                                                                           |                             |
| 4                              | 230                                       | 22.3                                                         | 23.9                                              | 135                      | 114.3                                                                                | 32                                               | 33           | 75                    | 33                                                       | 116.1                                           | 116.8                | 102.3                                            | 11 | ...                                                                           |                             |
| 5                              | 255                                       | 22.3                                                         | 23.9                                              | 164                      | 141.3                                                                                | 35                                               | 36           | 87                    | 36                                                       | 143.8                                           | 144.4                | 128.2                                            | 11 | ...                                                                           |                             |
| 6                              | 280                                       | 23.9                                                         | 25.4                                              | 192                      | 168.3                                                                                | 38                                               | 40           | 87                    | 40                                                       | 170.7                                           | 171.4                | 154.1                                            | 13 | ...                                                                           |                             |
| 8                              | 345                                       | 27.0                                                         | 28.6                                              | 246                      | 219.1                                                                                | 43                                               | 44           | 100                   | 44                                                       | 221.5                                           | 222.2                | 202.7                                            | 13 | ...                                                                           |                             |
| 10                             | 405                                       | 28.6                                                         | 30.2                                              | 305                      | 273.0                                                                                | 48                                               | 49           | 100                   | 49                                                       | 276.2                                           | 277.4                | 254.6                                            | 13 | ...                                                                           |                             |
| 12                             | 485                                       | 30.2                                                         | 31.8                                              | 365                      | 323.8                                                                                | 54                                               | 56           | 113                   | 56                                                       | 327.0                                           | 328.2                | 304.8                                            | 13 | ...                                                                           |                             |
| 14                             | 535                                       | 33.4                                                         | 35.0                                              | 400                      | 355.6                                                                                | 56                                               | 79           | 125                   | 57                                                       | 359.2                                           | 360.2                | To be                                            | 13 | ...                                                                           |                             |
| 16                             | 595                                       | 35.0                                                         | 36.6                                              | 457                      | 406.4                                                                                | 62                                               | 87           | 125                   | 64                                                       | 410.5                                           | 411.2                | Specified                                        | 13 | ...                                                                           |                             |
| 18                             | 635                                       | 38.1                                                         | 39.7                                              | 505                      | 457.0                                                                                | 67                                               | 97           | 138                   | 68                                                       | 461.8                                           | 462.3                | by                                               | 13 | ...                                                                           |                             |
| 20                             | 700                                       | 41.3                                                         | 42.9                                              | 559                      | 508.0                                                                                | 71                                               | 103          | 143                   | 73                                                       | 513.1                                           | 514.4                | Pur-                                             | 13 | ...                                                                           |                             |
| 24                             | 815                                       | 46.1                                                         | 47.7                                              | 663                      | 610.0                                                                                | 81                                               | 111          | 151                   | 83                                                       | 616.0                                           | 616.0                | chaser                                           | 13 | ...                                                                           |                             |

**Notes to Table 8**

## GENERAL NOTES:

- (a) Dimensions of Table 8 are in millimeters. For dimensions in inches, refer to Table F8 of Annex F.
- (b) For tolerance, see para. 7.
- (c) For facings, see para. 6.4.
- (d) For flange bolt holes, see para 6.5 and Table 7.
- (e) For spot facing, see para. 6.6.
- (f) For reducing threaded and slip-on flanges, see Table 6.
- (g) Blind flanges may be made with or without hubs at the manufacturer's option.
- (h) For reducing welding neck flanges, see para. 6.8.

## NOTES:

- (1) This dimension is for large end of hub, which may be straight or tapered. Taper shall not exceed 7 deg on threaded, slip-on, socket-welding, and lapped flanges. This dimension is defined as the diameter at the intersection between the hub taper and the back face of the flange.
- (2) The minimum thickness of these loose flanges, in sizes NPS 3½ and smaller, is slightly greater than the thickness of flanges on fittings, Table 9, which are reinforced by being cast integral with the body of the fitting.
- (3) These flanges may be supplied with a flat face. The flat face may be either the full  $t_f$  dimension of thickness plus 2 mm, or the  $t_f$  dimension thickness without the raised face height. See Para 6.3.2 for additional restrictions.
- (4) The flange dimensions illustrated are for regularly furnished 2 mm raised face (except lapped); for requirements of other facings, see Fig. 7.
- (5) For welding end bevel. See para. 6.7.
- (6) For thread of threaded flanges, see para. 6.9.
- (7) Dimensions in Column 13 correspond to the inside diameters of pipe as given in ASME B36.10M for Standard Wall pipe. Thickness of Standard Wall is the same as Schedule 40 in sizes NPS 10 and smaller. Tolerances in para. 7.5.2 apply. These bore sizes are furnished unless otherwise specified by the purchaser.

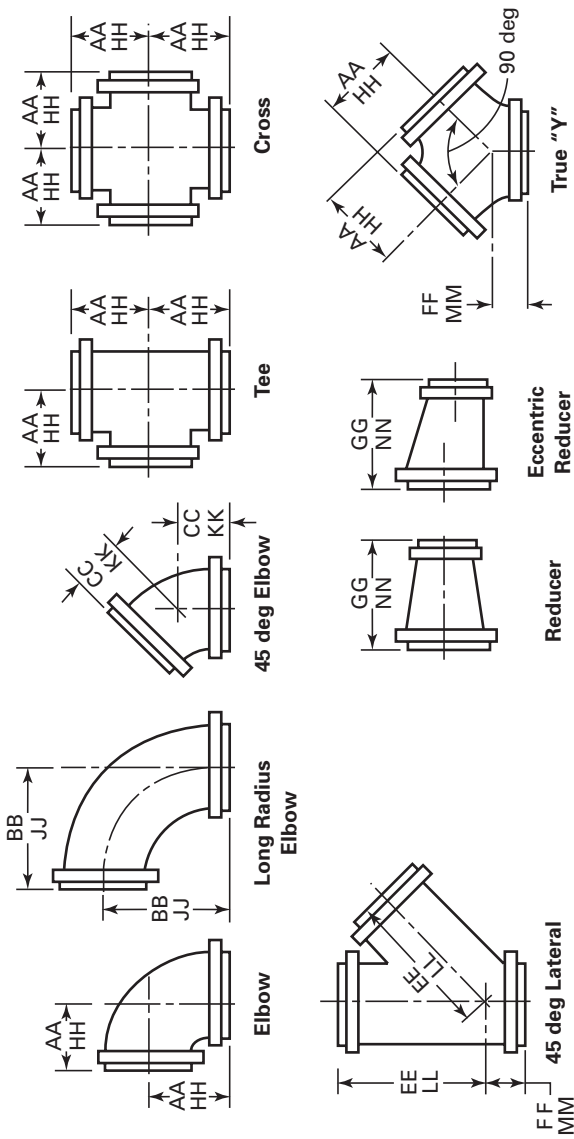


Table 9 Dimensions of Class 150 Flanged Fittings

| Nominal<br>Pipe<br>Size<br>NPS | Outside<br>Diameter<br>of<br>Flange,<br>O | Thickness of<br>Flange<br>Min.,<br>$t_f$<br>[Notes (1)–(3)] | Wall<br>Thickness<br>of Fitting,<br>Min.,<br>$t_m$ | Inside<br>diameter<br>of<br>Fitting,<br>d | 2 mm Raised Face [Note (4)]                        |                                                    |                                                    |                                                            |                                                             |                                                    |                                                               |            |     |     |
|--------------------------------|-------------------------------------------|-------------------------------------------------------------|----------------------------------------------------|-------------------------------------------|----------------------------------------------------|----------------------------------------------------|----------------------------------------------------|------------------------------------------------------------|-------------------------------------------------------------|----------------------------------------------------|---------------------------------------------------------------|------------|-----|-----|
|                                |                                           |                                                             |                                                    |                                           | Center-to-<br>Contact<br>Surface of<br>Raised Face | Center-to-<br>Contact<br>Surface of<br>Raised Face | Center-to-<br>Contact<br>Surface of<br>Raised Face | Long<br>Center-to-<br>Contact<br>Surface of<br>Raised Face | Short<br>Center-to-<br>Contact<br>Surface of<br>Raised Face | Center-to-<br>Contact<br>Surface of<br>Raised Face | Ring Joint<br>[Note (4)]                                      |            |     |     |
|                                |                                           |                                                             |                                                    |                                           | AA                                                 | BB                                                 | CC                                                 | EE                                                         | FF                                                          | GG                                                 | Center-to-End<br>Elbow, Tee,<br>Cross, and<br>True "Y",<br>HH | [Note (6)] |     |     |
| 1/2                            | 90                                        | 8.0                                                         | 2.8                                                | 13                                        | ...                                                | ...                                                | ...                                                | ...                                                        | ...                                                         | ...                                                | ...                                                           | ...        | ... | ... |
| 3/4                            | 100                                       | 8.9                                                         | 3.2                                                | 19                                        | ...                                                | ...                                                | ...                                                | ...                                                        | ...                                                         | ...                                                | ...                                                           | ...        | ... | ... |
| 1                              | 110                                       | 9.6                                                         | 4.0                                                | 25                                        | 89                                                 | 127                                                | 44                                                 | 146                                                        | 44                                                          | 114                                                | 95                                                            | 114        | 95  | 95  |
| 1 1/4                          | 115                                       | 11.2                                                        | 4.8                                                | 32                                        | 95                                                 | 140                                                | 51                                                 | 159                                                        | 44                                                          | 114                                                | 102                                                           | 114        | 102 | 102 |
| 1 1/2                          | 125                                       | 12.7                                                        | 4.8                                                | 38                                        | 102                                                | 152                                                | 57                                                 | 178                                                        | 51                                                          | 114                                                | 108                                                           | 114        | 108 | 108 |
| 2                              | 150                                       | 14.3                                                        | 5.6                                                | 51                                        | 114                                                | 165                                                | 64                                                 | 203                                                        | 64                                                          | 127                                                | 121                                                           | 127        | 121 | 121 |
| 2 1/2                          | 180                                       | 15.9                                                        | 5.6                                                | 64                                        | 127                                                | 178                                                | 76                                                 | 241                                                        | 64                                                          | 140                                                | 133                                                           | 140        | 133 | 133 |
| 3                              | 190                                       | 17.5                                                        | 5.6                                                | 76                                        | 140                                                | 197                                                | 76                                                 | 254                                                        | 76                                                          | 152                                                | 146                                                           | 152        | 146 | 146 |
| 3 1/2                          | 215                                       | 19.1                                                        | 6.4                                                | 89                                        | 152                                                | 216                                                | 89                                                 | 292                                                        | 76                                                          | 165                                                | 159                                                           | 165        | 159 | 159 |
| 4                              | 230                                       | 22.3                                                        | 6.4                                                | 102                                       | 165                                                | 229                                                | 102                                                | 305                                                        | 76                                                          | 178                                                | 171                                                           | 178        | 171 | 171 |

Table 9 Dimensions of Class 150 Flanged Fittings (Cont'd)

| 1                              | 2                                                | 3                                                                          | 4                                                                 | 5                                                | 6                                                                                                  | 7                                                                                    | 8                                                                            | 9                                                                            | 10                                                                                            | 11                                                                               | 12                                                            |
|--------------------------------|--------------------------------------------------|----------------------------------------------------------------------------|-------------------------------------------------------------------|--------------------------------------------------|----------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------|------------------------------------------------------------------------------|------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------|---------------------------------------------------------------|
| Nominal<br>Pipe<br>Size<br>NPS | Outside<br>Diameter<br>of<br>Flange,<br><i>O</i> | Thickness of<br>Flange<br>Min.,<br><i>t<sub>f</sub></i><br>[Notes (1)–(3)] | Wall<br>Thickness<br>of Fitting,<br>Min.,<br><i>t<sub>m</sub></i> | Inside<br>diameter<br>of<br>Fitting,<br><i>d</i> | 2 mm Raised Face [Note (4)]                                                                        |                                                                                      |                                                                              |                                                                              |                                                                                               |                                                                                  |                                                               |
|                                |                                                  |                                                                            |                                                                   |                                                  | Center-to-<br>Contact<br>Surface of<br>Raised Face<br>Elbow, Tee,<br>Cross, and<br>True “Y”,<br>AA | Center-to-<br>Contact<br>Surface of<br>Raised Face<br>Long<br>Radius<br>Elbow,<br>BB | Center-to-<br>Contact<br>Surface of<br>Raised Face<br>45 deg<br>Elbow,<br>CC | Long<br>Center-to-<br>Contact<br>Surface of<br>Raised Face<br>Lateral,<br>EE | Short<br>Center-to-<br>Contact<br>Surface of<br>Raised Face<br>Lateral and<br>True “Y”,<br>FF | Contact<br>Surface-to-<br>Contact<br>Surface of<br>Raised Face<br>Reducer,<br>GG | Ring joint<br>[Note (4)]                                      |
|                                |                                                  |                                                                            |                                                                   |                                                  |                                                                                                    |                                                                                      |                                                                              |                                                                              |                                                                                               |                                                                                  | Center-to-End<br>Elbow, Tee,<br>Cross, and<br>True “Y”,<br>HH |
|                                |                                                  |                                                                            |                                                                   |                                                  |                                                                                                    |                                                                                      |                                                                              |                                                                              |                                                                                               |                                                                                  | [Note (6)]                                                    |
| 5                              | 255                                              | 22.3                                                                       | 7.1                                                               | 127                                              | 190                                                                                                | 260                                                                                  | 114                                                                          | 343                                                                          | 89                                                                                            | 203                                                                              | 197                                                           |
| 6                              | 280                                              | 23.9                                                                       | 7.1                                                               | 152                                              | 203                                                                                                | 292                                                                                  | 127                                                                          | 368                                                                          | 89                                                                                            | 229                                                                              | 210                                                           |
| 8                              | 345                                              | 27.0                                                                       | 7.9                                                               | 203                                              | 229                                                                                                | 356                                                                                  | 140                                                                          | 444                                                                          | 114                                                                                           | 279                                                                              | 235                                                           |
| 10                             | 405                                              | 28.6                                                                       | 8.7                                                               | 254                                              | 279                                                                                                | 419                                                                                  | 165                                                                          | 521                                                                          | 127                                                                                           | 305                                                                              | 286                                                           |
| 12                             | 485                                              | 30.2                                                                       | 9.5                                                               | 305                                              | 305                                                                                                | 483                                                                                  | 190                                                                          | 622                                                                          | 140                                                                                           | 356                                                                              | 311                                                           |
| 14                             | 535                                              | 33.4                                                                       | 10.3                                                              | 337                                              | 356                                                                                                | 546                                                                                  | 190                                                                          | 686                                                                          | 152                                                                                           | 406                                                                              | 362                                                           |
| 16                             | 595                                              | 35.0                                                                       | 11.1                                                              | 387                                              | 381                                                                                                | 610                                                                                  | 203                                                                          | 762                                                                          | 165                                                                                           | 457                                                                              | 387                                                           |
| 18                             | 635                                              | 38.1                                                                       | 11.9                                                              | 438                                              | 419                                                                                                | 673                                                                                  | 216                                                                          | 813                                                                          | 178                                                                                           | 483                                                                              | 425                                                           |
| 20                             | 700                                              | 41.3                                                                       | 12.7                                                              | 489                                              | 457                                                                                                | 737                                                                                  | 241                                                                          | 889                                                                          | 203                                                                                           | 508                                                                              | 464                                                           |
| 24                             | 815                                              | 46.1                                                                       | 14.5                                                              | 591                                              | 559                                                                                                | 864                                                                                  | 279                                                                          | 1029                                                                         | 229                                                                                           | 610                                                                              | 565                                                           |

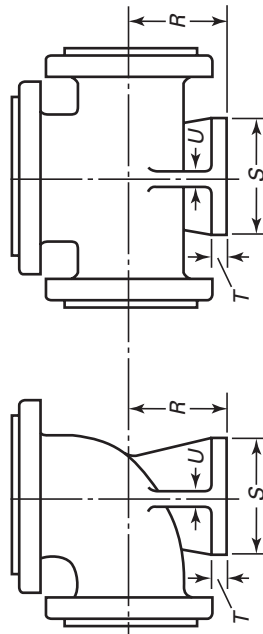
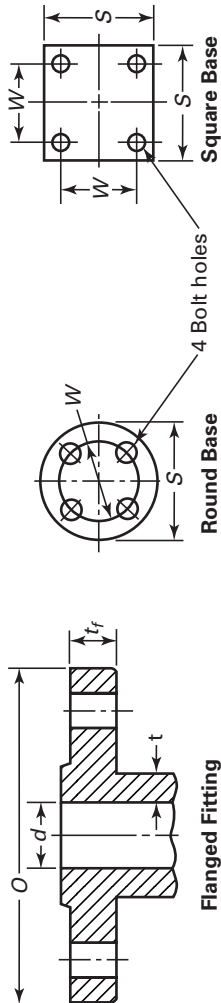


Table 9 Dimensions of Class 150 Flanged Fittings (Cont'd)

| 13                                  | 14                             | 15                             | 16                                           | 17                     | 18                | 19                                                | 20                   | 21                   | 22                             | 23                        | 1                     |
|-------------------------------------|--------------------------------|--------------------------------|----------------------------------------------|------------------------|-------------------|---------------------------------------------------|----------------------|----------------------|--------------------------------|---------------------------|-----------------------|
| Base Drilling [Note (11)]           |                                |                                |                                              |                        |                   |                                                   |                      |                      |                                |                           |                       |
|                                     |                                |                                |                                              |                        |                   |                                                   |                      |                      |                                |                           |                       |
| Center-to-End Long Radius Elbow, JJ | Center-to-End 45 deg Elbow, KK | Long Center-to-End Lateral, LL | Short Center-to-End Lateral And True "Y", MM | End-to-End Reducer, NN | Center-to-Base, R | Diameter of Round Base or Width of Square Base, S | Thickness of Base, T | Thickness of Ribs, U | Bolt Circle or Bolt Spacing, W | Diameter of Drilled Holes | Nominal Pipe Size NPS |
|                                     |                                |                                |                                              |                        |                   |                                                   |                      |                      |                                |                           |                       |
|                                     |                                |                                |                                              |                        |                   |                                                   |                      |                      |                                |                           |                       |
|                                     |                                |                                |                                              |                        |                   |                                                   |                      |                      |                                |                           |                       |
|                                     |                                |                                |                                              |                        |                   |                                                   |                      |                      |                                |                           |                       |
| ...                                 | ...                            | ...                            | ...                                          | ...                    | ...               | ...                                               | ...                  | ...                  | ...                            | ...                       | 1/2                   |
| ...                                 | ...                            | ...                            | ...                                          | ...                    | ...               | ...                                               | ...                  | ...                  | ...                            | ...                       | 3/4                   |
| 133                                 | 51                             | 152                            | 51                                           | ...                    | ...               | ...                                               | ...                  | ...                  | ...                            | ...                       | 1                     |
| 146                                 | 57                             | 165                            | 51                                           | ...                    | ...               | ...                                               | ...                  | ...                  | ...                            | ...                       | 1 1/4                 |
| 159                                 | 64                             | 184                            | 57                                           | ...                    | ...               | ...                                               | ...                  | ...                  | ...                            | ...                       | 1 1/2                 |
| 171                                 | 70                             | 210                            | 70                                           | ...                    | 105               | 117                                               | 13                   | 13                   | 88.9                           | 5/8                       | 2                     |
| 184                                 | 83                             | 248                            | 70                                           | ...                    | 114               | 117                                               | 13                   | 13                   | 88.9                           | 5/8                       | 2 1/2                 |
| 203                                 | 83                             | 260                            | 70                                           | ...                    | 124               | 127                                               | 14                   | 14                   | 98.4                           | 5/8                       | 3                     |
| 222                                 | 95                             | 298                            | 83                                           | ...                    | 133               | 127                                               | 14                   | 14                   | 98.4                           | 5/8                       | 3 1/2                 |
| 235                                 | 108                            | 311                            | 83                                           | ...                    | 140               | 152                                               | 16                   | 16                   | 120.6                          | 3/4                       | 4                     |

Table 9 Dimensions of Class 150 Flanged Fittings (Cont'd)

| 13                                  | 14                             | 15                             | 16                                        | 17                        | 18                | 19                                                | 20                   | 21                   | 22                             | 23                        | 1                     |
|-------------------------------------|--------------------------------|--------------------------------|-------------------------------------------|---------------------------|-------------------|---------------------------------------------------|----------------------|----------------------|--------------------------------|---------------------------|-----------------------|
| Ring Joint [Note (4)]               |                                |                                |                                           | Base Drilling [Note (11)] |                   |                                                   |                      |                      |                                |                           |                       |
| Center-to-End Long Radius Elbow, JJ | Center-to-End 45 deg Elbow, KK | Long Center-to-End Lateral, LL | Short Center-to-End Lateral, True "Y", MM |                           | Center-to-Base, R | Diameter of Round Base or Width of Square Base, S | Thickness of Base, T | Thickness of Ribs, U | Bolt Circle or Bolt Spacing, W | Diameter of Drilled Holes | Nominal Pipe Size NPS |
|                                     |                                |                                |                                           |                           |                   |                                                   |                      |                      |                                |                           |                       |
| [Note (6)]                          | [Note (6)]                     | [Note (6)]                     | [Note (6)]                                | End-to-End Reducer, NN    | [Notes (7)–(9)]   | [Note (7)]                                        | [Notes (7)–(10)]     | [Note (7)]           |                                |                           |                       |
| 267                                 | 121                            | 349                            | 95                                        | ...                       | 159               | 178                                               | 17                   | 17                   | 139.7                          | 3/4                       | 5                     |
| 298                                 | 133                            | 375                            | 95                                        | ...                       | 178               | 178                                               | 17                   | 17                   | 139.7                          | 3/4                       | 6                     |
| 362                                 | 146                            | 451                            | 121                                       | ...                       | 213               | 229                                               | 24                   | 24                   | 190.5                          | 3/4                       | 8                     |
| 425                                 | 171                            | 527                            | 133                                       | ...                       | 248               | 229                                               | 24                   | 24                   | 190.5                          | 3/4                       | 10                    |
| 489                                 | 197                            | 629                            | 146                                       | ...                       | 286               | 279                                               | 25                   | 25                   | 241.3                          | 7/8                       | 12                    |
| 552                                 | 197                            | 692                            | 159                                       | ...                       | 318               | 279                                               | 25                   | 25                   | 241.3                          | 7/8                       | 14                    |
| 616                                 | 210                            | 768                            | 171                                       | ...                       | 349               | 279                                               | 25                   | 25                   | 241.3                          | 7/8                       | 16                    |
| 679                                 | 222                            | 819                            | 184                                       | ...                       | 381               | 343                                               | 29                   | 29                   | 298.4                          | 7/8                       | 18                    |
| 743                                 | 248                            | 895                            | 210                                       | ...                       | 406               | 343                                               | 29                   | 29                   | 298.4                          | 7/8                       | 20                    |
| 870                                 | 286                            | 1035                           | 235                                       | ...                       | 470               | 343                                               | 29                   | 29                   | 298.4                          | 7/8                       | 24                    |

## Notes to Table 9

### GENERAL NOTES:

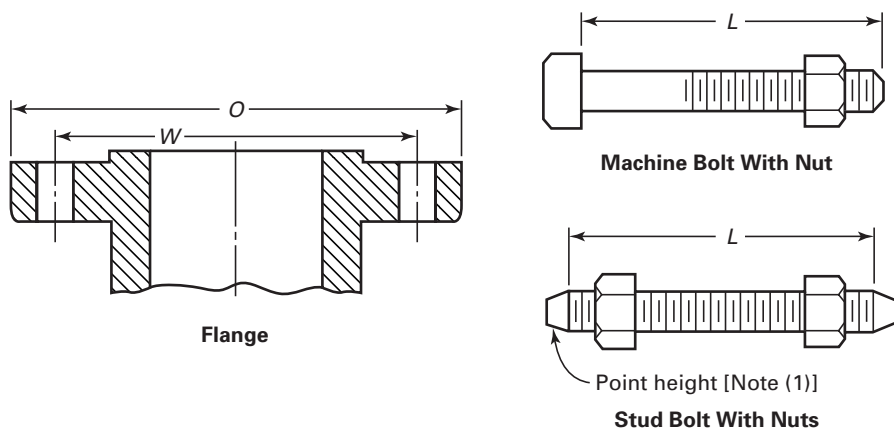
- (a) Dimensions of Table 9 are in millimeters. For dimensions in inch units, refer to Annex F, Table F9.
- (b) For tolerances, see para. 7.
- (c) For facings, see para. 6.4.
- (d) For flange bolt holes, see para. 6.5 and Table 8.
- (e) For spot facing, see para. 6.6.
- (f) For intersecting centerlines, center-to-contact surface, and center-to-end dimensions of side outlet fittings, see para. 6.2.4.
- (g) For center-to-contact surface and center-to-end dimensions of special degree elbows, see para. 6.2.5.
- (h) For reinforcement of certain fittings, see para. 6.1.
- (i) For drains, see para. 6.12.

### NOTES:

- (1) The thickness of flange minimum dimensions for loose flanges, Table 9 sizes NPS 3½ and smaller, are slightly heavier than for flanges on these fittings, which are reinforced by being cast integral with the body of fitting.
- (2) These fittings may be supplied with a flat face flange. The flat face may be either the full  $t_f$  dimension thickness plus 2 mm or the  $t_f$  dimension thickness without the raised face height. See para. 6.3.2 for additional restrictions.
- (3) The thickness of flange dimension illustrated is for regularly furnished 2 mm raised face (except lapped); for thickness requirements of other facings, see Fig. 7.
- (4) For center-to-contact surface and center-to-end dimensions of reducing fittings, see para. 6.2.3.
- (5) For contact surface-to-contact surface and end-to-end dimensions of reducers and eccentric reducers, see para. 6.2.3.
- (6) These dimensions apply to straight sizes only. See paras. 6.2.3 and 6.4.2.2. For center-to-end dimensions of reducing fittings or end-to-end dimensions of reducers, use center-to-contact surface or contact surface-to-contact surface dimensions of 2 mm raised face (flange edge) for largest opening and add the proper height to provide for ring joint groove applying to each flange. See Table 5 for ring joint facing dimensions.
- (7) The base dimensions apply to all straight and reducing sizes.
- (8) For reducing fittings, the size and center-to-face dimension of base are determined by the size of the largest opening of fittings. In the case of reducing base elbows, orders shall specify whether the base shall be opposite the larger or smaller opening.
- (9) Bases shall be plain faced unless otherwise specified, and the center-to-base dimension  $R$  shall be the finished dimension.
- (10) Bases may be cast integral or attached as weldments at the option of the manufacturer.
- (11) The bases of these fittings are intended for support in compression and are not to be used for anchors or supports in tension or shear.



## CLASS 300 PIPE FLANGES, AND FLANGED FITTINGS

**Table 10 Templates for Drilling Class 300 Flanges**

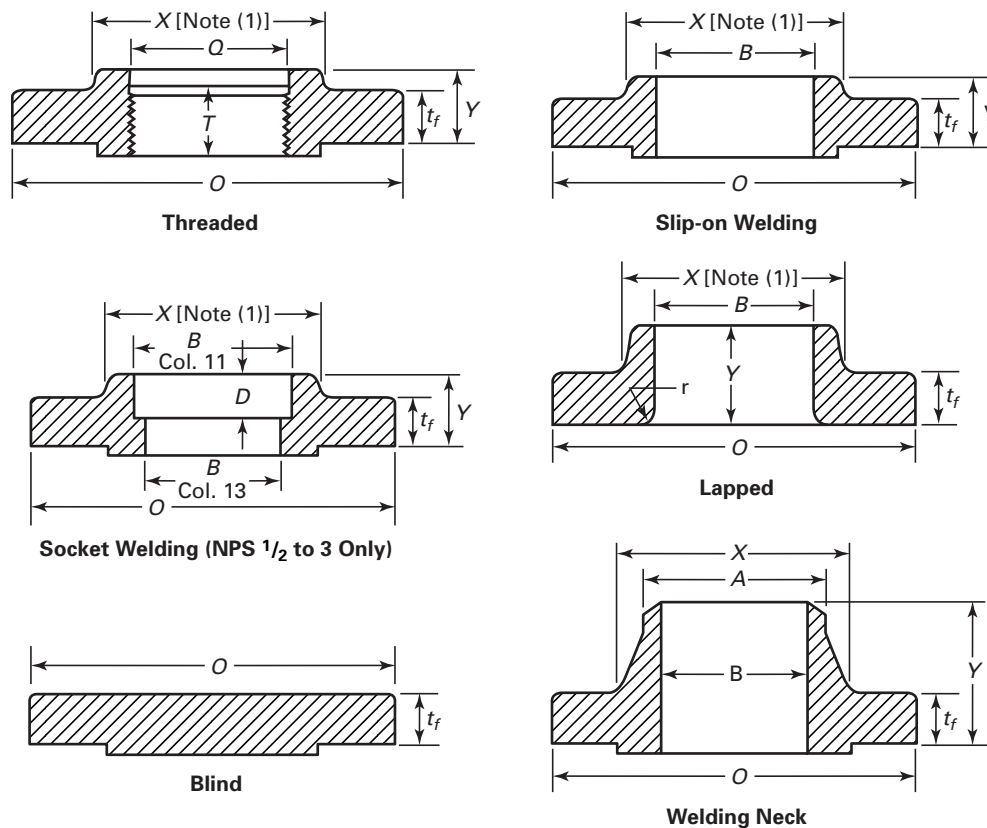
| 1                               | 2                                         | 3                                   | 4                                    | 5                     | 6                            | 7                                      | 8             | 9                      |
|---------------------------------|-------------------------------------------|-------------------------------------|--------------------------------------|-----------------------|------------------------------|----------------------------------------|---------------|------------------------|
| Drilling [Notes (2), (3)]       |                                           |                                     |                                      |                       |                              | Length of Bolts, L<br>[Notes (1), (4)] |               |                        |
| Nominal<br>Pipe<br>Size,<br>NPS | Outside<br>Diameter<br>of<br>Flange,<br>O | Diameter<br>of Bolt<br>Circle,<br>W | Diameter<br>of Bolt<br>Holes,<br>in. | Number<br>of<br>Bolts | Diameter<br>of Bolts,<br>in. | Stud Bolts<br>[Note (1)]               |               | Machine<br>Bolts       |
|                                 |                                           |                                     |                                      |                       |                              | 2 mm<br>Raised<br>Face                 | Ring<br>Joint | 2 mm<br>Raised<br>Face |
| 1/2                             | 95                                        | 66.7                                | 5/8                                  | 4                     | 1/2                          | 65                                     | 75            | 55                     |
| 3/4                             | 115                                       | 82.6                                | 3/4                                  | 4                     | 5/8                          | 75                                     | 90            | 65                     |
| 1                               | 125                                       | 88.9                                | 3/4                                  | 4                     | 5/8                          | 75                                     | 90            | 65                     |
| 1 1/4                           | 135                                       | 98.4                                | 3/4                                  | 4                     | 5/8                          | 85                                     | 95            | 70                     |
| 1 1/2                           | 155                                       | 114.3                               | 7/8                                  | 4                     | 3/4                          | 90                                     | 100           | 75                     |
| 2                               | 165                                       | 127.0                               | 3/4                                  | 8                     | 5/8                          | 90                                     | 100           | 75                     |
| 2 1/2                           | 190                                       | 149.2                               | 7/8                                  | 8                     | 3/4                          | 100                                    | 115           | 85                     |
| 3                               | 210                                       | 168.3                               | 7/8                                  | 8                     | 3/4                          | 110                                    | 120           | 90                     |
| 3 1/2                           | 230                                       | 184.2                               | 7/8                                  | 8                     | 3/4                          | 110                                    | 125           | 95                     |
| 4                               | 255                                       | 200.0                               | 7/8                                  | 8                     | 3/4                          | 115                                    | 125           | 95                     |
| 5                               | 280                                       | 235.0                               | 7/8                                  | 8                     | 3/4                          | 120                                    | 135           | 110                    |
| 6                               | 320                                       | 269.9                               | 7/8                                  | 12                    | 3/4                          | 120                                    | 140           | 110                    |
| 8                               | 380                                       | 330.2                               | 1                                    | 12                    | 7/8                          | 140                                    | 150           | 120                    |
| 10                              | 445                                       | 387.4                               | 1 1/8                                | 16                    | 1                            | 160                                    | 170           | 140                    |
| 12                              | 520                                       | 450.8                               | 1 1/4                                | 16                    | 1 1/8                        | 170                                    | 185           | 145                    |
| 14                              | 585                                       | 514.4                               | 1 1/4                                | 20                    | 1 1/8                        | 180                                    | 190           | 160                    |
| 16                              | 650                                       | 571.5                               | 1 3/8                                | 20                    | 1 1/4                        | 190                                    | 205           | 165                    |
| 18                              | 710                                       | 628.6                               | 1 3/8                                | 24                    | 1 1/4                        | 195                                    | 210           | 170                    |
| 20                              | 775                                       | 685.8                               | 1 3/8                                | 24                    | 1 1/4                        | 205                                    | 220           | 185                    |
| 24                              | 915                                       | 812.8                               | 1 5/8                                | 24                    | 1 1/2                        | 230                                    | 255           | 205                    |

## GENERAL NOTES:

- (a) Dimensions of Table 10 are in millimeters, except for diameters of bolts and bolt holes, which are in inch units. For dimensions in inch units, refer to Annex F, Table F10.
- (b) For other dimensions, see Tables 11 and 12.

## NOTES:

- (1) Length of stud bolt does not include the height of the points. See para. 6.10.2.
- (2) For flange bolt holes, see para. 6.5.
- (3) For spot facing, see para. 6.6.
- (4) Bolt lengths not shown in table may be determined in accordance with Annex D. See para. 6.10.2.



**Table 11 Dimensions of Class 300 Flanges**

Table 11 Dimensions of Class 300 Flanges (Cont'd)

| 1                              | 2                                         | 3                                                                        | 4                                                  | 5                        | 6                                               | 7                                                 | 8            | 9                     | 10                                                       | 11                                              | 12                   | 13                                                        | 14                             | 15                                                    | 16                          |
|--------------------------------|-------------------------------------------|--------------------------------------------------------------------------|----------------------------------------------------|--------------------------|-------------------------------------------------|---------------------------------------------------|--------------|-----------------------|----------------------------------------------------------|-------------------------------------------------|----------------------|-----------------------------------------------------------|--------------------------------|-------------------------------------------------------|-----------------------------|
| Nominal<br>Pipe<br>Size<br>NPS | Outside<br>Diameter<br>of<br>Flange,<br>O | Thickness<br>of<br>Flange<br>Min.,<br>t <sub>f</sub><br>[Notes (2), (3)] | Thickness<br>Lap Joint,<br>Min.,<br>t <sub>f</sub> | Diameter<br>of Hub,<br>X | Chamber<br>Welding,<br>Neck,<br>A<br>[Note (4)] | Length Through Hub                                |              |                       | Thread<br>Length<br>Threaded<br>Min.,<br>T<br>[Note (5)] | Bore                                            |                      |                                                           | Corner<br>Radius<br>of<br>Bore | Counter-<br>bore<br>Threaded<br>Flange,<br>Min.,<br>Q | Depth<br>of<br>Socket,<br>D |
|                                |                                           |                                                                          |                                                    |                          |                                                 | Threading/<br>Slip-on/<br>Socket<br>Welding,<br>Y | Lapped,<br>Y | Welding<br>Neck,<br>Y |                                                          | Slip-<br>on/<br>Socket<br>Welding<br>Min.,<br>B | Lapped<br>Min.,<br>B | Welding<br>Neck/<br>Socket<br>Welding,<br>B<br>[Note (6)] |                                |                                                       |                             |
|                                |                                           |                                                                          |                                                    |                          |                                                 |                                                   |              |                       |                                                          |                                                 |                      |                                                           |                                |                                                       |                             |
| 1½                             | 95                                        | 12.7                                                                     | 14.3                                               | 38                       | 21.3                                            | 21                                                | 22           | 51                    | 16                                                       | 22.2                                            | 22.9                 | 15.8                                                      | 3                              | 23.6                                                  | 10                          |
| ¾                              | 115                                       | 14.3                                                                     | 15.9                                               | 48                       | 26.7                                            | 24                                                | 25           | 56                    | 16                                                       | 27.7                                            | 28.2                 | 20.9                                                      | 3                              | 29.0                                                  | 11                          |
| 1                              | 125                                       | 15.9                                                                     | 17.5                                               | 54                       | 33.4                                            | 25                                                | 27           | 60                    | 18                                                       | 34.5                                            | 34.9                 | 26.6                                                      | 3                              | 35.8                                                  | 13                          |
| 1¼                             | 135                                       | 17.5                                                                     | 19.1                                               | 64                       | 42.2                                            | 25                                                | 27           | 64                    | 21                                                       | 43.2                                            | 43.7                 | 35.1                                                      | 5                              | 44.4                                                  | 14                          |
| 1½                             | 155                                       | 19.1                                                                     | 20.7                                               | 70                       | 48.3                                            | 29                                                | 30           | 67                    | 23                                                       | 49.5                                            | 50.0                 | 40.9                                                      | 6                              | 50.3                                                  | 16                          |
| 2                              | 165                                       | 20.7                                                                     | 22.3                                               | 84                       | 60.3                                            | 32                                                | 33           | 68                    | 29                                                       | 61.9                                            | 62.5                 | 52.5                                                      | 8                              | 63.5                                                  | 17                          |
| 2½                             | 190                                       | 23.9                                                                     | 25.4                                               | 100                      | 73.0                                            | 37                                                | 38           | 75                    | 32                                                       | 74.6                                            | 75.4                 | 62.7                                                      | 8                              | 76.2                                                  | 19                          |
| 3                              | 210                                       | 27.0                                                                     | 28.6                                               | 117                      | 88.9                                            | 41                                                | 43           | 78                    | 32                                                       | 90.7                                            | 91.4                 | 77.9                                                      | 10                             | 92.2                                                  | 21                          |
| 3½                             | 230                                       | 28.6                                                                     | 30.2                                               | 133                      | 101.6                                           | 43                                                | 44           | 79                    | 37                                                       | 103.4                                           | 104.1                | 90.1                                                      | 10                             | 104.9                                                 | ...                         |
| 4                              | 255                                       | 30.2                                                                     | 31.8                                               | 146                      | 114.3                                           | 46                                                | 48           | 84                    | 37                                                       | 116.1                                           | 116.8                | 102.3                                                     | 11                             | 117.6                                                 | ...                         |
| 5                              | 280                                       | 33.4                                                                     | 35.0                                               | 178                      | 141.3                                           | 49                                                | 51           | 97                    | 43                                                       | 143.8                                           | 144.4                | 128.2                                                     | 11                             | 144.4                                                 | ...                         |
| 6                              | 320                                       | 35.0                                                                     | 36.6                                               | 206                      | 168.3                                           | 51                                                | 52           | 97                    | 47                                                       | 170.7                                           | 171.4                | 154.1                                                     | 13                             | 171.4                                                 | ...                         |
| 8                              | 380                                       | 39.7                                                                     | 41.3                                               | 260                      | 219.1                                           | 60                                                | 62           | 110                   | 51                                                       | 221.5                                           | 222.2                | 202.7                                                     | 13                             | 222.2                                                 | ...                         |
| 10                             | 445                                       | 46.1                                                                     | 47.7                                               | 321                      | 273.0                                           | 65                                                | 95           | 116                   | 56                                                       | 276.2                                           | 277.4                | 254.6                                                     | 13                             | 276.2                                                 | ...                         |
| 12                             | 520                                       | 49.3                                                                     | 50.8                                               | 375                      | 323.8                                           | 71                                                | 102          | 129                   | 61                                                       | 327.0                                           | 328.2                | 304.8                                                     | 13                             | 328.6                                                 | ...                         |
| 14                             | 585                                       | 52.4                                                                     | 54.0                                               | 425                      | 355.6                                           | 75                                                | 111          | 141                   | 64                                                       | 359.2                                           | 360.2                | To be                                                     | 13                             | 360.4                                                 | ...                         |
| 16                             | 650                                       | 55.6                                                                     | 57.2                                               | 483                      | 406.4                                           | 81                                                | 121          | 144                   | 69                                                       | 410.5                                           | 411.2                | specified                                                 | 13                             | 411.2                                                 | ...                         |
| 18                             | 710                                       | 58.8                                                                     | 60.4                                               | 533                      | 457.0                                           | 87                                                | 130          | 157                   | 70                                                       | 461.8                                           | 462.3                | specified                                                 | 13                             | 462.0                                                 | ...                         |
| 20                             | 775                                       | 62.0                                                                     | 63.5                                               | 587                      | 508.0                                           | 94                                                | 140          | 160                   | 74                                                       | 513.1                                           | 514.4                | by                                                        | 13                             | 512.8                                                 | ...                         |
| 24                             | 915                                       | 68.3                                                                     | 69.9                                               | 702                      | 610.0                                           | 105                                               | 152          | 167                   | 83                                                       | 616.0                                           | 616.0                | Pur-                                                      | 13                             | 614.4                                                 | ...                         |

**Notes to Table 11**

## GENERAL NOTES:

- (a) Dimensions of Table 11 are in millimeters. For dimensions in inch units, refer to Annex F Table, F11.
- (b) For tolerances, see para 7.
- (c) For facings, see para. 6.4.
- (d) For flange bolt holes, see para. 6.5 and Table 10
- (e) For spot facing, see para. 6.6.
- (f) For reducing threaded and slip-on flanges, see Table 6.
- (g) Blind flanges may be made with or without hubs at the manufacturer's option.
- (h) For reducing welding neck flanges, see para. 6.8.

## NOTES:

- (1) This dimension is for large end of hub, which may be straight or tapered. Taper shall not exceed 7 deg on threaded, slip-on, socket-welding, and lapped flanges. This dimension is defined as the diameter at the intersection between the hub taper and the back face of the flange.
- (2) These flanges may be supplied with a flat face. The flat face may be either the full  $t_{ff}$  dimension thickness plus 2 mm or the  $t_f$  dimension thickness without the raised face height. See para. 6.3.2 for additional restrictions.
- (3) The flange dimensions illustrated are for regularly furnished 2 mm raised face (except lapped); for requirements of other facings, see Fig. 7.
- (4) For welding end bevel, see para. 6.7.
- (5) For thread of threaded flanges, see para. 6.9.
- (6) Dimensions in Column 12 correspond to the inside diameters of pipe as given in ASME B36.10M for Standard Wall pipe. Standard Wall dimensions are the same as Schedule 40 in sizes NPS 10 and smaller. Tolerances in para. 7.5.2 apply. These bore sizes are furnished unless otherwise specified by the purchaser.

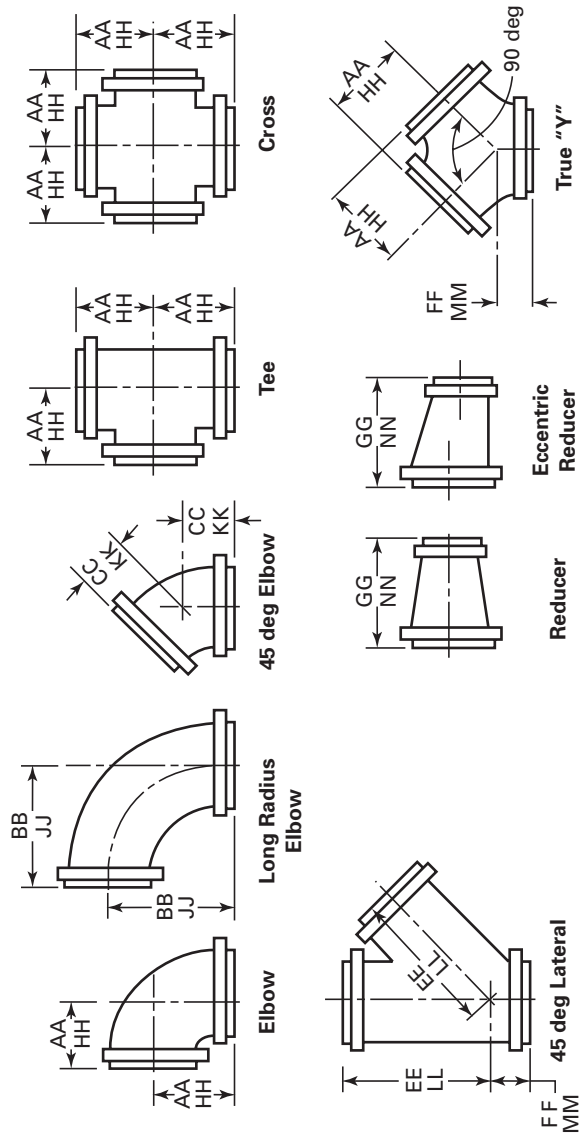
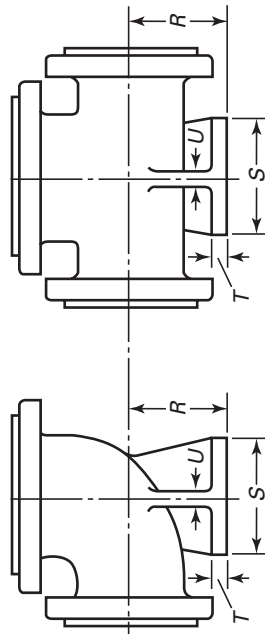
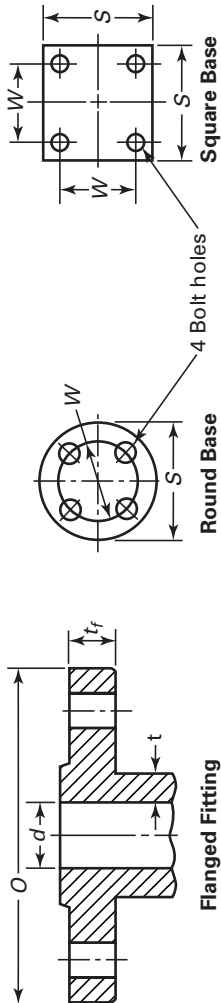


Table 12 Dimensions of Class 300 Flanged Fittings

| 1                                         | 2                                         | 3                                                                              | 4                                                           | 5                                         | 6                                                           | 7                                             | 8                                     | 9                                                | 10                                               | 11                                   | 12                                                                          |
|-------------------------------------------|-------------------------------------------|--------------------------------------------------------------------------------|-------------------------------------------------------------|-------------------------------------------|-------------------------------------------------------------|-----------------------------------------------|---------------------------------------|--------------------------------------------------|--------------------------------------------------|--------------------------------------|-----------------------------------------------------------------------------|
| 2 mm Raised Face (Flange Edge) [Note (4)] |                                           |                                                                                |                                                             |                                           |                                                             |                                               |                                       |                                                  |                                                  |                                      |                                                                             |
| Nominal<br>Pipe<br>Size,<br>NPS           | Outside<br>Diameter<br>of<br>Flange,<br>O | Thickness of<br>Flange<br>Min.,<br>t <sub>f</sub><br>[Notes (1),<br>(2), (11)] | Wall<br>Thickness<br>of Fitting,<br>Min.,<br>t <sub>m</sub> | Inside<br>Diameter<br>of<br>Fitting,<br>d | Center-to-<br>Contact<br>Surface of                         | Center-to-<br>Contact<br>Surface of           | Center-to-<br>Contact<br>Surface of   | Long to-<br>Center- to-<br>Contact<br>Surface of | Short<br>Center- to-<br>Contact<br>Surface of    | Center- to-<br>Contact<br>Surface of | Ring Joint<br>[Note (2)]                                                    |
|                                           |                                           |                                                                                |                                                             |                                           | Raised Face<br>Elbow, Tee,<br>Cross, and<br>True “Y”,<br>AA | Raised Face<br>Long<br>Radius<br>Elbow,<br>BB | Raised Face<br>45 deg<br>Elbow,<br>CC | Raised<br>Face<br>Lateral,<br>EE                 | Raised<br>Face<br>Lateral and<br>True “Y”,<br>FF | Raised<br>Face<br>Reducer,<br>GG     | Center-to-End<br>Elbow, Tee,<br>Cross, and<br>True “Y”,<br>HH<br>[Note (4)] |
| 1                                         | 125                                       | 15.9                                                                           | 4.8                                                         | 25                                        | 102                                                         | 127                                           | 57                                    | 165                                              | 51                                               | 114                                  | 108                                                                         |
| 1¼                                        | 135                                       | 17.5                                                                           | 4.8                                                         | 32                                        | 108                                                         | 140                                           | 64                                    | 184                                              | 57                                               | 114                                  | 114                                                                         |
| 1½                                        | 155                                       | 19.1                                                                           | 4.8                                                         | 38                                        | 114                                                         | 152                                           | 70                                    | 216                                              | 64                                               | 114                                  | 121                                                                         |
| 2                                         | 165                                       | 20.7                                                                           | 6.4                                                         | 51                                        | 127                                                         | 165                                           | 76                                    | 229                                              | 64                                               | 127                                  | 135                                                                         |
| 2½                                        | 190                                       | 23.9                                                                           | 6.4                                                         | 64                                        | 140                                                         | 178                                           | 89                                    | 267                                              | 64                                               | 140                                  | 148                                                                         |
| 3                                         | 210                                       | 27.0                                                                           | 7.1                                                         | 76                                        | 152                                                         | 197                                           | 89                                    | 279                                              | 76                                               | 152                                  | 160                                                                         |
| 3½                                        | 230                                       | 28.6                                                                           | 7.4                                                         | 89                                        | 165                                                         | 216                                           | 102                                   | 318                                              | 76                                               | 165                                  | 173                                                                         |
| 4                                         | 255                                       | 30.2                                                                           | 7.9                                                         | 102                                       | 178                                                         | 229                                           | 114                                   | 343                                              | 76                                               | 178                                  | 186                                                                         |

Table 12 Dimensions of Class 300 Flanged Fittings (Cont'd)

| 1                                         | 2                                                | 3                                                                                    | 4                                                                 | 5                                                | 6                                            | 7                              | 8                                     | 9          | 10         | 11               | 12                                                                         |
|-------------------------------------------|--------------------------------------------------|--------------------------------------------------------------------------------------|-------------------------------------------------------------------|--------------------------------------------------|----------------------------------------------|--------------------------------|---------------------------------------|------------|------------|------------------|----------------------------------------------------------------------------|
| 2 mm Raised Face (Flange Edge) [Note (4)] |                                                  |                                                                                      |                                                                   |                                                  |                                              |                                |                                       |            |            |                  |                                                                            |
| Nominal<br>Pipe<br>Size,<br>NPS           | Outside<br>Diameter<br>of<br>Flange,<br><i>O</i> | Thickness of<br>Flange<br>Min.,<br><i>t<sub>f</sub></i><br>[Notes (1),<br>(2), (11)] | Wall<br>Thickness<br>of Fitting,<br>Min.,<br><i>t<sub>m</sub></i> | Inside<br>Diameter<br>of<br>Fitting,<br><i>d</i> | Center-to-                                   | Center-to-                     | Center-to-                            | Long       | Short      | Contact          | Ring Joint<br>[Note (2)]                                                   |
|                                           |                                                  |                                                                                      |                                                                   |                                                  | Contact                                      | Contact                        | Contact                               | Center-to- | Center-to- | Surface-to-      |                                                                            |
|                                           |                                                  |                                                                                      |                                                                   |                                                  | Surface of                                   | Surface of                     | Surface of                            | Center-    | Surface of | Contact          |                                                                            |
|                                           |                                                  |                                                                                      |                                                                   |                                                  | Raised Face                                  | Raised Face                    | Raised Face                           | to-        | Surface of | Surface of       |                                                                            |
|                                           |                                                  |                                                                                      |                                                                   |                                                  | Elbow, tee,<br>Cross, and<br>True “Y”,<br>AA | Long<br>Radius<br>Elbow,<br>BB | Raised Face<br>45 deg<br>Elbow,<br>CC | to-        | Surface of | Surface of       |                                                                            |
|                                           |                                                  |                                                                                      |                                                                   |                                                  |                                              |                                |                                       | EE         | FF         | GG<br>[Note (3)] | Center-to-End<br>Elbow Tee,<br>Cross, and<br>True “Y”,<br>HH<br>[Note (4)] |
| 5                                         | 280                                              | 33.4                                                                                 | 9.5                                                               | 127                                              | 203                                          | 260                            | 127                                   | 381        | 89         | 203              | 211                                                                        |
| 6                                         | 320                                              | 35.0                                                                                 | 9.5                                                               | 152                                              | 216                                          | 292                            | 140                                   | 445        | 102        | 229              | 224                                                                        |
| 8                                         | 380                                              | 39.7                                                                                 | 11.1                                                              | 203                                              | 254                                          | 356                            | 152                                   | 521        | 127        | 279              | 262                                                                        |
| 10                                        | 445                                              | 46.1                                                                                 | 12.7                                                              | 254                                              | 292                                          | 419                            | 178                                   | 610        | 140        | 305              | 300                                                                        |
| 12                                        | 520                                              | 49.3                                                                                 | 14.3                                                              | 305                                              | 330                                          | 483                            | 203                                   | 698        | 152        | 356              | 338                                                                        |
| 14                                        | 585                                              | 52.4                                                                                 | 15.9                                                              | 337                                              | 381                                          | 546                            | 216                                   | 787        | 165        | 406              | 389                                                                        |
| 16                                        | 650                                              | 55.6                                                                                 | 17.5                                                              | 387                                              | 419                                          | 610                            | 241                                   | 876        | 190        | 457              | 427                                                                        |
| 18                                        | 710                                              | 58.8                                                                                 | 19.0                                                              | 432                                              | 457                                          | 673                            | 254                                   | 952        | 203        | 483              | 465                                                                        |
| 20                                        | 775                                              | 62.0                                                                                 | 20.6                                                              | 483                                              | 495                                          | 737                            | 267                                   | 1029       | 216        | 508              | 505                                                                        |
| 24                                        | 915                                              | 68.3                                                                                 | 23.8                                                              | 584                                              | 572                                          | 864                            | 305                                   | 1206       | 254        | 610              | 583                                                                        |



**Table 12 Dimensions of Class 300 Flanged Fittings (Cont'd)**

| Center-to-End<br>Long Radius<br>Elbow<br>JJ<br>[Note (5)] | Center-to-End<br>45 deg<br>Elbow<br>KK<br>[Note (5)] | Long<br>Center-to-End<br>Lateral,<br>LL<br>[Note (5)] | Short<br>Center-to-End<br>Lateral and<br>True "Y",<br>MM<br>[Note (5)] | End-to-End<br>Reducer,<br>NN<br>[Notes (4),<br>(5)] | Center-to-Base,<br>R<br>[Notes (6)–(8)] | Width of<br>Square<br>Base,<br>S<br>Note (6)] | Thickness of<br>Base,<br>T<br>[Notes (6)–(9)] | Thickness<br>of Ribs,<br>U<br>[Note (6)] | Bolt<br>Circle<br>or Bolt<br>Spacing,<br>W<br>[Note (6)] | Diameter<br>of<br>Drilled<br>Holes | Nominal<br>Pipe<br>Size,<br>NPS |
|-----------------------------------------------------------|------------------------------------------------------|-------------------------------------------------------|------------------------------------------------------------------------|-----------------------------------------------------|-----------------------------------------|-----------------------------------------------|-----------------------------------------------|------------------------------------------|----------------------------------------------------------|------------------------------------|---------------------------------|
|                                                           |                                                      |                                                       |                                                                        |                                                     |                                         |                                               |                                               |                                          |                                                          |                                    |                                 |
|                                                           |                                                      |                                                       |                                                                        |                                                     |                                         |                                               |                                               |                                          |                                                          |                                    |                                 |
| 13                                                        | 14                                                   | 15                                                    | 16                                                                     | 17                                                  | 18                                      | 19                                            | 20                                            | 21                                       | 22                                                       | 23                                 | 1                               |
| Base Tee                                                  |                                                      |                                                       |                                                                        |                                                     |                                         |                                               |                                               |                                          |                                                          |                                    |                                 |
| Base Elbow                                                |                                                      |                                                       |                                                                        |                                                     |                                         |                                               |                                               |                                          |                                                          |                                    |                                 |
| Round Base                                                |                                                      |                                                       |                                                                        |                                                     |                                         |                                               |                                               |                                          |                                                          |                                    |                                 |
| Square Base                                               |                                                      |                                                       |                                                                        |                                                     |                                         |                                               |                                               |                                          |                                                          |                                    |                                 |
| 133                                                       | 64                                                   | 171                                                   | 57                                                                     | ...                                                 | ...                                     | ...                                           | ...                                           | ...                                      | ...                                                      | ...                                | 1                               |
| 146                                                       | 70                                                   | 191                                                   | 64                                                                     | ...                                                 | ...                                     | ...                                           | ...                                           | ...                                      | ...                                                      | ...                                | 1 1/4                           |
| 159                                                       | 76                                                   | 222                                                   | 70                                                                     | ...                                                 | ...                                     | ...                                           | ...                                           | ...                                      | ...                                                      | ...                                | 1 1/2                           |
| 173                                                       | 84                                                   | 237                                                   | 71                                                                     | ...                                                 | 114                                     | 133                                           | 19                                            | 13                                       | 98.4                                                     | 3/4                                | 2                               |
| 186                                                       | 97                                                   | 275                                                   | 71                                                                     | ...                                                 | 121                                     | 133                                           | 19                                            | 13                                       | 98.4                                                     | 3/4                                | 2 1/2                           |
| 205                                                       | 97                                                   | 287                                                   | 84                                                                     | ...                                                 | 133                                     | 156                                           | 21                                            | 16                                       | 114.3                                                    | 7/8                                | 3                               |
| 224                                                       | 110                                                  | 325                                                   | 84                                                                     | ...                                                 | 143                                     | 156                                           | 21                                            | 16                                       | 114.3                                                    | 7/8                                | 3 1/2                           |
| 237                                                       | 124                                                  | 351                                                   | 84                                                                     | ...                                                 | 152                                     | 165                                           | 22                                            | 16                                       | 127.0                                                    | 3/4                                | 4                               |
| 268                                                       | 135                                                  | 389                                                   | 97                                                                     | ...                                                 | 171                                     | 190                                           | 25                                            | 19                                       | 149.2                                                    | 7/8                                | 5                               |
| 300                                                       | 148                                                  | 452                                                   | 110                                                                    | ...                                                 | 190                                     | 190                                           | 25                                            | 19                                       | 149.2                                                    | 7/8                                | 6                               |
| 364                                                       | 160                                                  | 529                                                   | 135                                                                    | ...                                                 | 229                                     | 254                                           | 32                                            | 22                                       | 200.0                                                    | 7/8                                | 8                               |
| 427                                                       | 186                                                  | 618                                                   | 148                                                                    | ...                                                 | 267                                     | 254                                           | 32                                            | 22                                       | 200.0                                                    | 7/8                                | 10                              |
| 491                                                       | 211                                                  | 706                                                   | 160                                                                    | ...                                                 | 305                                     | 318                                           | 36                                            | 25                                       | 269.9                                                    | 7/8                                | 12                              |

Table 12 Dimensions of Class 300 Flanged Fittings (Cont'd)

| 13                                                     | 14                                                | 15                                                 | 16                                                            | 17                        | 18                                                  | 19                                             | 20                                                                                       | 21                                                   | 22                                              | 23                                                | 1                                  |                                 |  |  |  |  |  |  |  |
|--------------------------------------------------------|---------------------------------------------------|----------------------------------------------------|---------------------------------------------------------------|---------------------------|-----------------------------------------------------|------------------------------------------------|------------------------------------------------------------------------------------------|------------------------------------------------------|-------------------------------------------------|---------------------------------------------------|------------------------------------|---------------------------------|--|--|--|--|--|--|--|
| Ring Joint [Note (4)]                                  |                                                   |                                                    |                                                               | Base Drilling [Note (10)] |                                                     |                                                |                                                                                          |                                                      |                                                 |                                                   |                                    |                                 |  |  |  |  |  |  |  |
| Center-to-End<br>Long Radius<br>Elbow JJ<br>[Note (5)] | Center-to-End<br>45 deg<br>Elbow KK<br>[Note (5)] | Long<br>Center-to-End<br>Lateral, LL<br>[Note (5)] | Short                                                         |                           | End-to-End<br>Reducer,<br>NN<br>[Notes<br>(4), (5)] | Center-to-Base,<br><i>R</i><br>[Notes (6)–(8)] | Diameter<br>of Round<br>Base or<br>Width of<br>Square<br>Base,<br><i>S</i><br>[Note (6)] | Thickness of<br>Base,<br><i>T</i><br>[Notes (6)–(9)] | Thickness<br>of Ribs,<br><i>U</i><br>[Note (6)] | Bolt<br>Circle<br>or Bolt<br>Spacing,<br><i>W</i> | Diameter<br>of<br>Drilled<br>Holes | Nominal<br>Pipe<br>Size,<br>NPS |  |  |  |  |  |  |  |
|                                                        |                                                   |                                                    | Center-to-End<br>Lateral and<br>True “Y”,<br>MM<br>[Note (5)] |                           |                                                     |                                                |                                                                                          |                                                      |                                                 |                                                   |                                    |                                 |  |  |  |  |  |  |  |
|                                                        |                                                   |                                                    |                                                               |                           |                                                     |                                                |                                                                                          |                                                      |                                                 |                                                   |                                    |                                 |  |  |  |  |  |  |  |
| 554                                                    | 224                                               | 795                                                | 173                                                           | ...                       | 343                                                 | 318                                            | 36                                                                                       | 25                                                   | 269.9                                           | 7/8                                               | 14                                 |                                 |  |  |  |  |  |  |  |
| 618                                                    | 249                                               | 884                                                | 198                                                           | ...                       | 375                                                 | 318                                            | 36                                                                                       | 29                                                   | 269.9                                           | 7/8                                               | 16                                 |                                 |  |  |  |  |  |  |  |
| 681                                                    | 262                                               | 960                                                | 211                                                           | ...                       | 413                                                 | 381                                            | 41                                                                                       | 29                                                   | 330.2                                           | 1                                                 | 18                                 |                                 |  |  |  |  |  |  |  |
| 746                                                    | 276                                               | 1038                                               | 225                                                           | ...                       | 454                                                 | 381                                            | 41                                                                                       | 32                                                   | 330.2                                           | 1                                                 | 20                                 |                                 |  |  |  |  |  |  |  |
| 875                                                    | 316                                               | 1218                                               | 285                                                           | ...                       | 527                                                 | 444                                            | 48                                                                                       | 32                                                   | 387.4                                           | 1 1/8                                             | 24                                 |                                 |  |  |  |  |  |  |  |

## GENERAL NOTES:

- Dimensions of Table 12 are in millimeters. For dimensions in inch units, refer to Annex F, Table F12.
- For tolerances, see para. 7.
- For facings, see para. 6.4.
- For flange bolt holes, see para. 6.5 and Table 8.
- For spot facing, see para. 6.6
- For intersecting centerlines, center-to-contact surface, and center-to-end dimensions of side outlet fittings, see para. 6.2.4.
- For center-to-contact surface and center-to-end dimensions of special degree elbows, see para. 6.2.5.
- For reinforcement of certain fittings, see para. 6.1.1.
- For drains, see para. 6.12.

## NOTES:

- These fittings may be supplied with a flat face flange. The flat face may be either the full  $t_f$  dimension thickness plus 2 mm or the  $t_f$  dimension thickness without the raised face height. See para. 6.3.2 for additional restrictions.
- The thickness of flange dimension illustrated is for regularly furnished 2 mm raised face (except lapped); for thickness requirements of other facings, see Fig. 7.
- For center-to-contact surface and center-to-end dimensions of reducing fittings, see para. 6.2.3.
- For contact surface-to-contact surface and end-to-end dimensions of reducers and eccentric reducers, see para. 6.2.3.
- These dimensions apply to straight sizes only. See paras. 6.2.3 and 6.4.2.2. For center-to-end dimensions of reducing fittings or end-to-end dimensions of reducers, use center-to-contact surface or contact surface-to-contact surface dimensions of 2 mm raised face (flange edge) for largest opening and add the proper height to provide for ring joint groove applying to each flange. See Table 5 for ring joint facing dimensions.
- The base dimensions apply to all straight and reducing sizes.
- For reducing fittings, the size and center-to-face dimension of base are determined by the size of the largest opening of fittings. In the case of reducing base elbows, orders shall specify whether the base shall be opposite the larger or smaller opening.
- Bases shall be plain faced unless otherwise specified, and the center-to-base dimension  $R$  shall be the finished dimension.
- Bases may be cast integral or attached as weldments at the option of the manufacturer.
- The bases of these fittings are intended for support in compression and are not to be used for anchors or supports in tension or shear.
- The thickness of flange minimum dimensions for loose flanges, Table 9, size NPS  $3\frac{1}{2}$  and smaller, are slightly heavier than for flanges on these fittings which are reinforced by being cast integral with the body of fitting.



## CLASS 400 PIPE FLANGES

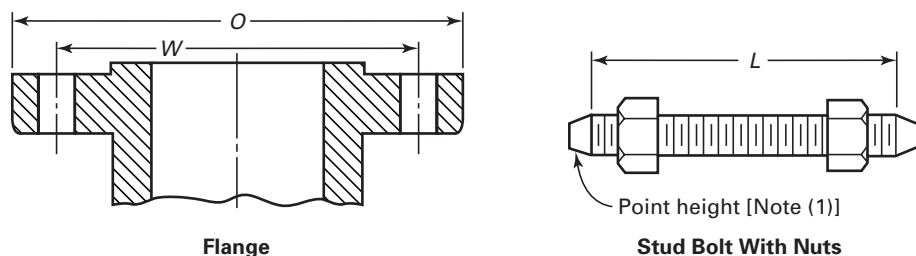


Table 13 Templates for Drilling Class 400 Flanges

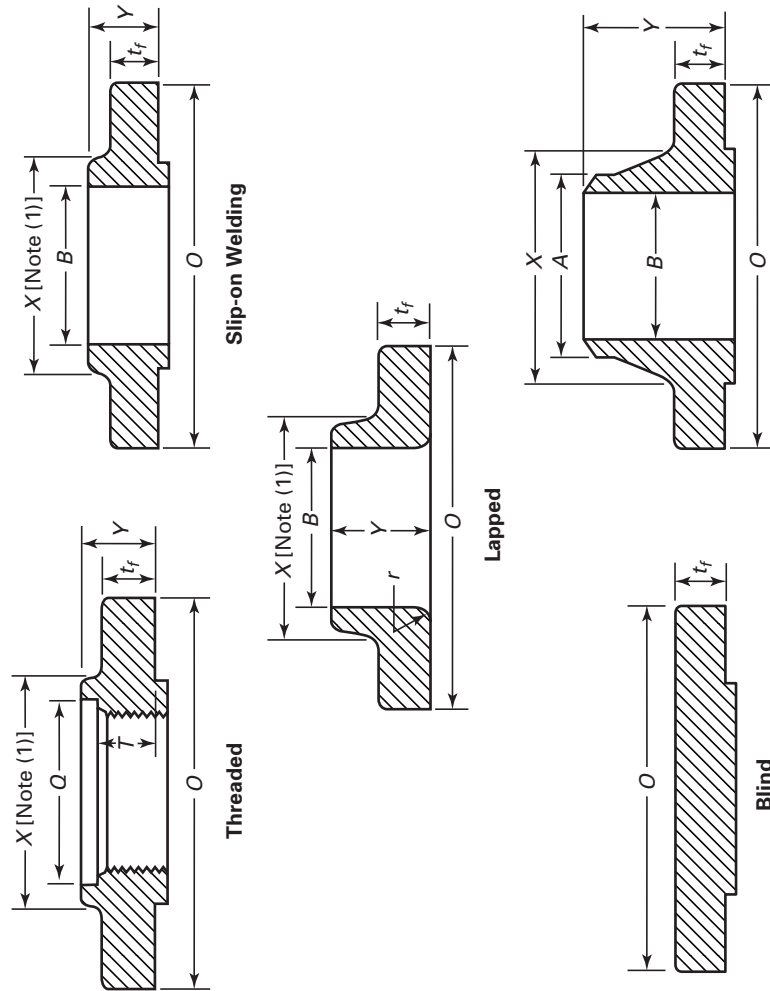
| 1                                       | 2                             | 3                          | 4                          | 5               | 6                                   | 7                | 8                                 | 9          |
|-----------------------------------------|-------------------------------|----------------------------|----------------------------|-----------------|-------------------------------------|------------------|-----------------------------------|------------|
| Drilling [Notes (2), (3)]               |                               |                            |                            |                 | Length of Bolts, L [Notes (1), (4)] |                  |                                   |            |
| Nominal Pipe Size NPS                   | Outside Diameter of Flange, O | Diameter of Bolt Circle, W | Diameter of Bolt Holes in. | Number of Bolts | Diameter of Bolts in.               | 7 mm Raised Face | Male and Female/Tongue and Groove | Ring Joint |
| 1/2                                     |                               |                            |                            |                 |                                     |                  |                                   |            |
| 3/4                                     |                               |                            |                            |                 |                                     |                  |                                   |            |
| 1                                       |                               |                            |                            |                 |                                     |                  |                                   |            |
| 1 1/4                                   |                               |                            |                            |                 |                                     |                  |                                   |            |
| 1 1/2                                   |                               |                            |                            |                 |                                     |                  |                                   |            |
| Use Class 600 Dimensions in these sizes |                               |                            |                            |                 |                                     |                  |                                   |            |
| 2                                       |                               |                            |                            |                 |                                     |                  |                                   |            |
| 2 1/2                                   |                               |                            |                            |                 |                                     |                  |                                   |            |
| 3                                       |                               |                            |                            |                 |                                     |                  |                                   |            |
| 3 1/2                                   |                               |                            |                            |                 |                                     |                  |                                   |            |
| 4                                       | 255                           | 200.0                      | 1                          | 8               | 7/8                                 | 140              | 135                               | 140        |
| 5                                       | 280                           | 235.0                      | 1                          | 8               | 7/8                                 | 145              | 135                               | 145        |
| 6                                       | 320                           | 269.9                      | 1                          | 12              | 7/8                                 | 150              | 145                               | 150        |
| 8                                       | 380                           | 330.0                      | 1 1/8                      | 12              | 1                                   | 170              | 165                               | 170        |
| 10                                      | 445                           | 387.4                      | 1 1/4                      | 16              | 1 1/8                               | 190              | 185                               | 190        |
| 12                                      | 520                           | 450.8                      | 1 3/8                      | 16              | 1 1/4                               | 205              | 195                               | 205        |
| 14                                      | 585                           | 514.4                      | 1 3/8                      | 20              | 1 1/4                               | 210              | 205                               | 210        |
| 16                                      | 650                           | 571.5                      | 1 1/2                      | 20              | 1 3/8                               | 220              | 215                               | 220        |
| 18                                      | 710                           | 628.6                      | 1 1/2                      | 24              | 1 3/8                               | 230              | 220                               | 230        |
| 20                                      | 775                           | 685.8                      | 1 5/8                      | 24              | 1 1/2                               | 240              | 235                               | 250        |
| 24                                      | 915                           | 812.8                      | 1 7/8                      | 24              | 1 3/4                               | 265              | 260                               | 280        |

## GENERAL NOTES:

- (a) Dimensions of Table 13 are in millimeters, except for diameter of bolts and bolt holes, which are in inch units. For dimensions in inch units refer to Annex F, Table F13.
- (b) For other dimensions, see Table 14.

## NOTES:

- (1) Length of stud bolt does not include the height of the points. See para. 6.10.2.
- (2) For flange bolt holes, see para. 6.5.
- (3) For spot facing, see para. 6.6.
- (4) Bolt lengths not shown in table may be determined in accordance with Annex D. See, para. 6.10.2.



Welding Neck

Table 14 Dimensions of Class 400 Flanges

| 1                           | 2                                        | 3                                        | 4                          | 5                                                                                      | 6                            | 7              | 8                       | 9                                                                    | 10                      | 11                     | 12                      | 13                                                                     | 14                                                |
|-----------------------------|------------------------------------------|------------------------------------------|----------------------------|----------------------------------------------------------------------------------------|------------------------------|----------------|-------------------------|----------------------------------------------------------------------|-------------------------|------------------------|-------------------------|------------------------------------------------------------------------|---------------------------------------------------|
| Nominal<br>Pipe Size<br>NPS | Outside<br>Diameter<br>of Flange,<br>$O$ | Thickness<br>of Flange<br>Min.,<br>$t_f$ | Diameter<br>of Hub,<br>$X$ | Hub<br>Diameter<br>Beginning<br>of Chamfer<br>of Welding<br>Neck,<br>$A$<br>[Note (2)] | Length Through Hub           |                |                         | Thread<br>Length<br>Threaded<br>Flange<br>Min.,<br>$T$<br>[Note (3)] | Bore                    |                        |                         | Corner<br>Radius of<br>Bore of<br>Lapped<br>Flange<br>and Pipe,<br>$r$ | Counterbore<br>Threaded<br>Flange<br>Min.,<br>$Q$ |
|                             |                                          |                                          |                            |                                                                                        | Threaded/<br>Slip-on,<br>$Y$ | Lapped,<br>$Y$ | Welding<br>Neck,<br>$Y$ |                                                                      | Slip-on<br>Min.,<br>$B$ | Lapped<br>Min.,<br>$B$ | Welding<br>Neck,<br>$B$ |                                                                        |                                                   |
|                             |                                          |                                          |                            |                                                                                        |                              |                |                         |                                                                      |                         |                        |                         |                                                                        |                                                   |
|                             |                                          |                                          |                            |                                                                                        |                              |                |                         |                                                                      |                         |                        |                         |                                                                        |                                                   |

Use Class 600 Dimensions in these sizes [Note (4)].

$\frac{1}{2}$   
 $\frac{3}{4}$   
 $1$   
 $1\frac{1}{4}$   
 $1\frac{1}{2}$

**Table 14 Dimensions of Class 400 Flanges (Cont'd)**

| 1                                                   | 2                                             | 3                                                       | 4                               | 5                                                                                        | 6                                 | 7                   | 8                            | 9                                                                        | 10                           | 11                          | 12                                                                          | 13                                                     | 14    |
|-----------------------------------------------------|-----------------------------------------------|---------------------------------------------------------|---------------------------------|------------------------------------------------------------------------------------------|-----------------------------------|---------------------|------------------------------|--------------------------------------------------------------------------|------------------------------|-----------------------------|-----------------------------------------------------------------------------|--------------------------------------------------------|-------|
| Nominal<br>Pipe Size<br>NPS                         | Outside<br>Diameter<br>of Flange,<br><i>O</i> | Thickness<br>of Flange<br>Min.,<br><i>t<sub>f</sub></i> | Diameter<br>of Hub,<br><i>X</i> | Hub<br>Diameter<br>Beginning<br>of Chamfer<br>Welding<br>Neck,<br><i>A</i><br>[Note (2)] | Length Through Hub                |                     |                              | Thread<br>Length<br>Through<br>Flange<br>Min.,<br><i>T</i><br>[Note (3)] | Bore                         |                             | Corner<br>Radius of<br>Bore of<br>Lapped<br>Flange<br>and Pipe,<br><i>r</i> | Counterbore<br>Threaded<br>Flange<br>Min.,<br><i>Q</i> |       |
|                                                     |                                               |                                                         |                                 |                                                                                          | Threaded/<br>Slip-on,<br><i>Y</i> | Lapped,<br><i>Y</i> | Welding<br>Neck,<br><i>Y</i> |                                                                          | Slip-on<br>Min.,<br><i>B</i> | Lapped<br>Min.,<br><i>B</i> |                                                                             |                                                        |       |
|                                                     |                                               |                                                         |                                 |                                                                                          |                                   |                     |                              |                                                                          |                              |                             |                                                                             |                                                        |       |
| Use Class 600 Dimensions in these sizes [Note (4)]. |                                               |                                                         |                                 |                                                                                          |                                   |                     |                              |                                                                          |                              |                             |                                                                             |                                                        |       |
| 2                                                   |                                               |                                                         |                                 |                                                                                          |                                   |                     |                              |                                                                          |                              |                             |                                                                             |                                                        |       |
| 2½                                                  |                                               |                                                         |                                 |                                                                                          |                                   |                     |                              |                                                                          |                              |                             |                                                                             |                                                        |       |
| 3                                                   |                                               |                                                         |                                 |                                                                                          |                                   |                     |                              |                                                                          |                              |                             |                                                                             |                                                        |       |
| 3½                                                  |                                               |                                                         |                                 |                                                                                          |                                   |                     |                              |                                                                          |                              |                             |                                                                             |                                                        |       |
| 4                                                   | 255                                           | 35.0                                                    | 146                             | 114.3                                                                                    | 51                                | 51                  | 89                           | 37                                                                       | 116.1                        | 116.8                       | To be                                                                       | 11                                                     | 117.6 |
| 5                                                   | 280                                           | 38.1                                                    | 178                             | 141.3                                                                                    | 54                                | 54                  | 102                          | 43                                                                       | 143.8                        | 144.5                       | specified                                                                   | 11                                                     | 144.4 |
| 6                                                   | 320                                           | 41.3                                                    | 206                             | 168.3                                                                                    | 57                                | 57                  | 103                          | 46                                                                       | 170.7                        | 171.4                       | by                                                                          | 13                                                     | 171.4 |
| 8                                                   | 380                                           | 47.7                                                    | 260                             | 219.1                                                                                    | 68                                | 68                  | 117                          | 51                                                                       | 221.5                        | 222.2                       | purchaser                                                                   | 13                                                     | 222.2 |
| 10                                                  | 445                                           | 54.0                                                    | 321                             | 273.0                                                                                    | 73                                | 102                 | 124                          | 56                                                                       | 276.2                        | 277.4                       |                                                                             | 13                                                     | 276.2 |
| 12                                                  | 520                                           | 57.2                                                    | 375                             | 323.8                                                                                    | 79                                | 108                 | 137                          | 61                                                                       | 327.0                        | 328.2                       |                                                                             | 13                                                     | 328.6 |
| 14                                                  | 585                                           | 60.4                                                    | 425                             | 355.6                                                                                    | 84                                | 117                 | 149                          | 64                                                                       | 359.2                        | 360.2                       |                                                                             | 13                                                     | 360.4 |
| 16                                                  | 650                                           | 63.5                                                    | 483                             | 406.4                                                                                    | 94                                | 127                 | 152                          | 69                                                                       | 410.5                        | 411.2                       |                                                                             | 13                                                     | 411.2 |
| 18                                                  | 710                                           | 66.7                                                    | 533                             | 457.0                                                                                    | 98                                | 137                 | 165                          | 70                                                                       | 461.8                        | 462.3                       |                                                                             | 13                                                     | 462.0 |
| 20                                                  | 775                                           | 69.9                                                    | 587                             | 508.0                                                                                    | 102                               | 146                 | 168                          | 74                                                                       | 513.1                        | 514.4                       |                                                                             | 13                                                     | 512.8 |
| 24                                                  | 915                                           | 76.2                                                    | 702                             | 610.0                                                                                    | 114                               | 159                 | 175                          | 83                                                                       | 616.0                        | 616.0                       |                                                                             | 13                                                     | 614.4 |

Use Class 600 Dimensions in these sizes [Note (4)].

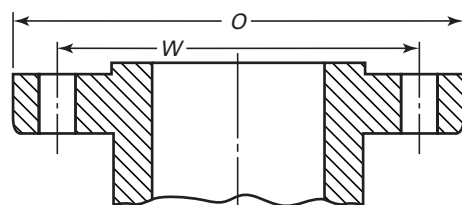
**GENERAL NOTES:**

- (a) Dimensions of Table 14 are in millimeters, except for diameter of bolts and bolt holes, which are in inch units. For dimensions in inch units, refer to Annex F, Table F7.
- (b) For tolerances, see para. 7.
- (c) For facings, see para. 6.4.
- (d) For flange bolt holes, see para. 6.5 and Table 13.
- (e) For spot facing, see para 6.6.
- (f) For reducing threaded and slip-on flanges, see Table 6.
- (g) Blind flanges may be made with or without hubs at the manufacturer's option.
- (h) For reducing welding neck flanges, see para 6.8.

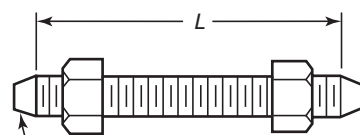
**NOTES:**

- (1) This dimension is for large end of hub, which may be straight or tapered. Taper shall not exceed 7 deg on threaded, slip-on, socket-welding, and lapped flanges. This dimension is defined as the diameter at the intersection between the hub taper and the back face of the flange.
- (2) For welding end bevel, see para. 6.7.
- (3) For thread of threaded flanges, see para. 6.9.
- (4) Socket welding flanges may be provided in NPS ½ through NPS 2½, using Class 600 dimensions.

## CLASS 600 PIPE FLANGES AND FLANGED FITTINGS



Flange



Point height [Note (1)]

Stud Bolt With Nuts

Table 15 Templates for Drilling Class 600 Flanges

| 1                           | 2                                             | 3                                          | 4                                   | 5                     | 6                           | 7                                                | 8                                           | 9             |
|-----------------------------|-----------------------------------------------|--------------------------------------------|-------------------------------------|-----------------------|-----------------------------|--------------------------------------------------|---------------------------------------------|---------------|
| Nominal<br>Pipe Size<br>NPS | Outside<br>Diameter<br>of Flange,<br><i>O</i> | Drilling [Notes (2), (3)]                  |                                     |                       |                             | Length of Bolts,<br><i>L</i><br>[Notes (1), (4)] |                                             |               |
|                             |                                               | Diameter<br>of Bolt<br>Circle,<br><i>W</i> | Diameter<br>of Bolt<br>Holes<br>in. | Number<br>of<br>Bolts | Diameter<br>of Bolts<br>in. | 7 mm<br>Raised<br>Face                           | Male and<br>Female/<br>Tongue<br>and Groove | Ring<br>Joint |
|                             |                                               |                                            |                                     |                       |                             |                                                  |                                             |               |
| 1/2                         | 95                                            | 66.7                                       | 5/8                                 | 4                     | 1/2                         | 75                                               | 70                                          | 75            |
| 3/4                         | 115                                           | 82.6                                       | 3/4                                 | 4                     | 5/8                         | 90                                               | 85                                          | 90            |
| 1                           | 125                                           | 88.9                                       | 3/4                                 | 4                     | 5/8                         | 90                                               | 85                                          | 90            |
| 1 1/4                       | 135                                           | 98.4                                       | 3/4                                 | 4                     | 5/8                         | 95                                               | 90                                          | 95            |
| 1 1/2                       | 155                                           | 114.3                                      | 7/8                                 | 4                     | 3/4                         | 110                                              | 100                                         | 110           |
| 2                           | 165                                           | 127.0                                      | 3/4                                 | 8                     | 5/8                         | 110                                              | 100                                         | 110           |
| 2 1/2                       | 190                                           | 149.2                                      | 7/8                                 | 8                     | 3/4                         | 120                                              | 115                                         | 120           |
| 3                           | 210                                           | 168.3                                      | 7/8                                 | 8                     | 3/4                         | 125                                              | 120                                         | 125           |
| 3 1/2                       | 230                                           | 184.2                                      | 1                                   | 8                     | 7/8                         | 140                                              | 135                                         | 140           |
| 4                           | 275                                           | 215.9                                      | 1                                   | 8                     | 7/8                         | 145                                              | 140                                         | 145           |
| 5                           | 330                                           | 266.7                                      | 1 1/8                               | 8                     | 1                           | 165                                              | 160                                         | 165           |
| 6                           | 355                                           | 292.1                                      | 1 1/8                               | 12                    | 1                           | 170                                              | 165                                         | 170           |
| 8                           | 420                                           | 349.2                                      | 1 1/4                               | 12                    | 1 1/8                       | 190                                              | 185                                         | 195           |
| 10                          | 510                                           | 431.8                                      | 1 3/8                               | 16                    | 1 1/4                       | 215                                              | 210                                         | 215           |
| 12                          | 560                                           | 489.0                                      | 1 3/8                               | 20                    | 1 1/4                       | 220                                              | 215                                         | 220           |
| 14                          | 605                                           | 527.0                                      | 1 1/2                               | 20                    | 1 3/8                       | 235                                              | 230                                         | 235           |
| 16                          | 685                                           | 603.2                                      | 1 5/8                               | 20                    | 1 1/2                       | 255                                              | 250                                         | 255           |
| 18                          | 745                                           | 654.0                                      | 1 3/4                               | 20                    | 1 5/8                       | 275                                              | 265                                         | 275           |
| 20                          | 815                                           | 723.9                                      | 1 3/4                               | 24                    | 1 5/8                       | 285                                              | 280                                         | 290           |
| 24                          | 940                                           | 838.2                                      | 2                                   | 24                    | 1 7/8                       | 330                                              | 325                                         | 335           |

## GENERAL NOTES:

- (a) Dimensions of Table 15 are in millimeters, except for diameters of bolts and bolt holes, which are expressed in inch units. For dimensions in inch units, refer to Annex F, Table F15.
- (b) For other dimensions, see Table 16.

## NOTES:

- (1) Length of stud bolt does not include the height of the points. See para 6.10.2.
- (2) For flange bolt holes, see para. 6.5.
- (3) For spot facing, see para 6.6.
- (4) Bolt lengths not shown in table may be in accordance with Annex D. See para. 6.10.2.

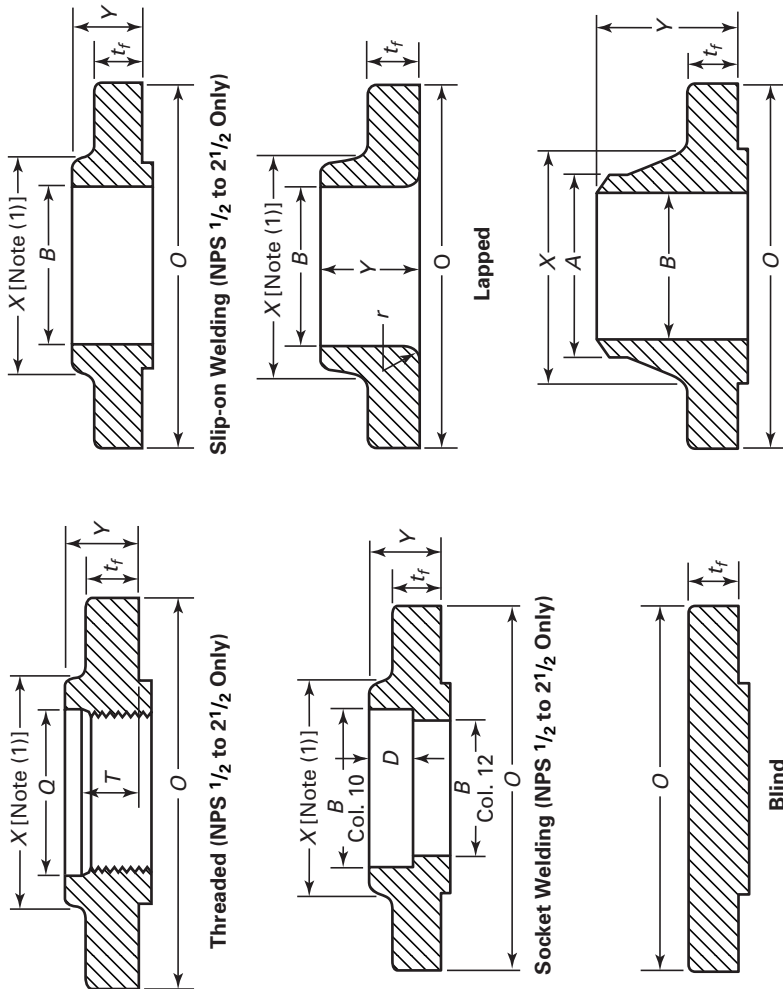


Table 16 Dimensions of Class 600 Flanges

| 1                           | 2                                         | 3                                                     | 4                           | 5                                                             | 6                                           | 7            | 8                     | 9                                            | 10                                                             | 11                   | 12                                          | 13                                                                   | 14                                                  | 15                       |
|-----------------------------|-------------------------------------------|-------------------------------------------------------|-----------------------------|---------------------------------------------------------------|---------------------------------------------|--------------|-----------------------|----------------------------------------------|----------------------------------------------------------------|----------------------|---------------------------------------------|----------------------------------------------------------------------|-----------------------------------------------------|--------------------------|
| Nominal<br>Pipe Size<br>NPS | Outside<br>Diameter<br>of<br>Flange,<br>O | Thickness<br>of<br>Flange,<br>Min.,<br>t <sub>f</sub> | Diameter<br>of<br>Hub,<br>X | Hub Diameter<br>Beginning of<br>Chamfer<br>Welding Neck,<br>A | Length Through Hub                          |              |                       |                                              | Thread<br>Length<br>Thru<br>Flange<br>Min.,<br>T<br>[Note (3)] | Bore                 |                                             | Corner<br>Radius of<br>Bore of<br>Lapped<br>Flange and<br>Pipe,<br>r | Counter<br>bore<br>Threaded<br>Flange<br>Min.,<br>Q | Depth of<br>Socket,<br>D |
|                             |                                           |                                                       |                             |                                                               | Thru<br>Slip-on/<br>Socket<br>Welding,<br>Y | Lapped,<br>Y | Welding<br>Neck,<br>Y | Slip-on/<br>Socket<br>Welding,<br>Min.,<br>B |                                                                | Lapped<br>Min.,<br>B | Welding<br>Neck/<br>Socket<br>Welding,<br>B |                                                                      |                                                     |                          |
|                             |                                           |                                                       |                             |                                                               |                                             |              |                       |                                              |                                                                |                      |                                             |                                                                      |                                                     |                          |
|                             |                                           |                                                       |                             |                                                               |                                             |              |                       |                                              |                                                                |                      |                                             |                                                                      |                                                     |                          |
|                             |                                           |                                                       |                             |                                                               |                                             |              |                       |                                              |                                                                |                      |                                             |                                                                      |                                                     |                          |
| 1/2                         | 95                                        | 14.3                                                  | 38                          | 21.3                                                          | 22                                          | 22           | 52                    | 16                                           | 22.2                                                           | 22.9                 | To be                                       | 3                                                                    | 23.6                                                | 10                       |
| 3/4                         | 115                                       | 15.9                                                  | 48                          | 26.7                                                          | 25                                          | 25           | 57                    | 16                                           | 27.7                                                           | 28.2                 | specified                                   | 3                                                                    | 29.0                                                | 11                       |
| 1                           | 125                                       | 17.5                                                  | 54                          | 33.4                                                          | 27                                          | 27           | 62                    | 18                                           | 34.5                                                           | 34.9                 | by                                          | 3                                                                    | 35.8                                                | 13                       |
| 1 1/4                       | 135                                       | 20.7                                                  | 64                          | 42.2                                                          | 29                                          | 29           | 67                    | 21                                           | 43.2                                                           | 43.7                 | Purchaser                                   | 5                                                                    | 44.4                                                | 14                       |
| 1 1/2                       | 155                                       | 22.3                                                  | 70                          | 48.3                                                          | 32                                          | 32           | 70                    | 23                                           | 49.5                                                           | 50.0                 |                                             | 6                                                                    | 50.6                                                | 16                       |

Table 16 Dimensions of Class 600 Flanges (Cont'd)

| 1                           | 2                                      | 3                                                 | 4                        | 5                                                                           | 6                                                 | 7            | 8                     | 9                                  | 10                                          | 11                    | 12                                          | 13                                                                   | 14                                                 | 15                       |
|-----------------------------|----------------------------------------|---------------------------------------------------|--------------------------|-----------------------------------------------------------------------------|---------------------------------------------------|--------------|-----------------------|------------------------------------|---------------------------------------------|-----------------------|---------------------------------------------|----------------------------------------------------------------------|----------------------------------------------------|--------------------------|
| Nominal<br>Pipe Size<br>NPS | Outside<br>Diameter<br>of Flange,<br>O | Thickness<br>of Flange,<br>Min.<br>t <sub>f</sub> | Diameter<br>of Hub,<br>X | Hub Diameter<br>Beginning of<br>Chamfer<br>Welding Neck,<br>A<br>[Note (2)] | Length Through Hub                                |              |                       | Thread<br>Length                   | Bore                                        |                       | Welding<br>Neck/<br>Socket<br>Welding,<br>B | Corner<br>Radius of<br>Bore of<br>Lapped<br>Flange and<br>Pipe,<br>r | Counter<br>bore<br>Threaded<br>Flange<br>Min.<br>Q | Depth of<br>Socket,<br>D |
|                             |                                        |                                                   |                          |                                                                             | Threading/<br>Slip-on/<br>Socket<br>Welding,<br>Y | Lapped,<br>Y | Welding<br>Neck,<br>Y | Flange<br>Min.,<br>T<br>[Note (3)] | Slip-on/<br>Socket<br>Welding<br>Min.,<br>B | Lapped,<br>Min.,<br>B |                                             |                                                                      |                                                    |                          |
| 2                           | 165                                    | 25.4                                              | 84                       | 60.3                                                                        | 37                                                | 37           | 73                    | 29                                 | 61.9                                        | 62.5                  |                                             | 8                                                                    | 63.5                                               | 17                       |
| 2½                          | 190                                    | 28.6                                              | 100                      | 73.0                                                                        | 41                                                | 41           | 79                    | 32                                 | 74.6                                        | 75.4                  |                                             | 8                                                                    | 76.2                                               | 19                       |
| 3                           | 210                                    | 31.8                                              | 117                      | 88.9                                                                        | 46                                                | 46           | 83                    | 35                                 | 90.7                                        | 91.4                  |                                             | 10                                                                   | 92.2                                               | 21                       |
| 3½                          | 230                                    | 35.0                                              | 133                      | 101.6                                                                       | 49                                                | 49           | 86                    | 40                                 | 103.4                                       | 104.1                 |                                             | 10                                                                   | 104.9                                              | ...                      |
| 4                           | 275                                    | 38.1                                              | 152                      | 114.3                                                                       | 54                                                | 54           | 102                   | 42                                 | 116.1                                       | 116.8                 |                                             | 11                                                                   | 117.6                                              | ...                      |
| 5                           | 330                                    | 44.5                                              | 189                      | 141.3                                                                       | 60                                                | 60           | 114                   | 48                                 | 143.8                                       | 144.4                 |                                             | 11                                                                   | 144.4                                              | ...                      |
| 6                           | 355                                    | 47.7                                              | 222                      | 168.3                                                                       | 67                                                | 67           | 117                   | 51                                 | 170.7                                       | 171.4                 |                                             | 13                                                                   | 171.4                                              | ...                      |
| 8                           | 420                                    | 55.6                                              | 273                      | 219.1                                                                       | 76                                                | 76           | 133                   | 58                                 | 221.5                                       | 222.2                 |                                             | 13                                                                   | 222.2                                              | ...                      |
| 10                          | 510                                    | 63.5                                              | 343                      | 273.0                                                                       | 86                                                | 111          | 152                   | 66                                 | 276.2                                       | 277.4                 |                                             | 13                                                                   | 276.2                                              | ...                      |
| 12                          | 560                                    | 66.7                                              | 400                      | 323.8                                                                       | 92                                                | 117          | 156                   | 70                                 | 327.0                                       | 328.2                 |                                             | 13                                                                   | 328.6                                              | ...                      |
| 14                          | 605                                    | 69.9                                              | 432                      | 355.6                                                                       | 94                                                | 127          | 165                   | 74                                 | 359.2                                       | 360.2                 |                                             | 13                                                                   | 360.4                                              | ...                      |
| 16                          | 685                                    | 76.2                                              | 495                      | 406.4                                                                       | 106                                               | 140          | 178                   | 78                                 | 410.5                                       | 411.2                 |                                             | 13                                                                   | 411.2                                              | ...                      |
| 18                          | 745                                    | 82.6                                              | 546                      | 457.0                                                                       | 117                                               | 152          | 184                   | 80                                 | 461.8                                       | 462.3                 |                                             | 13                                                                   | 462.0                                              | ...                      |
| 20                          | 815                                    | 88.9                                              | 610                      | 508.0                                                                       | 127                                               | 165          | 190                   | 83                                 | 513.1                                       | 514.4                 |                                             | 13                                                                   | 512.8                                              | ...                      |
| 24                          | 940                                    | 101.6                                             | 718                      | 610.0                                                                       | 140                                               | 184          | 203                   | 93                                 | 616.0                                       | 616.0                 |                                             | 13                                                                   | 614.4                                              | ...                      |

## GENERAL NOTES:

(a) Dimensions of Table 16 are in millimeters, except for diameter of bolts and bolt holes, which are in inch units. For dimensions in inch units, refer to Annex F, Table F16.

(b) For tolerance, see para. 7.

(c) For facings, see para. 6.4.

(d) For flange bolt holes, see para. 6.5 and Table 15.

(e) For spot facing, see para. 6.6.

(f) For reducing threaded and slip-on flanges, see Table 6.

(g) Blind flanges may be made with or without hubs at the manufacturer's option.

(h) For reducing welding neck flanges, see para. 6.8.

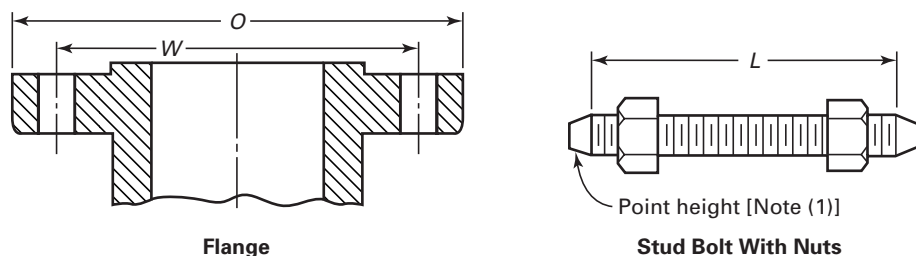
## NOTES:

(1) This dimension is for large end of hub, which may be straight or tapered. Taper shall not exceed 7 deg on threaded, slip-on, socket-welding, and lapped flanges. This dimension is defined as the diameter at the intersection between the hub taper and the back face of the flange.

(2) For welding end bevel, see para. 6.7.

(3) For thread of threaded flanges, see para. 6.9.

## CLASS 900 PIPE FLANGES AND FLANGED FITTINGS

**Table 17 Templates for Drilling Class 900 Flanges**

| Nominal<br>Pipe Size<br>NPS               | Outside<br>Diameter<br>of Flange,<br>O | Drilling [Notes (2), (3)]        |                                   |                    |                           | Length of Bolts,<br>L<br>[Notes (1), (4)] |                                       |            |
|-------------------------------------------|----------------------------------------|----------------------------------|-----------------------------------|--------------------|---------------------------|-------------------------------------------|---------------------------------------|------------|
|                                           |                                        | Diameter of<br>Bolt Circle,<br>W | Diameter of<br>Bolt Holes,<br>in. | Number of<br>Bolts | Diameter of<br>Bolts, in. | 7 mm<br>Raised Face                       | Male and Female/<br>Tongue and Groove | Ring Joint |
|                                           |                                        |                                  |                                   |                    |                           |                                           |                                       |            |
| 1/2                                       |                                        |                                  |                                   |                    |                           |                                           |                                       |            |
| 3/4                                       |                                        |                                  |                                   |                    |                           |                                           |                                       |            |
| 1                                         |                                        |                                  |                                   |                    |                           |                                           |                                       |            |
| Use Class 1500 dimensions in these sizes. |                                        |                                  |                                   |                    |                           |                                           |                                       |            |
| 1 1/4                                     |                                        |                                  |                                   |                    |                           |                                           |                                       |            |
| 1 1/2                                     |                                        |                                  |                                   |                    |                           |                                           |                                       |            |
| 2                                         |                                        |                                  |                                   |                    |                           |                                           |                                       |            |
| 2 1/2                                     |                                        |                                  |                                   |                    |                           |                                           |                                       |            |
| 3                                         | 240                                    | 190.5                            | 1                                 | 8                  | 7/8                       | 145                                       | 140                                   | 145        |
| 4                                         | 290                                    | 235.0                            | 1 1/4                             | 8                  | 1 1/8                     | 170                                       | 165                                   | 170        |
| 5                                         | 350                                    | 279.4                            | 1 3/8                             | 8                  | 1 1/4                     | 190                                       | 185                                   | 190        |
| 6                                         | 380                                    | 317.5                            | 1 1/4                             | 12                 | 1 1/8                     | 190                                       | 185                                   | 195        |
| 8                                         | 470                                    | 393.7                            | 1 1/2                             | 12                 | 1 3/8                     | 220                                       | 215                                   | 220        |
| 10                                        | 545                                    | 469.9                            | 1 1/2                             | 16                 | 1 3/8                     | 235                                       | 230                                   | 235        |
| 12                                        | 610                                    | 533.4                            | 1 1/2                             | 20                 | 1 3/8                     | 255                                       | 250                                   | 255        |
| 14                                        | 640                                    | 558.8                            | 1 5/8                             | 20                 | 1 1/2                     | 275                                       | 265                                   | 280        |
| 16                                        | 705                                    | 616.0                            | 1 3/4                             | 20                 | 1 5/8                     | 285                                       | 280                                   | 290        |
| 18                                        | 785                                    | 685.8                            | 2                                 | 20                 | 1 7/8                     | 325                                       | 320                                   | 335        |
| 20                                        | 855                                    | 749.3                            | 2 1/8                             | 20                 | 2                         | 350                                       | 345                                   | 360        |
| 24                                        | 1,040                                  | 901.7                            | 2 5/8                             | 20                 | 2 1/2                     | 440                                       | 430                                   | 455        |

## GENERAL NOTES:

- (a) Dimensions of Table 17 are in millimeters, except for diameters of bolts and bolt holes, which are in inch units. For dimensions in inch units, refer to Annex F, Table F17.
- (b) For other dimensions, see Tables 18 and 19.

## NOTES:

- (1) Length of stud bolt does not include the height of the points. See para 6.10.2.
- (2) For flange bolt holes, see para. 6.5.
- (3) For spot facing, see para. 6.6.
- (4) Bolt lengths not shown in Table may be determined in accordance with Annex D. See para. 6.10.2.

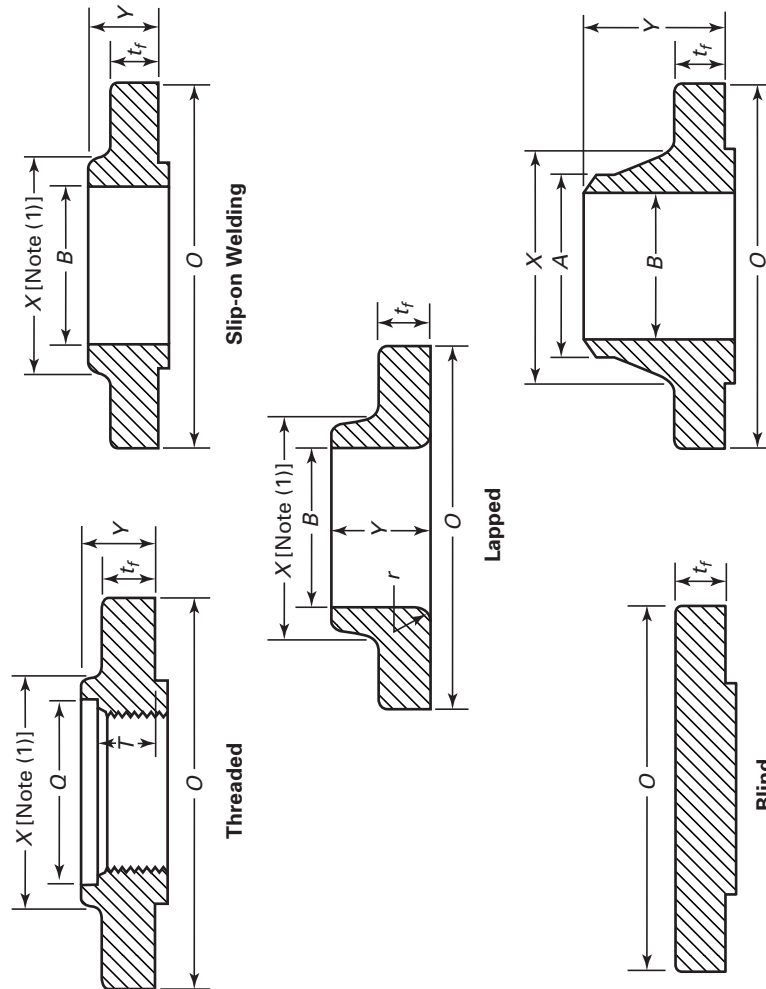


Table 18 Dimensions of Class 900 Flanges

| 1                      | 2                               | 3                                | 4                    | 5                                                              | 6                     | 7                       | 8                 | 9                                                  | 10                | 11               | 12                | 13                                                   | 14                                    |
|------------------------|---------------------------------|----------------------------------|----------------------|----------------------------------------------------------------|-----------------------|-------------------------|-------------------|----------------------------------------------------|-------------------|------------------|-------------------|------------------------------------------------------|---------------------------------------|
| Nominal Pipe Size, NPS | Outside Diameter of Flange, $O$ | Thickness of Flange, Min., $t_f$ | Diameter of Hub, $X$ | Hub Diameter Beginning of Chamfer Welding Neck, $A$ [Note (2)] | Threaded/Slip-on, $Y$ | Length Through Hub, $Y$ | Welding Neck, $Y$ | Thread Length Threaded Flange Min., $T$ [Note (3)] | Slip-on Min., $B$ | Lapped Min., $B$ | Welding Neck, $B$ | Corner Radius of Bore of Lapped Flange and Pipe, $r$ | Counterbore Threaded Flange Min., $Q$ |

Use Class 1500 Dimensions in these sizes [Note (4)].

$\frac{1}{2}$   
 $\frac{3}{4}$   
 1  
 $1\frac{1}{4}$



Table 18 Dimensions of Class 900 Flanges (Cont'd)

| 1                               | 2                                         | 3                                                 | 4                        | 5                                                             | 6                          | 7            | 8                     | 9          | 10                                                | 11                   | 12                                    | 13                                                             | 14                                              |
|---------------------------------|-------------------------------------------|---------------------------------------------------|--------------------------|---------------------------------------------------------------|----------------------------|--------------|-----------------------|------------|---------------------------------------------------|----------------------|---------------------------------------|----------------------------------------------------------------|-------------------------------------------------|
| Nominal<br>Pipe<br>Size,<br>NPS | Outside<br>Diameter<br>of<br>Flange,<br>O | Thickness<br>of Flange<br>Min.,<br>t <sub>f</sub> | Diameter of<br>Hub,<br>X | Hub Diameter<br>Beginning of<br>Chamfer<br>Welding Neck,<br>A | Length Through Hub         |              | Threaded Through Hub  |            | Thread Length<br>Threaded<br>Flange<br>Min.,<br>T |                      | Bore                                  |                                                                | Counterbore<br>Threaded<br>Flange<br>Min.,<br>Q |
|                                 |                                           |                                                   |                          | [Note (2)]                                                    | Threaded/<br>Slip-on,<br>Y | Lapped,<br>Y | Welding<br>Neck,<br>Y | [Note (3)] | Slip-on<br>Min.,<br>B                             | Lapped<br>Min.,<br>B | Welding<br>Neck,<br>B                 | Corner Radius<br>of Bore of<br>Lapped Flange<br>and Pipe,<br>r |                                                 |
| 1 1/2                           |                                           |                                                   |                          |                                                               |                            |              |                       |            |                                                   |                      |                                       |                                                                |                                                 |
| 2                               |                                           |                                                   |                          |                                                               |                            |              |                       |            |                                                   |                      |                                       |                                                                |                                                 |
| 2 1/2                           |                                           |                                                   |                          |                                                               |                            |              |                       |            |                                                   |                      |                                       |                                                                |                                                 |
| 3                               | 240                                       | 38.1                                              | 127                      | 88.9                                                          | 54                         | 54           | 102                   | 42         | 90.7                                              | 91.4                 | To be<br>specified<br>by<br>Purchaser | 10                                                             | 92.2                                            |
| 4                               | 290                                       | 44.5                                              | 159                      | 114.3                                                         | 70                         | 70           | 114                   | 48         | 116.1                                             | 116.8                |                                       | 11                                                             | 117.6                                           |
| 5                               | 350                                       | 50.8                                              | 190                      | 141.3                                                         | 79                         | 79           | 127                   | 54         | 143.8                                             | 144.4                |                                       | 11                                                             | 144.4                                           |
| 6                               | 380                                       | 55.6                                              | 235                      | 168.3                                                         | 86                         | 86           | 140                   | 58         | 170.7                                             | 171.4                |                                       | 13                                                             | 171.4                                           |
| 8                               | 470                                       | 63.5                                              | 298                      | 219.1                                                         | 102                        | 114          | 162                   | 64         | 221.5                                             | 222.2                |                                       | 13                                                             | 222.2                                           |
| 10                              | 545                                       | 69.9                                              | 368                      | 273.0                                                         | 108                        | 127          | 184                   | 72         | 276.2                                             | 277.4                |                                       | 13                                                             | 276.2                                           |
| 12                              | 610                                       | 79.4                                              | 419                      | 323.8                                                         | 117                        | 143          | 200                   | 77         | 327.0                                             | 328.2                |                                       | 13                                                             | 328.6                                           |
| 14                              | 640                                       | 85.8                                              | 451                      | 355.6                                                         | 130                        | 156          | 213                   | 83         | 359.2                                             | 360.2                |                                       | 13                                                             | 360.4                                           |
| 16                              | 705                                       | 88.9                                              | 508                      | 406.4                                                         | 133                        | 165          | 216                   | 86         | 410.5                                             | 411.2                |                                       | 13                                                             | 411.2                                           |
| 18                              | 785                                       | 101.6                                             | 565                      | 457.0                                                         | 152                        | 190          | 229                   | 89         | 461.8                                             | 462.3                |                                       | 13                                                             | 462.0                                           |
| 20                              | 855                                       | 108.0                                             | 622                      | 508.0                                                         | 159                        | 210          | 248                   | 93         | 513.1                                             | 514.4                |                                       | 13                                                             | 512.8                                           |
| 24                              | 1,040                                     | 139.7                                             | 749                      | 610.0                                                         | 203                        | 267          | 292                   | 102        | 616.0                                             | 616.0                |                                       | 13                                                             | 614.4                                           |

Use Class 1500 Dimensions in these sizes [Note (4)].

## GENERAL NOTES:

- (a) Dimensions of Table 18 are in millimeters. For dimensions in inch units, refer to Annex F, Table F18.
- (b) For tolerances, see para. 7.
- (c) For facings, see para. 6.4.
- (d) For flange bolt holes, see para. 6.5 and Table 17.
- (e) For spot facing, see para 6.6.
- (f) For reducing threaded and slip-on flanges, see Table 6.
- (g) Blind flanges may be made with or without hubs at the manufacturer's option.
- (h) For reducing welding neck flanges, see para. 6.8.

## NOTES:

- (1) This dimension is for large end of hub, which may be straight or tapered. Taper shall not exceed 7 deg on threaded, slip-on, socket-welding, and lapped flanges. This dimension is defined as the diameter at the intersection between the hub taper and the back face of the flange.
- (2) For welding end bevel, see para. 6.7.
- (3) For thread of threaded flanges, see para. 6.9.
- (4) Socket welding flanges may be provided in NPS 1/2 through NPS 2 1/2, using Class 1500 dimensions.

## CLASS 1500 PIPE FLANGES

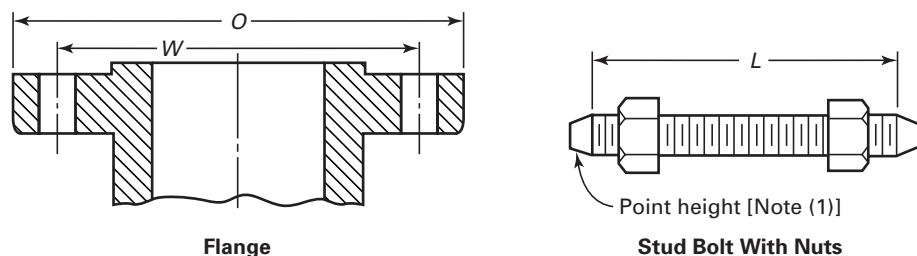


Table 19 Templates for Drilling Class 1500 Flanges

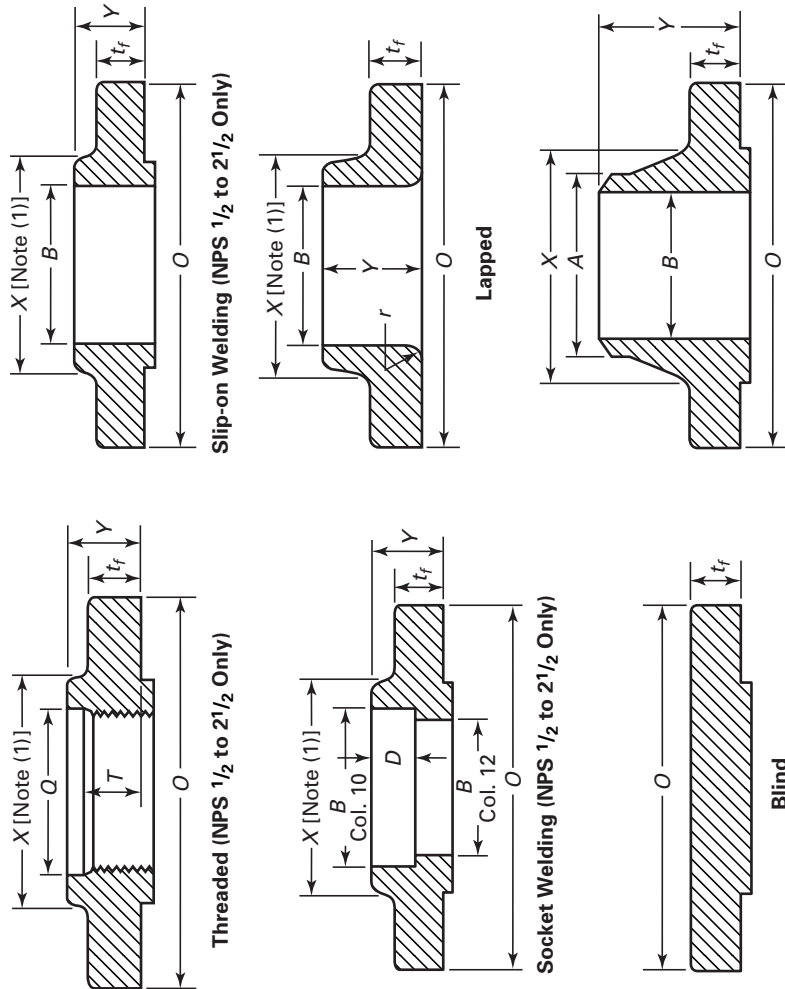
| 1                            | 2                                             | 3                                       | 4                                 | 5                  | 6                                                | 7                      | 8                                     | 9          |
|------------------------------|-----------------------------------------------|-----------------------------------------|-----------------------------------|--------------------|--------------------------------------------------|------------------------|---------------------------------------|------------|
|                              |                                               |                                         |                                   |                    | Length of Bolts,<br><i>L</i><br>[Notes (1), (4)] |                        |                                       |            |
| Nominal<br>Pipe Size,<br>NPS | Outside<br>Diameter<br>of Flange,<br><i>O</i> | Drilling [Notes (2), (3)]               |                                   |                    | Diameter of<br>Bolts,<br>in.                     | 7 mm<br>Raised<br>Face | Male and Female/<br>Tongue and Groove | Ring Joint |
|                              |                                               | Diameter of<br>Bolt Circle,<br><i>W</i> | Diameter of<br>Bolt Holes,<br>in. | Number of<br>Bolts |                                                  |                        |                                       |            |
| 1/2                          | 120                                           | 82.6                                    | 7/8                               | 4                  | 3/4                                              | 110                    | 100                                   | 110        |
| 3/4                          | 130                                           | 88.9                                    | 7/8                               | 4                  | 3/4                                              | 115                    | 110                                   | 115        |
| 1                            | 150                                           | 101.6                                   | 1                                 | 4                  | 7/8                                              | 125                    | 120                                   | 125        |
| 1 1/4                        | 160                                           | 111.1                                   | 1                                 | 4                  | 7/8                                              | 125                    | 120                                   | 125        |
| 1 1/2                        | 180                                           | 123.8                                   | 1 1/8                             | 4                  | 1                                                | 140                    | 135                                   | 140        |
| 2                            | 215                                           | 165.1                                   | 1                                 | 8                  | 7/8                                              | 145                    | 140                                   | 145        |
| 2 1/2                        | 245                                           | 190.5                                   | 1 1/8                             | 8                  | 1                                                | 160                    | 150                                   | 160        |
| 3                            | 265                                           | 203.2                                   | 1 1/4                             | 8                  | 1 1/8                                            | 180                    | 170                                   | 180        |
| 4                            | 310                                           | 241.3                                   | 1 3/8                             | 8                  | 1 1/4                                            | 195                    | 190                                   | 195        |
| 5                            | 375                                           | 292.1                                   | 1 5/8                             | 8                  | 1 1/2                                            | 250                    | 240                                   | 250        |
| 6                            | 395                                           | 317.5                                   | 1 1/2                             | 12                 | 1 3/8                                            | 260                    | 255                                   | 265        |
| 8                            | 485                                           | 393.7                                   | 1 3/4                             | 12                 | 1 5/8                                            | 290                    | 285                                   | 325        |
| 10                           | 585                                           | 482.6                                   | 2                                 | 12                 | 1 7/8                                            | 335                    | 330                                   | 345        |
| 12                           | 675                                           | 571.5                                   | 2 1/8                             | 16                 | 2                                                | 375                    | 370                                   | 385        |
| 14                           | 750                                           | 635.0                                   | 2 3/8                             | 16                 | 2 1/4                                            | 405                    | 400                                   | 425        |
| 16                           | 825                                           | 704.8                                   | 2 5/8                             | 16                 | 2 1/2                                            | 445                    | 440                                   | 470        |
| 18                           | 915                                           | 774.7                                   | 2 7/8                             | 16                 | 2 3/4                                            | 495                    | 490                                   | 525        |
| 20                           | 985                                           | 831.8                                   | 3 1/8                             | 16                 | 3                                                | 540                    | 535                                   | 565        |
| 24                           | 1 170                                         | 990.6                                   | 3 5/8                             | 16                 | 3 1/2                                            | 615                    | 610                                   | 650        |

## GENERAL NOTES:

- (a) Dimensions of Table 19 are in millimeters, except for diameters of bolts and bolt holes, which are in inch units. For dimensions in inch units, refer to Annex F, Table F19.
- (b) For other dimensions, see Table 20.

## NOTES:

- (1) Length of stud bolt does not include the height of the points. See para. 6.10.2.
- (2) For flange bolt holes, see para. 6.5.
- (3) For spot facing, see para. 6.6.
- (4) Bolt lengths not shown in table may be determined in accordance with Annex D. See para. 6.10.2.



Welding Neck

Table 20 Dimensions of Class 1500 Flanges

| 1                      | 2                             | 3                                | 4                  | 5                                    | 6                  | 7                                  | 8               | 9                                       | 10                             | 11                  | 12                             | 13                                                 | 14                                   | 15                 |
|------------------------|-------------------------------|----------------------------------|--------------------|--------------------------------------|--------------------|------------------------------------|-----------------|-----------------------------------------|--------------------------------|---------------------|--------------------------------|----------------------------------------------------|--------------------------------------|--------------------|
| Nominal Pipe Size, NPS | Outside Diameter of Flange, O | Thickness of Flange, Min., $t_f$ | Diameter of Hub, X | Hub Diameter Beginning of Chamfer, A | Length Through Hub | Threaded/Slip-on/Socket Welding, Y | Welding Neck, Y | Thread Length Flange Min., T [Note (3)] | Slip-on/Socket Welding Min., B | Bore Lapped Min., B | Welding Neck/Socket Welding, B | Corner Radius of Bore of Lapped Flange and Pipe, r | Counter bore Threaded Flange Min., Q | Depth of Socket, D |
| 1/2                    | 120                           | 22.3                             | 38                 | 21.3                                 | 32                 | 32                                 | 60              | 23                                      | 22.2                           | 22.9                | To be specified                | 3                                                  | 23.6                                 | 10                 |
| 3/4                    | 130                           | 25.4                             | 44                 | 26.7                                 | 35                 | 35                                 | 70              | 26                                      | 27.7                           | 28.2                | specified by                   | 3                                                  | 29.0                                 | 11                 |
| 1                      | 150                           | 28.6                             | 52                 | 33.4                                 | 41                 | 41                                 | 73              | 29                                      | 34.5                           | 34.9                | by                             | 3                                                  | 35.8                                 | 13                 |
| 1 1/4                  | 160                           | 28.6                             | 64                 | 42.2                                 | 41                 | 41                                 | 73              | 31                                      | 43.2                           | 43.7                | Purchaser                      | 5                                                  | 44.4                                 | 14                 |

Table 20 Dimensions of Class 1500 Flanges (Cont'd)

| 1                            | 2                                      | 3                                                 | 4                        | 5                                                             | 6                                                | 7            | 8                     | 9                        | 10                                          | 11                   | 12                                          | 13                                                             | 14                                                  | 15                       |
|------------------------------|----------------------------------------|---------------------------------------------------|--------------------------|---------------------------------------------------------------|--------------------------------------------------|--------------|-----------------------|--------------------------|---------------------------------------------|----------------------|---------------------------------------------|----------------------------------------------------------------|-----------------------------------------------------|--------------------------|
| Nominal<br>Pipe Size,<br>NPS | Outside<br>Diameter<br>of Flange,<br>O | Thickness<br>of Flange<br>Min.,<br>t <sub>f</sub> | Diameter<br>of Hub,<br>X | Hub Diameter<br>Beginning of<br>Chamfer<br>Welding Neck,<br>A | Length Through Hub                               |              | Thread Length         |                          | Bore                                        |                      | Welding<br>Neck/<br>Socket<br>Welding,<br>B | Corner Radius<br>of Bore of<br>Lapped Flange<br>and Pipe,<br>r | Counter<br>bore<br>Threaded<br>Flange<br>Min.,<br>Q | Depth of<br>Socket,<br>D |
|                              |                                        |                                                   |                          | [Note (2)]                                                    | Threaded/<br>Slip-on/<br>Socket<br>Welding,<br>Y | Lapped,<br>Y | Welding<br>Neck,<br>Y | Min.,<br>T<br>[Note (3)] | Slip-on/<br>Socket<br>Welding<br>Min.,<br>B | Lapped<br>Min.,<br>B |                                             |                                                                |                                                     |                          |
| 1½                           | 180                                    | 31.8                                              | 70                       | 48.3                                                          | 44                                               | 44           | 83                    | 32                       | 49.5                                        | 50.0                 |                                             | 6                                                              | 50.6                                                | 16                       |
| 2                            | 215                                    | 38.1                                              | 105                      | 60.3                                                          | 57                                               | 57           | 102                   | 39                       | 61.9                                        | 62.5                 |                                             | 8                                                              | 63.5                                                | 17                       |
| 2½                           | 245                                    | 41.3                                              | 124                      | 73.0                                                          | 64                                               | 64           | 105                   | 48                       | 74.6                                        | 75.4                 |                                             | 8                                                              | 76.2                                                | 19                       |
| 3                            | 265                                    | 47.7                                              | 133                      | 88.9                                                          | ...                                              | 73           | 117                   | ...                      | ...                                         | 91.4                 |                                             | 10                                                             | ...                                                 | ...                      |
| 4                            | 310                                    | 54.0                                              | 162                      | 114.3                                                         | ...                                              | 90           | 124                   | ...                      | ...                                         | 116.8                |                                             | 11                                                             | ...                                                 | ...                      |
| 5                            | 375                                    | 73.1                                              | 197                      | 141.3                                                         | ...                                              | 105          | 156                   | ...                      | ...                                         | 144.4                |                                             | 11                                                             | ...                                                 | ...                      |
| 6                            | 395                                    | 82.6                                              | 229                      | 168.3                                                         | ...                                              | 119          | 171                   | ...                      | ...                                         | 171.4                |                                             | 13                                                             | ...                                                 | ...                      |
| 8                            | 485                                    | 92.1                                              | 292                      | 219.1                                                         | ...                                              | 143          | 213                   | ...                      | ...                                         | 222.2                |                                             | 13                                                             | ...                                                 | ...                      |
| 10                           | 585                                    | 108.0                                             | 368                      | 273.0                                                         | ...                                              | 178          | 254                   | ...                      | ...                                         | 277.4                |                                             | 13                                                             | ...                                                 | ...                      |
| 12                           | 675                                    | 123.9                                             | 451                      | 323.8                                                         | ...                                              | 219          | 283                   | ...                      | ...                                         | 328.2                |                                             | 13                                                             | ...                                                 | ...                      |
| 14                           | 750                                    | 133.4                                             | 495                      | 355.6                                                         | ...                                              | 241          | 298                   | ...                      | ...                                         | 360.2                |                                             | 13                                                             | ...                                                 | ...                      |
| 16                           | 825                                    | 146.1                                             | 552                      | 406.4                                                         | ...                                              | 260          | 311                   | ...                      | ...                                         | 411.2                |                                             | 13                                                             | ...                                                 | ...                      |
| 18                           | 915                                    | 162.0                                             | 597                      | 457.0                                                         | ...                                              | 276          | 327                   | ...                      | ...                                         | 462.3                |                                             | 13                                                             | ...                                                 | ...                      |
| 20                           | 985                                    | 177.8                                             | 641                      | 508.0                                                         | ...                                              | 292          | 356                   | ...                      | ...                                         | 514.4                |                                             | 13                                                             | ...                                                 | ...                      |
| 24                           | 1 170                                  | 203.2                                             | 762                      | 610.0                                                         | ...                                              | 330          | 406                   | ...                      | ...                                         | 616.0                |                                             | 13                                                             | ...                                                 | ...                      |

## GENERAL NOTES:

(a) Dimensions of Table 20 are in millimeters. For dimensions in inch units, refer to Annex F, Table F20.

(b) For tolerances, see para. 7.

(c) For facings, see para. 6.4.

(d) For flange bolt holes, see para. 6.5 and Table 19.

(e) For spot facing, see para 6.6.

(f) For reducing threaded and slip-on flanges, see Table 6.

(g) Blind flanges may be made with or without hubs at the manufacturer's option.

(h) For reducing welding neck flanges, see para 6.8.

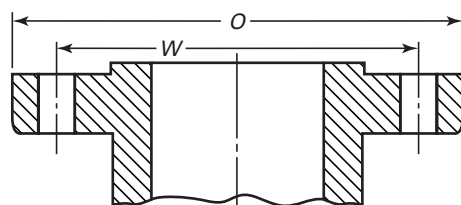
## NOTES:

(1) This dimension is for large end of hub, which may be straight or tapered. Taper shall not exceed 7 deg on threaded, slip-on, socket-welding, and lapped flanges. This dimension is defined as the diameter at the intersection between the hub taper and the back face of the flange.

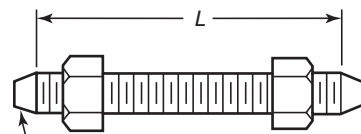
(2) For welding end bevel, see para. 6.7.

(3) For thread of threaded flanges, see para. 6.9.

## CLASS 2500 PIPE FLANGES



Flange



Point height [Note (1)]

Stud Bolt With Nuts

Table 21 Templates for Drilling Class 2500 Flanges

| 1                            | 2                                        | 3                                  | 4                                 | 5                  | 6                            | 7                      | 8                                     | 9          |
|------------------------------|------------------------------------------|------------------------------------|-----------------------------------|--------------------|------------------------------|------------------------|---------------------------------------|------------|
| Length of Bolts, $L$         |                                          |                                    |                                   |                    |                              |                        |                                       |            |
| [Notes (1), (4)]             |                                          |                                    |                                   |                    |                              |                        |                                       |            |
| Nominal<br>Pipe Size,<br>NPS | Outside<br>Diameter<br>of Flange,<br>$O$ | Drilling [Notes (2), (3)]          |                                   |                    | Diameter<br>of Bolts,<br>in. | 7 mm<br>Raised<br>Face | Male and Female/<br>Tongue and Groove | Ring Joint |
|                              |                                          | Diameter of<br>Bolt Circle,<br>$W$ | Diameter of<br>Bolt Holes,<br>in. | Number of<br>Bolts |                              |                        |                                       |            |
| $\frac{1}{2}$                | 135                                      | 88.9                               | $\frac{7}{8}$                     | 4                  | $\frac{3}{4}$                | 120                    | 115                                   | 120        |
| $\frac{3}{4}$                | 140                                      | 95.2                               | $\frac{7}{8}$                     | 4                  | $\frac{3}{4}$                | 125                    | 120                                   | 125        |
| 1                            | 160                                      | 108.0                              | 1                                 | 4                  | $\frac{7}{8}$                | 140                    | 135                                   | 140        |
| $1\frac{1}{4}$               | 185                                      | 130.2                              | $1\frac{1}{8}$                    | 4                  | 1                            | 150                    | 145                                   | 150        |
| $1\frac{1}{2}$               | 205                                      | 146.0                              | $1\frac{1}{4}$                    | 4                  | $1\frac{1}{8}$               | 170                    | 165                                   | 170        |
| 2                            | 235                                      | 171.4                              | $1\frac{1}{8}$                    | 8                  | 1                            | 180                    | 170                                   | 180        |
| $2\frac{1}{2}$               | 265                                      | 196.8                              | $1\frac{1}{4}$                    | 8                  | $1\frac{1}{8}$               | 195                    | 190                                   | 205        |
| 3                            | 305                                      | 228.6                              | $1\frac{3}{8}$                    | 8                  | $1\frac{1}{4}$               | 220                    | 215                                   | 230        |
| 4                            | 355                                      | 273.0                              | $1\frac{5}{8}$                    | 8                  | $1\frac{1}{2}$               | 255                    | 250                                   | 260        |
| 5                            | 420                                      | 323.8                              | $1\frac{7}{8}$                    | 8                  | $1\frac{3}{4}$               | 300                    | 290                                   | 310        |
| 6                            | 485                                      | 368.3                              | $2\frac{1}{8}$                    | 8                  | 2                            | 345                    | 335                                   | 355        |
| 8                            | 550                                      | 438.2                              | $2\frac{1}{8}$                    | 12                 | 2                            | 380                    | 375                                   | 395        |
| 10                           | 675                                      | 539.8                              | $2\frac{5}{8}$                    | 12                 | $2\frac{1}{2}$               | 490                    | 485                                   | 510        |
| 12                           | 760                                      | 619.1                              | $2\frac{7}{8}$                    | 12                 | $2\frac{3}{4}$               | 540                    | 535                                   | 560        |

## GENERAL NOTES:

- (a) Dimensions of Table 21 are in millimeters, except for diameters of bolts and bolt holes, which are in inch units. For dimensions in inch units, refer to Annex F, Table F21.
- (b) For other dimensions, see Table 22.

## NOTES:

- (1) Length of stud bolt does not include the height of the points. See para. 6.10.2.
- (2) For flange bolt holes, see para. 6.5.
- (3) For spot facing, see para. 6.6.
- (4) Bolt lengths not shown in table may be determined with Annex D. See para. 6.10.2.

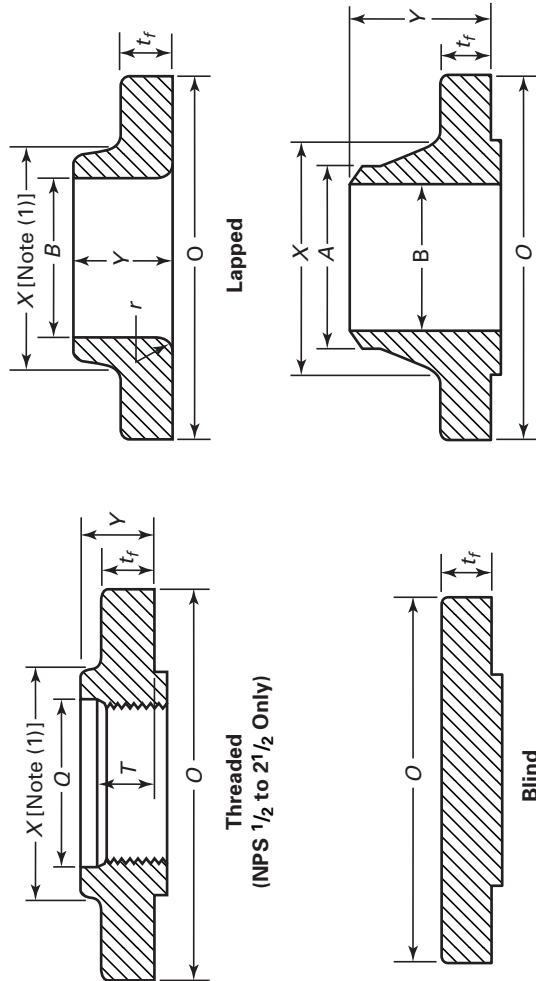


Table 22 Dimensions of Class 2500 Flanges

| 1                               | 2                                      | 3                                                 | 4                        | 5                                                             | 6                  | 7            | 8                     | 9                                                               | 10                   | 11                    | 12                                                             | 13                                              |
|---------------------------------|----------------------------------------|---------------------------------------------------|--------------------------|---------------------------------------------------------------|--------------------|--------------|-----------------------|-----------------------------------------------------------------|----------------------|-----------------------|----------------------------------------------------------------|-------------------------------------------------|
| Nominal<br>Pipe<br>Size,<br>NPS | Outside<br>Diameter<br>of Flange,<br>O | Thickness<br>of Flange<br>Min.,<br>t <sub>f</sub> | Diameter<br>of Hub,<br>X | Hub Diameter<br>Beginning of<br>Chamfer<br>Welding Neck,<br>A | Length Through Hub |              |                       | Thread Length<br>Threaded<br>Flange<br>Min.,<br>T<br>[Note (3)] | Bore                 |                       | Corner Radius<br>of Bore of<br>Lapped Flange<br>and Pipe,<br>r | Counterbore<br>Threaded<br>Flange<br>Min.,<br>Q |
|                                 |                                        |                                                   |                          |                                                               | Threaded,<br>Y     | Lapped,<br>Y | Welding<br>Neck,<br>Y |                                                                 | Lapped<br>Min.,<br>B | Welding<br>Neck,<br>B |                                                                |                                                 |
|                                 |                                        |                                                   |                          |                                                               |                    |              |                       |                                                                 |                      |                       |                                                                |                                                 |
| 1½                              | 135                                    | 30.2                                              | 43                       | 21.3                                                          | 40                 | 40           | 73                    | 29                                                              | 22.9                 | To be                 | 3                                                              | 23.6                                            |
| ¾                               | 140                                    | 31.8                                              | 51                       | 26.7                                                          | 43                 | 43           | 79                    | 32                                                              | 28.2                 | specified             | 3                                                              | 29.0                                            |
| 1                               | 160                                    | 35.0                                              | 57                       | 33.4                                                          | 48                 | 48           | 89                    | 35                                                              | 34.9                 | by                    | 3                                                              | 35.8                                            |
| 1¼                              | 185                                    | 38.1                                              | 73                       | 42.2                                                          | 52                 | 52           | 95                    | 39                                                              | 43.7                 | Purchaser             | 5                                                              | 44.4                                            |
| 1½                              | 205                                    | 44.5                                              | 79                       | 48.3                                                          | 60                 | 60           | 111                   | 45                                                              | 50.0                 |                       | 6                                                              | 50.6                                            |
| 2                               | 235                                    | 50.9                                              | 95                       | 60.3                                                          | 70                 | 70           | 127                   | 51                                                              | 62.5                 |                       | 8                                                              | 63.5                                            |
| 2½                              | 265                                    | 57.2                                              | 114                      | 73.0                                                          | 79                 | 79           | 143                   | 58                                                              | 75.4                 |                       | 8                                                              | 76.2                                            |
| 3                               | 305                                    | 66.7                                              | 133                      | 88.9                                                          | ...                | 92           | 168                   | ...                                                             | 91.4                 |                       | 10                                                             | ...                                             |
| 4                               | 355                                    | 76.2                                              | 165                      | 114.3                                                         | ...                | 108          | 190                   | ...                                                             | 116.8                |                       | 11                                                             | ...                                             |
| 5                               | 420                                    | 92.1                                              | 203                      | 141.3                                                         | ...                | 130          | 229                   | ...                                                             | 144.4                |                       | 11                                                             | ...                                             |
| 6                               | 485                                    | 108.0                                             | 235                      | 168.3                                                         | ...                | 152          | 273                   | ...                                                             | 171.4                |                       | 13                                                             | ...                                             |
| 8                               | 550                                    | 127.0                                             | 305                      | 219.1                                                         | ...                | 178          | 318                   | ...                                                             | 222.2                |                       | 13                                                             | ...                                             |
| 10                              | 675                                    | 165.1                                             | 375                      | 273.0                                                         | ...                | 229          | 419                   | ...                                                             | 277.4                |                       | 13                                                             | ...                                             |
| 12                              | 760                                    | 184.2                                             | 441                      | 323.8                                                         | ...                | 254          | 464                   | ...                                                             | 328.2                |                       | 13                                                             | ...                                             |

**Notes to Table 22**

## GENERAL NOTES:

- (a) Dimensions of Table 22 are in millimeters, except for diameter of bolts and bolt holes, which are in inch units. For dimensions in inch units, refer to Annex F, Table F22.
- (b) For tolerances, see para. 7.
- (c) For facings, see para. 6.4.
- (d) For flange bolt holes, see para. 6.5 and Table 21.
- (e) For spot facing, see para 6.6.
- (f) For reducing threaded and slip-on flanges, see Table 6.
- (g) Blind flanges may be made with or without hubs at the manufacturer's option.
- (h) For reducing welding neck flanges, see para 6.8.

## NOTES:

- (1) This dimension is for large end of hub, which may be straight or tapered. Taper shall not exceed 7 deg on threaded, slip-on, socket-welding, and lapped flanges. This dimension is defined as the diameter at the intersection between the hub taper and the back face of the flange.
- (2) For welding end bevel, see para. 6.7.
- (3) For thread of threaded flanges, see para. 6.9.

## ANNEX A

# THREADING OF PIPE FOR AMERICAN NATIONAL STANDARD THREADED FLANGES<sup>1</sup>

The length of external taper threads in ASME B1.20.1 is sufficient to provide a satisfactory joint when assembled with corresponding internal taper threads in couplings and fittings. In this Standard, the length of internal thread in Class 150, Class 300, and Class 400 flanges also conforms to ASME B1.20.1.

In Class 600 and higher rated flanges, the length through the hub may exceed the length for internal threads in ASME B1.20.1. Where this occurs, the extended length of internal threads follows the taper of the standard taper threads. Therefore, the diameters of the extra threads are smaller than those shown in ASME B1.20.1.

When threaded flanges conforming to this Standard are assembled with threaded-end pipe, it is intended that the end of the pipe be reasonably close to the mating

surface of the flange. To meet this intent, the following requirements are imposed on the mating pipe and external thread:

(a) Pipe to be threaded into flanges of Class 600 or higher rating shall be Schedule 80 or heavier in wall thickness.

(b) The length of external effective thread on the pipe end shall be greater than specified in ASME B1.20.1. When tested with the standard ring gage, the pipe end shall project beyond the gage by the distance specified in Table A1, subject to a tolerance of one thread pitch as provided in ASME B1.20.1.

(c) The extra threads shall continue the taper specified in ASME B1.20.1, so that the pitch diameter of the thread at the pipe end is less than specified therein.

(d) It is recommended that power equipment be used to assemble threaded joints having longer than standard taper threads, in order to bring the pipe end close to the flange face.

<sup>1</sup> This Annex is an integral part of ASME B16.5-2003, and is placed after the main text for convenience.



**Table A1 Projection of Threaded Pipe End Through a Ring Gage**

| Class<br>150, 300, 400 |                                                                 | Class 600                                                       |            |      | Class 900             |            |      | Class 1500            |            |      | Class 2500            |            |      |      |
|------------------------|-----------------------------------------------------------------|-----------------------------------------------------------------|------------|------|-----------------------|------------|------|-----------------------|------------|------|-----------------------|------------|------|------|
| NPS                    | Number<br>of<br>Turns                                           | Number<br>of<br>Turns                                           | Projection |      | Number<br>Of<br>Turns | Projection |      | Number<br>of<br>Turns | Projection |      | Number<br>of<br>Turns | Projection |      |      |
|                        |                                                                 |                                                                 | mm         | in.  |                       | mm         | in.  |                       | mm         | in.  |                       | mm         | in.  |      |
| 1½                     | ...                                                             | Use taper pipe<br>thread per<br>ASME B1.20.1<br>for these sizes | ...        | ...  | ...                   | ...        | ...  | 3½                    | 6.4        | 0.25 | 7                     | 12.7       | 0.50 |      |
| ¾                      | ...                                                             |                                                                 | ...        | ...  | ...                   | ...        | ...  | 5                     | 9.5        | 0.38 | 7                     | 12.7       | 0.50 |      |
| 1                      | ...                                                             |                                                                 | ...        | ...  | ...                   | ...        | ...  | 5                     | 11.1       | 0.44 | 7½                    | 16.5       | 0.65 |      |
| 1¼                     | ...                                                             |                                                                 | ...        | ...  | ...                   | ...        | ...  | 5                     | 11.1       | 0.44 | 7½                    | 16.5       | 0.65 |      |
| 1½                     | ...                                                             |                                                                 | ...        | ...  | ...                   | ...        | ...  | 5                     | 11.1       | 0.44 | 7½                    | 16.5       | 0.65 |      |
| 2                      | ...                                                             | Use taper pipe<br>thread per<br>ASME B1.20.1<br>for these sizes | ...        | ...  | ...                   | ...        | 11.1 | 5                     | 11.1       | 0.44 | 7½                    | 16.5       | 0.65 |      |
| 2½                     | ...                                                             |                                                                 | ...        | ...  | ...                   | ...        | ...  | 5                     | 15.9       | 0.62 | 8                     | 25.4       | 1.00 |      |
| 3                      | ...                                                             |                                                                 | 1          | 3.2  | 0.12                  | 3          | 9.5  | 0.38                  | 6          | 19.0 | 0.75                  | 10         | 31.8 | 1.25 |
| 3½                     | ...                                                             |                                                                 | 1          | 3.2  | 0.12                  | ...        | ...  | ...                   | ...        | ...  | ...                   | ...        | ...  |      |
| 4                      | ...                                                             |                                                                 | 1½         | 4.8  | 0.19                  | 3½         | 11.1 | 0.44                  | 6½         | 20.6 | 0.81                  | 10½        | 33.3 | 1.31 |
| 5                      | ...                                                             | 1½                                                              | 4.8        | 0.19 | 3½                    | 11.1       | 0.44 | 6½                    | 20.6       | 0.81 | 10½                   | 33.3       | 1.31 |      |
| 6                      | Use taper pipe<br>thread per<br>ASME B1.20.1<br>for these sizes | 1½                                                              | 4.8        | 0.19 | 3½                    | 11.1       | 0.44 | 7½                    | 23.8       | 0.94 | 11½                   | 36.5       | 1.44 |      |
| 8                      |                                                                 | 2                                                               | 6.4        | 0.25 | 4                     | 12.7       | 0.50 | 8                     | 25.4       | 1.00 | 14                    | 44.5       | 1.75 |      |
| 10                     |                                                                 | 3                                                               | 9.5        | 0.38 | 5                     | 15.9       | 0.62 | 9                     | 28.4       | 1.12 | 16                    | 50.8       | 2.00 |      |
| 12                     |                                                                 | 3                                                               | 9.5        | 0.38 | 5                     | 15.9       | 0.62 | 10                    | 31.8       | 1.25 | 19                    | 60.3       | 2.38 |      |
| 14                     |                                                                 | 3                                                               | 9.5        | 0.38 | 6                     | 19.0       | 0.75 | ...                   | ...        | ...  | ...                   | ...        | ...  |      |
| 16                     | 3                                                               | 9.5                                                             | 0.38       | 6    | 19.0                  | 0.75       | ...  | ...                   | ...        | ...  | ...                   | ...        |      |      |
| 18                     | 3                                                               | 9.5                                                             | 0.38       | 6    | 19.0                  | 0.75       | ...  | ...                   | ...        | ...  | ...                   | ...        |      |      |
| 20                     | 3                                                               | 9.5                                                             | 0.38       | 6    | 19.0                  | 0.75       | ...  | ...                   | ...        | ...  | ...                   | ...        |      |      |
| 24                     | 3                                                               | 9.5                                                             | 0.38       | 6    | 19.0                  | 0.75       | ...  | ...                   | ...        | ...  | ...                   | ...        |      |      |

# ANNEX B

## METHOD USED FOR ESTABLISHING PRESSURE-TEMPERATURE RATINGS<sup>1</sup>

### B1 GENERAL CONSIDERATIONS

#### B1.1 Introduction

Pressure-temperature ratings for this Standard have been determined by the procedures described in this Annex. These procedures are counterpart to those identified as Standard Class in ASME B16.34. The primary considerations in establishing ratings are component dimensions and material properties to sustain pressure and other loads.<sup>2</sup> Other considerations affecting or limiting ratings include

- (a) stresses in flanges resulting from bolt-up necessary to maintain a gasket seal
- (b) distortion of flanges and flanged fittings due to loads transmitted through attached piping
- (c) limitations applying primarily to flanged components (e.g., valves), but also imposed on flanges in order to preserve compatible ratings

#### B1.2 Bolt Cross-sectional Area

Total flange bolting cross-sectional area requirements are based on the following relationship

$$A_b \geq \frac{P_c A_g}{7000} \quad (1)$$

where

$A_b$  = total effective bolt tensile stress area

$A_g$  = an area whose circumference is defined by a diameter equal to the raised face dimension  $R$  in Table 4

$P_c$  = pressure rating class designation or number (e.g., for Class 150,  $P_c = 150$ ; for Class 300,  $P_c = 300$ )

#### B1.3 Flanged Fitting Wall Thickness

Wall thickness requirements for flanged fittings are specified in para. 6.1. The minimum wall thickness values  $t_m$  are shown in the tables designated in para. 6.1. These values are all greater than those determined by Eq. (2).

$$t = 1.5 \left[ \frac{P_c d}{2S_F - 1.2P_c} \right] \quad (2)$$

<sup>1</sup> This Annex is an integral part of ASME B16.5-2003, and is placed after the main text for convenience.

<sup>2</sup> This method is appropriate for materials listed in Table 1A. It may not be appropriate for other materials.

where

$P_c$  = pressure rating class designation or number (e.g., for Class 150,  $P_c = 150$ ; for Class 300,  $P_c = 300$ )

$S_F$  = stress base constant equal to 7000

$d$  = inside diameter of the fitting

$t$  = calculated thickness

The resultant units for  $t$  will be the same as those used to express  $d$ . Equation (2) results in a fitting wall thickness 50% greater than that for a simple cylinder designed for a stress of 48.28 MPa (7000 psi) when subjected to an internal pressure equal to the pressure rating class designation  $P_c$ . The actual values in the dimension tables referred to in para. 6.1 are approximately 2.5 mm (0.1 in.) larger than those given by the equation.

#### B1.4 Material Properties

The pressure-temperature rating method uses allowable stress, ultimate tensile strength, and yield strength values from Section II, Part D of the ASME Boiler and Pressure Vessel Code. For materials listed herein that have ratings either at temperature values that are above those shown in a reference Code Section or that are not listed in any of the reference Code Sections, the allowable stress, ultimate tensile strength, and yield strength data have been provided directly by the ASME Boiler and Pressure Vessel Subcommittee on Materials.

#### B1.5 Material Groups

Materials are grouped in Table 1A based on identical or closely matched allowable stress and yield strength values. When these values are not identical for each material listed, the lowest value has been used. Note that material groups in this Standard are not numbered consecutively. The unlisted numbers, numbers that are not part of this Standard may be found in the materials tables of ASME B16.34.

### B2 PRESSURE-TEMPERATURE RATING METHOD

#### B2.1 Rating Equation Class 300 and Higher

Pressure-temperature ratings for Class 300 and higher components, of materials listed to those in Table 1A, were established by the equation

$$p_t = \frac{C_1 S_1}{8750} P_r \leq p_c \quad (3)$$

where

$C_1$  = 10 when  $S_1$  is expressed in MPa units and the resultant  $p_t$  will be in bar units ( $C_1 = 1$  when  $S_1$  is expressed in psi units and the resultant  $p_t$  will be in psi units)

$P_r$  = pressure rating class index. For all designations Class 300 and above,  $P_r$  is equal to the class designation (e.g., for Class 300,  $P_r = 300$ ). (For Class 150, see para. B2.4 of this Annex.)

$S_1$  = selected stress, MPa (psi) for the specified material at temperature  $T$ . The value of  $S_1$  shall be established as described in paras. B2.2, B2.3, and B2.4.

$p_c$  = ceiling pressure, bar (psi), at temperature  $T$  as specified in para. B3

$p_t$  = rated working pressure, bar (psi), for the specified material at temperature  $T$

## B2.2 Ratings for Group No. 1 Materials

The selected stress for Group No. 1 materials in Table 1A is determined as follows:

(a) At temperatures below the creep range  $S_1$  shall be equal to or less than

(1) 60% of the specified minimum yield strength at 38°C (100°F)

(2) 60% of the yield strength at temperature  $T$

(3) 1.25 times 25% of the ultimate tensile strength value at temperature  $T$ , as listed in Section II, Part D of the ASME Boiler and Pressure Vessel Code for either Section I or Section VIII, Division 1.

(b) At temperatures in the creep range, the value of  $S_1$  shall be the allowable stress at temperature  $T$ , as listed in Section II, Part D of the ASME Boiler and Pressure Vessel Code, for either Section I or Section VIII, Division 1; but not exceeding 60% of the listed yield strength at temperature.

(c) In no case shall the selected stress value increase with increasing temperature.

(d) The creep range is considered to be at temperatures in excess of 370°C (700°F) for Group 1 materials.

(e) When the allowable stresses listed for the reference ASME Boiler and Pressure Vessel Code Section show a higher and lower value for allowable stress and the higher value is noted to the effect that these stress values exceed two-thirds of the yield strength at temperature, then the lower value shall be used. If lower allowable stress values do not appear and it is noted in the allowable stress table that the allowable stress values exceed two-thirds of the yield strength at temperature, then the allowable stress values used shall be determined as two-thirds of the tabulated yield strength at temperature.

(f) Yield strength shall be as listed in Section II, Part D of the ASME Boiler and Pressure Vessel Code, for either Section III or Section VIII, Division 2.

(g) Allowable stress values listed in Section II, Part D of the ASME Boiler and Pressure Vessel Code, for Section III, Class 2 or Class 3 values may only be used for a material not listed for either Section I or Section VIII, Division 1.

## B2.3 Method for Groups 2 and 3 Materials

Pressure-temperature ratings for Class 300 and higher, of materials corresponding to those in Materials Groups 2 and 3 of Table 1A are established by the method of paras. B2.1 and B2.2, except that in paras. B2.2(a)(1) and B2.2(a)(2), the 60% factor shall be changed to 70%. For Group 2 materials, the creep range is considered to be at temperatures in excess of 510°C (950°F) unless the material properties indicate lower temperatures should be used. For Group 3 materials, the creep range onset temperature shall be determined on an individual basis.

## B2.4 Method for Class 150 — All Materials

Pressure-temperature ratings for Class 150 rating designation are established by the method given for the related materials in paras. B2.1, B2.2, and B2.3 subject to the following exceptions:

(a) The value of  $P_r$ , the pressure class rating index in Eq. (2) for Class 150, shall be 115.

(b) The value for  $S_1$  the selected stress MPa (psi) for the specific material at temperature  $T$  shall be in accordance with the requirements of either para. B2.1 or B2.2, as applicable.

(c) The value of  $p_t$ , the rated working pressure bar (psi), for Class 150, shall not exceed values at temperature  $T$  as given by Eq. (4).

$$p_t \leq C_2 - C_3 T \quad (4)$$

where:

$$C_2 = 21.41$$

$$C_3 = 0.03724 \text{ with } T \text{ expressed in } ^\circ\text{C}, \text{ the resultant } p_t \text{ will be in bar units } (C_2 = 320 \text{ and } C_3 = 0.3, \text{ with } T \text{ expressed in } ^\circ\text{F}, \text{ the resultant } p_t \text{ will be in psi units})$$

$$T = \text{material temperature, } ^\circ\text{C } (^\circ\text{F})$$

The value of  $T$  in Eq. (4) shall not exceed 538°C (1000°F). For values of  $T$  less than 38°C (100°F), use  $T$  equal to 38°C (100°F) in Eq. (4).

## B3 MAXIMUM RATINGS

The rules for establishing pressure-temperature ratings include consideration of ceiling pressures  $p_c$  that effectively set limits on the selected stress. The ceiling pressure-temperature values set an upper bound for high strength materials and are imposed to limit deflection. Ceiling pressure values are listed in Tables B1 and B2. Ratings in excess of these ceiling values are not permitted under this Standard.

**Table B1 Rating Ceiling Pressure  $p_c$ , bar**

| Temperature<br>°C | CLASS        |              |              |              |              |               |               |
|-------------------|--------------|--------------|--------------|--------------|--------------|---------------|---------------|
|                   | Class<br>150 | Class<br>300 | Class<br>400 | Class<br>600 | Class<br>900 | Class<br>1500 | Class<br>2500 |
| -29 to 38         | 20.0         | 51.7         | 68.9         | 103.4        | 155.1        | 258.6         | 430.9         |
| 50                | 19.5         | 51.7         | 68.9         | 103.4        | 155.1        | 258.6         | 430.9         |
| 100               | 17.7         | 51.5         | 68.7         | 103.0        | 154.6        | 257.6         | 429.4         |
| 150               | 15.8         | 50.3         | 66.8         | 100.3        | 150.6        | 250.8         | 418.2         |
| 200               | 13.8         | 48.6         | 64.8         | 97.2         | 145.8        | 243.4         | 405.4         |
| 250               | 12.1         | 46.3         | 61.7         | 92.7         | 139.0        | 231.8         | 386.2         |
| 300               | 10.2         | 42.9         | 57.0         | 85.7         | 128.6        | 214.4         | 357.1         |
| 325               | 9.3          | 41.4         | 55.0         | 82.6         | 124.0        | 206.6         | 344.3         |
| 350               | 8.4          | 40.3         | 53.6         | 80.4         | 120.7        | 201.1         | 335.3         |
| 375               | 7.4          | 38.9         | 51.6         | 77.6         | 116.5        | 194.1         | 323.2         |
| 400               | 6.5          | 36.5         | 48.9         | 73.3         | 109.8        | 183.1         | 304.9         |
| 425               | 5.5          | 35.2         | 46.5         | 70.0         | 105.1        | 175.1         | 291.6         |
| 450               | 4.6          | 33.7         | 45.1         | 67.7         | 101.4        | 169.0         | 281.8         |
| 475               | 3.7          | 31.7         | 42.3         | 63.4         | 95.1         | 158.2         | 263.9         |
| 500               | 2.8          | 28.2         | 37.6         | 56.5         | 84.7         | 140.9         | 235.0         |
| 525               | 1.9          | 25.8         | 34.4         | 51.6         | 77.4         | 129.0         | 214.9         |
| 538               | 1.4          | 25.2         | 33.4         | 50.0         | 75.2         | 125.5         | 208.9         |
| 550               | (1)          | 25.0         | 33.3         | 49.8         | 74.8         | 124.9         | 208.0         |
| 575               | (1)          | 24.0         | 31.9         | 47.9         | 71.8         | 119.7         | 199.5         |
| 600               | (1)          | 21.6         | 28.6         | 42.9         | 64.2         | 107.0         | 178.5         |
| 625               | (1)          | 18.3         | 24.3         | 36.6         | 54.9         | 91.2          | 152.0         |
| 650               | (1)          | 14.1         | 18.9         | 28.1         | 42.5         | 70.7          | 117.7         |
| 675               | (1)          | 12.4         | 16.9         | 25.2         | 37.6         | 62.7          | 104.5         |
| 700               | (1)          | 10.1         | 13.4         | 20.0         | 29.8         | 49.7          | 83.0          |
| 725               | (1)          | 7.9          | 10.5         | 15.4         | 23.2         | 38.6          | 64.4          |
| 750               | (1)          | 5.9          | 7.9          | 11.7         | 17.6         | 29.6          | 49.1          |
| 775               | (1)          | 4.6          | 6.2          | 9.0          | 13.7         | 22.8          | 38.0          |
| 800               | (1)          | 3.5          | 4.8          | 7.0          | 10.5         | 17.4          | 29.2          |
| 816               | (1)          | 2.8          | 3.8          | 5.9          | 8.6          | 14.1          | 23.8          |

**NOTE:**

(1) Ratings for flanges and flanged fittings terminate at 538°C (1000°F).

**Table B2 Rating Ceiling Pressure —  $p_c$ , psi**

| Temperature<br>°F | Class        |              |              |              |              |               |               |
|-------------------|--------------|--------------|--------------|--------------|--------------|---------------|---------------|
|                   | Class<br>150 | Class<br>300 | Class<br>400 | Class<br>600 | Class<br>900 | Class<br>1500 | Class<br>2500 |
| –20 to 100        | 290          | 750          | 1000         | 1500         | 2250         | 3750          | 6250          |
| 200               | 260          | 750          | 1000         | 1500         | 2250         | 3750          | 6250          |
| 300               | 230          | 730          | 970          | 1455         | 2185         | 3640          | 6070          |
| 400               | 200          | 705          | 940          | 1410         | 2115         | 3530          | 5880          |
| 500               | 170          | 665          | 885          | 1330         | 1995         | 3325          | 5540          |
| 600               | 140          | 605          | 805          | 1210         | 1815         | 3025          | 5040          |
| 650               | 125          | 590          | 785          | 1175         | 1765         | 2940          | 4905          |
| 700               | 110          | 570          | 755          | 1135         | 1705         | 2840          | 4730          |
| 750               | 95           | 530          | 710          | 1065         | 1595         | 2660          | 4430          |
| 800               | 80           | 510          | 675          | 1015         | 1525         | 2540          | 4230          |
| 850               | 65           | 485          | 650          | 975          | 1460         | 2435          | 4060          |
| 900               | 50           | 450          | 600          | 900          | 1350         | 2245          | 3745          |
| 950               | 35           | 385          | 515          | 775          | 1160         | 1930          | 3220          |
| 1000              | 20           | 365          | 485          | 725          | 1090         | 1820          | 3030          |
| 1050              | (1)          | 360          | 480          | 720          | 1080         | 1800          | 3000          |
| 1100              | (1)          | 325          | 430          | 645          | 965          | 1610          | 2685          |
| 1150              | (1)          | 275          | 365          | 550          | 825          | 1370          | 2285          |
| 1200              | (1)          | 205          | 275          | 410          | 620          | 1030          | 1715          |
| 1250              | (1)          | 180          | 245          | 365          | 545          | 910           | 1515          |
| 1300              | (1)          | 140          | 185          | 275          | 410          | 685           | 1145          |
| 1350              | (1)          | 105          | 140          | 205          | 310          | 515           | 860           |
| 1400              | (1)          | 75           | 100          | 150          | 225          | 380           | 630           |
| 1450              | (1)          | 60           | 80           | 115          | 175          | 290           | 485           |
| 1500              | (1)          | 40           | 55           | 85           | 125          | 205           | 345           |

**NOTE:**

(1) Ratings of flanges and flanged fittings terminate at 1000°F (538°C).

## ANNEX C

# LIMITING DIMENSIONS OF GASKETS OTHER THAN RING JOINT GASKETS<sup>1</sup>

### C1 GASKET MATERIALS AND CONSTRUCTION

Classification of Gasket Materials and types is shown in Table C1. Other gaskets that result in no increase in bolt loads or flange moment over those resulting from the gaskets included in the respective Groups may be used. See para. 5.4

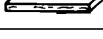
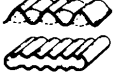
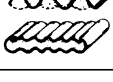
### C2 GASKET DIMENSIONS

Reference to a dimensional standard for gaskets (e.g., ASME B16.21) is recommended. In any event, selected

dimensions should be based on the type of gasket and its characteristics. These characteristics include density, flexibility, compatibility with the fluid being contained and gasket compression needed to maintain sealing. Consideration should be given to the need for a “pocket” at the gasket inside diameter (between the flange facings) or of intrusion of the gasket into the flange bore. Consideration should also be given to the effects that the contained fluid may have upon the gasket including damage that may result from partial disintegration of the gasket material.

<sup>1</sup> This Annex is not a mandatory annex of ASME B16.5-2003, and is placed after the main text for information.

**Table C1 Gasket Groups and Typical Materials**

| Gasket Group Number | Gasket Material                                                                                                                    | Sketches                                                                              |
|---------------------|------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|
| Ia                  | Self-energizing types:<br>O rings, metallic, elastomer, other gasket types considered as self-sealing                              |                                                                                       |
|                     | Elastomer without fabric                                                                                                           |    |
|                     | Compressed sheet suitable for the operating conditions                                                                             |    |
|                     | Fluoropolymer, Elastomer with cotton fabric insertion                                                                              |    |
|                     | Elastomer with or without wire reinforcement                                                                                       |    |
|                     | Vegetable fiber                                                                                                                    |    |
| Ib                  | Spiral-wound metal, with nonmetallic filler                                                                                        |    |
|                     | Corrugated aluminum, copper or copper alloy or corrugated aluminum, copper or copper alloy double jacketed with nonmetallic filler |    |
|                     | Corrugated aluminum, copper, or brass                                                                                              |   |
| IIa and IIb         | Corrugated metal or corrugated metal double jacketed with nonmetallic filler                                                       |  |
|                     | Corrugated metal                                                                                                                   |  |
|                     | Flat metal jacketed with nonmetallic filler                                                                                        |  |
|                     | Grooved metal                                                                                                                      |  |
|                     | Solid flat soft aluminum<br>Solid flat metal                                                                                       |  |
|                     | Ring joint                                                                                                                         |                                                                                       |

## ANNEX D

### METHOD FOR CALCULATING BOLT LENGTHS<sup>1, 2</sup>

The following equations were used in establishing dimension  $L$  as listed in various dimensional tables.

$$L_{CSB} = A + n$$

$$L_{CMB} = B + n$$

For lapped joints, calculate stud bolt and machine bolt length as follows.

For ring joint groove facing:

$$L_{CSB} = A + (\text{pipe thickness for each lap}) + n$$

$$L_{CMB} = B + (\text{pipe thickness for each lap}) + n$$

For other than ring joint facing:

$$L_{CSB} = A - F + (\text{Table D3 thicknesses}) + n$$

$$L_{CMB} = B - F + (\text{Table D3 thicknesses}) + n$$

where:

$$A = 2(t_f + t + d) + G + F - a \text{ (i.e., stud bolt length exclusive of negative length tolerance } n)$$

<sup>1</sup> This Annex is not a mandatory annex of ASME B16.5-2003 and is placed after the main text for information.

<sup>2</sup> The equations used in this Annex are for calculated bolt lengths established to ensure full thread engagement of heavy hexagon nuts when worst case tolerances occur on all relevant dimensions of the flanged joint. The use of shorter bolt lengths is acceptable provided that full thread engagement is obtained at assembly (see para. 6.10.2).

$B = 2(t_f + t) + d + G + F + p - a$  (i.e., machine bolt length exclusive of negative tolerance  $n$ )

$F$  = total height of facings or depth of ring joint groove for both flanges (see Table D1)

$G$  = 3.0 mm (0.12 in.) gasket thickness for raised face, male and female tongue and groove flanges; also approximate distance between ring joint flanges listed in Table 5 (Table F5 of Annex F)

$L_{CMB}$  = calculated machine bolt length as measured from underside of head to end of point

$L_{CSB}$  = calculated stud bolt length (effective thread length, excluding end points)

$L_{SMB}$  = specified machine bolt length (from underhead to end, including end point), which is  $L_{CMB}$  rounded off to the nearest 5 mm (0.25 in.) increment (see Fig. D2)

$L_{SSB}$  = specified stud bolt length (effective thread length, excluding end points) which is  $L_{CSB}$  rounded off to the nearest 5 mm (0.25 in.) increment (see Fig. D1)

$a$  = zero, except where the small female face is on the end of pipe,  $a = 5$  mm (0.19 in.)

$d$  = heavy nut thickness (equals nominal bolt diameter, see ASME B18.2.2)

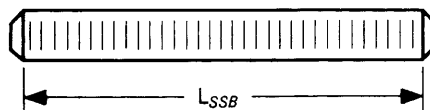
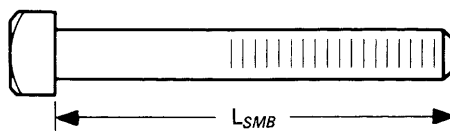
$n$  = negative tolerance on bolt length (see Table D2)

$p$  = allowance for height of point of machine bolt (1.5 times thread pitch)

$t$  = plus tolerance for flange thickness (see para. 7.3)

$t_f$  = minimum flange thickness (see applicable dimensional tables)



**Fig.D1 Specified Stud Bolt Length****Fig. D2 Specified Machine Bolt Length****Table D1 F Values**

| Class       | Total Height of Facings or Depth of Ring Joint Groove for Both Flanges, $F$ , mm (in.) |                         |                                            |                  |
|-------------|----------------------------------------------------------------------------------------|-------------------------|--------------------------------------------|------------------|
|             | Type of Flange Facing [Note (1)]                                                       |                         |                                            |                  |
|             | 2 mm Raised<br>0.06 in.                                                                | 7 mm Raised<br>0.25 in. | Male and Female<br>or<br>Tongue and Groove | Ring Joint       |
| 150 and 300 | 4 mm (0.12)                                                                            | 14 mm (0.50)            | 7 mm (0.25)                                | 2 × groove depth |
| 400 to 2500 | 4 mm (0.12)                                                                            | 14 mm (0.50)            | 7 mm (0.25)                                | 2 × groove depth |

NOTE:

(1) See Fig. 8 (Fig. F8 of Annex F) and Tables 4 and 5 (Tables F4 and F5 of Annex F).

**Table D2 n Values**

| Dimensions                                                                                                 | Negative Tolerance on Bolt<br>Lengths, $n$ , mm (in.)               | Length, mm (in.)                                     |
|------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------|------------------------------------------------------|
| Stud Bolt                                                                                                  |                                                                     |                                                      |
| $A$<br>or<br>[ $A + (\text{pipe thickness})$ for each lap]                                                 | 1.5 (0.06)                                                          | $\leq 305 (\leq 12)$                                 |
| $A - F + (\text{Table D3 thickness})$                                                                      | 7.0 (0.25)                                                          | $> 305 (> 12), \leq 460 (\leq 18)$<br>$> 460 (> 18)$ |
| Machine Bolt                                                                                               |                                                                     |                                                      |
| $B$<br>or<br>[ $B + (\text{pipe thickness for each lap})$<br>or<br>[ $B - F + (\text{Table D3 thickness})$ | For $n$ values, use negative length<br>tolerances per ASME B18.2.1. | ...                                                  |

**Table D3 Thickness for Lapped Joints**

| Lap Combination                                   | Classes 150 Through 2500 Flanges                              |
|---------------------------------------------------|---------------------------------------------------------------|
| For lapped to 2 mm (0.06 in.) male face on flange | One lap and 2 mm (0.06 in.)                                   |
| For lapped to lapped                              | Both laps                                                     |
| For lapped to 7 mm (0.25 in.) male face on flange | One lap and 7 mm (0.25 in.)                                   |
| For lapped to female face on flange               | One lap not less than 7 mm (0.25 in.)                         |
| For male in lap to female in lap                  | 2 × pipe wall with lap for male not less than 7 mm (0.25 in.) |

## ANNEX E

### QUALITY SYSTEM PROGRAM<sup>1</sup>

The products manufactured in accordance with this Standard shall be produced under a quality system program following the principles of an appropriate standard from the ISO 9000 series.<sup>2</sup> A determination of the

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<sup>1</sup> This Annex is an integral part of ASME B16.5-2003, and is placed after the main text for convenience.

<sup>2</sup> The series is also available from the American National Standards Institute (ANSI) and the American Society for Quality Control (ASQC) as American National Standards that are identified by a prefix "Q", replacing the prefix "ISO." Each standard of the series is listed under Annex H, References.

need for registration and/or certification of the product manufacturer's quality system program by an independent organization shall be the responsibility of the manufacturer. The detailed documentation demonstrating program compliance shall be available to the purchaser at the manufacturer's facility. A written summary description of the program utilized by the product manufacturer shall be available to the purchaser upon request. The product manufacturer is defined as the entity whose name or trademark appears on the product in accordance with the marking or identification requirements of this Standard.

## **ANNEX F**

# **PRESSURE-TEMPERATURE RATINGS AND DIMENSIONAL DATA FOR CLASSES 150, 300, 400, 600, 900, 1500, AND 2500 FLANGES AND CLASSES 150 AND 300 FLANGED FITTINGS IN U.S. CUSTOMARY UNITS**

This Annex is an integral part of ASME B16.5-2003, and is placed after the main text for convenience.

The pressure-temperature ratings for the materials listed in Table 1A and covered by this Standard, are as listed in Tables 2-1.1 through 2-3.17 and Tables F2-1.1 through F2-3.17 of of this Annex.

Tables 2-1.1 through 2-3.17 have pressure-temperature ratings using bar units for pressure (1 bar = 100 kPa) and degrees Celsius units for temperature.

Tables F2-1.1 through F2-3.17 of Annex F have coterminous pressure-temperature ratings using psi units for

pressure and degrees Fahrenheit units for temperature.

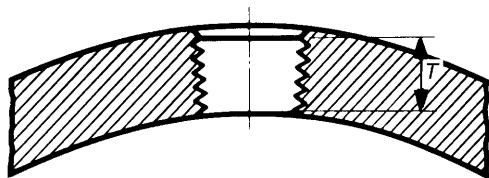
All tabulated pressures are gage pressures.

Other tables and figures included in this Annex provide dimensional data in U.S. Customary units for the following:

(a) Classes 150, 300, 400, 600, 900, 1500, and 2500 flanges

(b) Classes 150 and 300 flanged fittings

Annex G includes dimensional data for Classes 400, 600, 900, 1500, and 2500 flanged fittings for information.



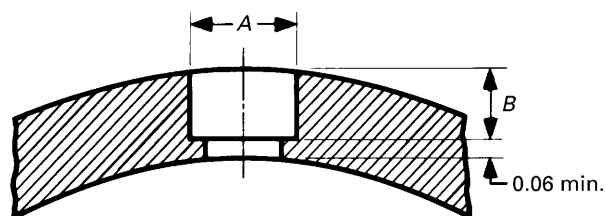
| Connection Size, NPS               | $\frac{3}{8}$ | $\frac{1}{2}$ | $\frac{3}{4}$ | 1    | $1\frac{1}{4}$ | $1\frac{1}{2}$ | 2    |
|------------------------------------|---------------|---------------|---------------|------|----------------|----------------|------|
| Thread length $T$ , in. [Note (1)] | 0.41          | 0.53          | 0.55          | 0.68 | 0.71           | 0.72           | 0.76 |

GENERAL NOTE: See paras. 6.12.2, 6.12.5, and 6.12.6.

NOTE:

- (1) In no case shall the effective length of thread  $T$  be less than that shown in the table above. These lengths are equal to the effective thread length of external pipe threads (ASME B1.20.1).

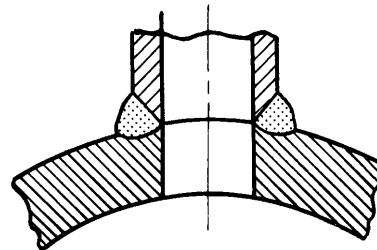
**Fig. F3 Thread for Connection Tapping**



| Connection Size, NPS                 | $\frac{3}{8}$ | $\frac{1}{2}$ | $\frac{3}{4}$ | 1    | $1\frac{1}{4}$ | $1\frac{1}{2}$ | 2    |
|--------------------------------------|---------------|---------------|---------------|------|----------------|----------------|------|
| Minimum diameter of socket $A$ , in. | 0.69          | 0.86          | 1.06          | 1.33 | 1.68           | 1.92           | 2.41 |
| Minimum depth $B$ , in.              | 0.19          | 0.19          | 0.25          | 0.25 | 0.25           | 0.25           | 0.31 |

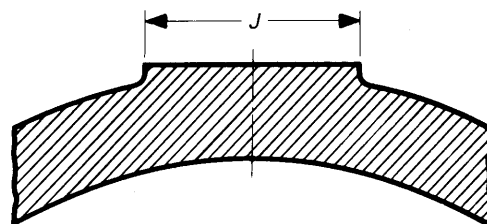
GENERAL NOTE: See paras. 6.12.3, 6.12.5, and 6.12.6.

**Fig. F4 Socket Welding for Connections**



GENERAL NOTE: See paras. 6.12.4 and 6.12.5.

**Fig. F5 Butt Welding for Connections**

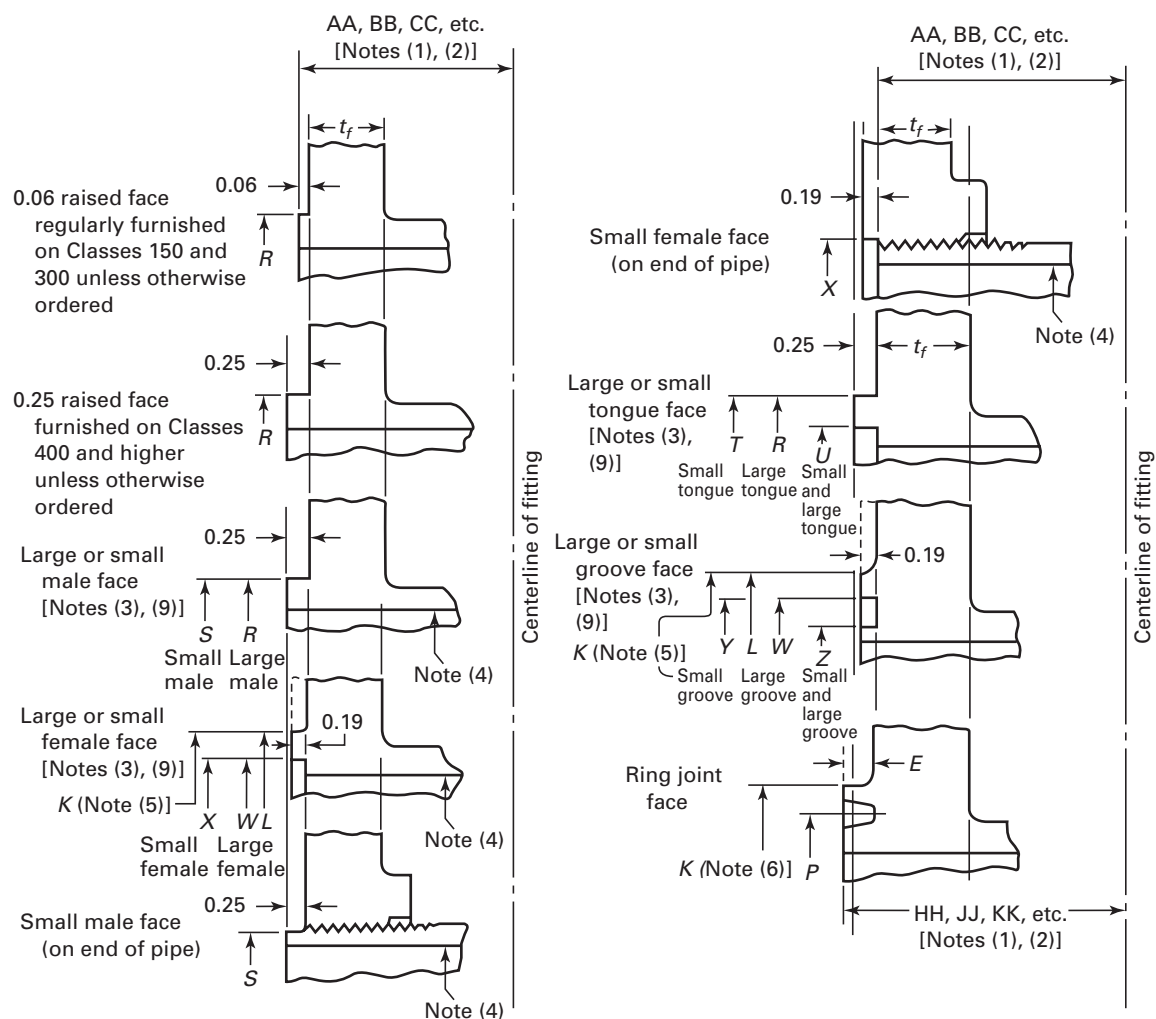


| Connection Size, NPS            | $\frac{3}{8}$ | $\frac{1}{2}$ | $\frac{3}{4}$ | 1    | $1\frac{1}{4}$ | $1\frac{1}{2}$ | 2    |
|---------------------------------|---------------|---------------|---------------|------|----------------|----------------|------|
| Minimum boss diameter $J$ , in. | 1.25          | 1.50          | 1.75          | 2.12 | 2.50           | 2.75           | 3.38 |

GENERAL NOTE: See para. 6.12.5.

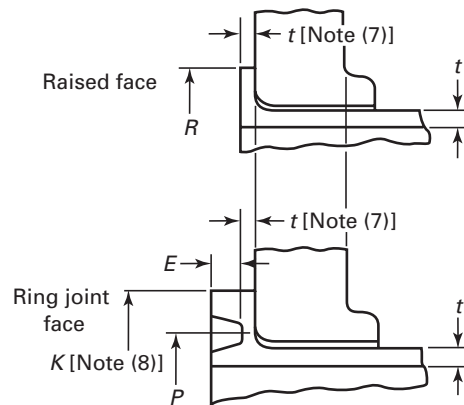
**Fig. F6 Bosses for Connections**

**END FLANGE FACINGS**  
**Flange Thickness and Center-to-End Dimensions**  
**Classes 150 through 2500**



**Fig. F7 End Flange Facings and Their Relationship to Flange Thickness and Center-to-End and End-to-End Dimensions**

**END FLANGE FACINGS**  
**Flange Thickness and End-to-End Dimensions**  
**Lapped Joints**



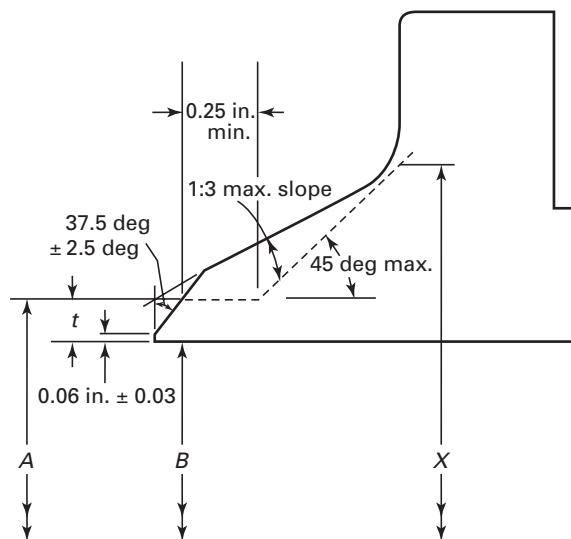
GENERAL NOTE: Dimensions are in inches. For dimensions in millimeters, refer to Fig. 7.

NOTES:

- (1) See paras. 6.2 and 6.4.
- (2) See Tables F7 through F22.
- (3) See Table F4 for dimensions of facings (other than ring joint) and Table F5 for ring joint facing.
- (4) For small male and female joints, care should be taken in the use of these dimensions to insure that the inside diameter of fitting of pipe is small enough to permit sufficient bearing surface to prevent crushing of the gasket (See Table F4.). This applies particularly on lines where the joint is made on the end of the pipe. Threaded companion flanges for small male and female joints are furnished with plain face and are threaded with American National Standard Locknut Thread (NPSL).
- (5) See Table F4.
- (6) See Table F5.
- (7) See para. 6.4.3.
- (8) See para. 6.4.3.5 and Table F5.
- (9) Large male and female faces and large tongue and groove are not applicable to Class 150 because of potential dimensional conflicts.

**Fig. F7 End Flange Facings and Their  
 Relationship to Flange Thickness and Center-to-  
 End and End-to-End Dimensions (Cont'd)**

**WELDING ENDS**  
(Welding Neck Flanges, No Backing Rings)



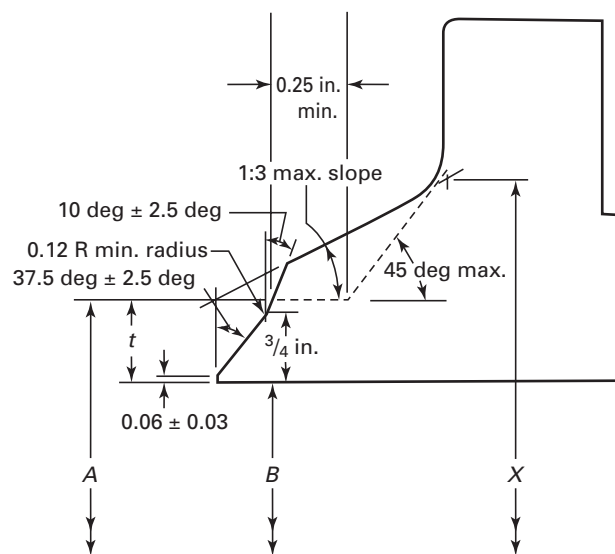
A = nominal outside diameter of pipe  
B = nominal inside diameter of pipe  
t = nominal wall thickness of pipe

**GENERAL NOTES:**

- Dimensions are in inches. For dimensions in millimeters, refer to Figs. 8 and 9.
- See paras. 6.7, 6.8, and 7.4 for details and tolerances.
- See Figs. F10 and F11 for additional details of welding ends.
- When the thickness of the hub at the bevel is greater than that of the pipe to which the flange is joined and the additional thickness is provided on the outside diameter, a taper weld having a slope not exceeding 1 to 3 may be employed or, alternatively, the greater outside diameter may be tapered at the same maximum slope or less, from a point on the welding bevel equal to the outside diameter of the mating pipe. Similarly, when the greater thickness is provided on the inside of the flange, it shall be taper-bored from the welding end at a slope not exceeding 1 to 3. When flanges covered by this Standard are intended for services with light wall, higher strength pipe, the thickness of the hub at the bevel may be greater than that of the pipe to which the flange is joined. Under these conditions, a single taper hub may be provided, and the outside diameter of the hub at the base (dimension X) may also be modified. The additional thickness may be provided on either inside or outside or partially on each side, but the total additional thickness shall not exceed one-half times the nominal wall thickness of intended mating pipe. See Figs. 12, 13, and 14.
- The hub transition from the A diameter to the X diameter shall fall within the maximum and minimum envelope outlined by the 1:3 max. slope and the dashed line.
- For welding end dimensions, refer to ASME B16.25

**Fig. F8 Bevel for Wall Thicknesses  $t$  from 0.19 in. to 0.88 in. Inclusive**

**WELDING ENDS**  
(Welding Neck Flanges, No Backing Rings)

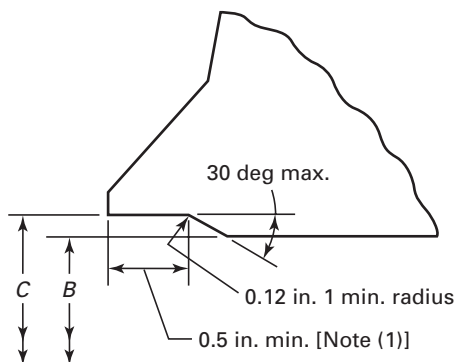


A = nominal outside diameter of pipe  
B = nominal inside diameter of pipe  
t = nominal wall thickness of pipe

GENERAL NOTE: Please see General Notes for Fig. F8.

**Fig. F9 Bevel for Wall Thicknesses  $t$  Greater Than 0.88 in.**

**WELDING ENDS**  
(Welding Neck Flanges)



- $A$  = nominal outside diameter of welding end, in.  
 $B$  = nominal inside diameter of pipe ( $-A - 2t$ ), in.  
 $C = A - 0.031 - 1.75t - 0.010$  in.  
 $T$  = nominal wall thickness of pipe  
 0.031 in. = minus tolerance on outside diameter of pipe to ASTM A 106, etc.  
 $1.75t = 87\frac{1}{2}\%$  of nominal wall (permitted by ASTM A 106, etc.) multiplied by two to convert into terms of diameter  
 0.010 in. = plus tolerance on diameter  $C$ . See para. 7.5.3.

**GENERAL NOTES:**

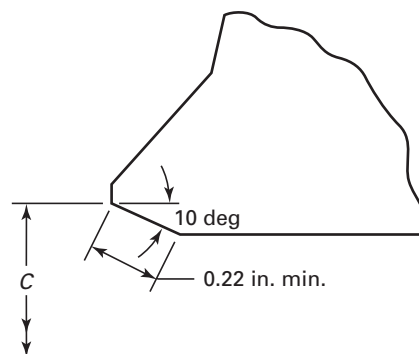
- Dimensions are in inches. For dimensions in millimeters, refer to Figs. 10 and 11.
- See paras. 6.7, 6.8, and 7.5 for details and tolerances.
- See Figs. F8 and F9 for welding end details of welding neck flanges.
- For dimensions, see ASME B16.25.

**NOTE:**

- 0.5 in. depth based on use of 0.75-in. wide backing ring.

**Fig. F10 Inside Contour for Use With Rectangular Backing Ring**

**WELDING ENDS**  
(Welding Neck Flanges)



- $A$  = nominal outside diameter of welding end, in.  
 $B$  = nominal inside diameter of pipe ( $-A - 2t$ ), in.  
 $C = A - 0.031 - 1.75t - 0.010$  in.  
 $T$  = nominal wall thickness of pipe  
 0.031 in. = minus tolerance on outside diameter of pipe to ASTM A 106, etc.  
 $1.75t = 87\frac{1}{2}\%$  of nominal wall (permitted by ASTM A 106, etc.) multiplied by two to convert into terms of diameter  
 0.010 in. = plus tolerance on diameter  $C$ . See para. 7.5.3.

**GENERAL NOTES:**

- Dimensions are in inches. For dimensions in millimeters, refer to Figs. 10 and 11.
- 0.5 in. depth based on use of 0.75-in. wide backing ring.
- See Figs. 6.7, 6.8, and 7.5 for details and tolerances.
- See Figs. F8 and F9 for welding end details of welding neck flanges.
- For dimensions, see ASME B16.25.

**Fig. F11 Inside Contour for Use With Taper Backing Ring**



**Table F2-1.1 Pressure–Temperature Ratings for Group 1.1 Materials**

| Nominal Designation                | Forgings                |     | Castings          |      | Plates                |      |      |
|------------------------------------|-------------------------|-----|-------------------|------|-----------------------|------|------|
| C–Si                               | A 105 (1)               |     | A 216 Gr. WCB (1) |      | A 515 Gr. 70 (1)      |      |      |
| C–Mn–Si                            | A 350 Gr. LF2 (1)       |     |                   |      | A 516 Gr. 70 (1), (2) |      |      |
| C–Mn–Si–V                          | A 350 Gr. LF6 Cl. 1 (4) |     |                   |      | A 537 Cl. 1 (3)       |      |      |
| 3½Ni                               | A 350 Gr. LF 3          |     |                   |      |                       |      |      |
| Working Pressures by Classes, psig |                         |     |                   |      |                       |      |      |
| Class Temp., °F                    | 150                     | 300 | 400               | 600  | 900                   | 1500 | 2500 |
| –20 to 100                         | 285                     | 740 | 985               | 1480 | 2220                  | 3705 | 6170 |
| 200                                | 260                     | 680 | 905               | 1360 | 2035                  | 3395 | 5655 |
| 300                                | 230                     | 655 | 870               | 1310 | 1965                  | 3270 | 5450 |
| 400                                | 200                     | 635 | 845               | 1265 | 1900                  | 3170 | 5280 |
| 500                                | 170                     | 605 | 805               | 1205 | 1810                  | 3015 | 5025 |
| 600                                | 140                     | 570 | 755               | 1135 | 1705                  | 2840 | 4730 |
| 650                                | 125                     | 550 | 730               | 1100 | 1650                  | 2745 | 4575 |
| 700                                | 110                     | 530 | 710               | 1060 | 1590                  | 2655 | 4425 |
| 750                                | 95                      | 505 | 675               | 1015 | 1520                  | 2535 | 4230 |
| 800                                | 80                      | 410 | 550               | 825  | 1235                  | 2055 | 3430 |
| 850                                | 65                      | 320 | 425               | 640  | 955                   | 1595 | 2655 |
| 900                                | 50                      | 230 | 305               | 460  | 690                   | 1150 | 1915 |
| 950                                | 35                      | 135 | 185               | 275  | 410                   | 685  | 1145 |
| 1000                               | 20                      | 85  | 115               | 170  | 255                   | 430  | 715  |

## NOTES:

- (1) Upon prolonged exposure to temperatures above 800°F, the carbide phase of steel may be converted to graphite. Permissible, but not recommended for prolonged use above 800°F.
- (2) Not to be used over 850°F.
- (3) Not to be used over 700°F.
- (4) Not to be used over 500°F.

**Table F2-1.2 Pressure–Temperature Ratings for Group 1.2 Materials**

| Nominal Designation                | Forgings                |     |      | Castings                               |      | Plates          |      |
|------------------------------------|-------------------------|-----|------|----------------------------------------|------|-----------------|------|
| C–Mn–Si                            |                         |     |      | A 216 Gr. WCC (1)<br>A 352 Gr. LCC (2) |      |                 |      |
| C–Mn–Si–V                          | A 350 Gr. LF6 Cl. 2 (3) |     |      |                                        |      |                 |      |
| 2½Ni                               |                         |     |      | A 352 Gr. LC2                          |      | A 203 Gr. B (1) |      |
| 3½Ni                               |                         |     |      | A 352 Gr. LC3                          |      | A 203 Gr. E (1) |      |
| Working Pressures by Classes, psig |                         |     |      |                                        |      |                 |      |
| Class Temp., °F                    | 150                     | 300 | 400  | 600                                    | 900  | 1500            | 2500 |
| –20 to 100                         | 290                     | 750 | 1000 | 1500                                   | 2250 | 3750            | 6250 |
| 200                                | 260                     | 750 | 1000 | 1500                                   | 2250 | 3750            | 6250 |
| 300                                | 230                     | 730 | 970  | 1455                                   | 2185 | 3640            | 6070 |
| 400                                | 200                     | 705 | 940  | 1405                                   | 2110 | 3520            | 5865 |
| 500                                | 170                     | 665 | 885  | 1330                                   | 1995 | 3325            | 5540 |
| 600                                | 140                     | 605 | 805  | 1210                                   | 1815 | 3025            | 5040 |
| 650                                | 125                     | 590 | 785  | 1175                                   | 1765 | 2940            | 4905 |
| 700                                | 110                     | 555 | 740  | 1110                                   | 1665 | 2775            | 4630 |
| 750                                | 95                      | 505 | 675  | 1015                                   | 1520 | 2535            | 4230 |
| 800                                | 80                      | 410 | 550  | 825                                    | 1235 | 2055            | 3430 |
| 850                                | 65                      | 320 | 425  | 640                                    | 955  | 1595            | 2655 |
| 900                                | 50                      | 225 | 295  | 445                                    | 670  | 1115            | 1855 |
| 950                                | 35                      | 135 | 185  | 275                                    | 410  | 685             | 1145 |
| 1000                               | 20                      | 85  | 115  | 170                                    | 255  | 430             | 715  |

## NOTES:

- (1) Upon prolonged exposure to temperatures above 800°F, the carbide phase of steel may be converted to graphite. Permissible, but not recommended for prolonged use above 800°F.
- (2) Not to be used over 650°F
- (3) Not to be used over 500°F.

**Table F2-1.3 Pressure–Temperature Ratings for Group 1.3 Materials**

| Nominal Designation                | Forgings |     | Castings                                    |      |      | Plates                |      |
|------------------------------------|----------|-----|---------------------------------------------|------|------|-----------------------|------|
| C–Si                               |          |     | A 352 Gr. LCB (3)                           |      |      | A 515 Gr. 65 (1)      |      |
| C–Mn–Si                            |          |     |                                             |      |      | A 516 Gr. 65 (1), (2) |      |
| C– $\frac{1}{2}$ Mo                |          |     | A 217 Gr. WC1 (4), (5)<br>A 352 Gr. LC1 (3) |      |      |                       |      |
| 2 $\frac{1}{2}$ Ni                 |          |     |                                             |      |      | A 203 Gr. A (1)       |      |
| 3 $\frac{1}{2}$ Ni                 |          |     |                                             |      |      | A 203 Gr. D (1)       |      |
| Working Pressures by Classes, psig |          |     |                                             |      |      |                       |      |
| Class Temp., °F                    | 150      | 300 | 400                                         | 600  | 900  | 1500                  | 2500 |
| –20 to 100                         | 265      | 695 | 930                                         | 1395 | 2090 | 3480                  | 5805 |
| 200                                | 255      | 660 | 880                                         | 1320 | 1980 | 3300                  | 5505 |
| 300                                | 230      | 640 | 850                                         | 1275 | 1915 | 3190                  | 5315 |
| 400                                | 200      | 615 | 820                                         | 1230 | 1845 | 3075                  | 5125 |
| 500                                | 170      | 585 | 780                                         | 1175 | 1760 | 2930                  | 4885 |
| 600                                | 140      | 550 | 735                                         | 1105 | 1655 | 2755                  | 4595 |
| 650                                | 125      | 535 | 710                                         | 1065 | 1600 | 2665                  | 4440 |
| 700                                | 110      | 510 | 685                                         | 1025 | 1535 | 2560                  | 4270 |
| 750                                | 95       | 475 | 635                                         | 955  | 1430 | 2385                  | 3970 |
| 800                                | 80       | 390 | 520                                         | 780  | 1175 | 1955                  | 3255 |
| 850                                | 65       | 300 | 400                                         | 595  | 895  | 1490                  | 2485 |
| 900                                | 50       | 200 | 270                                         | 405  | 605  | 1010                  | 1685 |
| 950                                | 35       | 135 | 185                                         | 275  | 410  | 685                   | 1145 |
| 1000                               | 20       | 85  | 115                                         | 170  | 255  | 430                   | 715  |

## NOTES:

- (1) Upon prolonged exposure to temperatures above 800°F, the carbide phase of steel may be converted to graphite. Permissible, but not recommended for prolonged use above 800°F.
- (2) Not to be used over 850°F
- (3) Not to be used over 650°F.
- (4) Upon prolonged exposure to temperatures above 875°F, the carbide phase of steel may be converted to graphite. Permissible, but not recommended for prolonged use above 875°F.
- (5) Use normalized and tempered material only.

**Table F2-1.4 Pressure–Temperature Ratings for Group 1.4 Materials**

| Nominal Designation                | Forgings                |     |     | Castings |      | Plates                |      |
|------------------------------------|-------------------------|-----|-----|----------|------|-----------------------|------|
| C–Si                               |                         |     |     |          |      | A 515 Gr. 60 (1)      |      |
| C–Mn–Si                            | A 350 Gr. LF1, Cl.1 (1) |     |     |          |      | A 516 Gr. 60 (1), (2) |      |
| Working Pressures by Classes, psig |                         |     |     |          |      |                       |      |
| Class Temp., °F                    | 150                     | 300 | 400 | 600      | 900  | 1500                  | 2500 |
| –20 to 100                         | 235                     | 615 | 825 | 1235     | 1850 | 3085                  | 5145 |
| 200                                | 215                     | 565 | 755 | 1130     | 1695 | 2830                  | 4715 |
| 300                                | 210                     | 545 | 725 | 1090     | 1635 | 2725                  | 4545 |
| 400                                | 200                     | 525 | 700 | 1055     | 1580 | 2635                  | 4390 |
| 500                                | 170                     | 500 | 670 | 1005     | 1505 | 2510                  | 4185 |
| 600                                | 140                     | 475 | 630 | 945      | 1420 | 2365                  | 3945 |
| 650                                | 125                     | 455 | 610 | 915      | 1370 | 2285                  | 3805 |
| 700                                | 110                     | 440 | 590 | 885      | 1325 | 2210                  | 3685 |
| 750                                | 95                      | 430 | 570 | 855      | 1285 | 2140                  | 3565 |
| 800                                | 80                      | 370 | 495 | 740      | 1110 | 1850                  | 3085 |
| 850                                | 65                      | 300 | 400 | 595      | 895  | 1490                  | 2485 |
| 900                                | 50                      | 170 | 230 | 345      | 515  | 855                   | 1430 |
| 950                                | 35                      | 135 | 185 | 275      | 410  | 685                   | 1145 |
| 1000                               | 20                      | 85  | 115 | 170      | 255  | 430                   | 715  |

## NOTES:

- (1) Upon prolonged exposure to temperatures above 800°F, the carbide phase of steel may be converted to graphite. Permissible, but not recommended for prolonged use above 800°F.
- (2) Not to be used over 850°F.

**Table F2-1.5 Pressure–Temperature Ratings for Group 1.5 Materials**

| Nominal Designation                | Forgings         |     |     | Castings |      | Plates          |                 |
|------------------------------------|------------------|-----|-----|----------|------|-----------------|-----------------|
| C- <sup>1</sup> / <sub>2</sub> Mo  | A 182 Gr. F1 (1) |     |     |          |      | A 204 Gr. A (1) | A 204 Gr. B (1) |
| Working Pressures by Classes, psig |                  |     |     |          |      |                 |                 |
| Class Temp., °F                    | 150              | 300 | 400 | 600      | 900  | 1500            | 2500            |
| -20 to 100                         | 265              | 695 | 930 | 1395     | 2090 | 3480            | 5805            |
| 200                                | 260              | 695 | 930 | 1395     | 2090 | 3480            | 5805            |
| 300                                | 230              | 685 | 915 | 1375     | 2060 | 3435            | 5725            |
| 400                                | 200              | 660 | 885 | 1325     | 1985 | 3310            | 5520            |
| 500                                | 170              | 640 | 855 | 1285     | 1925 | 3210            | 5350            |
| 600                                | 140              | 605 | 805 | 1210     | 1815 | 3025            | 5040            |
| 650                                | 125              | 590 | 785 | 1175     | 1765 | 2940            | 4905            |
| 700                                | 110              | 570 | 755 | 1135     | 1705 | 2840            | 4730            |
| 750                                | 95               | 530 | 710 | 1065     | 1595 | 2660            | 4430            |
| 800                                | 80               | 510 | 675 | 1015     | 1525 | 2540            | 4230            |
| 850                                | 65               | 485 | 650 | 975      | 1460 | 2435            | 4060            |
| 900                                | 50               | 450 | 600 | 900      | 1350 | 2245            | 3745            |
| 950                                | 35               | 280 | 375 | 560      | 845  | 1405            | 2345            |
| 1000                               | 20               | 165 | 220 | 330      | 495  | 825             | 1370            |

**NOTE:**

- (1) Upon prolonged exposure to temperatures above 875°F, the carbide phase of carbon–molybdenum steel may be converted to graphite. Permissible, but not recommended for prolonged use above 875°F.

**Table F2-1.7 Pressure–Temperature Ratings for Group 1.7 Materials**

| Nominal Designation                                    | Forgings               |     |      | Castings |      | Plates |      |
|--------------------------------------------------------|------------------------|-----|------|----------|------|--------|------|
| $\frac{1}{2}\text{Cr}-\frac{1}{2}\text{Mo}$            | A 182 Gr. F2 (1)       |     |      |          |      |        |      |
| $\text{Ni}-\frac{1}{2}\text{Cr}-\frac{1}{2}\text{Mo}$  | A 217 Gr. WC4 (1), (2) |     |      |          |      |        |      |
| $\frac{3}{4}\text{Ni}-\frac{3}{4}\text{Cr}-1\text{Mo}$ | A 217 Gr. WC5 (2)      |     |      |          |      |        |      |
| Working Pressures by Classes, psig                     |                        |     |      |          |      |        |      |
| Class Temp., °F                                        | 150                    | 300 | 400  | 600      | 900  | 1500   | 2500 |
| −20 to 100                                             | 290                    | 750 | 1000 | 1500     | 2250 | 3750   | 6250 |
| 200                                                    | 260                    | 750 | 1000 | 1500     | 2250 | 3750   | 6250 |
| 300                                                    | 230                    | 730 | 970  | 1455     | 2185 | 3640   | 6070 |
| 400                                                    | 200                    | 705 | 940  | 1410     | 2115 | 3530   | 5880 |
| 500                                                    | 170                    | 665 | 885  | 1330     | 1995 | 3325   | 5540 |
| 600                                                    | 140                    | 605 | 805  | 1210     | 1815 | 3025   | 5040 |
| 650                                                    | 125                    | 590 | 785  | 1175     | 1765 | 2940   | 4905 |
| 700                                                    | 110                    | 570 | 755  | 1135     | 1705 | 2840   | 4730 |
| 750                                                    | 95                     | 530 | 710  | 1065     | 1595 | 2660   | 4430 |
| 800                                                    | 80                     | 510 | 675  | 1015     | 1525 | 2540   | 4230 |
| 850                                                    | 65                     | 485 | 650  | 975      | 1460 | 2435   | 4060 |
| 900                                                    | 50                     | 450 | 600  | 900      | 1350 | 2245   | 3745 |
| 950                                                    | 35                     | 315 | 420  | 630      | 945  | 1575   | 2630 |
| 1000                                                   | 20                     | 200 | 270  | 405      | 605  | 1010   | 1685 |
| 1050                                                   | ...                    | 160 | 210  | 315      | 475  | 790    | 1315 |

## NOTES:

(1) Not to be used over 1000°F.

(2) Use normalized and tempered material only.

**Table F2-1.9 Pressure–Temperature Ratings for Group 1.9 Materials**

| Nominal Designation                | Forgings                     |     |      | Castings |                        | Plates |      |
|------------------------------------|------------------------------|-----|------|----------|------------------------|--------|------|
| 1¼Cr–½Mo                           | A 217 Gr. WC6 (1), (3)       |     |      |          |                        |        |      |
| 1¼Cr–½Mo–Si                        | A 182 Gr. F11 Cl. 2 (1), (2) |     |      |          | A 387 Gr. 11 Cl. 2 (2) |        |      |
| Working Pressures by Classes, psig |                              |     |      |          |                        |        |      |
| Class<br>Temp., °F                 | 150                          | 300 | 400  | 600      | 900                    | 1500   | 2500 |
| –20 to 100                         | 290                          | 750 | 1000 | 1500     | 2250                   | 3750   | 6250 |
| 200                                | 260                          | 750 | 1000 | 1500     | 2250                   | 3750   | 6250 |
| 300                                | 230                          | 720 | 965  | 1445     | 2165                   | 3610   | 6015 |
| 400                                | 200                          | 695 | 925  | 1385     | 2080                   | 3465   | 5775 |
| 500                                | 170                          | 665 | 885  | 1330     | 1995                   | 3325   | 5540 |
| 600                                | 140                          | 605 | 805  | 1210     | 1815                   | 3025   | 5040 |
| 650                                | 125                          | 590 | 785  | 1175     | 1765                   | 2940   | 4905 |
| 700                                | 110                          | 570 | 755  | 1135     | 1705                   | 2840   | 4730 |
| 750                                | 95                           | 530 | 710  | 1065     | 1595                   | 2660   | 4430 |
| 800                                | 80                           | 510 | 675  | 1015     | 1525                   | 2540   | 4230 |
| 850                                | 65                           | 485 | 650  | 975      | 1460                   | 2435   | 4060 |
| 900                                | 50                           | 450 | 600  | 900      | 1350                   | 2245   | 3745 |
| 950                                | 35                           | 320 | 425  | 640      | 955                    | 1595   | 2655 |
| 1000                               | 20                           | 215 | 290  | 430      | 650                    | 1080   | 1800 |
| 1050                               | ...                          | 145 | 190  | 290      | 430                    | 720    | 1200 |
| 1100                               | ...                          | 95  | 130  | 190      | 290                    | 480    | 800  |
| 1150                               | ...                          | 65  | 85   | 130      | 195                    | 325    | 545  |
| 1200                               | ...                          | 40  | 55   | 80       | 125                    | 205    | 345  |

## NOTES:

- (1) Use normalized and tempered material only.
- (2) Permissible, but not recommended for prolonged use above 1100°F.
- (3) Not to be used over 1100°F.

**Table F2-1.10 Pressure–Temperature Ratings for Group 1.10 Materials**

| Nominal Designation                  | Forgings                |     |      | Castings               |      | Plates                 |      |
|--------------------------------------|-------------------------|-----|------|------------------------|------|------------------------|------|
| 2 <sup>1</sup> / <sub>4</sub> Cr–1Mo | A 182 Gr. F22 Cl. 3 (1) |     |      | A 217 Gr. WC9 (2), (3) |      | A 387 Gr. 22 Cl. 2 (1) |      |
| Working Pressures by Classes, psig   |                         |     |      |                        |      |                        |      |
| Class<br>Temp., °F                   | 150                     | 300 | 400  | 600                    | 900  | 1500                   | 2500 |
| –20 to 100                           | 290                     | 750 | 1000 | 1500                   | 2250 | 3750                   | 6250 |
| 200                                  | 260                     | 750 | 1000 | 1500                   | 2250 | 3750                   | 6250 |
| 300                                  | 230                     | 730 | 970  | 1455                   | 2185 | 3640                   | 6070 |
| 400                                  | 200                     | 705 | 940  | 1410                   | 2115 | 3530                   | 5880 |
| 500                                  | 170                     | 665 | 885  | 1330                   | 1995 | 3325                   | 5540 |
| 600                                  | 140                     | 605 | 805  | 1210                   | 1815 | 3025                   | 5040 |
| 650                                  | 125                     | 590 | 785  | 1175                   | 1765 | 2940                   | 4905 |
| 700                                  | 110                     | 570 | 755  | 1135                   | 1705 | 2840                   | 4730 |
| 750                                  | 95                      | 530 | 710  | 1065                   | 1595 | 2660                   | 4430 |
| 800                                  | 80                      | 510 | 675  | 1015                   | 1525 | 2540                   | 4230 |
| 850                                  | 65                      | 485 | 650  | 975                    | 1460 | 2435                   | 4060 |
| 900                                  | 50                      | 450 | 600  | 900                    | 1350 | 2245                   | 3745 |
| 950                                  | 35                      | 385 | 515  | 775                    | 1160 | 1930                   | 3220 |
| 1000                                 | 20                      | 265 | 355  | 535                    | 800  | 1335                   | 2230 |
| 1050                                 | ...                     | 175 | 235  | 350                    | 525  | 875                    | 1455 |
| 1100                                 | ...                     | 110 | 145  | 220                    | 330  | 550                    | 915  |
| 1150                                 | ...                     | 70  | 90   | 135                    | 205  | 345                    | 570  |
| 1200                                 | ...                     | 40  | 55   | 80                     | 125  | 205                    | 345  |

## NOTES:

- (1) Permissible, but not recommended for prolonged use above 1100°F.  
 (2) Use normalized and tempered material only.  
 (3) Not to be used over 1100°F.



**Table F2-1.11 Pressure–Temperature Ratings for Group 1.11 Materials**

| Nominal Designation                | Forgings         |     |      | Castings |      | Plates |      |
|------------------------------------|------------------|-----|------|----------|------|--------|------|
| C- $\frac{1}{2}$ Mo                | A 204, Gr. C (1) |     |      |          |      |        |      |
| Working Pressures by Classes, psig |                  |     |      |          |      |        |      |
| Class<br>Temp., °F                 | 150              | 300 | 400  | 600      | 900  | 1500   | 2500 |
| -20 to 100                         | 290              | 750 | 1000 | 1500     | 2250 | 3750   | 6250 |
| 200                                | 260              | 750 | 1000 | 1500     | 2250 | 3750   | 6250 |
| 300                                | 230              | 730 | 970  | 1455     | 2185 | 3640   | 6070 |
| 400                                | 200              | 705 | 940  | 1410     | 2115 | 3530   | 5880 |
| 500                                | 170              | 665 | 885  | 1330     | 1995 | 3325   | 5540 |
| 600                                | 140              | 605 | 805  | 1210     | 1815 | 3025   | 5040 |
| 650                                | 125              | 590 | 785  | 1175     | 1765 | 2940   | 4905 |
| 700                                | 110              | 570 | 755  | 1135     | 1705 | 2840   | 4730 |
| 750                                | 95               | 530 | 710  | 1065     | 1595 | 2660   | 4430 |
| 800                                | 80               | 510 | 675  | 1015     | 1525 | 2540   | 4230 |
| 850                                | 65               | 485 | 650  | 975      | 1460 | 2435   | 4060 |
| 900                                | 50               | 450 | 600  | 900      | 1345 | 2245   | 3745 |
| 950                                | 35               | 280 | 375  | 560      | 845  | 1405   | 2345 |
| 1000                               | 20               | 165 | 220  | 330      | 495  | 825    | 1370 |
| 1050                               | ...              | 165 | 220  | 330      | 495  | 825    | 1370 |
| 1100                               | ...              | 110 | 145  | 220      | 330  | 550    | 915  |
| 1150                               | ...              | 80  | 110  | 165      | 245  | 410    | 685  |
| 1200                               | ...              | 45  | 60   | 90       | 135  | 225    | 370  |

## NOTE:

- (1) Upon prolonged exposure to temperatures above 875°F, the carbide phase of carbon-molybdenum steel may be converted to graphite. Permissible, but not recommended for prolonged use above 875°F.

**Table F2-1.13 Pressure–Temperature Ratings for Group 1.13 Materials**

| Nominal Designation                | Forgings      |     |      | Castings         |      | Plates |      |
|------------------------------------|---------------|-----|------|------------------|------|--------|------|
| 5Cr– $\frac{1}{2}$ Mo              | A 182 Gr. F5a |     |      | A 217 Gr. C5 (1) |      |        |      |
| Working Pressures by Classes, psig |               |     |      |                  |      |        |      |
| Class<br>Temp., °F                 | 150           | 300 | 400  | 600              | 900  | 1500   | 2500 |
| –20 to 100                         | 290           | 750 | 1000 | 1500             | 2250 | 3750   | 6250 |
| 200                                | 260           | 750 | 1000 | 1500             | 2250 | 3750   | 6250 |
| 300                                | 230           | 730 | 970  | 1455             | 2185 | 3640   | 6070 |
| 400                                | 200           | 705 | 940  | 1410             | 2115 | 3530   | 5880 |
| 500                                | 170           | 665 | 885  | 1330             | 1995 | 3325   | 5540 |
| 600                                | 140           | 605 | 805  | 1210             | 1815 | 3025   | 5040 |
| 650                                | 125           | 590 | 785  | 1175             | 1765 | 2940   | 4905 |
| 700                                | 110           | 570 | 755  | 1135             | 1705 | 2840   | 4730 |
| 750                                | 95            | 530 | 710  | 1065             | 1595 | 2660   | 4430 |
| 800                                | 80            | 510 | 675  | 1015             | 1525 | 2540   | 4230 |
| 850                                | 65            | 485 | 650  | 975              | 1460 | 2435   | 4060 |
| 900                                | 50            | 375 | 500  | 745              | 1120 | 1870   | 3115 |
| 950                                | 35            | 275 | 365  | 550              | 825  | 1370   | 2285 |
| 1000                               | 20            | 200 | 265  | 400              | 595  | 995    | 1655 |
| 1050                               | ...           | 145 | 190  | 290              | 430  | 720    | 1200 |
| 1100                               | ...           | 100 | 135  | 200              | 300  | 495    | 830  |
| 1150                               | ...           | 60  | 80   | 125              | 185  | 310    | 515  |
| 1200                               | ...           | 35  | 45   | 70               | 105  | 170    | 285  |

NOTE:

(1) Use normalized and tempered material only.

**Table F2-1.14 Pressure–Temperature Ratings for Group 1.14 Materials**

| Nominal Designation                |     | Forgings     |      |      | Castings          |      | Plates |
|------------------------------------|-----|--------------|------|------|-------------------|------|--------|
| 9Cr–1Mo                            |     | A 182 Gr. F9 |      |      | A 217 Gr. C12 (1) |      |        |
| Working Pressures by Classes, psig |     |              |      |      |                   |      |        |
| Class<br>Temp., °F                 | 150 | 300          | 400  | 600  | 900               | 1500 | 2500   |
| –20 to 100                         | 290 | 750          | 1000 | 1500 | 2250              | 3750 | 6250   |
| 200                                | 260 | 750          | 1000 | 1500 | 2250              | 3750 | 6250   |
| 300                                | 230 | 730          | 970  | 1455 | 2185              | 3640 | 6070   |
| 400                                | 200 | 705          | 940  | 1410 | 2115              | 3530 | 5880   |
| 500                                | 170 | 665          | 885  | 1330 | 1995              | 3325 | 5540   |
| 600                                | 140 | 605          | 805  | 1210 | 1815              | 3025 | 5040   |
| 650                                | 125 | 590          | 785  | 1175 | 1765              | 2940 | 4905   |
| 700                                | 110 | 570          | 755  | 1135 | 1705              | 2840 | 4730   |
| 750                                | 95  | 530          | 710  | 1065 | 1595              | 2660 | 4430   |
| 800                                | 80  | 510          | 675  | 1015 | 1525              | 2540 | 4230   |
| 850                                | 65  | 485          | 650  | 975  | 1460              | 2435 | 4060   |
| 900                                | 50  | 450          | 600  | 900  | 1350              | 2245 | 3745   |
| 950                                | 35  | 375          | 505  | 755  | 1130              | 1885 | 3145   |
| 1000                               | 20  | 255          | 340  | 505  | 760               | 1270 | 2115   |
| 1050                               | ... | 170          | 230  | 345  | 515               | 855  | 1430   |
| 1100                               | ... | 115          | 150  | 225  | 340               | 565  | 945    |
| 1150                               | ... | 75           | 100  | 150  | 225               | 375  | 630    |
| 1200                               | ... | 50           | 70   | 105  | 155               | 255  | 430    |

NOTE:

(1) Use normalized and tempered material only.

**Table F2-1.15 Pressure–Temperature Ratings for Group 1.15 Materials**

| Nominal Designation                | Forgings      |     |      | Castings        |      | Plates             |      |
|------------------------------------|---------------|-----|------|-----------------|------|--------------------|------|
| 9Cr–1Mo–V                          | A 182 Gr. F91 |     |      | A 217 Gr. C12 A |      | A 387 Gr. 91 Cl. 2 |      |
| Working Pressures by Classes, psig |               |     |      |                 |      |                    |      |
| Class<br>Temp., °F                 | 150           | 300 | 400  | 600             | 900  | 1500               | 2500 |
| –20 to 100                         | 290           | 750 | 1000 | 1500            | 2250 | 3750               | 6250 |
| 200                                | 260           | 750 | 1000 | 1500            | 2250 | 3750               | 6250 |
| 300                                | 230           | 730 | 970  | 1455            | 2185 | 3640               | 6070 |
| 400                                | 200           | 705 | 940  | 1410            | 2115 | 3530               | 5880 |
| 500                                | 170           | 665 | 885  | 1330            | 1995 | 3325               | 5540 |
| 600                                | 140           | 605 | 805  | 1210            | 1815 | 3025               | 5040 |
| 650                                | 125           | 590 | 785  | 1175            | 1765 | 2940               | 4905 |
| 700                                | 110           | 570 | 755  | 1135            | 1705 | 2840               | 4730 |
| 750                                | 95            | 530 | 710  | 1065            | 1595 | 2660               | 4430 |
| 800                                | 80            | 510 | 675  | 1015            | 1525 | 2540               | 4230 |
| 850                                | 65            | 485 | 650  | 975             | 1460 | 2435               | 4060 |
| 900                                | 50            | 450 | 600  | 900             | 1350 | 2245               | 3745 |
| 950                                | 35            | 385 | 515  | 775             | 1160 | 1930               | 3220 |
| 1000                               | 20            | 365 | 485  | 725             | 1090 | 1820               | 3030 |
| 1050                               | ...           | 360 | 480  | 720             | 1080 | 1800               | 3000 |
| 1100                               | ...           | 300 | 400  | 605             | 905  | 1510               | 2515 |
| 1150                               | ...           | 225 | 295  | 445             | 670  | 1115               | 1855 |
| 1200                               | ...           | 145 | 190  | 290             | 430  | 720                | 1200 |

**Table F2-1.17 Pressure–Temperature Ratings for Group 1.17 Materials**

| Nominal Designation                | Forgings                     |     |      |      | Castings |      | Plates |
|------------------------------------|------------------------------|-----|------|------|----------|------|--------|
| 1Cr– $\frac{1}{2}$ Mo              | A 182 Gr. F12 Cl. 2 (1), (2) |     |      |      |          |      |        |
| 5Cr– $\frac{1}{2}$                 | A 182 Gr. F5                 |     |      |      |          |      |        |
| Working Pressures by Classes, psig |                              |     |      |      |          |      |        |
| Class<br>Temp., °F                 | 150                          | 300 | 400  | 600  | 900      | 1500 | 2500   |
| –20 to 100                         | 290                          | 750 | 1000 | 1500 | 2250     | 3750 | 6250   |
| 200                                | 260                          | 735 | 980  | 1470 | 2210     | 3680 | 6135   |
| 300                                | 230                          | 700 | 935  | 1400 | 2100     | 3495 | 5830   |
| 400                                | 200                          | 670 | 890  | 1335 | 2005     | 3345 | 5570   |
| 500                                | 170                          | 645 | 860  | 1290 | 1940     | 3230 | 5385   |
| 600                                | 140                          | 605 | 805  | 1210 | 1815     | 3025 | 5040   |
| 650                                | 125                          | 590 | 785  | 1175 | 1765     | 2940 | 4905   |
| 700                                | 110                          | 570 | 755  | 1135 | 1705     | 2840 | 4730   |
| 750                                | 95                           | 530 | 710  | 1065 | 1595     | 2660 | 4430   |
| 800                                | 80                           | 510 | 675  | 1015 | 1525     | 2540 | 4230   |
| 850                                | 65                           | 485 | 650  | 975  | 1460     | 2435 | 4060   |
| 900                                | 50                           | 375 | 500  | 745  | 1120     | 1870 | 3115   |
| 950                                | 35                           | 275 | 365  | 550  | 825      | 1370 | 2285   |
| 1000                               | 20                           | 200 | 265  | 400  | 595      | 995  | 1655   |
| 1050                               | ...                          | 145 | 190  | 290  | 430      | 720  | 1200   |
| 1100                               | ...                          | 95  | 130  | 190  | 290      | 480  | 800    |
| 1150                               | ...                          | 60  | 80   | 125  | 185      | 310  | 515    |
| 1200                               | ...                          | 35  | 45   | 70   | 105      | 170  | 285    |

## NOTES:

- (1) Use normalized and tempered material only.  
 (2) Permissible, but not recommended for prolonged use above 1100°F.

**Table F2-2.1 Pressure–Temperature Ratings for Group 2.1 Materials**

| Nominal Designation                | Forgings           |     |     | Castings          |      | Plates            |      |
|------------------------------------|--------------------|-----|-----|-------------------|------|-------------------|------|
| 18Cr–8Ni                           | A 182 Gr. F304 (1) |     |     | A 351 Gr. CF3 (2) |      | A 240 Gr. 304 (1) |      |
|                                    | A 182 Gr. F304H    |     |     | A 351 Gr. CF8 (1) |      | A 240 Gr. 304H    |      |
| Working Pressures by Classes, psig |                    |     |     |                   |      |                   |      |
| Class Temp., °F                    | 150                | 300 | 400 | 600               | 900  | 1500              | 2500 |
| –20 to 100                         | 275                | 720 | 960 | 1440              | 2160 | 3600              | 6000 |
| 200                                | 230                | 600 | 800 | 1200              | 1800 | 3000              | 5000 |
| 300                                | 205                | 540 | 715 | 1075              | 1615 | 2690              | 4480 |
| 400                                | 190                | 495 | 660 | 995               | 1490 | 2485              | 4140 |
| 500                                | 170                | 465 | 620 | 930               | 1395 | 2330              | 3880 |
| 600                                | 140                | 440 | 590 | 885               | 1325 | 2210              | 3680 |
| 650                                | 125                | 430 | 575 | 865               | 1295 | 2160              | 3600 |
| 700                                | 110                | 420 | 565 | 845               | 1265 | 2110              | 3520 |
| 750                                | 95                 | 415 | 550 | 825               | 1240 | 2065              | 3440 |
| 800                                | 80                 | 405 | 540 | 810               | 1215 | 2030              | 3380 |
| 850                                | 65                 | 395 | 530 | 790               | 1190 | 1980              | 3300 |
| 900                                | 50                 | 390 | 520 | 780               | 1165 | 1945              | 3240 |
| 950                                | 35                 | 380 | 510 | 765               | 1145 | 1910              | 3180 |
| 1000                               | 20                 | 355 | 470 | 710               | 1065 | 1770              | 2950 |
| 1050                               | ...                | 325 | 435 | 650               | 975  | 1630              | 2715 |
| 1100                               | ...                | 255 | 345 | 515               | 770  | 1285              | 2145 |
| 1150                               | ...                | 205 | 275 | 410               | 615  | 1030              | 1715 |
| 1200                               | ...                | 165 | 220 | 330               | 495  | 825               | 1370 |
| 1250                               | ...                | 135 | 180 | 265               | 400  | 670               | 1115 |
| 1300                               | ...                | 115 | 150 | 225               | 340  | 565               | 945  |
| 1350                               | ...                | 95  | 125 | 185               | 280  | 465               | 770  |
| 1400                               | ...                | 75  | 100 | 150               | 225  | 380               | 630  |
| 1450                               | ...                | 60  | 80  | 115               | 175  | 290               | 485  |
| 1500                               | ...                | 40  | 55  | 85                | 125  | 205               | 345  |

## NOTES:

- (1) At temperatures over 1000°F, use only when the carbon content is 0.04% or higher.  
 (2) Not to be used over 800°F.

**Table F2-2.2 Pressure–Temperature Ratings for Group 2.2 Materials**

| Nominal Designation                | Forgings           |     | Castings           |      | Plates            |      |      |
|------------------------------------|--------------------|-----|--------------------|------|-------------------|------|------|
| 16Cr–12Ni–2Mo                      | A 182 Gr. F316 (1) |     | A 351 Gr. CF3M (2) |      | A 240 Gr. 316 (1) |      |      |
|                                    | A 182 Gr. F316H    |     | A 351 Gr. CF8M (1) |      | A 240 Gr. 316H    |      |      |
| 18Cr–13Ni–3Mo                      | A 182 Gr. F317 (1) |     |                    |      | A 240 Gr. 317 (1) |      |      |
| 19Cr–10Ni–3Mo                      |                    |     | A 351 Gr. CG8M (3) |      |                   |      |      |
| Working Pressures by Classes, psig |                    |     |                    |      |                   |      |      |
| Class Temp., °F                    | 150                | 300 | 400                | 600  | 900               | 1500 | 2500 |
| –20 to 100                         | 275                | 720 | 960                | 1440 | 2160              | 3600 | 6000 |
| 200                                | 235                | 620 | 825                | 1240 | 1860              | 3095 | 5160 |
| 300                                | 215                | 560 | 745                | 1120 | 1680              | 2795 | 4660 |
| 400                                | 195                | 515 | 685                | 1025 | 1540              | 2570 | 4280 |
| 500                                | 170                | 480 | 635                | 955  | 1435              | 2390 | 3980 |
| 600                                | 140                | 450 | 600                | 900  | 1355              | 2255 | 3760 |
| 650                                | 125                | 440 | 590                | 885  | 1325              | 2210 | 3680 |
| 700                                | 110                | 435 | 580                | 870  | 1305              | 2170 | 3620 |
| 750                                | 95                 | 425 | 570                | 855  | 1280              | 2135 | 3560 |
| 800                                | 80                 | 420 | 565                | 845  | 1265              | 2110 | 3520 |
| 850                                | 65                 | 420 | 555                | 835  | 1255              | 2090 | 3480 |
| 900                                | 50                 | 415 | 555                | 830  | 1245              | 2075 | 3460 |
| 950                                | 35                 | 385 | 515                | 775  | 1160              | 1930 | 3220 |
| 1000                               | 20                 | 365 | 485                | 725  | 1090              | 1820 | 3030 |
| 1050                               | ...                | 360 | 480                | 720  | 1080              | 1800 | 3000 |
| 1100                               | ...                | 305 | 405                | 610  | 915               | 1525 | 2545 |
| 1150                               | ...                | 235 | 315                | 475  | 710               | 1185 | 1970 |
| 1200                               | ...                | 185 | 245                | 370  | 555               | 925  | 1545 |
| 1250                               | ...                | 145 | 195                | 295  | 440               | 735  | 1230 |
| 1300                               | ...                | 115 | 155                | 235  | 350               | 585  | 970  |
| 1350                               | ...                | 95  | 130                | 190  | 290               | 480  | 800  |
| 1400                               | ...                | 75  | 100                | 150  | 225               | 380  | 630  |
| 1450                               | ...                | 60  | 80                 | 115  | 175               | 290  | 485  |
| 1500                               | ...                | 40  | 55                 | 85   | 125               | 205  | 345  |

## NOTES:

- (1) At temperatures over 1000°F, use only when the carbon content is 0.04% or higher.  
 (2) Not to be used over 850°F.  
 (3) Not to be used over 1000°F.

**Table F2-2.3 Pressure–Temperature Ratings for Group 2.3 Materials**

| Nominal Designation                | Forgings            |     |     | Castings |      | Plates             |      |
|------------------------------------|---------------------|-----|-----|----------|------|--------------------|------|
| 16Cr–12Ni–2Mo                      | A 182 Gr. F316L     |     |     |          |      | A 240 Gr. 316L     |      |
| 18Cr–8Ni                           | A 182 Gr. F304L (1) |     |     |          |      | A 240 Gr. 304L (1) |      |
| Working Pressures by Classes, psig |                     |     |     |          |      |                    |      |
| Class Temp., °F                    | 150                 | 300 | 400 | 600      | 900  | 1500               | 2500 |
| –20 to 100                         | 230                 | 600 | 800 | 1200     | 1800 | 3000               | 5000 |
| 200                                | 195                 | 510 | 680 | 1020     | 1535 | 2555               | 4260 |
| 300                                | 175                 | 455 | 610 | 910      | 1370 | 2280               | 3800 |
| 400                                | 160                 | 420 | 560 | 840      | 1260 | 2100               | 3500 |
| 500                                | 150                 | 395 | 525 | 785      | 1180 | 1970               | 3280 |
| 600                                | 140                 | 370 | 495 | 745      | 1115 | 1860               | 3100 |
| 650                                | 125                 | 365 | 485 | 730      | 1095 | 1825               | 3040 |
| 700                                | 110                 | 360 | 480 | 720      | 1080 | 1800               | 3000 |
| 750                                | 95                  | 355 | 470 | 705      | 1060 | 1765               | 2940 |
| 800                                | 80                  | 345 | 460 | 690      | 1035 | 1730               | 2880 |
| 850                                | 65                  | 340 | 450 | 675      | 1015 | 1690               | 2820 |

NOTE:

(1) Not to be used over 800°F.



**Table F2-2.4 Pressure–Temperature Ratings for Group 2.4 Materials**

| Nominal Designation                | Forgings            |     |     | Castings |      | Plates             |      |
|------------------------------------|---------------------|-----|-----|----------|------|--------------------|------|
| 18Cr–10Ni–Ti                       | A 182 Gr. F321 (1)  |     |     |          |      | A 240 Gr. 321 (1)  |      |
|                                    | A 182 Gr. F321H (2) |     |     |          |      | A 240 Gr. 321H (2) |      |
| Working Pressures by Classes, psig |                     |     |     |          |      |                    |      |
| Class Temp., °F                    | 150                 | 300 | 400 | 600      | 900  | 1500               | 2500 |
| –20 to 100                         | 275                 | 720 | 960 | 1440     | 2160 | 3600               | 6000 |
| 200                                | 250                 | 650 | 865 | 1295     | 1945 | 3240               | 5400 |
| 300                                | 230                 | 595 | 795 | 1190     | 1785 | 2975               | 4960 |
| 400                                | 200                 | 550 | 735 | 1105     | 1655 | 2760               | 4600 |
| 500                                | 170                 | 515 | 690 | 1030     | 1550 | 2580               | 4300 |
| 600                                | 140                 | 485 | 650 | 975      | 1460 | 2435               | 4060 |
| 650                                | 125                 | 475 | 635 | 950      | 1425 | 2375               | 3960 |
| 700                                | 110                 | 465 | 620 | 930      | 1395 | 2330               | 3880 |
| 750                                | 95                  | 460 | 610 | 915      | 1375 | 2290               | 3820 |
| 800                                | 80                  | 450 | 600 | 900      | 1355 | 2255               | 3760 |
| 850                                | 65                  | 445 | 595 | 895      | 1340 | 2230               | 3720 |
| 900                                | 50                  | 440 | 590 | 885      | 1325 | 2210               | 3680 |
| 950                                | 35                  | 385 | 515 | 775      | 1160 | 1930               | 3220 |
| 1000                               | 20                  | 365 | 485 | 725      | 1090 | 1820               | 3030 |
| 1050                               | ...                 | 360 | 480 | 720      | 1080 | 1800               | 3000 |
| 1100                               | ...                 | 310 | 415 | 625      | 935  | 1560               | 2600 |
| 1150                               | ...                 | 235 | 315 | 475      | 710  | 1185               | 1970 |
| 1200                               | ...                 | 185 | 245 | 370      | 555  | 925                | 1545 |
| 1250                               | ...                 | 140 | 185 | 280      | 420  | 705                | 1170 |
| 1300                               | ...                 | 110 | 145 | 220      | 330  | 550                | 915  |
| 1350                               | ...                 | 85  | 115 | 170      | 255  | 430                | 715  |
| 1400                               | ...                 | 65  | 85  | 130      | 195  | 325                | 545  |
| 1450                               | ...                 | 50  | 70  | 105      | 155  | 255                | 430  |
| 1500                               | ...                 | 40  | 50  | 75       | 115  | 190                | 315  |

## NOTES:

- (1) Not to be used over 1000°F.
- (2) At temperatures over 1000°F, use only if the material is heat treated by heating to a minimum temperature of 2000°F.

**Table F2-2.5 Pressure–Temperature Ratings for Group 2.5 Materials**

| Nominal Designation                | Forgings            |     |     | Castings |      | Plates             |      |
|------------------------------------|---------------------|-----|-----|----------|------|--------------------|------|
| 18Cr–10Ni–Cb                       | A 182 Gr. F347 (1)  |     |     |          |      | A 240 Gr. 347 (1)  |      |
|                                    | A 182 Gr. F347H (2) |     |     |          |      | A 240 Gr. 347H (2) |      |
|                                    | A 182 Gr. F348 (1)  |     |     |          |      | A 240 Gr. 348 (1)  |      |
|                                    | A 182 Gr. F348H (2) |     |     |          |      | A 240 Gr. 348H (2) |      |
| Working Pressures by Classes, psig |                     |     |     |          |      |                    |      |
| Class<br>Temp., °F                 | 150                 | 300 | 400 | 600      | 900  | 1500               | 2500 |
| –20 to 100                         | 275                 | 720 | 960 | 1440     | 2160 | 3600               | 6000 |
| 200                                | 255                 | 660 | 885 | 1325     | 1985 | 3310               | 5520 |
| 300                                | 230                 | 615 | 820 | 1235     | 1850 | 3085               | 5140 |
| 400                                | 200                 | 575 | 770 | 1150     | 1730 | 2880               | 4800 |
| 500                                | 170                 | 540 | 725 | 1085     | 1625 | 2710               | 4520 |
| 600                                | 140                 | 515 | 690 | 1030     | 1550 | 2580               | 4300 |
| 650                                | 125                 | 505 | 675 | 1015     | 1520 | 2530               | 4220 |
| 700                                | 110                 | 495 | 660 | 995      | 1490 | 2485               | 4140 |
| 750                                | 95                  | 490 | 655 | 985      | 1475 | 2460               | 4100 |
| 800                                | 80                  | 485 | 650 | 975      | 1460 | 2435               | 4060 |
| 850                                | 65                  | 485 | 645 | 970      | 1455 | 2425               | 4040 |
| 900                                | 50                  | 450 | 600 | 900      | 1350 | 2245               | 3745 |
| 950                                | 35                  | 385 | 515 | 775      | 1160 | 1930               | 3220 |
| 1000                               | 20                  | 365 | 485 | 725      | 1090 | 1820               | 3030 |
| 1050                               | ...                 | 360 | 480 | 720      | 1080 | 1800               | 3000 |
| 1100                               | ...                 | 325 | 430 | 645      | 965  | 1610               | 2685 |
| 1150                               | ...                 | 275 | 365 | 550      | 825  | 1370               | 2285 |
| 1200                               | ...                 | 205 | 275 | 410      | 620  | 1030               | 1715 |
| 1250                               | ...                 | 180 | 245 | 365      | 545  | 910                | 1515 |
| 1300                               | ...                 | 140 | 185 | 275      | 410  | 685                | 1145 |
| 1350                               | ...                 | 105 | 140 | 205      | 310  | 515                | 860  |
| 1400                               | ...                 | 75  | 100 | 150      | 225  | 380                | 630  |
| 1450                               | ...                 | 60  | 80  | 115      | 175  | 290                | 485  |
| 1500                               | ...                 | 40  | 55  | 85       | 125  | 205                | 345  |

## NOTES:

- (1) Not to be used over 1000°F.
- (2) For temperatures over 1000°F use only if the material is heat treated by heating to a minimum temperature of 2000°F.

**Table F2-2.6 Pressure–Temperature Ratings for Group 2.6 Materials**

| Nominal Designation                | Forgings       |     |     | Castings |      | Plates |      |
|------------------------------------|----------------|-----|-----|----------|------|--------|------|
| 23Cr–12Ni                          | A 240 Gr. 309H |     |     |          |      |        |      |
| Working Pressures by Classes, psig |                |     |     |          |      |        |      |
| Class<br>Temp., °F                 | 150            | 300 | 400 | 600      | 900  | 1500   | 2500 |
| –20 to 100                         | 275            | 720 | 960 | 1440     | 2160 | 3600   | 6000 |
| 200                                | 240            | 630 | 840 | 1260     | 1895 | 3155   | 5260 |
| 300                                | 225            | 580 | 775 | 1160     | 1740 | 2905   | 4840 |
| 400                                | 200            | 545 | 725 | 1090     | 1635 | 2725   | 4540 |
| 500                                | 170            | 520 | 690 | 1035     | 1555 | 2590   | 4320 |
| 600                                | 140            | 500 | 665 | 1000     | 1500 | 2495   | 4160 |
| 650                                | 125            | 490 | 655 | 985      | 1475 | 2460   | 4100 |
| 700                                | 110            | 485 | 645 | 970      | 1455 | 2425   | 4040 |
| 750                                | 95             | 480 | 640 | 960      | 1440 | 2400   | 4000 |
| 800                                | 80             | 475 | 630 | 945      | 1420 | 2365   | 3940 |
| 850                                | 65             | 465 | 620 | 930      | 1395 | 2330   | 3880 |
| 900                                | 50             | 450 | 600 | 900      | 1350 | 2245   | 3745 |
| 950                                | 35             | 385 | 515 | 775      | 1160 | 1930   | 3220 |
| 1000                               | 20             | 365 | 485 | 725      | 1090 | 1820   | 3030 |
| 1050                               | ...            | 355 | 470 | 705      | 1060 | 1765   | 2945 |
| 1100                               | ...            | 260 | 345 | 520      | 780  | 1305   | 2170 |
| 1150                               | ...            | 190 | 250 | 375      | 565  | 945    | 1570 |
| 1200                               | ...            | 135 | 185 | 275      | 410  | 685    | 1145 |
| 1250                               | ...            | 105 | 135 | 205      | 310  | 515    | 855  |
| 1300                               | ...            | 75  | 100 | 150      | 225  | 375    | 630  |
| 1350                               | ...            | 60  | 80  | 115      | 175  | 290    | 485  |
| 1400                               | ...            | 45  | 60  | 90       | 135  | 225    | 370  |
| 1450                               | ...            | 35  | 45  | 70       | 105  | 170    | 285  |
| 1500                               | ...            | 25  | 35  | 50       | 75   | 130    | 215  |

**Table F2-2.7 Pressure–Temperature Ratings for Group 2.7 Materials**

| Nominal Designation                | Forgings                |     |     | Castings       |      | Plates |      |
|------------------------------------|-------------------------|-----|-----|----------------|------|--------|------|
| 25Cr–20Ni                          | A 182 Gr. F310 (1), (2) |     |     | A 240 Gr. 310H |      |        |      |
| Working Pressures by Classes, psig |                         |     |     |                |      |        |      |
| Class Temp., °F                    | 150                     | 300 | 400 | 600            | 900  | 1500   | 2500 |
| –20 to 100                         | 275                     | 720 | 960 | 1440           | 2160 | 3600   | 6000 |
| 200                                | 245                     | 635 | 850 | 1270           | 1910 | 3180   | 5300 |
| 300                                | 225                     | 580 | 775 | 1160           | 1740 | 2905   | 4840 |
| 400                                | 200                     | 540 | 725 | 1085           | 1625 | 2710   | 4520 |
| 500                                | 170                     | 515 | 685 | 1025           | 1540 | 2570   | 4280 |
| 600                                | 140                     | 495 | 660 | 990            | 1485 | 2470   | 4120 |
| 650                                | 125                     | 485 | 645 | 970            | 1455 | 2425   | 4040 |
| 700                                | 110                     | 480 | 635 | 955            | 1435 | 2390   | 3980 |
| 750                                | 95                      | 470 | 625 | 940            | 1410 | 2350   | 3920 |
| 800                                | 80                      | 465 | 620 | 930            | 1395 | 2330   | 3880 |
| 850                                | 65                      | 460 | 610 | 915            | 1375 | 2290   | 3820 |
| 900                                | 50                      | 450 | 600 | 900            | 1350 | 2245   | 3745 |
| 950                                | 35                      | 385 | 515 | 775            | 1160 | 1930   | 3220 |
| 1000                               | 20                      | 365 | 485 | 725            | 1090 | 1820   | 3030 |
| 1050                               | ...                     | 355 | 470 | 705            | 1060 | 1765   | 2945 |
| 1100                               | ...                     | 260 | 345 | 520            | 780  | 1305   | 2170 |
| 1150                               | ...                     | 190 | 250 | 375            | 565  | 945    | 1570 |
| 1200                               | ...                     | 135 | 185 | 275            | 410  | 685    | 1145 |
| 1250                               | ...                     | 105 | 135 | 205            | 310  | 515    | 855  |
| 1300                               | ...                     | 75  | 100 | 150            | 225  | 375    | 630  |
| 1350                               | ...                     | 60  | 80  | 115            | 175  | 290    | 485  |
| 1400                               | ...                     | 45  | 60  | 90             | 135  | 225    | 370  |
| 1450                               | ...                     | 35  | 45  | 65             | 100  | 165    | 275  |
| 1500                               | ...                     | 25  | 35  | 50             | 75   | 130    | 215  |

## NOTES:

- (1) At temperatures over 1000°F, use only when the carbon content is 0.04% or higher.
- (2) Service temperatures of 1050°F and above should be used only when assurance is provided that grain size is not finer than ASTM 6.

**Table F2-2.8 Pressure–Temperature Ratings for Group 2.8 Materials**

| Nominal Designation                | Forgings          |     |      | Castings               |      | Plates               |      |
|------------------------------------|-------------------|-----|------|------------------------|------|----------------------|------|
| 20Cr–18Ni–6Mo                      | A 182 Gr. F44     |     |      | A 351 Gr. CK3MCuN      |      | A 240 Gr. S31254     |      |
| 22Cr–5Ni–3Mo–N                     | A 182 Gr. F51 (1) |     |      |                        |      | A 240 Gr. S31803 (1) |      |
| 25Cr–7Ni–4Mo–N                     | A 182 Gr. F53 (1) |     |      |                        |      | A 240 Gr. S32750 (1) |      |
| 24Cr–10Ni–4Mo–V                    |                   |     |      | A 351 Gr. CE8MN (1)    |      |                      |      |
| 25Cr–5Ni–2Mo–3Cu                   |                   |     |      | A 351 Gr. CD4MCu (1)   |      |                      |      |
| 25Cr–7Ni–3.5Mo–W–Cb                |                   |     |      | A 351 Gr. CD3MWCuN (1) |      |                      |      |
| 25Cr–7Ni–3.5Mo–N–Cu–W              | A 182 Gr. F55 (1) |     |      |                        |      | A 240 Gr. S32760 (1) |      |
| Working Pressures by Classes, psig |                   |     |      |                        |      |                      |      |
| Class<br>Temp., °F                 | 150               | 300 | 400  | 600                    | 900  | 1500                 | 2500 |
| 100                                | 290               | 750 | 1000 | 1500                   | 2250 | 3750                 | 6250 |
| 200                                | 260               | 745 | 990  | 1490                   | 2230 | 3720                 | 6200 |
| 300                                | 230               | 665 | 890  | 1335                   | 2000 | 3335                 | 5560 |
| 400                                | 200               | 615 | 820  | 1230                   | 1845 | 3070                 | 5120 |
| 500                                | 170               | 580 | 775  | 1160                   | 1740 | 2905                 | 4840 |
| 600                                | 140               | 555 | 740  | 1115                   | 1670 | 2785                 | 4640 |
| 650                                | 125               | 545 | 730  | 1095                   | 1640 | 2735                 | 4560 |
| 700                                | 110               | 540 | 725  | 1085                   | 1625 | 2710                 | 4520 |
| 750                                | 95                | 530 | 710  | 1065                   | 1595 | 2660                 | 4430 |

## NOTE:

- (1) This steel may become brittle after service at moderately elevated temperatures. Not to be used over 600°F.

**Table F2-2.9 Pressure–Temperature Ratings for Group 2.9 Materials**

| Nominal Designation                | Forgings                     |     | Castings |      | Plates |      |      |
|------------------------------------|------------------------------|-----|----------|------|--------|------|------|
| 23Cr–12Ni                          | A 240 Gr. 309S (1), (2), (3) |     |          |      |        |      |      |
| 25Cr–20Ni                          | A 240 Gr. 310S (1), (2), (3) |     |          |      |        |      |      |
| Working Pressures by Classes, psig |                              |     |          |      |        |      |      |
| Class Temp., °F                    | 150                          | 300 | 400      | 600  | 900    | 1500 | 2500 |
| –20 to 100                         | 275                          | 720 | 960      | 1440 | 2160   | 3600 | 6000 |
| 200                                | 240                          | 630 | 840      | 1260 | 1895   | 3155 | 5260 |
| 300                                | 225                          | 580 | 775      | 1160 | 1740   | 2905 | 4840 |
| 400                                | 200                          | 540 | 725      | 1085 | 1625   | 2710 | 4520 |
| 500                                | 170                          | 515 | 685      | 1025 | 1540   | 2570 | 4280 |
| 600                                | 140                          | 495 | 660      | 990  | 1485   | 2470 | 4120 |
| 650                                | 125                          | 485 | 645      | 970  | 1455   | 2425 | 4040 |
| 700                                | 110                          | 480 | 635      | 955  | 1435   | 2390 | 3980 |
| 750                                | 95                           | 470 | 625      | 940  | 1410   | 2350 | 3920 |
| 800                                | 80                           | 465 | 620      | 930  | 1395   | 2330 | 3880 |
| 850                                | 65                           | 460 | 610      | 915  | 1375   | 2290 | 3820 |
| 900                                | 50                           | 450 | 600      | 900  | 1350   | 2245 | 3745 |
| 950                                | 35                           | 385 | 515      | 775  | 1160   | 1930 | 3220 |
| 1000                               | 20                           | 340 | 455      | 680  | 1020   | 1695 | 2830 |
| 1050                               | ...                          | 245 | 325      | 485  | 730    | 1215 | 2030 |
| 1100                               | ...                          | 170 | 230      | 345  | 515    | 855  | 1430 |
| 1150                               | ...                          | 125 | 165      | 245  | 370    | 615  | 1030 |
| 1200                               | ...                          | 85  | 115      | 170  | 255    | 430  | 715  |
| 1250                               | ...                          | 50  | 70       | 105  | 155    | 255  | 430  |
| 1300                               | ...                          | 25  | 35       | 55   | 80     | 135  | 230  |
| 1350                               | ...                          | 15  | 25       | 35   | 50     | 85   | 145  |
| 1400                               | ...                          | 15  | 20       | 25   | 40     | 70   | 115  |
| 1450                               | ...                          | 10  | 15       | 20   | 30     | 50   | 85   |
| 1500                               | ...                          | 5   | 10       | 15   | 20     | 35   | 55   |

## NOTES:

- (1) At temperatures over 1000°F, use only when the carbon content is 0.04% or higher.
- (2) At temperatures above 1000°F, use only if the material is solution heat treated to the minimum temperature specified in the specification, but not lower than 1900°F, and quenching in water or rapidly cooling by other means.
- (3) This material should be used for service temperatures 1050°F and above only when assurance is provided that grain size is not finer than ASTM 6.

**Table F2-2.10 Pressure–Temperature Ratings for Group 2.10 Materials**

| Nominal Designation                | Forgings |     |     | Castings                                |      | Plates |      |
|------------------------------------|----------|-----|-----|-----------------------------------------|------|--------|------|
| 25Cr–12Ni                          |          |     |     | A 351 Gr. CH8 (1)<br>A 351 Gr. CH20 (1) |      |        |      |
| Working Pressures by Classes, psig |          |     |     |                                         |      |        |      |
| Class<br>Temp., °F                 | 150      | 300 | 400 | 600                                     | 900  | 1500   | 2500 |
| –20 to 100                         | 260      | 670 | 895 | 1345                                    | 2015 | 3360   | 5600 |
| 200                                | 210      | 550 | 735 | 1100                                    | 1650 | 2750   | 4580 |
| 300                                | 195      | 505 | 675 | 1015                                    | 1520 | 2530   | 4220 |
| 400                                | 185      | 485 | 645 | 970                                     | 1455 | 2425   | 4040 |
| 500                                | 170      | 470 | 625 | 940                                     | 1410 | 2350   | 3920 |
| 600                                | 140      | 455 | 610 | 910                                     | 1370 | 2280   | 3800 |
| 650                                | 125      | 445 | 595 | 895                                     | 1340 | 2230   | 3720 |
| 700                                | 110      | 435 | 580 | 870                                     | 1305 | 2170   | 3620 |
| 750                                | 95       | 420 | 565 | 845                                     | 1265 | 2110   | 3520 |
| 800                                | 80       | 410 | 545 | 820                                     | 1230 | 2050   | 3420 |
| 850                                | 65       | 400 | 530 | 795                                     | 1195 | 1990   | 3320 |
| 900                                | 50       | 385 | 510 | 770                                     | 1150 | 1920   | 3200 |
| 950                                | 35       | 370 | 495 | 740                                     | 1110 | 1850   | 3080 |
| 1000                               | 20       | 340 | 450 | 675                                     | 1015 | 1690   | 2820 |
| 1050                               | ...      | 290 | 390 | 585                                     | 875  | 1455   | 2430 |
| 1100                               | ...      | 225 | 295 | 445                                     | 670  | 1115   | 1855 |
| 1150                               | ...      | 170 | 230 | 345                                     | 515  | 855    | 1430 |
| 1200                               | ...      | 130 | 175 | 260                                     | 390  | 650    | 1085 |
| 1250                               | ...      | 100 | 135 | 200                                     | 300  | 495    | 830  |
| 1300                               | ...      | 80  | 105 | 160                                     | 235  | 395    | 655  |
| 1350                               | ...      | 60  | 80  | 125                                     | 185  | 310    | 515  |
| 1400                               | ...      | 45  | 60  | 90                                      | 135  | 225    | 370  |
| 1450                               | ...      | 30  | 40  | 60                                      | 95   | 155    | 255  |
| 1500                               | ...      | 25  | 35  | 55                                      | 80   | 135    | 230  |

NOTE:

(1) At temperatures over 1000°F, use only when the carbon content is 0.04% or higher.

**Table F2-2.11 Pressure–Temperature Ratings for Group 2.11 Materials**

| Nominal Designation                | Forgings           |     |     | Castings |      |      | Plates |
|------------------------------------|--------------------|-----|-----|----------|------|------|--------|
| 18Cr–10Ni–Cb                       | A 351 Gr. CF8C (1) |     |     |          |      |      |        |
| Working Pressures by Classes, psig |                    |     |     |          |      |      |        |
| Class<br>Temp., °F                 | 150                | 300 | 400 | 600      | 900  | 1500 | 2500   |
| –20 to 100                         | 275                | 720 | 960 | 1440     | 2160 | 3600 | 6000   |
| 200                                | 255                | 660 | 885 | 1325     | 1985 | 3310 | 5520   |
| 300                                | 230                | 615 | 820 | 1235     | 1850 | 3085 | 5140   |
| 400                                | 200                | 575 | 770 | 1150     | 1730 | 2880 | 4800   |
| 500                                | 170                | 540 | 725 | 1085     | 1625 | 2710 | 4520   |
| 600                                | 140                | 515 | 690 | 1030     | 1550 | 2580 | 4300   |
| 650                                | 125                | 505 | 675 | 1015     | 1520 | 2530 | 4220   |
| 700                                | 110                | 495 | 660 | 995      | 1490 | 2485 | 4140   |
| 750                                | 95                 | 490 | 655 | 985      | 1475 | 2460 | 4100   |
| 800                                | 80                 | 485 | 650 | 975      | 1460 | 2435 | 4060   |
| 850                                | 65                 | 485 | 645 | 970      | 1455 | 2425 | 4040   |
| 900                                | 50                 | 450 | 600 | 900      | 1350 | 2245 | 3745   |
| 950                                | 35                 | 385 | 515 | 775      | 1160 | 1930 | 3220   |
| 1000                               | 20                 | 365 | 485 | 725      | 1090 | 1820 | 3030   |
| 1050                               | ...                | 360 | 480 | 720      | 1080 | 1800 | 3000   |
| 1100                               | ...                | 310 | 415 | 625      | 935  | 1560 | 2600   |
| 1150                               | ...                | 210 | 280 | 420      | 625  | 1045 | 1745   |
| 1200                               | ...                | 150 | 200 | 300      | 455  | 755  | 1255   |
| 1250                               | ...                | 115 | 150 | 225      | 340  | 565  | 945    |
| 1300                               | ...                | 75  | 100 | 150      | 225  | 375  | 630    |
| 1350                               | ...                | 50  | 70  | 105      | 155  | 255  | 430    |
| 1400                               | ...                | 40  | 55  | 80       | 125  | 205  | 345    |
| 1450                               | ...                | 30  | 40  | 60       | 95   | 155  | 255    |
| 1500                               | ...                | 25  | 35  | 55       | 80   | 135  | 230    |

## NOTE:

(1) At temperatures over 1000°F, use only when the carbon content is 0.04% or higher.



**Table F2-2.12 Pressure–Temperature Ratings for Group 2.12 Materials**

| Nominal Designation                | Forgings           |     |     | Castings |      | Plates |      |
|------------------------------------|--------------------|-----|-----|----------|------|--------|------|
| 25Cr–20Ni                          | A 351 Gr. CK20 (1) |     |     |          |      |        |      |
| Working Pressures by Classes, psig |                    |     |     |          |      |        |      |
| Class<br>Temp., °F                 | 150                | 300 | 400 | 600      | 900  | 1500   | 2500 |
| –20 to 100                         | 260                | 670 | 895 | 1345     | 2015 | 3360   | 5600 |
| 200                                | 210                | 550 | 735 | 1100     | 1650 | 2750   | 4580 |
| 300                                | 195                | 505 | 675 | 1015     | 1520 | 2530   | 4220 |
| 400                                | 185                | 485 | 645 | 970      | 1455 | 2425   | 4040 |
| 500                                | 170                | 470 | 625 | 940      | 1410 | 2350   | 3920 |
| 600                                | 140                | 455 | 610 | 910      | 1370 | 2280   | 3800 |
| 650                                | 125                | 445 | 595 | 895      | 1340 | 2230   | 3720 |
| 700                                | 110                | 435 | 580 | 870      | 1305 | 2170   | 3620 |
| 750                                | 95                 | 420 | 565 | 845      | 1265 | 2110   | 3520 |
| 800                                | 80                 | 410 | 545 | 820      | 1230 | 2050   | 3420 |
| 850                                | 65                 | 400 | 530 | 795      | 1195 | 1990   | 3320 |
| 900                                | 50                 | 385 | 510 | 770      | 1150 | 1920   | 3200 |
| 950                                | 35                 | 370 | 495 | 740      | 1110 | 1850   | 3080 |
| 1000                               | 20                 | 340 | 450 | 675      | 1015 | 1690   | 2820 |
| 1050                               | ...                | 325 | 435 | 650      | 975  | 1630   | 2715 |
| 1100                               | ...                | 290 | 390 | 585      | 875  | 1455   | 2430 |
| 1150                               | ...                | 250 | 335 | 500      | 750  | 1250   | 2085 |
| 1200                               | ...                | 205 | 275 | 410      | 615  | 1030   | 1715 |
| 1250                               | ...                | 165 | 220 | 330      | 495  | 825    | 1370 |
| 1300                               | ...                | 120 | 160 | 240      | 360  | 600    | 1000 |
| 1350                               | ...                | 80  | 110 | 165      | 245  | 410    | 685  |
| 1400                               | ...                | 55  | 75  | 110      | 165  | 275    | 455  |
| 1450                               | ...                | 40  | 50  | 75       | 115  | 190    | 315  |
| 1500                               | ...                | 25  | 35  | 55       | 80   | 135    | 230  |

NOTE:

(1) At temperatures over 1000°F, use only when the carbon content is 0.04% or higher.

**Table F2-3.1 Pressure–Temperature Ratings for Group 3.1 Materials**

| Nominal Designation                | Forgings             |     |      | Castings             |      | Plates |      |
|------------------------------------|----------------------|-----|------|----------------------|------|--------|------|
| 35Ni–35Fe–10Cr–Cb                  | B 462 Gr. N08020 (1) |     |      | B 463 Gr. N08020 (1) |      |        |      |
| Working Pressures by Classes, psig |                      |     |      |                      |      |        |      |
| Class Temp., °F                    | 150                  | 300 | 400  | 600                  | 900  | 1500   | 2500 |
| –20 to 100                         | 290                  | 750 | 1000 | 1500                 | 2250 | 3750   | 6250 |
| 200                                | 260                  | 740 | 990  | 1485                 | 2225 | 3710   | 6180 |
| 300                                | 230                  | 710 | 945  | 1420                 | 2130 | 3550   | 5920 |
| 400                                | 200                  | 680 | 910  | 1365                 | 2045 | 3410   | 5680 |
| 500                                | 170                  | 655 | 875  | 1310                 | 1965 | 3275   | 5460 |
| 600                                | 140                  | 605 | 805  | 1210                 | 1815 | 3025   | 5040 |
| 650                                | 125                  | 590 | 785  | 1175                 | 1765 | 2940   | 4905 |
| 700                                | 110                  | 570 | 755  | 1135                 | 1705 | 2840   | 4730 |
| 750                                | 95                   | 530 | 710  | 1065                 | 1595 | 2660   | 4430 |
| 800                                | 80                   | 510 | 675  | 1015                 | 1525 | 2540   | 4230 |

NOTE:

(1) Use annealed material only.

**Table F2-3.2 Pressure–Temperature Ratings for Group 3.2 Materials**

| Nominal Designation                | Forgings                  |     |     | Castings             |      | Plates |      |
|------------------------------------|---------------------------|-----|-----|----------------------|------|--------|------|
| 99.0Ni                             | B 160 Gr. N02200 (1), (2) |     |     | B 162 Gr. N02200 (1) |      |        |      |
| Working Pressures by Classes, psig |                           |     |     |                      |      |        |      |
| Class Temp., °F                    | 150                       | 300 | 400 | 600                  | 900  | 1500   | 2500 |
| −20 to 100                         | 185                       | 480 | 640 | 960                  | 1440 | 2400   | 4000 |
| 200                                | 185                       | 480 | 640 | 960                  | 1440 | 2400   | 4000 |
| 300                                | 185                       | 480 | 640 | 960                  | 1440 | 2400   | 4000 |
| 400                                | 185                       | 480 | 640 | 960                  | 1440 | 2400   | 4000 |
| 500                                | 170                       | 455 | 605 | 905                  | 1360 | 2270   | 3780 |
| 600                                | 140                       | 415 | 550 | 825                  | 1240 | 2065   | 3440 |

NOTES:

(1) Use annealed material only.

(2) The chemical composition, mechanical properties, heat treating requirements, and grain size requirements shall conform to the applicable ASTM specification. The manufacturing procedures, tolerances, tests, certification, and markings shall be in accordance with ASTM B 564.

**Table F2-3.3 Pressure–Temperature Ratings for Group 3.3 Materials**

| Nominal Designation                | Forgings                 |     |     | Castings             |     | Plates |      |
|------------------------------------|--------------------------|-----|-----|----------------------|-----|--------|------|
| 99.0Ni–Low C                       | B160 Gr. N02201 (1), (2) |     |     | B 162 Gr. N02201 (1) |     |        |      |
| Working Pressures by Classes, psig |                          |     |     |                      |     |        |      |
| Class<br>Temp., °F                 | 150                      | 300 | 400 | 600                  | 900 | 1500   | 2500 |
| –20 to 100                         | 90                       | 240 | 320 | 480                  | 720 | 1200   | 2000 |
| 200                                | 90                       | 230 | 305 | 460                  | 690 | 1150   | 1920 |
| 300                                | 85                       | 225 | 300 | 450                  | 675 | 1130   | 1880 |
| 400                                | 85                       | 225 | 300 | 450                  | 675 | 1130   | 1880 |
| 500                                | 85                       | 225 | 300 | 450                  | 675 | 1130   | 1880 |
| 600                                | 85                       | 225 | 300 | 450                  | 675 | 1130   | 1880 |
| 650                                | 85                       | 225 | 300 | 445                  | 670 | 1115   | 1860 |
| 700                                | 85                       | 225 | 300 | 445                  | 670 | 1115   | 1860 |
| 750                                | 85                       | 220 | 295 | 440                  | 660 | 1105   | 1840 |
| 800                                | 80                       | 215 | 290 | 430                  | 650 | 1080   | 1800 |
| 850                                | 65                       | 210 | 280 | 420                  | 635 | 1055   | 1760 |
| 900                                | 50                       | 205 | 275 | 415                  | 620 | 1030   | 1720 |
| 950                                | 35                       | 195 | 260 | 395                  | 590 | 985    | 1640 |
| 1000                               | 20                       | 190 | 255 | 380                  | 570 | 950    | 1580 |
| 1050                               | ...                      | 80  | 110 | 165                  | 245 | 410    | 685  |
| 1100                               | ...                      | 70  | 90  | 135                  | 205 | 345    | 570  |
| 1150                               | ...                      | 50  | 70  | 105                  | 155 | 255    | 430  |
| 1200                               | ...                      | 40  | 55  | 80                   | 125 | 205    | 345  |

## NOTES:

- (1) Use annealed material only.
- (2) The chemical composition, mechanical properties, heat treating requirements, and grain size requirements shall conform to the applicable ASTM specification. The manufacturing procedures, tolerances, tests, certification, and markings shall be in accordance with ASTM B 564.

**Table F2-3.4 Pressure–Temperature Ratings for Group 3.4 Materials**

| Nominal Designation                | Forgings                  |     |     | Castings             |      | Plates |      |
|------------------------------------|---------------------------|-----|-----|----------------------|------|--------|------|
| 67Ni-30Cu                          | B 564 Gr. N04400 (1)      |     |     | B 127 Gr. N04400 (1) |      |        |      |
| 67Ni-30Cu-S                        | B 164 Gr. N04405 (1), (2) |     |     |                      |      |        |      |
| Working Pressures by Classes, psig |                           |     |     |                      |      |        |      |
| Class<br>Temp., °F                 | 150                       | 300 | 400 | 600                  | 900  | 1500   | 2500 |
| -20 to 100                         | 230                       | 600 | 800 | 1200                 | 1800 | 3000   | 5000 |
| 200                                | 200                       | 525 | 700 | 1050                 | 1575 | 2630   | 4380 |
| 300                                | 190                       | 490 | 655 | 980                  | 1470 | 2450   | 4080 |
| 400                                | 180                       | 475 | 630 | 945                  | 1420 | 2365   | 3940 |
| 500                                | 170                       | 475 | 630 | 945                  | 1420 | 2365   | 3940 |
| 600                                | 140                       | 475 | 630 | 945                  | 1420 | 2365   | 3940 |
| 650                                | 125                       | 475 | 630 | 945                  | 1420 | 2365   | 3940 |
| 700                                | 110                       | 470 | 625 | 940                  | 1410 | 2350   | 3920 |
| 750                                | 95                        | 465 | 620 | 930                  | 1395 | 2330   | 3880 |
| 800                                | 80                        | 460 | 610 | 915                  | 1375 | 2290   | 3820 |
| 850                                | 65                        | 375 | 505 | 755                  | 1130 | 1885   | 3145 |
| 900                                | 50                        | 275 | 365 | 550                  | 825  | 1370   | 2285 |

## NOTES:

- (1) Use annealed material only.
- (2) The chemical composition, mechanical properties, heat treating requirements, and grain size requirements shall conform to the applicable ASTM specification. The manufacturing procedures, tolerances, tests, certification, and markings shall be in accordance with ASTM B 564.

**Table F2-3.5 Pressure–Temperature Ratings for Group 3.5 Materials**

| Nominal Designation                | Forgings             |     |      | Castings             |      | Plates |      |
|------------------------------------|----------------------|-----|------|----------------------|------|--------|------|
| 72Ni–15Cr–8Fe                      | B 564 Gr. N06600 (1) |     |      | B 168 Gr. N06600 (1) |      |        |      |
| Working Pressures by Classes, psig |                      |     |      |                      |      |        |      |
| Class Temp., °F                    | 150                  | 300 | 400  | 600                  | 900  | 1500   | 2500 |
| –20 to 100                         | 290                  | 750 | 1000 | 1500                 | 2250 | 3750   | 6250 |
| 200                                | 260                  | 750 | 1000 | 1500                 | 2250 | 3750   | 6250 |
| 300                                | 230                  | 730 | 970  | 1455                 | 2185 | 3640   | 6070 |
| 400                                | 200                  | 705 | 940  | 1410                 | 2115 | 3530   | 5880 |
| 500                                | 170                  | 665 | 885  | 1330                 | 1995 | 3325   | 5540 |
| 600                                | 140                  | 605 | 805  | 1210                 | 1815 | 3025   | 5040 |
| 650                                | 125                  | 590 | 785  | 1175                 | 1765 | 2940   | 4905 |
| 700                                | 110                  | 570 | 755  | 1135                 | 1705 | 2840   | 4730 |
| 750                                | 95                   | 530 | 710  | 1065                 | 1595 | 2660   | 4430 |
| 800                                | 80                   | 510 | 675  | 1015                 | 1525 | 2540   | 4230 |
| 850                                | 65                   | 485 | 650  | 975                  | 1460 | 2435   | 4060 |
| 900                                | 50                   | 450 | 600  | 900                  | 1350 | 2245   | 3745 |
| 950                                | 35                   | 365 | 485  | 725                  | 1090 | 1815   | 3030 |
| 1000                               | 20                   | 240 | 320  | 480                  | 720  | 1200   | 2000 |
| 1050                               | ...                  | 155 | 205  | 310                  | 465  | 770    | 1285 |
| 1100                               | ...                  | 105 | 135  | 205                  | 310  | 515    | 855  |
| 1150                               | ...                  | 75  | 100  | 150                  | 225  | 375    | 630  |
| 1200                               | ...                  | 70  | 90   | 135                  | 205  | 345    | 570  |

NOTE:

(1) Use annealed material only.

**Table F2-3.6 Pressure–Temperature Ratings for Group 3.6 Materials**

| Nominal Designation                | Forgings             |     |     | Castings             |      | Plates |      |
|------------------------------------|----------------------|-----|-----|----------------------|------|--------|------|
| 33Ni–42Fe–21Cr                     | B 564 Gr. N08800 (1) |     |     | B 409 Gr. N08800 (1) |      |        |      |
| Working Pressures by Classes, psig |                      |     |     |                      |      |        |      |
| Class<br>Temp., °F                 | 150                  | 300 | 400 | 600                  | 900  | 1500   | 2500 |
| –20 to 100                         | 275                  | 720 | 960 | 1440                 | 2160 | 3600   | 6000 |
| 200                                | 255                  | 665 | 885 | 1330                 | 1995 | 3325   | 5540 |
| 300                                | 230                  | 640 | 850 | 1275                 | 1915 | 3190   | 5320 |
| 400                                | 200                  | 620 | 825 | 1240                 | 1860 | 3095   | 5160 |
| 500                                | 170                  | 600 | 805 | 1205                 | 1805 | 3010   | 5020 |
| 600                                | 140                  | 590 | 785 | 1175                 | 1765 | 2940   | 4900 |
| 650                                | 125                  | 580 | 770 | 1155                 | 1735 | 2890   | 4820 |
| 700                                | 110                  | 570 | 755 | 1135                 | 1705 | 2840   | 4730 |
| 750                                | 95                   | 530 | 710 | 1065                 | 1595 | 2660   | 4430 |
| 800                                | 80                   | 510 | 675 | 1015                 | 1525 | 2540   | 4230 |
| 850                                | 65                   | 485 | 650 | 975                  | 1460 | 2435   | 4060 |
| 900                                | 50                   | 450 | 600 | 900                  | 1350 | 2245   | 3745 |
| 950                                | 35                   | 385 | 515 | 775                  | 1160 | 1930   | 3220 |
| 1000                               | 20                   | 365 | 485 | 725                  | 1090 | 1820   | 3030 |
| 1050                               | ...                  | 360 | 480 | 720                  | 1080 | 1800   | 3000 |
| 1100                               | ...                  | 325 | 430 | 645                  | 965  | 1610   | 2685 |
| 1150                               | ...                  | 275 | 365 | 550                  | 825  | 1370   | 2285 |
| 1200                               | ...                  | 205 | 275 | 410                  | 620  | 1030   | 1715 |
| 1250                               | ...                  | 145 | 190 | 290                  | 430  | 720    | 1200 |
| 1300                               | ...                  | 70  | 90  | 135                  | 205  | 345    | 570  |
| 1350                               | ...                  | 55  | 75  | 110                  | 165  | 275    | 455  |
| 1400                               | ...                  | 40  | 50  | 75                   | 115  | 190    | 315  |
| 1450                               | ...                  | 35  | 45  | 70                   | 105  | 170    | 285  |
| 1500                               | ...                  | 25  | 35  | 55                   | 80   | 135    | 230  |

NOTE:

(1) Use annealed material only.

**Table F2-3.7 Pressure–Temperature Ratings for Group 3.7 Materials**

| Nominal Designation                |     | Forgings             |      | Castings |      | Plates               |      |
|------------------------------------|-----|----------------------|------|----------|------|----------------------|------|
| 65Ni–28Mo–2Fe                      |     | B 462 Gr. N10665 (1) |      |          |      | B 333 Gr. N10665 (1) |      |
| 64Ni–29.5Mo–2Cr–2Fe–Mn–W           |     | B 462 Gr. N10675 (1) |      |          |      | B 333 Gr. N10675 (1) |      |
| Working Pressures by Classes, psig |     |                      |      |          |      |                      |      |
| Class<br>Temp., °F                 | 150 | 300                  | 400  | 600      | 900  | 1500                 | 2500 |
| –20 to 100                         | 290 | 750                  | 1000 | 1500     | 2250 | 3750                 | 6250 |
| 200                                | 260 | 750                  | 1000 | 1500     | 2250 | 3750                 | 6250 |
| 300                                | 230 | 730                  | 970  | 1455     | 2185 | 3640                 | 6070 |
| 400                                | 200 | 705                  | 940  | 1410     | 2115 | 3530                 | 5880 |
| 500                                | 170 | 665                  | 885  | 1330     | 1995 | 3325                 | 5540 |
| 600                                | 140 | 605                  | 805  | 1210     | 1815 | 3025                 | 5040 |
| 650                                | 125 | 590                  | 785  | 1175     | 1765 | 2940                 | 4905 |
| 700                                | 110 | 570                  | 755  | 1135     | 1705 | 2840                 | 4730 |
| 750                                | 95  | 530                  | 710  | 1065     | 1595 | 2660                 | 4430 |
| 800                                | 80  | 510                  | 675  | 1015     | 1525 | 2540                 | 4230 |

NOTE:

(1) Use solution annealed material only.

**Table F2-3.8 Pressure–Temperature Ratings for Group 3.8 Materials**

| Nominal Designation                | Forgings                       | Castings | Plates                         |      |      |      |      |
|------------------------------------|--------------------------------|----------|--------------------------------|------|------|------|------|
| 54Ni–16Mo–15Cr                     | B 462 Gr. N10276 (1), (2)      |          | B 575 Gr. N10276 (1), (2)      |      |      |      |      |
| 60Ni–22Cr–9Mo–3.5Cb                | B 564 Gr. N06625 (3), (4)      |          | B 443 Gr. N06625 (3), (4)      |      |      |      |      |
| 62Ni–28Mo–5Fe                      | B 335 Gr. N10001 (1), (5), (6) |          | B 333 Gr. N10001 (1), (6)      |      |      |      |      |
| 70Ni–16Mo–7Cr–5Fe                  | B 573 Gr. N10003 (5), (3)      |          | B 434 Gr. N10003 (3)           |      |      |      |      |
| 61Ni–16Mo–16Cr                     | B 574 Gr. N06455 (1), (5), (6) |          | B 575 Gr. N06455 (1), (6)      |      |      |      |      |
| 42Ni–21.5Cr–3Mo–2.3Cu              | B 564 Gr. N08825 (3), (7)      |          | B 424 Gr. N08825 (3), (7)      |      |      |      |      |
| 55Ni–21Cr–13.5Mo                   | B 462 Gr. N06022 (1), (2), (8) |          | B 575 Gr. N06022 (1), (2), (8) |      |      |      |      |
| 55Ni–23Cr–16Mo–1.6Cu               | B 462 Gr. N06200 (1), (6)      |          | B 575 Gr. N06200 (1), (6)      |      |      |      |      |
| Working Pressures by Classes, psig |                                |          |                                |      |      |      |      |
| Class<br>Temp., °F                 | 150                            | 300      | 400                            | 600  | 900  | 1500 | 2500 |
| –20 to 100                         | 290                            | 750      | 1000                           | 1500 | 2250 | 3750 | 6250 |
| 200                                | 260                            | 750      | 1000                           | 1500 | 2250 | 3750 | 6250 |
| 300                                | 230                            | 730      | 970                            | 1455 | 2185 | 3640 | 6070 |
| 400                                | 200                            | 700      | 930                            | 1395 | 2095 | 3490 | 5820 |
| 500                                | 170                            | 665      | 885                            | 1330 | 1995 | 3325 | 5540 |
| 600                                | 140                            | 605      | 805                            | 1210 | 1815 | 3025 | 5040 |
| 650                                | 125                            | 590      | 785                            | 1175 | 1765 | 2940 | 4905 |
| 700                                | 110                            | 570      | 755                            | 1135 | 1705 | 2840 | 4730 |
| 750                                | 95                             | 530      | 710                            | 1065 | 1595 | 2660 | 4430 |
| 800                                | 80                             | 510      | 675                            | 1015 | 1525 | 2540 | 4230 |
| 850                                | 65                             | 485      | 650                            | 975  | 1460 | 2435 | 4060 |
| 900                                | 50                             | 450      | 600                            | 900  | 1350 | 2245 | 3745 |
| 950                                | 35                             | 385      | 515                            | 775  | 1160 | 1930 | 3220 |
| 1000                               | 20                             | 365      | 485                            | 725  | 1090 | 1820 | 3030 |
| 1050                               | ...                            | 360      | 480                            | 720  | 1080 | 1800 | 3000 |
| 1100                               | ...                            | 325      | 430                            | 645  | 965  | 1610 | 2685 |
| 1150                               | ...                            | 275      | 365                            | 550  | 825  | 1370 | 2285 |
| 1200                               | ...                            | 205      | 275                            | 410  | 615  | 1030 | 1715 |
| 1250                               | ...                            | 165      | 220                            | 330  | 495  | 825  | 1370 |
| 1300                               | ...                            | 120      | 160                            | 240  | 360  | 600  | 1000 |

## NOTES:

- (1) Use solution annealed material only.
- (2) Not to be used over 1250°F.
- (3) Use annealed material only.
- (4) Not to be used over 1200°F. Alloy N06625 in the annealed condition is subject to severe loss of impact strength at room temperatures after exposure in the range of 1000°F to 1400°F.
- (5) The chemical composition, mechanical properties, heat treating requirements, and grain size requirements shall conform to the applicable ASTM specification. The manufacturing procedures, tolerances, tests, certification, and markings shall be in accordance with ASTM B 564.
- (6) Not to be used over 800°F.
- (7) Not to be used over 1000°F.
- (8) Alloy N06022 in the solution annealed condition is subject to severe loss of impact strength at room temperature after exposure to temperatures in the range of 1000°F to 1250°F.



**Table F2-3.9 Pressure–Temperature Ratings for Group 3.9 Materials**

| Nominal Designation                |     | Forgings                  |      | Castings |      | Plates               |      |
|------------------------------------|-----|---------------------------|------|----------|------|----------------------|------|
| 47Ni–22Cr–9Mo–18Fe                 |     | B 572 Gr. N06002 (1), (2) |      |          |      | B 435 Gr. N06002 (1) |      |
| Working Pressures by Classes, psig |     |                           |      |          |      |                      |      |
| Class<br>Temp., °F                 | 150 | 300                       | 400  | 600      | 900  | 1500                 | 2500 |
| –20 to 100                         | 290 | 750                       | 1000 | 1500     | 2250 | 3750                 | 6250 |
| 200                                | 260 | 750                       | 1000 | 1500     | 2250 | 3750                 | 6250 |
| 300                                | 230 | 690                       | 920  | 1380     | 2075 | 3455                 | 5760 |
| 400                                | 200 | 640                       | 850  | 1275     | 1915 | 3190                 | 5320 |
| 500                                | 170 | 595                       | 795  | 1190     | 1785 | 2975                 | 4960 |
| 600                                | 140 | 565                       | 750  | 1130     | 1690 | 2820                 | 4700 |
| 650                                | 125 | 550                       | 735  | 1105     | 1655 | 2760                 | 4600 |
| 700                                | 110 | 540                       | 725  | 1085     | 1625 | 2710                 | 4520 |
| 750                                | 95  | 530                       | 710  | 1065     | 1595 | 2660                 | 4430 |
| 800                                | 80  | 510                       | 675  | 1015     | 1525 | 2540                 | 4230 |
| 850                                | 65  | 485                       | 650  | 975      | 1460 | 2435                 | 4060 |
| 900                                | 50  | 450                       | 600  | 900      | 1350 | 2245                 | 3745 |
| 950                                | 35  | 385                       | 515  | 775      | 1160 | 1930                 | 3220 |
| 1000                               | 20  | 365                       | 485  | 725      | 1090 | 1820                 | 3030 |
| 1050                               | ... | 360                       | 480  | 720      | 1080 | 1800                 | 3000 |
| 1100                               | ... | 325                       | 430  | 645      | 965  | 1610                 | 2685 |
| 1150                               | ... | 275                       | 365  | 550      | 825  | 1370                 | 2285 |
| 1200                               | ... | 205                       | 275  | 410      | 620  | 1030                 | 1715 |
| 1250                               | ... | 180                       | 245  | 365      | 545  | 910                  | 1515 |
| 1300                               | ... | 140                       | 185  | 275      | 410  | 685                  | 1145 |
| 1350                               | ... | 105                       | 140  | 205      | 310  | 515                  | 860  |
| 1400                               | ... | 75                        | 100  | 150      | 225  | 380                  | 630  |
| 1450                               | ... | 60                        | 80   | 115      | 175  | 290                  | 485  |
| 1500                               | ... | 40                        | 55   | 85       | 125  | 205                  | 345  |

## NOTES:

- (1) Use solution annealed material only.
- (2) The chemical composition, mechanical properties, heat treating requirements, and grain size requirements shall conform to the applicable ASTM specification. The manufacturing procedures, tolerances, tests, certification, and markings shall be in accordance with ASTM B 564.

**Table F2-3.10 Pressure–Temperature Ratings for Group 3.10 Materials**

| Nominal Designation                | Forgings                  |     |      | Castings             |      | Plates |      |
|------------------------------------|---------------------------|-----|------|----------------------|------|--------|------|
| 25Ni–46Fe–21Cr–5Mo                 | B 672 Gr. N08700 (1), (2) |     |      | B 599 Gr. N08700 (1) |      |        |      |
| Working Pressures by Classes, psig |                           |     |      |                      |      |        |      |
| Class<br>Temp., °F                 | 150                       | 300 | 400  | 600                  | 900  | 1500   | 2500 |
| –20 to 100                         | 290                       | 750 | 1000 | 1500                 | 2250 | 3750   | 6250 |
| 200                                | 260                       | 750 | 1000 | 1500                 | 2250 | 3750   | 6250 |
| 300                                | 230                       | 685 | 910  | 1370                 | 2050 | 3420   | 5700 |
| 400                                | 200                       | 640 | 850  | 1275                 | 1915 | 3190   | 5320 |
| 500                                | 170                       | 615 | 820  | 1235                 | 1850 | 3085   | 5140 |
| 600                                | 140                       | 595 | 790  | 1185                 | 1780 | 2965   | 4940 |
| 650                                | 125                       | 570 | 760  | 1140                 | 1715 | 2855   | 4760 |

## NOTES:

- (1) Use solution annealed material only.
- (2) The chemical composition, mechanical properties, heat treating requirements, and grain size requirements shall conform to the applicable ASTM specification. The manufacturing procedures, tolerances, tests, certification, and markings shall be in accordance with ASTM B 564.

**Table F2-3.11 Pressure–Temperature Ratings for Group 3.11 Materials**

| Nominal Designation                | Forgings                  |     |     | Castings |                      | Plates |      |
|------------------------------------|---------------------------|-----|-----|----------|----------------------|--------|------|
| 44Fe–25Ni–21Cr–Mo                  | B 649 Gr. N08904 (1), (2) |     |     |          | B 625 Gr. N08904 (1) |        |      |
| Working Pressures by Classes, psig |                           |     |     |          |                      |        |      |
| Class Temp., °F                    | 150                       | 300 | 400 | 600      | 900                  | 1500   | 2500 |
| –20 to 100                         | 285                       | 745 | 990 | 1490     | 2230                 | 3720   | 6200 |
| 200                                | 230                       | 600 | 805 | 1205     | 1805                 | 3010   | 5020 |
| 300                                | 210                       | 545 | 725 | 1090     | 1635                 | 2725   | 4540 |
| 400                                | 190                       | 500 | 665 | 1000     | 1500                 | 2495   | 4160 |
| 500                                | 170                       | 455 | 610 | 910      | 1370                 | 2280   | 3800 |
| 600                                | 140                       | 425 | 570 | 855      | 1280                 | 2135   | 3560 |
| 650                                | 125                       | 420 | 555 | 835      | 1255                 | 2090   | 3480 |
| 700                                | 110                       | 410 | 545 | 820      | 1230                 | 2050   | 3420 |

## NOTES:

- (1) Use annealed material only.
- (2) The chemical composition, mechanical properties, heat treating requirements, and grain size requirements shall conform to the applicable ASTM specification. The manufacturing procedures, tolerances, tests, certification, and markings shall be in accordance with ASTM B 564.

**Table F2-3.12 Pressure–Temperature Ratings for Group 3.12 Materials**

| Nominal Designation                |     | Forgings                  |     | Castings            |      | Plates               |      |
|------------------------------------|-----|---------------------------|-----|---------------------|------|----------------------|------|
| 26Ni–43Fe–22Cr–5Mo                 |     | B 621 Gr. N08320 (1), (2) |     |                     |      | B 620 Gr. N08320 (1) |      |
| 47Ni–22Cr–20Fe–7Mo                 |     | B 581 Gr. N06985 (1), (2) |     |                     |      | B 582 Gr. N06985 (1) |      |
| 46Fe–24Ni–21Cr–6Mo–Cu–N            |     | B 462 Gr. N08367 (1)      |     | A 351 Gr. CN3MM (1) |      | B 688 Gr. N08367 (1) |      |
| Working Pressures by Classes, psig |     |                           |     |                     |      |                      |      |
| Class<br>Temp., °F                 | 150 | 300                       | 400 | 600                 | 900  | 1500                 | 2500 |
| –20 to 100                         | 260 | 670                       | 895 | 1345                | 2015 | 3360                 | 5600 |
| 200                                | 240 | 620                       | 830 | 1245                | 1865 | 3110                 | 5180 |
| 300                                | 225 | 585                       | 780 | 1165                | 1750 | 2915                 | 4860 |
| 400                                | 200 | 540                       | 715 | 1075                | 1615 | 2690                 | 4480 |
| 500                                | 170 | 500                       | 665 | 1000                | 1500 | 2495                 | 4160 |
| 600                                | 140 | 475                       | 630 | 945                 | 1420 | 2365                 | 3940 |
| 650                                | 125 | 460                       | 615 | 920                 | 1380 | 2305                 | 3840 |
| 700                                | 110 | 450                       | 600 | 900                 | 1355 | 2255                 | 3760 |
| 750                                | 95  | 440                       | 590 | 885                 | 1325 | 2210                 | 3680 |
| 800                                | 80  | 430                       | 575 | 865                 | 1295 | 2160                 | 3600 |

## NOTES:

- (1) Use solution annealed material only.
- (2) The chemical composition, mechanical properties, heat treating requirements, and grain size requirements shall conform to the applicable ASTM specification. The manufacturing procedures, tolerances, tests, certification, and markings shall be in accordance with ASTM B 564.

**Table F2-3.13 Pressure–Temperature Ratings for Group 3.13 Materials**

| Nominal Designation                | Forgings                  |     |      | Castings |                      | Plates |      |
|------------------------------------|---------------------------|-----|------|----------|----------------------|--------|------|
| 49Ni–25Cr–18Fe–6Mo                 | B 581 Gr. N06975 (1), (2) |     |      |          | B 582 Gr. N06975 (1) |        |      |
| Ni–Fe–Cr–Mo–Cu–Low C               | B 564 Gr. N08031 (3)      |     |      |          | B 625 Gr. N08031 (3) |        |      |
| Working Pressures by Classes, psig |                           |     |      |          |                      |        |      |
| Class<br>Temp., °F                 | 150                       | 300 | 400  | 600      | 900                  | 1500   | 2500 |
| –20 to 100                         | 290                       | 750 | 1000 | 1500     | 2250                 | 3750   | 6250 |
| 200                                | 260                       | 705 | 940  | 1405     | 2110                 | 3515   | 5860 |
| 300                                | 230                       | 665 | 885  | 1330     | 1995                 | 3325   | 5540 |
| 400                                | 200                       | 630 | 840  | 1260     | 1885                 | 3145   | 5240 |
| 500                                | 170                       | 595 | 795  | 1190     | 1785                 | 2975   | 4960 |
| 600                                | 140                       | 560 | 750  | 1125     | 1685                 | 2810   | 4680 |
| 650                                | 125                       | 550 | 735  | 1100     | 1650                 | 2750   | 4580 |
| 700                                | 110                       | 540 | 720  | 1080     | 1620                 | 2700   | 4500 |
| 750                                | 95                        | 530 | 710  | 1065     | 1595                 | 2660   | 4430 |
| 800                                | 80                        | 510 | 675  | 1015     | 1525                 | 2540   | 4230 |

## NOTES:

- (1) Use solution annealed material only.
- (2) The chemical composition, mechanical properties, heat treating requirements, and grain size requirements shall conform to the applicable ASTM specification. The manufacturing procedures, tolerances, tests, certification, and markings shall be in accordance with ASTM B 564.
- (3) Use annealed material only.

**Table F2-3.14 Pressure–Temperature Ratings for Group 3.14 Materials**

| Nominal Designation                | Forgings                  |     |     | Castings |                           | Plates |      |
|------------------------------------|---------------------------|-----|-----|----------|---------------------------|--------|------|
| 47Ni–22Cr–19Fe–6Mo                 | B 581 Gr. N06007 (1), (2) |     |     |          | B 582 Gr. N06007 (1)      |        |      |
| 40Ni–29Cr–15Fe–5Mo                 | B 462 Gr. N06030 (1), (3) |     |     |          | B 582 Gr. N06030 (1), (3) |        |      |
| Working Pressures by Classes, psig |                           |     |     |          |                           |        |      |
| Class<br>Temp., °F                 | 150                       | 300 | 400 | 600      | 900                       | 1500   | 2500 |
| –20 to 100                         | 275                       | 720 | 960 | 1440     | 2160                      | 3600   | 6000 |
| 200                                | 250                       | 650 | 865 | 1295     | 1945                      | 3240   | 5400 |
| 300                                | 230                       | 600 | 800 | 1200     | 1800                      | 3000   | 5000 |
| 400                                | 200                       | 565 | 750 | 1130     | 1690                      | 2820   | 4700 |
| 500                                | 170                       | 540 | 715 | 1075     | 1615                      | 2690   | 4480 |
| 600                                | 140                       | 520 | 690 | 1035     | 1555                      | 2590   | 4320 |
| 650                                | 125                       | 510 | 680 | 1020     | 1535                      | 2555   | 4260 |
| 700                                | 110                       | 505 | 675 | 1015     | 1520                      | 2530   | 4220 |
| 750                                | 95                        | 500 | 670 | 1005     | 1505                      | 2510   | 4180 |
| 800                                | 80                        | 500 | 665 | 1000     | 1500                      | 2495   | 4160 |
| 850                                | 65                        | 485 | 650 | 975      | 1460                      | 2435   | 4060 |
| 900                                | 50                        | 450 | 600 | 900      | 1350                      | 2245   | 3745 |
| 950                                | 35                        | 385 | 515 | 775      | 1160                      | 1930   | 3220 |
| 1000                               | 20                        | 365 | 485 | 725      | 1090                      | 1820   | 3030 |

## NOTES:

- (1) Use solution annealed material only.
- (2) The chemical composition, mechanical properties, heat treating requirements, and grain size requirements shall conform to the applicable ASTM specification. The manufacturing procedures, tolerances, tests, certification, and markings shall be in accordance with ASTM B 564.
- (3) Not to be used over 800°F.

**Table F2-3.15 Pressure–Temperature Ratings for Group 3.15 Materials**

| Nominal Designation                |     | Forgings             |     | Castings |      | Plates               |      |
|------------------------------------|-----|----------------------|-----|----------|------|----------------------|------|
| 33Ni–42Fe–21Cr                     |     | B 564 Gr. N08810 (1) |     |          |      | B 409 Gr. N08810 (1) |      |
| Working Pressures by Classes, psig |     |                      |     |          |      |                      |      |
| Class<br>Temp., °F                 | 150 | 300                  | 400 | 600      | 900  | 1500                 | 2500 |
| –20 to 100                         | 230 | 600                  | 800 | 1200     | 1800 | 3000                 | 5000 |
| 200                                | 210 | 550                  | 735 | 1105     | 1655 | 2760                 | 4600 |
| 300                                | 200 | 520                  | 695 | 1040     | 1560 | 2605                 | 4340 |
| 400                                | 190 | 490                  | 655 | 980      | 1470 | 2450                 | 4080 |
| 500                                | 170 | 465                  | 620 | 925      | 1390 | 2315                 | 3860 |
| 600                                | 140 | 440                  | 585 | 880      | 1320 | 2195                 | 3660 |
| 650                                | 125 | 430                  | 575 | 860      | 1290 | 2150                 | 3580 |
| 700                                | 110 | 420                  | 555 | 835      | 1255 | 2090                 | 3480 |
| 750                                | 95  | 410                  | 545 | 820      | 1230 | 2050                 | 3420 |
| 800                                | 80  | 400                  | 535 | 800      | 1200 | 2005                 | 3340 |
| 850                                | 65  | 395                  | 525 | 785      | 1180 | 1970                 | 3280 |
| 900                                | 50  | 385                  | 515 | 775      | 1160 | 1930                 | 3220 |
| 950                                | 35  | 380                  | 505 | 760      | 1140 | 1895                 | 3160 |
| 1000                               | 20  | 365                  | 485 | 725      | 1090 | 1820                 | 3030 |
| 1050                               | ... | 350                  | 465 | 700      | 1050 | 1750                 | 2915 |
| 1100                               | ... | 325                  | 430 | 645      | 965  | 1610                 | 2685 |
| 1150                               | ... | 275                  | 365 | 550      | 825  | 1370                 | 2285 |
| 1200                               | ... | 205                  | 275 | 410      | 620  | 1030                 | 1715 |
| 1250                               | ... | 180                  | 245 | 365      | 545  | 910                  | 1515 |
| 1300                               | ... | 140                  | 185 | 275      | 410  | 685                  | 1145 |
| 1350                               | ... | 105                  | 140 | 205      | 310  | 515                  | 860  |
| 1400                               | ... | 75                   | 100 | 150      | 225  | 380                  | 630  |
| 1450                               | ... | 60                   | 80  | 115      | 175  | 290                  | 485  |
| 1500                               | ... | 40                   | 55  | 85       | 125  | 205                  | 345  |

NOTE:

(1) Use solution annealed material only.

**Table F2-3.16 Pressure–Temperature Ratings for Group 3.16 Materials**

| Nominal Designation                |     | Forgings                  |     |      | Castings |                      | Plates |  |
|------------------------------------|-----|---------------------------|-----|------|----------|----------------------|--------|--|
| 35Ni–19Cr–1¼Si                     |     | B 511 Gr. N08330 (1), (2) |     |      |          | B 536 Gr. N08330 (1) |        |  |
| Working Pressures by Classes, psig |     |                           |     |      |          |                      |        |  |
| Class<br>Temp., °F                 | 150 | 300                       | 400 | 600  | 900      | 1500                 | 2500   |  |
| –20 to 100                         | 275 | 720                       | 960 | 1440 | 2160     | 3600                 | 6000   |  |
| 200                                | 245 | 635                       | 850 | 1270 | 1910     | 3180                 | 5300   |  |
| 300                                | 225 | 595                       | 790 | 1185 | 1780     | 2965                 | 4940   |  |
| 400                                | 200 | 555                       | 740 | 1115 | 1670     | 2785                 | 4640   |  |
| 500                                | 170 | 530                       | 705 | 1055 | 1585     | 2640                 | 4400   |  |
| 600                                | 140 | 505                       | 670 | 1010 | 1510     | 2520                 | 4200   |  |
| 650                                | 125 | 495                       | 660 | 990  | 1485     | 2470                 | 4120   |  |
| 700                                | 110 | 480                       | 645 | 965  | 1445     | 2410                 | 4020   |  |
| 750                                | 95  | 475                       | 630 | 945  | 1420     | 2365                 | 3940   |  |
| 800                                | 80  | 465                       | 620 | 925  | 1390     | 2315                 | 3860   |  |
| 850                                | 65  | 455                       | 605 | 905  | 1360     | 2270                 | 3780   |  |
| 900                                | 50  | 445                       | 590 | 890  | 1330     | 2220                 | 3700   |  |
| 950                                | 35  | 385                       | 515 | 775  | 1160     | 1930                 | 3220   |  |
| 1000                               | 20  | 365                       | 485 | 725  | 1090     | 1820                 | 3030   |  |
| 1050                               | ... | 345                       | 455 | 685  | 1030     | 1715                 | 2855   |  |
| 1100                               | ... | 265                       | 355 | 535  | 800      | 1335                 | 2230   |  |
| 1150                               | ... | 205                       | 275 | 410  | 615      | 1030                 | 1715   |  |
| 1200                               | ... | 160                       | 215 | 320  | 485      | 805                  | 1345   |  |
| 1250                               | ... | 130                       | 175 | 260  | 390      | 650                  | 1085   |  |
| 1300                               | ... | 105                       | 140 | 215  | 320      | 530                  | 885    |  |
| 1350                               | ... | 80                        | 110 | 165  | 245      | 410                  | 685    |  |
| 1400                               | ... | 60                        | 80  | 125  | 185      | 310                  | 515    |  |
| 1450                               | ... | 50                        | 70  | 105  | 155      | 255                  | 430    |  |
| 1500                               | ... | 40                        | 50  | 75   | 115      | 190                  | 315    |  |

**NOTES:**

- (1) Use solution annealed material only.
- (2) The chemical composition, mechanical properties, heat treating requirements, and grain size requirements shall conform to the applicable ASTM specification. The manufacturing procedures, tolerances, tests, certification, and markings shall be in accordance with ASTM B 564.

**Table F2-3.17 Pressure–Temperature Ratings for Group 3.17 Materials**

| Nominal Designation                |     | Forgings |     | Castings           |      | Plates |      |
|------------------------------------|-----|----------|-----|--------------------|------|--------|------|
| 29Ni–20.5Cr–3.5Cu–2.5Mo            |     |          |     | A 351 Gr. CN7M (1) |      |        |      |
| Working Pressures by Classes, psig |     |          |     |                    |      |        |      |
| Class<br>Temp., °F                 | 150 | 300      | 400 | 600                | 900  | 1500   | 2500 |
| –20 to 100                         | 230 | 600      | 800 | 1200               | 1800 | 3000   | 5000 |
| 200                                | 200 | 520      | 690 | 1035               | 1555 | 2590   | 4320 |
| 300                                | 180 | 465      | 620 | 930                | 1395 | 2330   | 3880 |
| 400                                | 160 | 420      | 565 | 845                | 1265 | 2110   | 3520 |
| 500                                | 150 | 390      | 520 | 780                | 1165 | 1945   | 3240 |
| 600                                | 140 | 360      | 480 | 720                | 1080 | 1800   | 3000 |

NOTE:

(1) Use solution annealed material only.

**Table F3 Permissible Imperfections in Flange Facing Finish for Raised Face and Large Male and Female Flanges**

| NPS   | Maximum Radial<br>Projection of<br>Imperfections Which<br>Are No Deeper Than<br>the Bottom of the<br>Serrations, in. | Maximum Depth and<br>Radial Projection of<br>Imperfections Which<br>Are Deeper Than the<br>Bottom of the<br>Serrations, in. |
|-------|----------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------|
| 1/2   | 0.12                                                                                                                 | 0.06                                                                                                                        |
| 3/4   | 0.12                                                                                                                 | 0.06                                                                                                                        |
| 1     | 0.12                                                                                                                 | 0.06                                                                                                                        |
| 1 1/4 | 0.12                                                                                                                 | 0.06                                                                                                                        |
| 1 1/2 | 0.12                                                                                                                 | 0.06                                                                                                                        |
| 2     | 0.12                                                                                                                 | 0.06                                                                                                                        |
| 2 1/2 | 0.12                                                                                                                 | 0.06                                                                                                                        |
| 3     | 0.18                                                                                                                 | 0.06                                                                                                                        |
| 3 1/2 | 0.25                                                                                                                 | 0.12                                                                                                                        |
| 4     | 0.25                                                                                                                 | 0.12                                                                                                                        |
| 5     | 0.25                                                                                                                 | 0.12                                                                                                                        |
| 6     | 0.25                                                                                                                 | 0.12                                                                                                                        |
| 8     | 0.31                                                                                                                 | 0.18                                                                                                                        |
| 10    | 0.31                                                                                                                 | 0.18                                                                                                                        |
| 12    | 0.31                                                                                                                 | 0.18                                                                                                                        |
| 14    | 0.31                                                                                                                 | 0.18                                                                                                                        |
| 16    | 0.38                                                                                                                 | 0.18                                                                                                                        |
| 18    | 0.50                                                                                                                 | 0.25                                                                                                                        |
| 20    | 0.50                                                                                                                 | 0.25                                                                                                                        |
| 24    | 0.50                                                                                                                 | 0.25                                                                                                                        |

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

| 1                       | 2                | 3          | 4          | 5                                            | 6          | 7                                         | 8          | 9                                                                      | 10    | 11                                             | 12    | 13                                                                                   | 14               | 15                                         | 1     |                                                                                                                   |    |                         |
|-------------------------|------------------|------------|------------|----------------------------------------------|------------|-------------------------------------------|------------|------------------------------------------------------------------------|-------|------------------------------------------------|-------|--------------------------------------------------------------------------------------|------------------|--------------------------------------------|-------|-------------------------------------------------------------------------------------------------------------------|----|-------------------------|
| Nominal<br>Pipe<br>Size | Outside Diameter |            |            | Inside Diameter of Large and Small Tongue, U |            | Inside Diameter of Small Male, [Note (1)] |            | Outside Diameter Large Female and Groove, W Small Female, X [Note (1)] |       | Inside Diameter of Large and Small Groove, Y Z |       | Height Raised Face [Notes (2), (3)] Large and Small Male and Tongue [Notes (2), (4)] |                  | Depth of Groove or Female [Notes (2), (5)] |       | Minimum Outside Diameter of Raised Portion [Notes (6), (7)] Small Female and Groove, K Large Female and Groove, L |    | Nominal<br>Pipe<br>Size |
|                         | R                | S          | T          | U                                            | [Note (1)] | [Note (1)]                                | [Note (1)] | W                                                                      | X     | Y                                              | Z     | [Notes (2), (3)]                                                                     | [Notes (2), (4)] | [Notes (2), (5)]                           | K     | L                                                                                                                 |    |                         |
|                         | [Note (1)]       | [Note (1)] | [Note (1)] |                                              |            |                                           |            |                                                                        |       |                                                |       |                                                                                      |                  |                                            |       |                                                                                                                   |    |                         |
| 1½                      | 1.38             | 0.72       | 1.38       | 1.00                                         | ...        | ...                                       | ...        | 1.44                                                                   | 0.78  | 1.44                                           | 0.94  | ...                                                                                  | ...              | ...                                        | 1.75  | 1.81                                                                                                              | 1½ |                         |
| ¾                       | 1.69             | 0.94       | 1.69       | 1.31                                         | ...        | ...                                       | ...        | 1.75                                                                   | 1.00  | 1.75                                           | 1.25  | ...                                                                                  | ...              | ...                                        | 2.06  | 2.12                                                                                                              | ¾  |                         |
| 1                       | 2.00             | 1.19       | 1.88       | 1.50                                         | ...        | ...                                       | ...        | 2.06                                                                   | 1.25  | 1.94                                           | 1.44  | ...                                                                                  | ...              | ...                                        | 2.25  | 2.44                                                                                                              | 1  |                         |
| 1¼                      | 2.50             | 1.50       | 2.25       | 1.88                                         | ...        | ...                                       | ...        | 2.56                                                                   | 1.56  | 2.31                                           | 1.81  | ...                                                                                  | ...              | ...                                        | 2.62  | 2.94                                                                                                              | 1¼ |                         |
| 1½                      | 2.88             | 1.75       | 2.50       | 2.12                                         | ...        | ...                                       | ...        | 2.94                                                                   | 1.81  | 2.56                                           | 2.06  | ...                                                                                  | ...              | ...                                        | 2.88  | 3.31                                                                                                              | 1½ |                         |
| 2                       | 3.62             | 2.25       | 3.25       | 2.88                                         | ...        | ...                                       | ...        | 3.69                                                                   | 2.31  | 3.31                                           | 2.81  | ...                                                                                  | ...              | ...                                        | 3.62  | 4.06                                                                                                              | 2  |                         |
| 2½                      | 4.12             | 2.69       | 3.75       | 3.38                                         | ...        | ...                                       | ...        | 4.19                                                                   | 2.75  | 3.81                                           | 3.31  | ...                                                                                  | ...              | ...                                        | 4.12  | 4.56                                                                                                              | 2½ |                         |
| 3                       | 5.00             | 3.31       | 4.62       | 4.25                                         | ...        | ...                                       | ...        | 5.06                                                                   | 3.38  | 4.69                                           | 4.19  | ...                                                                                  | ...              | ...                                        | 5.00  | 5.44                                                                                                              | 3  |                         |
| 3½                      | 5.50             | 3.81       | 5.12       | 4.75                                         | ...        | ...                                       | ...        | 5.56                                                                   | 3.88  | 5.19                                           | 4.69  | ...                                                                                  | ...              | ...                                        | 5.50  | 5.94                                                                                                              | 3½ |                         |
| 4                       | 6.19             | 4.31       | 5.69       | 5.19                                         | ...        | ...                                       | ...        | 6.25                                                                   | 4.38  | 5.75                                           | 5.12  | ...                                                                                  | ...              | ...                                        | 6.19  | 6.62                                                                                                              | 4  |                         |
| 5                       | 7.31             | 5.38       | 6.81       | 6.31                                         | ...        | ...                                       | ...        | 7.38                                                                   | 5.44  | 6.88                                           | 6.25  | ...                                                                                  | ...              | ...                                        | 7.31  | 7.75                                                                                                              | 5  |                         |
| 6                       | 8.50             | 6.38       | 8.00       | 7.50                                         | ...        | ...                                       | ...        | 8.56                                                                   | 6.44  | 8.06                                           | 7.44  | ...                                                                                  | ...              | ...                                        | 8.50  | 8.94                                                                                                              | 6  |                         |
| 8                       | 10.62            | 8.38       | 10.00      | 9.38                                         | ...        | ...                                       | ...        | 10.69                                                                  | 8.44  | 10.06                                          | 9.31  | ...                                                                                  | ...              | ...                                        | 10.62 | 11.06                                                                                                             | 8  |                         |
| 10                      | 12.75            | 10.50      | 12.00      | 11.25                                        | ...        | ...                                       | ...        | 12.81                                                                  | 10.56 | 12.06                                          | 11.19 | ...                                                                                  | ...              | ...                                        | 12.75 | 13.19                                                                                                             | 10 |                         |
| 12                      | 15.00            | 12.50      | 14.25      | 13.50                                        | ...        | ...                                       | ...        | 15.06                                                                  | 12.56 | 14.31                                          | 13.44 | ...                                                                                  | ...              | ...                                        | 15.00 | 15.44                                                                                                             | 12 |                         |
| 14                      | 16.25            | 13.75      | 15.50      | 14.75                                        | ...        | ...                                       | ...        | 16.31                                                                  | 13.81 | 15.56                                          | 14.69 | ...                                                                                  | ...              | ...                                        | 16.25 | 16.69                                                                                                             | 14 |                         |
| 16                      | 18.50            | 15.75      | 17.62      | 16.75                                        | ...        | ...                                       | ...        | 18.56                                                                  | 15.81 | 17.69                                          | 16.69 | ...                                                                                  | ...              | ...                                        | 18.50 | 18.94                                                                                                             | 16 |                         |
| 18                      | 21.00            | 17.75      | 20.12      | 19.25                                        | ...        | ...                                       | ...        | 21.06                                                                  | 17.81 | 20.19                                          | 19.19 | ...                                                                                  | ...              | ...                                        | 21.00 | 21.44                                                                                                             | 18 |                         |
| 20                      | 23.00            | 19.75      | 22.00      | 21.00                                        | ...        | ...                                       | ...        | 23.06                                                                  | 19.81 | 22.06                                          | 20.94 | ...                                                                                  | ...              | ...                                        | 23.00 | 23.44                                                                                                             | 20 |                         |
| 24                      | 27.25            | 23.75      | 26.25      | 25.25                                        | ...        | ...                                       | ...        | 27.31                                                                  | 23.81 | 26.31                                          | 25.19 | ...                                                                                  | ...              | ...                                        | 27.25 | 27.69                                                                                                             | 24 |                         |

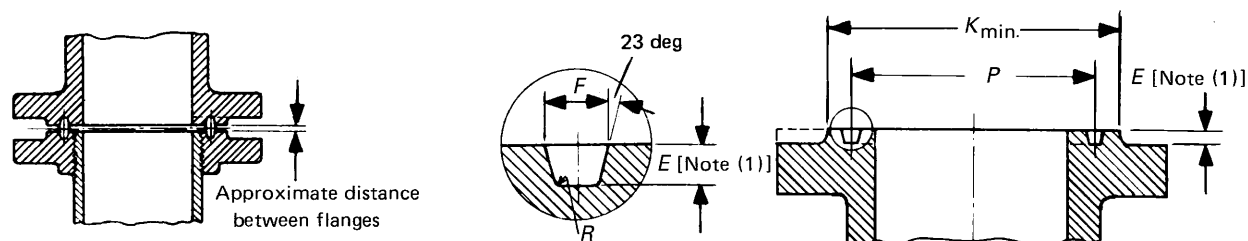
**GENERAL NOTES:**

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

**NOTES:**

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



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

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

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

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

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

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

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

| 13                                   | 14                         | 15           | 16            | 17            | 18                                   | 19           | 20           | 21           | 22           | 23            | 24            |
|--------------------------------------|----------------------------|--------------|---------------|---------------|--------------------------------------|--------------|--------------|--------------|--------------|---------------|---------------|
| Diameter of Raised Portion, <i>K</i> |                            |              |               |               | Approximate Distance Between Flanges |              |              |              |              |               |               |
| Class<br>150                         | Class<br>300<br>400<br>600 | Class<br>900 | Class<br>1500 | Class<br>2500 | Class<br>150                         | Class<br>300 | Class<br>400 | Class<br>600 | Class<br>900 | Class<br>1500 | Class<br>2500 |
| ...                                  | ...                        | ...          | ...           | 13.38         | ...                                  | ...          | ...          | ...          | ...          | ...           | 0.19          |
| 13.00                                | ...                        | ...          | ...           | ...           | 0.16                                 | ...          | ...          | ...          | ...          | ...           | ...           |
| ...                                  | 14.00                      | 14.25        | ...           | ...           | ...                                  | 0.22         | 0.22         | 0.19         | 0.16         | ...           | ...           |
| ...                                  | ...                        | ...          | 14.62         | ...           | ...                                  | ...          | ...          | ...          | ...          | 0.16          | ...           |
| ...                                  | ...                        | ...          | ...           | 16.75         | ...                                  | ...          | ...          | ...          | ...          | ...           | 0.25          |
| 16.00                                | ...                        | ...          | ...           | ...           | 0.16                                 | ...          | ...          | ...          | ...          | ...           | ...           |
| ...                                  | 16.25                      | 16.50        | ...           | ...           | ...                                  | 0.22         | 0.22         | 0.19         | 0.16         | ...           | ...           |
| ...                                  | ...                        | ...          | 17.25         | ...           | ...                                  | ...          | ...          | ...          | ...          | 0.19          | ...           |
| 16.75                                | ...                        | ...          | ...           | ...           | 0.12                                 | ...          | ...          | ...          | ...          | ...           | ...           |
| ...                                  | ...                        | ...          | ...           | 19.50         | ...                                  | ...          | ...          | ...          | ...          | ...           | 0.31          |
| ...                                  | 18.00                      | ...          | ...           | ...           | ...                                  | 0.22         | 0.22         | 0.19         | ...          | ...           | ...           |
| ...                                  | ...                        | 18.38        | ...           | ...           | ...                                  | ...          | ...          | ...          | 0.16         | ...           | ...           |
| ...                                  | ...                        | ...          | 19.25         | ...           | ...                                  | ...          | ...          | ...          | ...          | 0.22          | ...           |
| 19.00                                | ...                        | ...          | ...           | ...           | 0.12                                 | ...          | ...          | ...          | ...          | ...           | ...           |
| ...                                  | 20.00                      | ...          | ...           | ...           | ...                                  | 0.22         | 0.22         | 0.19         | ...          | ...           | ...           |
| ...                                  | ...                        | 20.62        | ...           | ...           | ...                                  | ...          | ...          | ...          | 0.16         | ...           | ...           |
| ...                                  | ...                        | ...          | 21.50         | ...           | ...                                  | ...          | ...          | ...          | ...          | 0.31          | ...           |
| 21.50                                | ...                        | ...          | ...           | ...           | 0.12                                 | ...          | ...          | ...          | ...          | ...           | ...           |
| ...                                  | 22.62                      | ...          | ...           | ...           | ...                                  | 0.22         | 0.22         | 0.19         | ...          | ...           | ...           |
| ...                                  | ...                        | 23.38        | ...           | ...           | ...                                  | ...          | ...          | ...          | 0.19         | ...           | ...           |
| ...                                  | ...                        | ...          | 24.12         | ...           | ...                                  | ...          | ...          | ...          | ...          | 0.31          | ...           |
| 23.50                                | ...                        | ...          | ...           | ...           | 0.12                                 | ...          | ...          | ...          | ...          | ...           | ...           |
| ...                                  | 25.00                      | ...          | ...           | ...           | ...                                  | 0.22         | 0.22         | 0.19         | ...          | ...           | ...           |
| ...                                  | ...                        | 25.50        | ...           | ...           | ...                                  | ...          | ...          | ...          | 0.19         | ...           | ...           |
| ...                                  | ...                        | ...          | 26.50         | ...           | ...                                  | ...          | ...          | ...          | ...          | 0.38          | ...           |
| 28.00                                | ...                        | ...          | ...           | ...           | 0.12                                 | ...          | ...          | ...          | ...          | ...           | ...           |
| ...                                  | 29.50                      | ...          | ...           | ...           | ...                                  | 0.25         | 0.25         | 0.22         | ...          | ...           | ...           |
| ...                                  | ...                        | 30.38        | ...           | ...           | ...                                  | ...          | ...          | ...          | 0.22         | ...           | ...           |
| ...                                  | ...                        | ...          | 31.25         | ...           | ...                                  | ...          | ...          | ...          | ...          | 0.44          | ...           |

**GENERAL NOTES:**

- (a) Dimensions are in inches.  
 (b) For facing requirements for flanges and flanged fittings, see para. 6.4.1 and Fig. F7.  
 (c) For facing requirements for lapped joints, see para. 6.4.3 and Fig. F7.  
 (d) See para 4.2.7 for marking requirements.

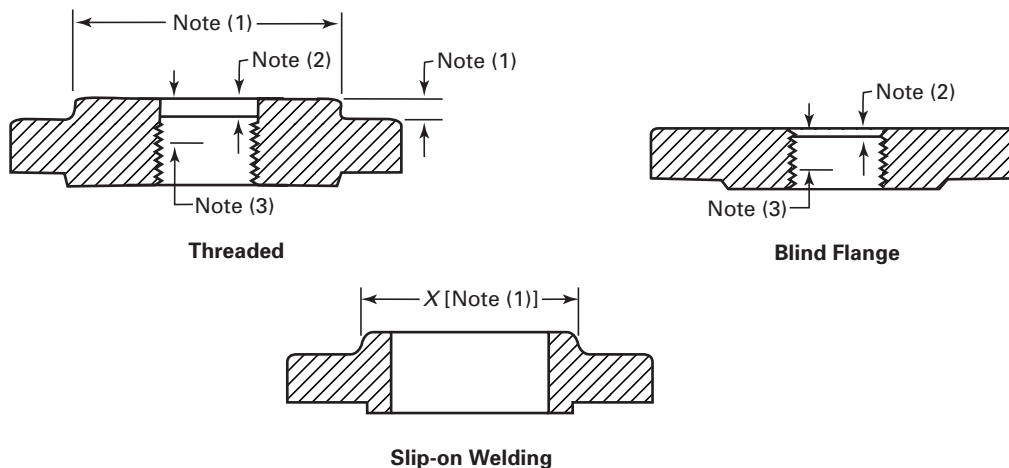
**NOTES:**

- (1) Height of raised portion is equal to the depth of groove dimension *E*, but is not subjected to the tolerances for *E*. Former full-face contour may be used.  
 (2) Use Class 600 in sizes NPS  $\frac{1}{2}$  to NPS  $3\frac{1}{2}$  for Class 400.  
 (3) Use Class 1500 in sizes NPS  $\frac{1}{2}$  to NPS  $2\frac{1}{2}$  for Class 900.  
 (4) For ring joints with lapped flanges in Classes 300 and 600, ring and groove number R30 are used instead of R31.

**TOLERANCES:**

- E* (depth) +0.016, -0.0  
*F* (width) ±0.008  
*P* (pitch diameter) ±0.005  
*R* (radius at bottom)  
 $R \leq 0.06$  +0.03, -0.0  
 $R > 0.06$  ± 0.03  
 23 deg (angle) ±  $\frac{1}{2}$  deg

## REDUCING THREADED AND SLIP-ON PIPE FLANGES

**Table F6 Reducing Threaded and Slip-on Flanges for Classes 150 Through 2500**

| 1                               | 2                                                                    | 3                               | 4                                                                    | 5                               | 6                                                                    |
|---------------------------------|----------------------------------------------------------------------|---------------------------------|----------------------------------------------------------------------|---------------------------------|----------------------------------------------------------------------|
| Nominal Pipe Size<br>[Note (4)] | Smallest Size of Reducing Outlet Requiring Hub Flanges<br>[Note (1)] | Nominal Pipe Size<br>[Note (4)] | Smallest Size of Reducing Outlet Requiring Hub Flanges<br>[Note (1)] | Nominal Pipe Size<br>[Note (4)] | Smallest Size of Reducing Outlet Requiring Hub Flanges<br>[Note (1)] |
| 1                               | $\frac{1}{2}$                                                        | $3\frac{1}{2}$                  | $1\frac{1}{2}$                                                       | 12                              | $3\frac{1}{2}$                                                       |
| $1\frac{1}{4}$                  | $\frac{1}{2}$                                                        | 4                               | $1\frac{1}{2}$                                                       | 14                              | $3\frac{1}{2}$                                                       |
| $1\frac{1}{2}$                  | $\frac{1}{2}$                                                        | 5                               | $1\frac{1}{2}$                                                       | 16                              | 4                                                                    |
| 2                               | 1                                                                    | 6                               | $2\frac{1}{2}$                                                       | 18                              | 4                                                                    |
| $2\frac{1}{2}$                  | $1\frac{1}{4}$                                                       | 8                               | 3                                                                    | 20                              | 4                                                                    |
| 3                               | $1\frac{1}{4}$                                                       | 10                              | $3\frac{1}{2}$                                                       | 24                              | 4                                                                    |

## NOTES:

- (1) The hub dimensions shall be at least as large as those of the standard flanges of the size to which the reduction is being made except flanges reducing to a size smaller than those of Columns 2, 4, and 6 may be made from blind flanges. See Example B.
- (2) Class 150 flanges do not have a counterbore. Class 300 and higher pressure flanges will have depth of counterbore of 0.25 in. for NPS 2 and smaller tapping and 0.38 in. for NPS  $2\frac{1}{2}$  and larger. The diameter  $Q$  of counterbore is the same as that given in the tables of the threaded flanges for the corresponding tapping.
- (3) Minimum length of effective threads shall be at least equal to dimension  $T$  of the corresponding pressure class threaded flange as shown in tables but does not necessarily extend for the face of the flange. For thread of threaded flanges, see para. 6.9.
- (4) For method of designating reducing threaded and reducing slip-on flanges, see para. 3.3 and the example below.

## EXAMPLES:

- A. The size designation is NPS  $6 \times 2\frac{1}{2}$  — Class 300 reducing threaded flange. This flange has the following dimensions:
  - NPS  $2\frac{1}{2}$  = taper pipe thread tapping (ASME B1.20.1)
  - 12.5 in. = diameter of regular NPS 6 Class 300 threaded flange
  - 1.44 in. = thickness of regular NPS 6 Class 300 threaded flange
  - 7.0 in. = diameter of hub for regular NPS 5 Class 300 threaded flange. Hub diameter may be one size smaller to reduce machining. In this example a hub diameter of NPS  $2\frac{1}{2}$  would be the smallest acceptable.
  - 0.62 in. = height of hub for regular NPS 5 Class 300 threaded flange
 Other dimensions the same as for regular NPS 6 Class 300 threaded flange, Table F12.
- B. The size designation is NPS  $6 \times 2$  — Class 300 reducing threaded flange. Use regular NPS 6 Class 300 blind flange tapped with NPS 2 taper pipe thread (ASME B1.20.1).

## CLASS 150 PIPE FLANGES AND FLANGED FITTINGS

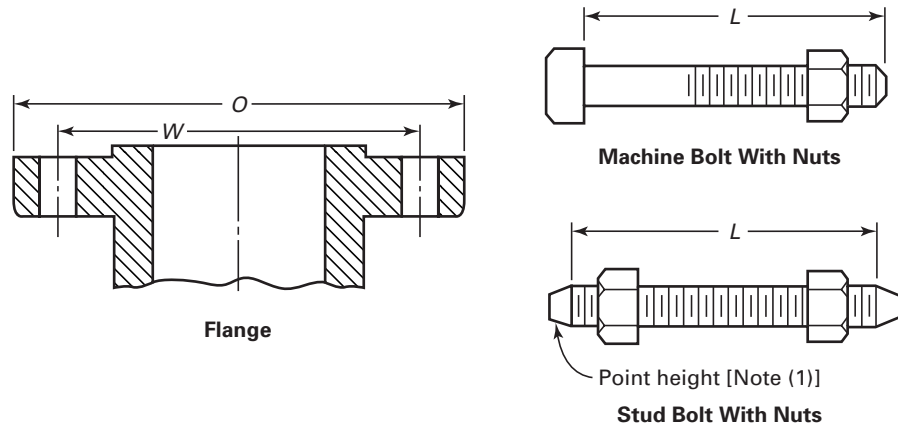


Table F7 Templates for Drilling Class 150 Flanges

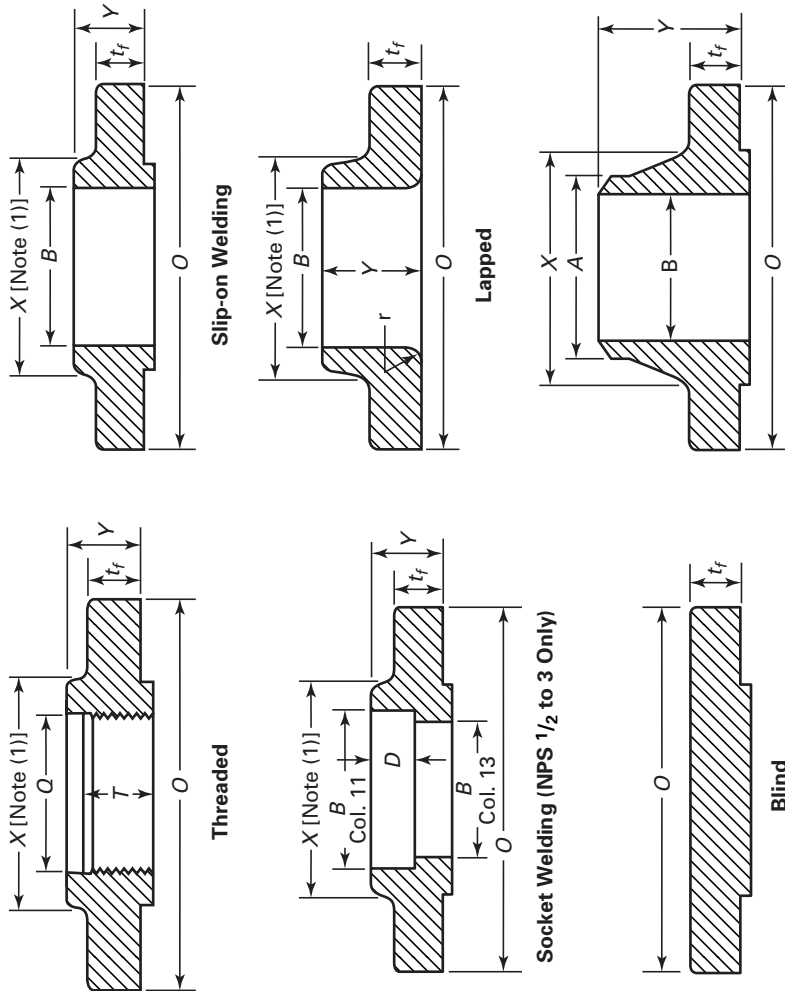
| 1                       | 2                                      | 3                                | 4                         | 5                  | 6                    | 7                                   | 8             | 9                       |
|-------------------------|----------------------------------------|----------------------------------|---------------------------|--------------------|----------------------|-------------------------------------|---------------|-------------------------|
|                         |                                        |                                  |                           |                    |                      | Length of Bolts,<br>L<br>[Note (4)] |               |                         |
| Nominal<br>Size,<br>NPS | Outside<br>Diameter<br>of Flange,<br>O | Drilling [Notes (2), (3)]        |                           |                    |                      | Stud Bolts<br>[Note (1)]            |               | Machine<br>Bolts        |
|                         |                                        | Diameter of<br>Bolt Circle,<br>W | Diameter of<br>Bolt Holes | Number<br>of Bolts | Diameter<br>of Bolts | Raised Face<br>0.06 in.             | Ring<br>Joint | Raised Face<br>0.06 in. |
| 1/2                     | 3.50                                   | 2.38                             | 5/8                       | 4                  | 1/2                  | 2.25                                | ...           | 2.00                    |
| 3/4                     | 3.88                                   | 2.75                             | 5/8                       | 4                  | 1/2                  | 2.50                                | ...           | 2.00                    |
| 1                       | 4.25                                   | 3.12                             | 5/8                       | 4                  | 1/2                  | 2.50                                | 3.00          | 2.25                    |
| 1 1/4                   | 4.62                                   | 3.50                             | 5/8                       | 4                  | 1/2                  | 2.75                                | 3.25          | 2.25                    |
| 1 1/2                   | 5.00                                   | 3.88                             | 5/8                       | 4                  | 1/2                  | 2.75                                | 3.25          | 2.50                    |
| 2                       | 6.00                                   | 4.75                             | 3/4                       | 4                  | 5/8                  | 3.25                                | 3.75          | 2.75                    |
| 2 1/2                   | 7.00                                   | 5.50                             | 3/4                       | 4                  | 5/8                  | 3.50                                | 4.00          | 3.00                    |
| 3                       | 7.50                                   | 6.00                             | 3/4                       | 4                  | 5/8                  | 3.50                                | 4.00          | 3.00                    |
| 3 1/2                   | 8.50                                   | 7.00                             | 3/4                       | 8                  | 5/8                  | 3.50                                | 4.00          | 3.00                    |
| 4                       | 9.00                                   | 7.50                             | 3/4                       | 8                  | 5/8                  | 3.50                                | 4.00          | 3.00                    |
| 5                       | 10.00                                  | 8.50                             | 7/8                       | 8                  | 3/4                  | 3.75                                | 4.25          | 3.25                    |
| 6                       | 11.00                                  | 9.50                             | 7/8                       | 8                  | 3/4                  | 4.00                                | 4.50          | 3.25                    |
| 8                       | 13.50                                  | 11.75                            | 7/8                       | 8                  | 3/4                  | 4.25                                | 4.75          | 3.50                    |
| 10                      | 16.00                                  | 14.25                            | 1                         | 12                 | 7/8                  | 4.50                                | 5.00          | 4.00                    |
| 12                      | 19.00                                  | 17.00                            | 1                         | 12                 | 7/8                  | 4.75                                | 5.25          | 4.00                    |
| 14                      | 21.00                                  | 18.75                            | 1 1/8                     | 12                 | 1                    | 5.25                                | 5.75          | 4.50                    |
| 16                      | 23.50                                  | 21.25                            | 1 1/8                     | 16                 | 1                    | 5.25                                | 5.75          | 4.50                    |
| 18                      | 25.00                                  | 22.75                            | 1 1/4                     | 16                 | 1 1/8                | 5.75                                | 6.25          | 5.00                    |
| 20                      | 27.50                                  | 25.00                            | 1 1/4                     | 20                 | 1 1/8                | 6.25                                | 6.75          | 5.50                    |
| 24                      | 32.00                                  | 29.50                            | 1 3/8                     | 20                 | 1 1/4                | 6.75                                | 7.25          | 6.00                    |

## GENERAL NOTES:

- (a) Dimensions are in inches.  
 (b) For other dimensions see Tables F8 and F9.

## NOTES:

- (1) Length of stud bolt does not include the height of the points. See para. 6.10.2.  
 (2) For flange bolt holes, see para. 6.5.  
 (3) For spot facing, see para. 6.6.  
 (4) Bolt lengths not shown in table may be determined in accordance with Annex D. See para. 6.10.2.



**Table F8 Dimensions of Class 150 Flanges**

| 1                    | 2                                             | 3                                                                          | 4                              | 5                               | 6                                                                                 | Length Through Hub                                    |                              |                     | 10                                                              | 11                                                 | 12                          | 13                                                               | 14                                                                    | 15                                 |
|----------------------|-----------------------------------------------|----------------------------------------------------------------------------|--------------------------------|---------------------------------|-----------------------------------------------------------------------------------|-------------------------------------------------------|------------------------------|---------------------|-----------------------------------------------------------------|----------------------------------------------------|-----------------------------|------------------------------------------------------------------|-----------------------------------------------------------------------|------------------------------------|
| Nominal<br>Pipe Size | Outside<br>Diameter<br>of Flange,<br><i>O</i> | Thickness of<br>Flange<br>Min.,<br><i>t<sub>f</sub></i><br>[Notes (2)–(4)] | Thickness<br>Lap Joint<br>Min. | Diameter<br>of Hub,<br><i>X</i> | Diameter<br>Beginning<br>of Chamfer<br>Welding<br>Neck,<br><i>A</i><br>[Note (5)] | Length Through Hub                                    |                              |                     | Thread<br>Length<br>Threaded<br>Min.,<br><i>T</i><br>[Note (6)] | Bore                                               |                             |                                                                  | Corner Radius<br>of Bore of<br>Lapped Flange<br>and Pipe,<br><i>r</i> | Depth<br>of<br>Socket,<br><i>D</i> |
|                      |                                               |                                                                            |                                |                                 |                                                                                   | Threaded<br>Slip-on<br>Socket<br>Welding,<br><i>Y</i> | Welding<br>Neck,<br><i>Y</i> | Lapped,<br><i>Y</i> |                                                                 | Slip-on<br>Socket<br>Welding,<br>Min.,<br><i>B</i> | Lapped<br>Min.,<br><i>B</i> | Welding<br>Neck/<br>Socket<br>Welding,<br><i>B</i><br>[Note (7)] |                                                                       |                                    |
|                      |                                               |                                                                            |                                |                                 |                                                                                   |                                                       |                              |                     |                                                                 |                                                    |                             |                                                                  |                                                                       |                                    |
|                      |                                               |                                                                            |                                |                                 |                                                                                   |                                                       |                              |                     |                                                                 |                                                    |                             |                                                                  |                                                                       |                                    |
|                      |                                               |                                                                            |                                |                                 |                                                                                   |                                                       |                              |                     |                                                                 |                                                    |                             |                                                                  |                                                                       |                                    |
| 1½                   | 3.50                                          | 0.38                                                                       | 0.44                           | 1.19                            | 0.84                                                                              | 0.56                                                  | 0.62                         | 1.81                | 0.62                                                            | 0.88                                               | 0.90                        | 0.62                                                             | 0.12                                                                  | 0.38                               |
| ¾                    | 3.88                                          | 0.44                                                                       | 0.50                           | 1.50                            | 1.05                                                                              | 0.56                                                  | 0.62                         | 2.00                | 0.62                                                            | 1.09                                               | 1.11                        | 0.82                                                             | 0.12                                                                  | 0.44                               |
| 1                    | 4.25                                          | 0.50                                                                       | 0.56                           | 1.94                            | 1.32                                                                              | 0.62                                                  | 0.69                         | 2.12                | 0.69                                                            | 1.36                                               | 1.38                        | 1.05                                                             | 0.12                                                                  | 0.50                               |
| 1¼                   | 4.62                                          | 0.56                                                                       | 0.62                           | 2.31                            | 1.66                                                                              | 0.75                                                  | 0.81                         | 2.19                | 0.81                                                            | 1.70                                               | 1.72                        | 1.38                                                             | 0.19                                                                  | 0.56                               |
| 1½                   | 5.00                                          | 0.62                                                                       | 0.69                           | 2.56                            | 1.90                                                                              | 0.81                                                  | 0.88                         | 2.38                | 0.88                                                            | 1.95                                               | 1.97                        | 1.61                                                             | 0.25                                                                  | 0.62                               |

Table F8 Dimensions of Class 150 Flanges (Cont'd)

| 1                    | 2                                             | 3                                                                          | 4                                                 | 5                               | 6                                                                                 | 7                                                     | 8                   | 9                            | 10                                                              | 11                                                 | 12                          | 13                                                      | 14                                                                    | 15                                 |
|----------------------|-----------------------------------------------|----------------------------------------------------------------------------|---------------------------------------------------|---------------------------------|-----------------------------------------------------------------------------------|-------------------------------------------------------|---------------------|------------------------------|-----------------------------------------------------------------|----------------------------------------------------|-----------------------------|---------------------------------------------------------|-----------------------------------------------------------------------|------------------------------------|
| Nominal<br>Pipe Size | Outside<br>Diameter<br>of Flange,<br><i>O</i> | Thickness of<br>Flange<br>Min.,<br><i>t<sub>f</sub></i><br>[Notes (2)–(4)] | Thickness<br>Lap Joint<br>Min.<br>[Notes (2)–(4)] | Diameter<br>of Hub,<br><i>X</i> | Diameter<br>Beginning<br>of Chamfer<br>Welding<br>Neck,<br><i>A</i><br>[Note (5)] | Length Through Hub                                    |                     |                              | Thread<br>Length<br>Threaded<br>Min.,<br><i>T</i><br>[Note (6)] | Bore                                               |                             |                                                         | Corner Radius<br>of Bore of<br>Lapped Flange<br>and Pipe,<br><i>r</i> | Depth<br>of<br>Socket,<br><i>D</i> |
|                      |                                               |                                                                            |                                                   |                                 |                                                                                   | Threaded<br>Slip-on<br>Socket<br>Welding,<br><i>Y</i> | Lapped,<br><i>Y</i> | Welding<br>Neck,<br><i>Y</i> |                                                                 | Slip-on<br>Socket<br>Welding,<br>Min.,<br><i>B</i> | Lapped<br>Min.,<br><i>B</i> | Welding<br>Socket<br>Welding,<br><i>B</i><br>[Note (7)] |                                                                       |                                    |
|                      |                                               |                                                                            |                                                   |                                 |                                                                                   |                                                       |                     |                              |                                                                 |                                                    |                             |                                                         |                                                                       |                                    |
| 2                    | 6.00                                          | 0.69                                                                       | 0.75                                              | 3.06                            | 2.38                                                                              | 0.94                                                  | 1.00                | 2.44                         | 1.00                                                            | 2.44                                               | 2.46                        | 2.07                                                    | 0.31                                                                  | 0.69                               |
| 2½                   | 7.00                                          | 0.81                                                                       | 0.88                                              | 3.56                            | 2.88                                                                              | 1.06                                                  | 1.12                | 2.69                         | 1.12                                                            | 2.94                                               | 2.97                        | 2.47                                                    | 0.31                                                                  | 0.75                               |
| 3                    | 7.50                                          | 0.88                                                                       | 0.94                                              | 4.25                            | 3.50                                                                              | 1.12                                                  | 1.19                | 2.69                         | 1.19                                                            | 3.57                                               | 3.60                        | 3.07                                                    | 0.38                                                                  | 0.81                               |
| 3½                   | 8.50                                          | 0.88                                                                       | 0.94                                              | 4.81                            | 4.00                                                                              | 1.19                                                  | 1.25                | 2.75                         | 1.25                                                            | 4.07                                               | 4.10                        | 3.55                                                    | 0.38                                                                  | ...                                |
| 4                    | 9.00                                          | 0.88                                                                       | 0.94                                              | 5.31                            | 4.50                                                                              | 1.25                                                  | 1.31                | 2.94                         | 1.31                                                            | 4.57                                               | 4.60                        | 4.03                                                    | 0.44                                                                  | ...                                |
| 5                    | 10.00                                         | 0.88                                                                       | 0.94                                              | 6.44                            | 5.56                                                                              | 1.38                                                  | 1.44                | 3.44                         | 1.44                                                            | 5.66                                               | 5.69                        | 5.05                                                    | 0.44                                                                  | ...                                |
| 6                    | 11.00                                         | 0.94                                                                       | 1.00                                              | 7.56                            | 6.63                                                                              | 1.50                                                  | 1.56                | 3.44                         | 1.56                                                            | 6.72                                               | 6.75                        | 6.07                                                    | 0.50                                                                  | ...                                |
| 8                    | 13.50                                         | 1.06                                                                       | 1.12                                              | 9.69                            | 8.63                                                                              | 1.69                                                  | 1.75                | 3.94                         | 1.75                                                            | 8.72                                               | 8.75                        | 7.98                                                    | 0.50                                                                  | ...                                |
| 10                   | 16.00                                         | 1.12                                                                       | 1.19                                              | 12.00                           | 10.75                                                                             | 1.88                                                  | 1.94                | 3.94                         | 1.94                                                            | 10.88                                              | 10.92                       | 10.02                                                   | 0.50                                                                  | ...                                |
| 12                   | 19.00                                         | 1.19                                                                       | 1.25                                              | 14.38                           | 12.75                                                                             | 2.12                                                  | 2.19                | 4.44                         | 2.19                                                            | 12.88                                              | 12.92                       | 12.00                                                   | 0.50                                                                  | ...                                |
| 14                   | 21.00                                         | 1.31                                                                       | 1.38                                              | 15.75                           | 14.00                                                                             | 2.19                                                  | 3.12                | 4.94                         | 2.25                                                            | 14.14                                              | 14.18                       | To                                                      | 0.50                                                                  | ...                                |
| 16                   | 23.50                                         | 1.38                                                                       | 1.44                                              | 18.00                           | 16.00                                                                             | 2.44                                                  | 3.44                | 4.94                         | 2.50                                                            | 16.16                                              | 16.19                       | be                                                      | 0.50                                                                  | ...                                |
| 18                   | 25.00                                         | 1.50                                                                       | 1.56                                              | 19.88                           | 18.00                                                                             | 2.62                                                  | 3.81                | 5.44                         | 2.69                                                            | 18.18                                              | 18.20                       | Specified                                               | 0.50                                                                  | ...                                |
| 20                   | 27.50                                         | 1.62                                                                       | 1.69                                              | 22.00                           | 20.00                                                                             | 2.81                                                  | 4.06                | 5.62                         | 2.88                                                            | 20.20                                              | 20.25                       | by                                                      | 0.50                                                                  | ...                                |
| 24                   | 32.00                                         | 1.81                                                                       | 1.88                                              | 26.12                           | 24.00                                                                             | 3.19                                                  | 4.38                | 5.94                         | 3.25                                                            | 24.25                                              | 24.25                       | Purchaser                                               | 0.50                                                                  | ...                                |



## Notes to Table F8

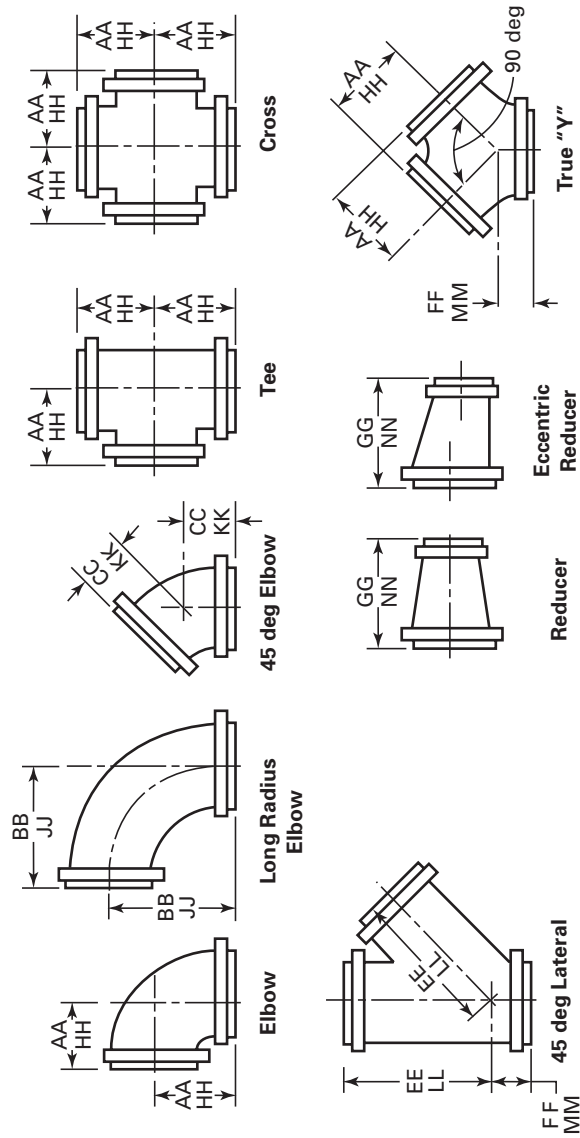
### GENERAL NOTES:

- (a) Dimensions are in inches.
- (b) For tolerances, see para. 7.
- (c) For facings, see para. 6.4.
- (d) For flange bolt holes, see para. 6.5 and Table F7.
- (e) For spot facing, see para. 6.6.
- (f) For reducing threaded and slip-on flanges, see Table F6.
- (g) Blind flanges may be made with or without hubs at the manufacturers option.
- (h) For reducing welding neck flanges, see para. 6.8.

### NOTES:

- (1) This dimension is for large end of hub, which may be straight or tapered. Taper shall not exceed 7 deg on threaded, slip-on, socket-welding, and lapped flanges.
- (2) The minimum thickness of these loose flanges, in sizes NPS  $3\frac{1}{2}$  and smaller, is slightly greater than the thickness of flanges on fittings, Table F9, which are reinforced by being cast integral with the body of the fitting.
- (3) When these flanges are required with flat face, the flat face may be either the full  $t_f$  dimension thickness plus 0.06 in., or the  $t_f$  dimension thickness without the raised face height. See para. 6.3.2 for additional restrictions.
- (4) The flange dimensions illustrated are for regularly furnished 0.06 in. raised face (except lapped); for requirements of other facings, see Fig F7.
- (5) For welding end bevel, see para. 6.7.
- (6) For thread of threaded flanges, see para. 6.9.
- (7) Dimensions in Column 13 correspond to the inside diameters of pipe as given in ASME B36.10M for Standard Wall pipe. Thickness of Standard Wall is the same as Schedule 40 in sizes NPS 10 and smaller. Tolerances in para. 7.5.2 apply. These bore sizes are furnished unless otherwise specked by the purchaser.

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**Table F9 Dimensions of Class 150 Flanged Fittings**

| 1                                  | 2                                             | 3                                                    | 4                                                                | 5                                             | 6                                                                                                  | 7                                                                                    | 8                                                                            | 9                                                                            | 10                                                                                            | 11                                                                               | 12                       |
|------------------------------------|-----------------------------------------------|------------------------------------------------------|------------------------------------------------------------------|-----------------------------------------------|----------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------|------------------------------------------------------------------------------|------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------|--------------------------|
| 0.06 in. Raised Face (Flange Edge) |                                               |                                                      |                                                                  |                                               |                                                                                                    |                                                                                      |                                                                              |                                                                              |                                                                                               |                                                                                  |                          |
| Nominal<br>Pipe<br>Size,<br>NPS    | Outside<br>Diameter<br>of Flange,<br><i>O</i> | Thickness of<br>Flange Min.,<br><i>t<sub>f</sub></i> | Wall<br>Thickness<br>of Fitting<br>Min.,<br><i>t<sub>m</sub></i> | Inside<br>Diameter<br>of Fitting,<br><i>d</i> | [Note (4)]                                                                                         |                                                                                      |                                                                              |                                                                              |                                                                                               |                                                                                  |                          |
|                                    |                                               |                                                      |                                                                  |                                               | Center-to-<br>Contact<br>Surface of<br>Raised Face<br>Elbow, Tee,<br>Cross, and<br>True “Y”,<br>AA | Center-to-<br>Contact<br>Surface of<br>Raised Face<br>Long<br>Radius<br>Elbow,<br>BB | Center-to-<br>Contact<br>Surface of<br>Raised Face<br>45 deg<br>Elbow,<br>CC | Long<br>Center-to-<br>Contact<br>Surface of<br>Raised Face<br>Lateral,<br>EE | Short<br>Center-to-<br>Contact<br>Surface of<br>Raised Face<br>Lateral and<br>True “Y”,<br>FF | Contact<br>Surface-to-<br>Contact<br>Surface of<br>Raised Face<br>Reducer,<br>GG | Ring Joint<br>[Note (4)] |
| 1/2                                | 3.5                                           | 0.31                                                 | 0.11                                                             | 0.50                                          | ...                                                                                                | ...                                                                                  | ...                                                                          | ...                                                                          | ...                                                                                           | ...                                                                              | ...                      |
| 3/4                                | 3.88                                          | 0.34                                                 | 0.12                                                             | 0.75                                          | ...                                                                                                | ...                                                                                  | ...                                                                          | ...                                                                          | ...                                                                                           | ...                                                                              | ...                      |
| 1                                  | 4.25                                          | 0.38                                                 | 0.16                                                             | 1.00                                          | 3.50                                                                                               | 5.00                                                                                 | 1.75                                                                         | 5.75                                                                         | 1.75                                                                                          | 4.50                                                                             | 3.75                     |
| 1 1/4                              | 4.62                                          | 0.44                                                 | 0.19                                                             | 1.25                                          | 3.75                                                                                               | 5.50                                                                                 | 2.00                                                                         | 6.25                                                                         | 1.75                                                                                          | 4.50                                                                             | 4.00                     |
| 1 1/2                              | 5.00                                          | 0.5                                                  | 0.19                                                             | 1.50                                          | 4.00                                                                                               | 6.00                                                                                 | 2.25                                                                         | 7.00                                                                         | 2.00                                                                                          | 4.50                                                                             | 4.25                     |
| 2                                  | 6.00                                          | 0.56                                                 | 0.22                                                             | 2.00                                          | 4.50                                                                                               | 6.50                                                                                 | 2.50                                                                         | 8.00                                                                         | 2.50                                                                                          | 5.00                                                                             | 4.75                     |
| 2 1/2                              | 7.00                                          | 0.62                                                 | 0.22                                                             | 2.50                                          | 5.00                                                                                               | 7.00                                                                                 | 3.00                                                                         | 9.50                                                                         | 2.50                                                                                          | 5.50                                                                             | 5.25                     |
| 3                                  | 7.50                                          | 0.69                                                 | 0.22                                                             | 3.00                                          | 5.50                                                                                               | 7.75                                                                                 | 3.00                                                                         | 10.00                                                                        | 3.00                                                                                          | 6.00                                                                             | 5.75                     |
| 3 1/2                              | 8.50                                          | 0.75                                                 | 0.25                                                             | 3.50                                          | 6.00                                                                                               | 8.50                                                                                 | 3.50                                                                         | 11.50                                                                        | 3.00                                                                                          | 6.50                                                                             | 6.25                     |
| 4                                  | 9.00                                          | 0.88                                                 | 0.25                                                             | 4.00                                          | 6.50                                                                                               | 9.00                                                                                 | 4.00                                                                         | 12.00                                                                        | 3.00                                                                                          | 7.00                                                                             | 6.75                     |

Table F9 Dimensions of Class 150 Flanged Fittings (Cont'd)

| 1                                  | 2                                             | 3                                                                       | 4                                                                | 5                                             | 6                                                                            | 7                                                              | 8                                                         | 9                                                         | 10                                                                      | 11                                         | 12                    |
|------------------------------------|-----------------------------------------------|-------------------------------------------------------------------------|------------------------------------------------------------------|-----------------------------------------------|------------------------------------------------------------------------------|----------------------------------------------------------------|-----------------------------------------------------------|-----------------------------------------------------------|-------------------------------------------------------------------------|--------------------------------------------|-----------------------|
| 0.06 in. Raised Face (Flange Edge) |                                               |                                                                         |                                                                  |                                               |                                                                              |                                                                |                                                           |                                                           |                                                                         |                                            |                       |
| Nominal<br>Pipe<br>Size,<br>NPS    | Outside<br>Diameter<br>of Flange,<br><i>O</i> | Thickness of<br>Flange Min.,<br><i>t<sub>f</sub></i><br>[Notes (1)–(3)] | Wall<br>Thickness<br>of Fitting<br>Min.,<br><i>t<sub>m</sub></i> | Inside<br>Diameter of<br>Fitting,<br><i>d</i> | Center-to-Contact Surface of Raised Face (Note 4)                            |                                                                |                                                           |                                                           |                                                                         |                                            |                       |
|                                    |                                               |                                                                         |                                                                  |                                               | Center-to-Contact Surface of Raised Face Elbow, Tee, Cross, and True “Y”, AA | Center-to-Contact Surface of Raised Face Long Radius Elbow, BB | Center-to-Contact Surface of Raised Face 45 deg Elbow, CC | Long Center-to-Contact Surface of Raised Face Lateral, EE | Short Center-to-Contact Surface of Raised Face Lateral and True “Y”, FF | Contact Surface of Raised Face Reducer, GG | Ring Joint [Note (4)] |
| 5                                  | 10.00                                         | 0.88                                                                    | 0.28                                                             | 5.00                                          | 7.50                                                                         | 10.25                                                          | 4.50                                                      | 13.50                                                     | 3.50                                                                    | 8.00                                       | 7.75                  |
| 6                                  | 11.00                                         | 0.94                                                                    | 0.28                                                             | 6.00                                          | 8.00                                                                         | 11.50                                                          | 5.00                                                      | 14.50                                                     | 3.50                                                                    | 9.00                                       | 8.25                  |
| 8                                  | 13.50                                         | 1.06                                                                    | 0.31                                                             | 8.00                                          | 9.00                                                                         | 14.00                                                          | 5.50                                                      | 17.50                                                     | 4.50                                                                    | 11.00                                      | 9.25                  |
| 10                                 | 16.00                                         | 1.12                                                                    | 0.34                                                             | 10.00                                         | 11.00                                                                        | 16.50                                                          | 6.50                                                      | 20.50                                                     | 5.00                                                                    | 12.00                                      | 11.25                 |
| 12                                 | 19.00                                         | 1.19                                                                    | 0.38                                                             | 12.00                                         | 12.00                                                                        | 19.00                                                          | 7.50                                                      | 24.50                                                     | 6.50                                                                    | 14.00                                      | 12.25                 |
| 14                                 | 21.00                                         | 1.31                                                                    | 0.41                                                             | 13.25                                         | 14.00                                                                        | 21.50                                                          | 7.50                                                      | 27.00                                                     | 6.00                                                                    | 16.00                                      | 14.25                 |
| 16                                 | 23.50                                         | 1.38                                                                    | 0.44                                                             | 15.25                                         | 15.00                                                                        | 24.00                                                          | 8.00                                                      | 30.00                                                     | 6.50                                                                    | 18.00                                      | 15.25                 |
| 18                                 | 25.00                                         | 1.5                                                                     | 0.47                                                             | 17.25                                         | 16.50                                                                        | 26.50                                                          | 8.50                                                      | 32.00                                                     | 7.00                                                                    | 19.00                                      | 16.75                 |
| 20                                 | 27.50                                         | 1.62                                                                    | 0.50                                                             | 19.25                                         | 18.00                                                                        | 29.00                                                          | 9.50                                                      | 35.00                                                     | 8.00                                                                    | 20.00                                      | 18.25                 |
| 24                                 | 32.00                                         | 1.81                                                                    | 0.57                                                             | 23.25                                         | 22.00                                                                        | 34.00                                                          | 11.00                                                     | 40.50                                                     | 9.00                                                                    | 24.00                                      | 22.25                 |

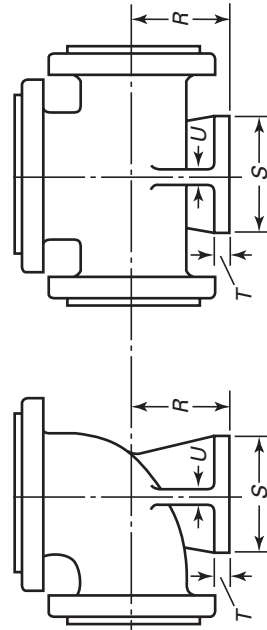
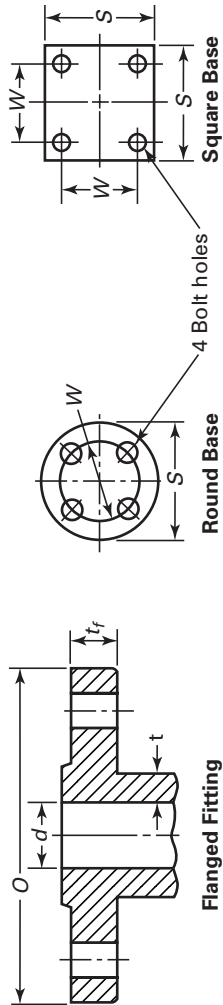


Table F9 Dimensions of Class 150 Flanged Fittings (Cont'd)

| 13                                                         | 14                                                    | 15                                                     | 16                                                                      | 17                                        | 18                                         | 19                                                                          | 20                                             | 21                                       | 22                                      | 23                              | 1                           |
|------------------------------------------------------------|-------------------------------------------------------|--------------------------------------------------------|-------------------------------------------------------------------------|-------------------------------------------|--------------------------------------------|-----------------------------------------------------------------------------|------------------------------------------------|------------------------------------------|-----------------------------------------|---------------------------------|-----------------------------|
| Ring Joint [Note (4)]                                      |                                                       |                                                        |                                                                         |                                           |                                            |                                                                             |                                                |                                          |                                         |                                 |                             |
| Center-to-End<br>Long Radius<br>Elbow,<br>JJ<br>[Note (6)] | Center-to-End<br>45 deg<br>Elbow,<br>KK<br>[Note (6)] | Long Center-<br>to-End<br>Lateral,<br>LL<br>[Note (6)] | Short Center-<br>to-End<br>Lateral and<br>True "Y",<br>MM<br>[Note (6)] | End-to-End<br>Reducer<br>NN<br>[Note (6)] | Center-to-<br>Base<br>R<br>[Notes (7)–(9)] | Diameter of<br>Round Base<br>or Width of<br>Square<br>Base, S<br>[Note (7)] | Thickness of<br>Base,<br>T<br>[Notes (7)–(10)] | Thickness<br>of Ribs,<br>U<br>[Note (7)] | Base Drilling [Note (11)]               |                                 |                             |
|                                                            |                                                       |                                                        |                                                                         |                                           |                                            |                                                                             |                                                |                                          | Bolt Circle<br>or Bolt<br>Spacing,<br>W | Diameter of<br>Drilled<br>Holes | Nominal<br>Pipe Size<br>NPS |
|                                                            |                                                       |                                                        |                                                                         |                                           |                                            |                                                                             |                                                |                                          |                                         |                                 |                             |
| ...                                                        | ...                                                   | ...                                                    | ...                                                                     | Please                                    | ...                                        | ...                                                                         | ...                                            | ...                                      | ...                                     | ...                             | 1/2                         |
| ...                                                        | ...                                                   | ...                                                    | ...                                                                     | see                                       | ...                                        | ...                                                                         | ...                                            | ...                                      | ...                                     | ...                             | 3/4                         |
| 5.25                                                       | 2.00                                                  | 6.00                                                   | 2.00                                                                    | Note (5)                                  | ...                                        | ...                                                                         | ...                                            | ...                                      | ...                                     | ...                             | 1                           |
| 5.75                                                       | 2.25                                                  | 6.50                                                   | 2.00                                                                    | and                                       | ...                                        | ...                                                                         | ...                                            | ...                                      | ...                                     | ...                             | 1 1/4                       |
| 6.25                                                       | 2.50                                                  | 7.25                                                   | 2.25                                                                    | Note (6).                                 | ...                                        | ...                                                                         | ...                                            | ...                                      | ...                                     | ...                             | 1 1/2                       |
| 6.75                                                       | 2.75                                                  | 8.25                                                   | 2.75                                                                    |                                           | 4.12                                       | 4.62                                                                        | 0.50                                           | 0.50                                     | 3.50                                    | 5/8                             | 2                           |
| 7.25                                                       | 3.25                                                  | 9.75                                                   | 2.75                                                                    |                                           | 4.50                                       | 4.62                                                                        | 0.50                                           | 0.50                                     | 3.50                                    | 5/8                             | 2 1/2                       |
| 8.00                                                       | 3.25                                                  | 10.25                                                  | 3.25                                                                    |                                           | 4.88                                       | 5.00                                                                        | 0.56                                           | 0.56                                     | 3.88                                    | 5/8                             | 3                           |
| 8.75                                                       | 3.75                                                  | 11.75                                                  | 3.25                                                                    |                                           | 5.25                                       | 5.00                                                                        | 0.56                                           | 0.56                                     | 3.88                                    | 5/8                             | 3 1/2                       |
| 9.25                                                       | 4.25                                                  | 12.25                                                  | 3.25                                                                    |                                           | 5.50                                       | 6.00                                                                        | 0.62                                           | 0.62                                     | 4.75                                    | 3/4                             | 4                           |

Table F9 Dimensions of Class 150 Flanged Fittings (Cont'd)

| 13         | 14         | 15         | 16         | 17         | 18              | 19         | 20               | 21         | 22    | 23  | 1  |                                              |                                         |                                          |                                                           |                             |                         |                                                                  |                            |                            |                                         |                                 |
|------------|------------|------------|------------|------------|-----------------|------------|------------------|------------|-------|-----|----|----------------------------------------------|-----------------------------------------|------------------------------------------|-----------------------------------------------------------|-----------------------------|-------------------------|------------------------------------------------------------------|----------------------------|----------------------------|-----------------------------------------|---------------------------------|
|            |            |            |            |            |                 |            |                  |            |       |     |    | Ring Joint [Note (4)]                        |                                         |                                          |                                                           |                             |                         |                                                                  |                            |                            |                                         |                                 |
|            |            |            |            |            |                 |            |                  |            |       |     |    | Center-to-End<br>Long Radius<br>Elbow,<br>JJ | Center-to-End<br>45 deg<br>Elbow,<br>KK | Long Center-<br>to-End<br>Lateral,<br>LL | Short Center-<br>to-End<br>Lateral and<br>True "Y",<br>MM | End-to-End<br>Reducer<br>NN | Center-to-<br>Base<br>R | Diameter of<br>Round Base<br>or Width of<br>Square<br>Base,<br>S | Thickness of<br>Base,<br>T | Thickness<br>of Ribs,<br>U | Base Drilling [Note (11)]               |                                 |
|            |            |            |            |            |                 |            |                  |            |       |     |    |                                              |                                         |                                          |                                                           |                             |                         |                                                                  |                            |                            | Bolt Circle<br>or Bolt<br>Spacing,<br>W | Diameter of<br>Drilled<br>Holes |
| [Note (6)] | [Note (6)] | [Note (6)] | [Note (6)] | [Note (6)] | [Notes (7)–(9)] | [Note (7)] | [Notes (7)–(10)] | [Note (7)] |       |     |    |                                              |                                         |                                          |                                                           |                             |                         |                                                                  |                            |                            |                                         |                                 |
| 10.50      | 4.75       | 13.75      | 3.75       | Please     | 6.25            | 7.00       | 0.69             | 0.65       | 5.50  | 3/4 | 5  |                                              |                                         |                                          |                                                           |                             |                         |                                                                  |                            |                            |                                         |                                 |
| 11.75      | 5.25       | 14.75      | 3.75       | see        | 7.00            | 7.00       | 0.69             | 0.65       | 5.50  | 3/4 | 6  |                                              |                                         |                                          |                                                           |                             |                         |                                                                  |                            |                            |                                         |                                 |
| 14.25      | 5.75       | 17.75      | 4.75       | Note (5)   | 8.38            | 9.00       | 0.94             | 0.94       | 7.50  | 3/4 | 8  |                                              |                                         |                                          |                                                           |                             |                         |                                                                  |                            |                            |                                         |                                 |
| 16.75      | 6.75       | 20.75      | 5.25       | and        | 9.75            | 9.00       | 0.94             | 0.94       | 7.50  | 3/4 | 10 |                                              |                                         |                                          |                                                           |                             |                         |                                                                  |                            |                            |                                         |                                 |
| 19.25      | 7.75       | 24.75      | 5.75       | Note (6).  | 11.25           | 11.00      | 1.00             | 1.00       | 9.50  | 7/8 | 12 |                                              |                                         |                                          |                                                           |                             |                         |                                                                  |                            |                            |                                         |                                 |
| 21.75      | 7.75       | 27.25      | 6.25       |            | 12.50           | 11.00      | 1.00             | 1.00       | 9.50  | 7/8 | 14 |                                              |                                         |                                          |                                                           |                             |                         |                                                                  |                            |                            |                                         |                                 |
| 24.25      | 8.25       | 30.25      | 6.75       |            | 13.75           | 11.00      | 1.00             | 1.00       | 9.50  | 7/8 | 16 |                                              |                                         |                                          |                                                           |                             |                         |                                                                  |                            |                            |                                         |                                 |
| 26.75      | 8.75       | 32.25      | 7.25       |            | 15.00           | 13.50      | 1.12             | 1.12       | 11.75 | 7/8 | 18 |                                              |                                         |                                          |                                                           |                             |                         |                                                                  |                            |                            |                                         |                                 |
| 29.25      | 9.75       | 35.25      | 8.25       |            | 16.00           | 13.50      | 1.12             | 1.12       | 11.75 | 7/8 | 20 |                                              |                                         |                                          |                                                           |                             |                         |                                                                  |                            |                            |                                         |                                 |
| 34.25      | 11.25      | 40.75      | 9.25       |            | 18.50           | 13.50      | 1.12             | 1.12       | 11.75 | 7/8 | 24 |                                              |                                         |                                          |                                                           |                             |                         |                                                                  |                            |                            |                                         |                                 |

## GENERAL NOTE:

- (a) Dimensions of Table F9 are in inches.  
 (b) For tolerances, see para. 7.  
 (c) For facings, see para. 6.4.  
 (d) For flange bolt holes, see para. 6.5 and Table F7.  
 (e) For spot facing, see para. 6.6.  
 (f) For intersecting centerlines, center-to-contact surface, and center-to-end dimensions of side outlet fittings, see para. 6.2.4.  
 (g) For center-to-contact surface and center-to-end dimensions of special degree elbows, see para. 6.2.5.  
 (h) For reinforcement of certain fittings, see para. 6.1.  
 (i) For drains, see para. 6.12.

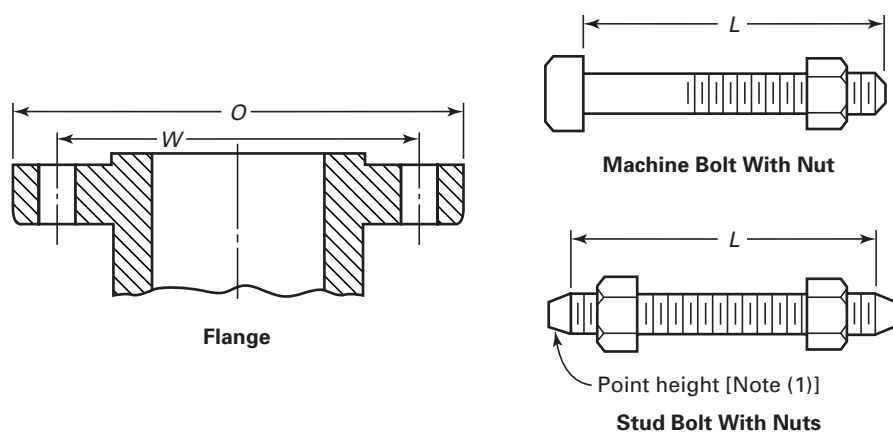
## NOTES:

- (1) The thickness of flange minimum dimensions for loose flanges, Table F9, sizes NPS 3½ and smaller, are slightly heavier than for flanges on these fittings, which are reinforced by being cast integral with the body of fitting.  
 (2) These fittings may be supplied with a flat face flange. The flat face may be either the full  $t_f$  dimension thickness plus 0.06 in. or the  $t_f$  dimension thickness without the raised face height. See para. 6.3.2 for additional restrictions.  
 (3) The thickness of flange dimension illustrated is for regularly furnished 0.06 in. raised face (except lapped); for thickness requirements of other facings, see Fig. F7.  
 (4) For center-to-contact surface and center-to-end dimensions of reducing fittings, see para. 6.2.3.  
 (5) For contact surface-to-contact surface and end-to-end dimensions of reducers and eccentric reducers, see para. 6.2.3.  
 (6) These dimensions apply to straight sizes only. See paras. 6.2.3 and 6.4.2.2. For center-to-end dimensions of reducing fittings or end-to-end dimensions of reducers, use center-to-contact surface or contact surface-to-contact surface dimensions of 0.06 in. raised face (flange edge) for largest opening and add the proper height to provide for ring joint groove applying to each flange. See Table F5 for ring joint facing dimensions.

**Notes to Table F9 (Cont'd)**

- (7) The base dimensions apply to all straight and reducing sizes.
- (8) For reducing fittings, the size, and center-to-face dimension of base are determined by the size of the largest opening of fittings. In the case of reducing base elbows, orders shall specify whether the base shall be opposite the larger or smaller opening.
- (9) Bases shall be plain faced, unless otherwise specified, and the center-to-base dimension  $R$  shall be the finished dimension.
- (10) Bases may be cast integral or attached as weldments at the option of the manufacturer.
- (11) The bases of these fittings are intended for support in compression and are not to be used for anchors or supports in tension or shear.

## CLASS 300 PIPE FLANGES, AND FLANGED FITTINGS

**Table F10 Templates for Drilling Class 300 Flanges**

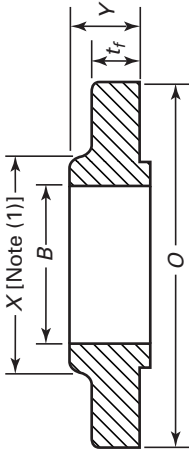
| 1                    | 2                                             | 3                                       | 4                         | 5                  | 6                    | 7                                          | 8          | 9                       |
|----------------------|-----------------------------------------------|-----------------------------------------|---------------------------|--------------------|----------------------|--------------------------------------------|------------|-------------------------|
| Nominal<br>Pipe Size | Outside<br>Diameter of<br>Flange,<br><i>O</i> | Drilling [Note (2), (3)]                |                           |                    |                      | Length of Bolts,<br><i>L</i><br>[Note (4)] |            |                         |
|                      |                                               | Diameter of<br>Bolt Circle,<br><i>W</i> | Diameter of<br>Bolt Holes | Number of<br>Bolts | Diameter of<br>Bolts | Stud Bolts [Note (1)]                      |            | Machine Bolts           |
|                      |                                               |                                         |                           |                    |                      | Raised Face<br>0.06 in.                    | Ring Joint | Raised Face<br>0.06 in. |
|                      |                                               |                                         |                           |                    |                      |                                            |            |                         |
| 1/2                  | 3.75                                          | 2.62                                    | 5/8                       | 4                  | 1/2                  | 2.50                                       | 3.00       | 2.25                    |
| 3/4                  | 4.62                                          | 3.25                                    | 3/4                       | 4                  | 5/8                  | 3.00                                       | 3.50       | 2.50                    |
| 1                    | 4.88                                          | 3.50                                    | 3/4                       | 4                  | 5/8                  | 3.00                                       | 3.50       | 2.50                    |
| 1 1/4                | 5.25                                          | 3.88                                    | 3/4                       | 4                  | 5/8                  | 3.25                                       | 3.75       | 2.75                    |
| 1 1/2                | 6.12                                          | 4.50                                    | 7/8                       | 4                  | 3/4                  | 3.50                                       | 4.00       | 3.00                    |
| 2                    | 6.50                                          | 5.00                                    | 3/4                       | 8                  | 5/8                  | 3.50                                       | 4.00       | 3.00                    |
| 2 1/2                | 7.50                                          | 5.88                                    | 7/8                       | 8                  | 3/4                  | 4.00                                       | 4.50       | 3.25                    |
| 3                    | 8.25                                          | 6.62                                    | 7/8                       | 8                  | 3/4                  | 4.25                                       | 4.75       | 3.50                    |
| 3 1/2                | 9.00                                          | 7.25                                    | 7/8                       | 8                  | 3/4                  | 4.25                                       | 5.00       | 3.75                    |
| 4                    | 10.00                                         | 7.88                                    | 7/8                       | 8                  | 3/4                  | 4.50                                       | 5.00       | 3.75                    |
| 5                    | 11.00                                         | 9.25                                    | 7/8                       | 8                  | 3/4                  | 4.75                                       | 5.25       | 4.25                    |
| 6                    | 12.50                                         | 10.62                                   | 7/8                       | 12                 | 3/4                  | 4.75                                       | 5.50       | 4.25                    |
| 8                    | 15.00                                         | 13.00                                   | 1                         | 12                 | 7/8                  | 5.50                                       | 6.00       | 4.75                    |
| 10                   | 17.50                                         | 15.25                                   | 1 1/8                     | 16                 | 1                    | 6.25                                       | 6.75       | 5.50                    |
| 12                   | 20.50                                         | 17.75                                   | 1 1/4                     | 16                 | 1 1/8                | 6.75                                       | 7.25       | 5.75                    |
| 14                   | 23.00                                         | 20.25                                   | 1 1/4                     | 20                 | 1 1/8                | 7.00                                       | 7.50       | 6.25                    |
| 16                   | 25.50                                         | 22.50                                   | 1 3/8                     | 20                 | 1 1/4                | 7.50                                       | 8.00       | 6.50                    |
| 18                   | 28.00                                         | 24.75                                   | 1 3/8                     | 24                 | 1 1/4                | 7.75                                       | 8.25       | 6.75                    |
| 20                   | 30.50                                         | 27.00                                   | 1 3/8                     | 24                 | 1 1/4                | 8.00                                       | 8.75       | 7.25                    |
| 24                   | 36.00                                         | 32.00                                   | 1 5/8                     | 24                 | 1 1/2                | 9.00                                       | 10.00      | 8.00                    |

## GENERAL NOTES:

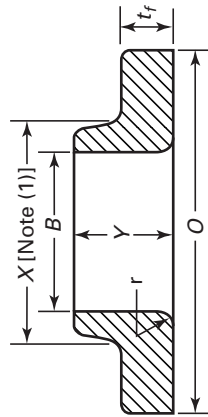
- (a) Dimensions are in inches.  
 (b) For other dimensions see, Tables F11 and F12.

## NOTES:

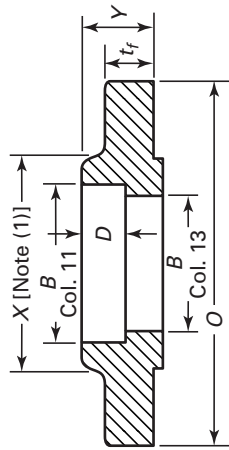
- (1) Length of stud bolt does not include the height of the points. See para. 6.10.2.  
 (2) For flange bolt holes, see para. 6.5.  
 (3) For spot facing, see para. 6.6.  
 (4) Bolt lengths not shown in the Table may be determined in accordance with Annex D. See para. 6.10.2.



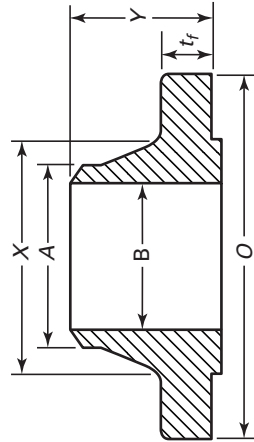
Threaded



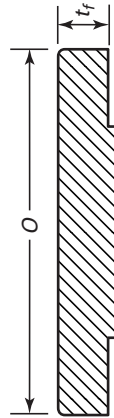
Slip-on Welding



Socket Welding (NPS 1/2 to 3 Only)



Lapped



Blind

Welding Neck

Table F11 Dimensions of Class 300 Flanges

| 1                    | 2                                         | 3                                                                    | 4                                               | 5                        | 6                                                              | 7                                              | 8            | 9                     | 10                                                       | 11                                         | 12                   | 13                          | 14                                                                   | 15                                                   | 16                          |
|----------------------|-------------------------------------------|----------------------------------------------------------------------|-------------------------------------------------|--------------------------|----------------------------------------------------------------|------------------------------------------------|--------------|-----------------------|----------------------------------------------------------|--------------------------------------------|----------------------|-----------------------------|----------------------------------------------------------------------|------------------------------------------------------|-----------------------------|
| Nominal<br>Pipe Size | Outside<br>Diameter<br>of<br>Flange,<br>O | Thickness of<br>Flange<br>Min.,<br>t <sub>f</sub><br>[Notes (2)-(4)] | Thickness<br>of Lap<br>Joint,<br>t <sub>f</sub> | Diameter<br>of Hub,<br>X | Beginning of<br>Chamber<br>Welding<br>Neck,<br>A<br>[Note (5)] | Length Through Hub                             |              |                       | Thread<br>Length<br>Threaded<br>Min.,<br>T<br>[Note (5)] | Bore                                       |                      |                             | Corner<br>Radius of<br>Bore of<br>Lapped<br>Flange<br>and Pipe,<br>r | Counter-<br>bore<br>Threaded<br>Flange<br>Min.,<br>Q | Depth<br>of<br>Socket,<br>D |
|                      |                                           |                                                                      |                                                 |                          |                                                                | Threaded<br>Slip-on<br>Socket<br>Welding,<br>Y | Lapped,<br>Y | Welding<br>Neck,<br>Y |                                                          | Slip-on<br>Socket<br>Welding<br>Min.,<br>B | Lapped<br>Min.,<br>B | Welding,<br>B<br>[Note (6)] |                                                                      |                                                      |                             |
| 1/2                  | 3.75                                      | 0.50                                                                 | 0.56                                            | 1.50                     | 0.84                                                           | 0.81                                           | 0.88         | 2.00                  | 0.62                                                     | 0.88                                       | 0.90                 | 0.62                        | 0.12                                                                 | 0.93                                                 | 0.38                        |
| 3/4                  | 4.62                                      | 0.56                                                                 | 0.62                                            | 1.88                     | 1.05                                                           | 0.94                                           | 1.00         | 2.19                  | 0.62                                                     | 1.09                                       | 1.11                 | 0.82                        | 0.12                                                                 | 1.14                                                 | 0.44                        |
| 1                    | 4.88                                      | 0.62                                                                 | 0.69                                            | 2.12                     | 1.32                                                           | 1.00                                           | 1.06         | 2.38                  | 0.69                                                     | 1.36                                       | 1.38                 | 1.05                        | 0.12                                                                 | 1.41                                                 | 0.50                        |
| 1 1/4                | 5.25                                      | 0.69                                                                 | 0.75                                            | 2.50                     | 1.66                                                           | 1.00                                           | 1.06         | 2.50                  | 0.81                                                     | 1.70                                       | 1.72                 | 1.38                        | 0.19                                                                 | 1.75                                                 | 0.56                        |
| 1 1/2                | 6.12                                      | 0.75                                                                 | 0.81                                            | 2.75                     | 1.90                                                           | 1.13                                           | 1.19         | 2.63                  | 0.88                                                     | 1.95                                       | 1.97                 | 1.61                        | 0.25                                                                 | 1.98                                                 | 0.62                        |

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Table F11 Dimensions of Class 300 Flanges (Cont'd)

| 1                    | 2                                         | 3                                                                    | 4                                                          | 5                        | 6                                                                          | 7                                                | 8                                                             | 9                                                             | 10                                                            | 11                                          | 12                   | 13                                                        | 14                                                                   | 15                                                   | 16                          |
|----------------------|-------------------------------------------|----------------------------------------------------------------------|------------------------------------------------------------|--------------------------|----------------------------------------------------------------------------|--------------------------------------------------|---------------------------------------------------------------|---------------------------------------------------------------|---------------------------------------------------------------|---------------------------------------------|----------------------|-----------------------------------------------------------|----------------------------------------------------------------------|------------------------------------------------------|-----------------------------|
| Nominal<br>Pipe Size | Outside<br>Diameter<br>of<br>Flange,<br>O | Thickness of<br>Flange<br>Min.,<br>t <sub>f</sub><br>[Notes (2)–(4)] | Thickness<br>of<br>Lap<br>Joint<br>Min.,<br>t <sub>l</sub> | Diameter<br>of Hub,<br>X | Diameter<br>Beginning of<br>Chamfer<br>Welding<br>Neck,<br>A<br>[Note (5)] | Length Through Hub                               |                                                               |                                                               |                                                               | Bore                                        |                      |                                                           | Corner<br>Radius of<br>Bore of<br>Lapped<br>Flange<br>and Pipe,<br>r | Counter-<br>bore<br>Threaded<br>Flange<br>Min.,<br>Q | Depth<br>of<br>Socket,<br>D |
|                      |                                           |                                                                      |                                                            |                          |                                                                            | Hub                                              |                                                               | Thread                                                        |                                                               | Slip-on<br>Socket<br>Welding,<br>Min.,<br>B | Lapped<br>Min.,<br>B | Welding<br>Neck/<br>Socket<br>Welding,<br>B<br>[Note (6)] |                                                                      |                                                      |                             |
|                      |                                           |                                                                      |                                                            |                          |                                                                            | Threading<br>Welding<br>Neck,<br>Y<br>[Note (5)] | Threading<br>Slip-on<br>Socket<br>Welding,<br>Y<br>[Note (5)] | Threading<br>Slip-on<br>Socket<br>Welding,<br>Y<br>[Note (5)] | Threading<br>Slip-on<br>Socket<br>Welding,<br>Y<br>[Note (5)] |                                             |                      |                                                           |                                                                      |                                                      |                             |
| 2                    | 6.50                                      | 0.81                                                                 | 0.88                                                       | 3.31                     | 2.38                                                                       | 1.25                                             | 1.31                                                          | 2.69                                                          | 1.12                                                          | 2.44                                        | 2.46                 | 2.07                                                      | 0.31                                                                 | 2.50                                                 | 0.69                        |
| 2½                   | 7.50                                      | 0.94                                                                 | 1.00                                                       | 3.94                     | 2.88                                                                       | 1.44                                             | 1.50                                                          | 2.94                                                          | 1.25                                                          | 2.94                                        | 2.97                 | 2.47                                                      | 0.31                                                                 | 3.00                                                 | 0.75                        |
| 3                    | 8.25                                      | 1.06                                                                 | 1.12                                                       | 4.62                     | 3.50                                                                       | 1.63                                             | 1.69                                                          | 3.06                                                          | 1.25                                                          | 3.57                                        | 3.60                 | 3.07                                                      | 0.38                                                                 | 3.63                                                 | 0.81                        |
| 3½                   | 9.00                                      | 1.12                                                                 | 1.19                                                       | 5.25                     | 4.00                                                                       | 1.69                                             | 1.75                                                          | 3.13                                                          | 1.44                                                          | 4.07                                        | 4.10                 | 3.55                                                      | 0.38                                                                 | 4.13                                                 | ...                         |
| 4                    | 10.00                                     | 1.19                                                                 | 1.25                                                       | 5.75                     | 4.50                                                                       | 1.82                                             | 1.88                                                          | 3.32                                                          | 1.44                                                          | 4.57                                        | 4.60                 | 4.03                                                      | 0.44                                                                 | 4.63                                                 | ...                         |
| 5                    | 11.00                                     | 1.31                                                                 | 1.38                                                       | 7.00                     | 5.56                                                                       | 1.94                                             | 2.00                                                          | 3.82                                                          | 1.69                                                          | 5.66                                        | 5.69                 | 5.05                                                      | 0.44                                                                 | 5.69                                                 | ...                         |
| 6                    | 12.50                                     | 1.38                                                                 | 1.44                                                       | 8.12                     | 6.63                                                                       | 2.00                                             | 2.06                                                          | 3.82                                                          | 1.81                                                          | 6.72                                        | 6.75                 | 6.07                                                      | 0.50                                                                 | 6.75                                                 | ...                         |
| 8                    | 15.00                                     | 1.56                                                                 | 1.62                                                       | 10.25                    | 8.63                                                                       | 2.38                                             | 2.44                                                          | 4.32                                                          | 2.00                                                          | 8.72                                        | 8.75                 | 7.98                                                      | 0.50                                                                 | 8.75                                                 | ...                         |
| 10                   | 17.50                                     | 1.81                                                                 | 1.88                                                       | 12.62                    | 10.75                                                                      | 2.56                                             | 3.75                                                          | 4.56                                                          | 2.19                                                          | 10.88                                       | 10.92                | 10.02                                                     | 0.50                                                                 | 10.88                                                | ...                         |
| 12                   | 20.50                                     | 1.94                                                                 | 2.00                                                       | 14.75                    | 12.75                                                                      | 2.82                                             | 4.00                                                          | 5.06                                                          | 2.38                                                          | 12.88                                       | 12.92                | 12.00                                                     | 0.50                                                                 | 12.94                                                | ...                         |
| 14                   | 23.00                                     | 2.06                                                                 | 2.12                                                       | 16.75                    | 14.00                                                                      | 2.94                                             | 4.38                                                          | 5.56                                                          | 2.50                                                          | 14.14                                       | 14.18                | To                                                        | 0.50                                                                 | 14.19                                                | ...                         |
| 16                   | 25.50                                     | 2.19                                                                 | 2.25                                                       | 19.00                    | 16.00                                                                      | 3.19                                             | 4.75                                                          | 5.69                                                          | 2.69                                                          | 16.16                                       | 16.19                | be                                                        | 0.50                                                                 | 16.19                                                | ...                         |
| 18                   | 28.00                                     | 2.31                                                                 | 2.38                                                       | 21.00                    | 18.00                                                                      | 3.44                                             | 5.12                                                          | 6.19                                                          | 2.75                                                          | 18.18                                       | 18.20                | Speci-<br>fied<br>by                                      | 0.50                                                                 | 18.19                                                | ...                         |
| 20                   | 30.50                                     | 2.44                                                                 | 2.50                                                       | 23.12                    | 20.00                                                                      | 3.69                                             | 5.50                                                          | 6.32                                                          | 2.88                                                          | 20.20                                       | 20.25                | Pur-<br>chaser                                            | 0.50                                                                 | 20.19                                                | ...                         |
| 24                   | 36.00                                     | 2.69                                                                 | 2.75                                                       | 27.62                    | 24.00                                                                      | 4.13                                             | 6.00                                                          | 6.56                                                          | 3.25                                                          | 24.25                                       | 24.25                |                                                           | 0.50                                                                 | 24.19                                                | ...                         |

## GENERAL NOTES:

- (a) Dimensions of Table F11 are in inches.  
 (b) For tolerances, see para. 7.  
 (c) For facings, see para. 6.4.  
 (d) For flange bolt holes, see para. 6.5 and Table F10.  
 (e) For spot facing, see para. 6.6.  
 (f) For reducing threaded and slip-on flanges, see Table F6.  
 (g) Blind flanges may be made with or without hubs at the manufacturer's option.  
 (h) For reducing welding neck flanges, see para. 6.8.

**Notes to Table F11**

## NOTES:

- (1) This dimension is for large end of hub, which may be straight or tapered. Taper shall not exceed 7 deg on threaded, slip-on, socket-welding, and lapped flanges. This dimension is defined as the diameter at the intersection between the hub taper and the back face of the flange.
- (2) These flanges may be supplied with a flat face. The flat face may be either the full  $t_f$  dimension thickness plus 0.06 in. or the  $t_f$  dimension thickness without the raised face height. See para. 6.3.2 for additional restrictions.
- (3) The flange dimensions illustrated are for regularly furnished 0.06 in raised face (except lapped); for requirements of other facings, see Fig. F-7.
- (4) For welding end bevel, see para. 6.7.
- (5) For thread of threaded flanges, see para. 6.9.
- (6) Dimensions in Column 13 correspond to the inside diameters of pipe as give in ASME B36.10M for Standard Wall pipe. Standard Wall dimensions are the same as Schedule 40 in sizes NPS 10 and smaller. Tolerances in para. 7.5.2 apply. These bore sizes are furnished unless otherwise specified by the purchaser.

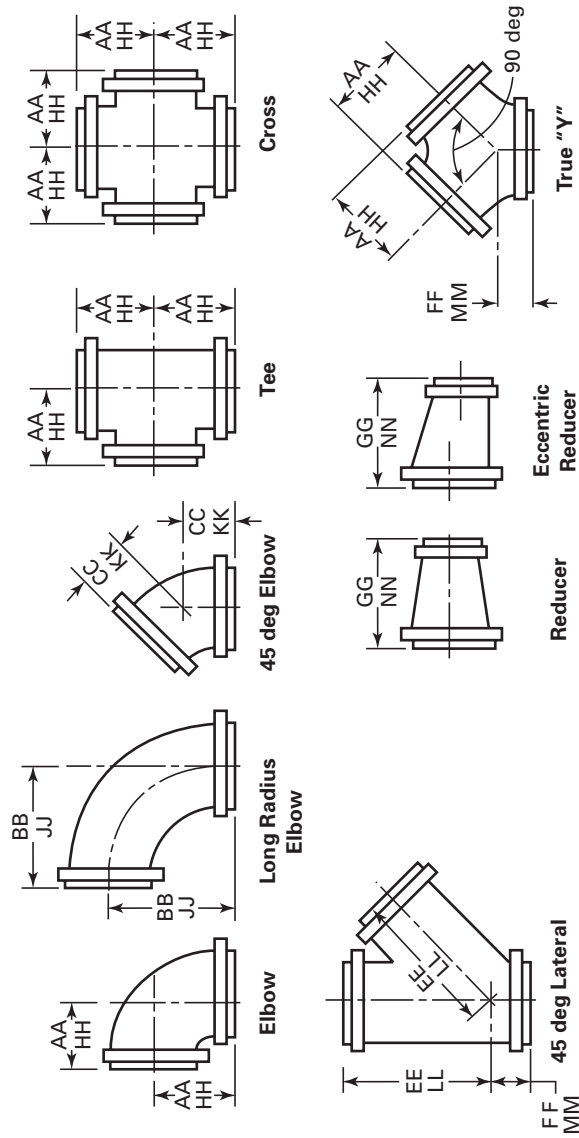
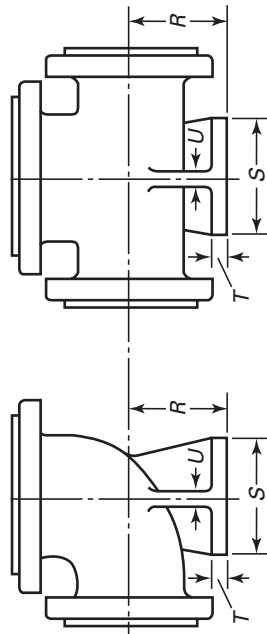
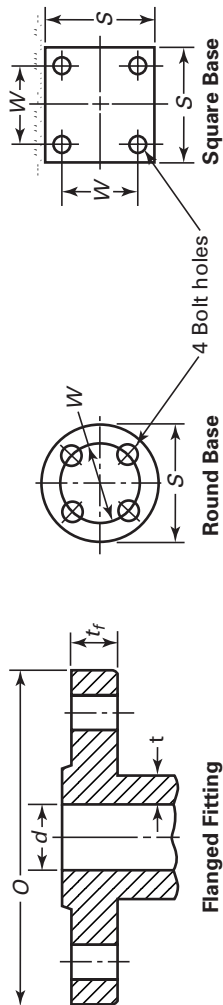


Table F12 Dimensions of Class 300 Flanged Fittings

| 1                                             | 2                             | 3                                                      | 4                                     | 5                               | 6                                          | 7                                                              | 8                                                         | 9                                                         | 10                                                                | 11                                                                       | 12                                                          |
|-----------------------------------------------|-------------------------------|--------------------------------------------------------|---------------------------------------|---------------------------------|--------------------------------------------|----------------------------------------------------------------|-----------------------------------------------------------|-----------------------------------------------------------|-------------------------------------------------------------------|--------------------------------------------------------------------------|-------------------------------------------------------------|
| 0.06 in. Raised Face (Flange Edge) [Note (4)] |                               |                                                        |                                       |                                 |                                            |                                                                |                                                           |                                                           |                                                                   |                                                                          |                                                             |
| Nominal Pipe Size, NPS                        | Outside Diameter of Flange, O | Thickness of Flange Min., $t_f$ [Notes (1), (2), (11)] | Wall Thickness of Fitting Min., $t_m$ | Inside Diameter of Fitting, $d$ | Center-to-Contact Surface of               |                                                                |                                                           | Short                                                     |                                                                   |                                                                          | Center-to-End Elbow Tee, Cross, and True "y", HH [Note (4)] |
|                                               |                               |                                                        |                                       |                                 | Raised Elbow, Tee, Cross, and True "Y", AA | Center-to-Contact Surface of Raised Face Long Radius Elbow, BB | Center-to-Contact Surface of Raised Face 45 deg Elbow, CC | Long Center-to-Contact Surface of Raised Face Lateral, EE | Center-to-Contact Surface of Raised Face Lateral and True "y", FF | Contact Surface-to-Contact Surface of Raised Face Reducer, GG [Note (3)] |                                                             |
| 1                                             | 4.88                          | 0.62                                                   | 0.19                                  | 1.00                            | 4.00                                       | 5.00                                                           | 2.25                                                      | 6.50                                                      | 2.00                                                              | 4.50                                                                     | 4.25                                                        |
| 1 1/4                                         | 5.25                          | 0.69                                                   | 0.19                                  | 1.25                            | 4.25                                       | 5.50                                                           | 2.50                                                      | 7.25                                                      | 2.25                                                              | 4.50                                                                     | 4.50                                                        |
| 1 1/2                                         | 6.12                          | 0.75                                                   | 0.19                                  | 1.50                            | 4.50                                       | 6.00                                                           | 2.75                                                      | 8.50                                                      | 2.50                                                              | 4.50                                                                     | 4.75                                                        |
| 2                                             | 6.50                          | 0.81                                                   | 0.25                                  | 2.00                            | 5.00                                       | 6.50                                                           | 3.00                                                      | 9.00                                                      | 2.50                                                              | 5.00                                                                     | 5.31                                                        |
| 2 1/2                                         | 7.50                          | 0.94                                                   | 0.25                                  | 2.50                            | 5.50                                       | 7.00                                                           | 3.50                                                      | 10.50                                                     | 2.50                                                              | 5.50                                                                     | 5.81                                                        |
| 3                                             | 8.25                          | 1.06                                                   | 0.28                                  | 3.00                            | 6.00                                       | 7.75                                                           | 3.50                                                      | 11.00                                                     | 3.00                                                              | 6.00                                                                     | 6.31                                                        |
| 3 1/2                                         | 9.00                          | 1.12                                                   | 0.29                                  | 3.50                            | 6.50                                       | 8.50                                                           | 4.00                                                      | 12.50                                                     | 3.00                                                              | 6.50                                                                     | 6.81                                                        |
| 4                                             | 10.00                         | 1.19                                                   | 0.31                                  | 4.00                            | 7.00                                       | 9.00                                                           | 4.50                                                      | 13.50                                                     | 3.00                                                              | 7.00                                                                     | 7.31                                                        |

Table F12 Dimensions of Class 300 Flanged Fittings (Cont'd)

| 1                                             | 2                               | 3                                                      | 4                                     | 5                               | 6                                                                            | 7                                                              | 8                                                         | 9                                                         | 10                                                                      | 11                                                            | 12                                                          |
|-----------------------------------------------|---------------------------------|--------------------------------------------------------|---------------------------------------|---------------------------------|------------------------------------------------------------------------------|----------------------------------------------------------------|-----------------------------------------------------------|-----------------------------------------------------------|-------------------------------------------------------------------------|---------------------------------------------------------------|-------------------------------------------------------------|
| Nominal Pipe Size, NPS                        | Outside Diameter of Flange, $O$ | Thickness of Flange Min., $t_f$ [Notes (1), (2), (11)] | Wall Thickness of Fitting Min., $t_m$ | Inside Diameter of Fitting, $d$ | Center-to-Contact Surface of Raised Face Elbow, Tee, Cross, and True "Y", AA | Center-to-Contact Surface of Raised Face Long Radius Elbow, BB | Center-to-Contact Surface of Raised Face 45 deg Elbow, CC | Long Center-to-Contact Surface of Raised Face Lateral, EE | Short Center-to-Contact Surface of Raised Face Lateral and True "Y", FF | Contact Surface-to-Contact Surface of Raised Face Reducer, GG | Center-to-End Elbow Tee, Cross, and True "Y", HH [Note (4)] |
| 0.06 in. Raised Face (Flange Edge) [Note (4)] |                                 |                                                        |                                       |                                 |                                                                              |                                                                |                                                           |                                                           |                                                                         |                                                               |                                                             |
| 5                                             | 11.00                           | 1.31                                                   | 0.38                                  | 5.00                            | 8.00                                                                         | 10.25                                                          | 5.00                                                      | 15.00                                                     | 3.50                                                                    | 8.00                                                          | 8.31                                                        |
| 6                                             | 12.50                           | 1.38                                                   | 0.38                                  | 6.00                            | 8.50                                                                         | 11.50                                                          | 5.50                                                      | 17.50                                                     | 4.00                                                                    | 9.00                                                          | 8.81                                                        |
| 8                                             | 15.00                           | 1.56                                                   | 0.44                                  | 8.00                            | 10.00                                                                        | 14.00                                                          | 6.00                                                      | 20.50                                                     | 5.00                                                                    | 11.00                                                         | 10.31                                                       |
| 10                                            | 17.50                           | 1.81                                                   | 0.50                                  | 10.00                           | 11.50                                                                        | 16.50                                                          | 7.00                                                      | 24.00                                                     | 5.50                                                                    | 12.00                                                         | 11.81                                                       |
| 12                                            | 20.50                           | 1.94                                                   | 0.56                                  | 12.00                           | 13.00                                                                        | 19.00                                                          | 8.00                                                      | 27.50                                                     | 6.00                                                                    | 14.00                                                         | 13.31                                                       |
| 14                                            | 23.00                           | 2.06                                                   | 0.62                                  | 13.25                           | 15.00                                                                        | 21.50                                                          | 8.50                                                      | 31.00                                                     | 6.50                                                                    | 16.00                                                         | 15.31                                                       |
| 16                                            | 25.50                           | 2.19                                                   | 0.69                                  | 15.25                           | 16.50                                                                        | 24.00                                                          | 9.50                                                      | 34.50                                                     | 7.50                                                                    | 18.00                                                         | 16.81                                                       |
| 18                                            | 28.00                           | 2.31                                                   | 0.75                                  | 17.00                           | 18.00                                                                        | 26.50                                                          | 10.00                                                     | 37.50                                                     | 8.00                                                                    | 19.00                                                         | 18.31                                                       |
| 20                                            | 30.50                           | 2.44                                                   | 0.81                                  | 19.00                           | 19.50                                                                        | 29.00                                                          | 10.50                                                     | 40.50                                                     | 8.50                                                                    | 20.00                                                         | 19.89                                                       |
| 24                                            | 36.00                           | 2.69                                                   | 0.94                                  | 23.00                           | 22.50                                                                        | 34.00                                                          | 12.00                                                     | 47.50                                                     | 10.00                                                                   | 24.00                                                         | 22.94                                                       |



**Table F12 Dimensions of Class 300 Flanged Fittings (Cont'd)**

| 13                                                        | 14                                                    | 15                                                   | 16                                                                     | 17                                                  | 18                                     | 19                                                                          | 20                                            | 21                                       | 22                                      | 23                                 | 1                               |
|-----------------------------------------------------------|-------------------------------------------------------|------------------------------------------------------|------------------------------------------------------------------------|-----------------------------------------------------|----------------------------------------|-----------------------------------------------------------------------------|-----------------------------------------------|------------------------------------------|-----------------------------------------|------------------------------------|---------------------------------|
| Ring Joint [Note (4)]                                     |                                                       |                                                      |                                                                        |                                                     |                                        |                                                                             |                                               |                                          |                                         |                                    |                                 |
| Center-to-End<br>Long Radius<br>Elbow<br>JJ<br>[Note (5)] | Center-to-End<br>45 deg<br>Elbow,<br>KK<br>[Note (5)] | Long<br>Center-to-End<br>Lateral<br>LL<br>[Note (5)] | Short<br>Center-to-End<br>Lateral And<br>True "Y",<br>MM<br>[Note (5)] | End-to-End<br>Reducer,<br>NN<br>[Notes<br>(4), (5)] | Center-to-Base<br>R<br>[Notes (6)–(8)] | Diameter of<br>Round Base<br>or Width of<br>Square Base,<br>S<br>[Note (6)] | Thickness of<br>Base,<br>T<br>[Notes (6)–(9)] | Thickness<br>of Ribs,<br>U<br>[Note (6)] | Base Drilling<br>[Note (10)]            |                                    | Nominal<br>Pipe<br>Size,<br>NPS |
|                                                           |                                                       |                                                      |                                                                        |                                                     |                                        |                                                                             |                                               |                                          | Bolt Circle<br>or Bolt<br>Spacing,<br>W | Diameter<br>of<br>Drilled<br>Holes |                                 |
|                                                           |                                                       |                                                      |                                                                        |                                                     |                                        |                                                                             |                                               |                                          |                                         |                                    |                                 |
| 5.25                                                      | 2.50                                                  | 6.75                                                 | 2.25                                                                   | ...                                                 | ...                                    | ...                                                                         | ...                                           | ...                                      | ...                                     | ...                                | 1                               |
| 5.75                                                      | 2.75                                                  | 7.50                                                 | 2.50                                                                   | ...                                                 | ...                                    | ...                                                                         | ...                                           | ...                                      | ...                                     | ...                                | 1¼                              |
| 6.25                                                      | 3.00                                                  | 8.75                                                 | 2.75                                                                   | ...                                                 | ...                                    | ...                                                                         | ...                                           | ...                                      | ...                                     | ...                                | 1½                              |
| 6.81                                                      | 3.31                                                  | 9.31                                                 | 2.81                                                                   | ...                                                 | 4.50                                   | 5.25                                                                        | 0.75                                          | 0.50                                     | 3.88                                    | ¾                                  | 2                               |
| 7.31                                                      | 3.81                                                  | 10.81                                                | 2.81                                                                   | ...                                                 | 4.75                                   | 5.25                                                                        | 0.75                                          | 0.50                                     | 3.88                                    | ¾                                  | 2½                              |
| 8.06                                                      | 3.81                                                  | 11.31                                                | 3.31                                                                   | ...                                                 | 5.25                                   | 6.12                                                                        | 0.81                                          | 0.62                                     | 4.50                                    | 7⁄8                                | 3                               |
| 8.81                                                      | 4.31                                                  | 12.81                                                | 3.31                                                                   | ...                                                 | 5.62                                   | 6.12                                                                        | 0.81                                          | 0.62                                     | 4.50                                    | 7⁄8                                | 3½                              |
| 9.31                                                      | 4.88                                                  | 13.81                                                | 3.31                                                                   | ...                                                 | 6.00                                   | 6.50                                                                        | 0.88                                          | 0.62                                     | 5.00                                    | ¾                                  | 4                               |
| 10.56                                                     | 5.31                                                  | 15.31                                                | 3.81                                                                   | ...                                                 | 6.75                                   | 7.50                                                                        | 1.00                                          | 0.75                                     | 5.88                                    | 7⁄8                                | 5                               |
| 11.81                                                     | 5.81                                                  | 17.81                                                | 4.31                                                                   | ...                                                 | 7.50                                   | 7.50                                                                        | 1.00                                          | 0.75                                     | 5.88                                    | 7⁄8                                | 6                               |
| 14.31                                                     | 6.31                                                  | 20.81                                                | 5.31                                                                   | ...                                                 | 9.00                                   | 10.00                                                                       | 1.25                                          | 0.88                                     | 7.88                                    | 7⁄8                                | 8                               |
| 16.81                                                     | 7.31                                                  | 24.31                                                | 5.81                                                                   | ...                                                 | 10.50                                  | 10.00                                                                       | 1.25                                          | 0.88                                     | 7.88                                    | 7⁄8                                | 10                              |
| 19.31                                                     | 8.31                                                  | 27.81                                                | 6.31                                                                   | ...                                                 | 12.00                                  | 12.50                                                                       | 1.44                                          | 1.00                                     | 10.62                                   | 7⁄8                                | 12                              |

Table F12 Dimensions of Class 300 Flanged Fittings (Cont'd)

| 13                                                        | 14                                                   | 15                                                   | 16                                                                     | 17                                                      | 18                                     | 19                                                                          | 20                                            | 21                                       | 22                                      | 23                                 | 1                               |
|-----------------------------------------------------------|------------------------------------------------------|------------------------------------------------------|------------------------------------------------------------------------|---------------------------------------------------------|----------------------------------------|-----------------------------------------------------------------------------|-----------------------------------------------|------------------------------------------|-----------------------------------------|------------------------------------|---------------------------------|
| Ring Joint [Note (4)]                                     |                                                      |                                                      |                                                                        |                                                         |                                        |                                                                             |                                               |                                          |                                         |                                    |                                 |
| Center-to-End<br>Long Radius<br>Elbow<br>JJ<br>[Note (5)] | Center-to-End<br>45 deg<br>Elbow<br>KK<br>[Note (5)] | Long<br>Center-to-End<br>Lateral<br>LL<br>[Note (5)] | Short<br>Center-to-End<br>Lateral And<br>True "Y",<br>MM<br>[Note (5)] | End-to-<br>End<br>Reducer,<br>NN<br>[Notes<br>(4), (5)] | Center-to-Base<br>R<br>[Notes (6)–(8)] | Diameter of<br>Round Base<br>or Width of<br>Square Base,<br>S<br>[Note (6)] | Thickness of<br>Base,<br>T<br>[Notes (6)–(9)] | Thickness<br>of Ribs,<br>U<br>[Note (6)] | Base Drilling<br>[Note (10)]            |                                    | Nominal<br>Pipe<br>Size,<br>NPS |
|                                                           |                                                      |                                                      |                                                                        |                                                         |                                        |                                                                             |                                               |                                          | Bolt Circle<br>or Bolt<br>Spacing,<br>W | Diameter<br>of<br>Drilled<br>Holes |                                 |
| 21.81                                                     | 8.81                                                 | 31.31                                                | 6.81                                                                   | ...                                                     | 13.50                                  | 12.50                                                                       | 1.44                                          | 1.00                                     | 10.62                                   | 7/8                                | 14                              |
| 24.31                                                     | 9.81                                                 | 34.81                                                | 7.81                                                                   | ...                                                     | 14.75                                  | 12.50                                                                       | 1.44                                          | 1.12                                     | 10.62                                   | 7/8                                | 16                              |
| 26.81                                                     | 10.31                                                | 37.81                                                | 8.31                                                                   | ...                                                     | 16.25                                  | 15.00                                                                       | 1.62                                          | 1.12                                     | 13.00                                   | 1                                  | 18                              |
| 29.38                                                     | 10.88                                                | 40.88                                                | 8.88                                                                   | ...                                                     | 17.88                                  | 15.00                                                                       | 1.62                                          | 1.25                                     | 13.00                                   | 1                                  | 20                              |
| 34.44                                                     | 12.44                                                | 47.94                                                | 10.44                                                                  | ...                                                     | 20.75                                  | 17.50                                                                       | 1.88                                          | 1.25                                     | 15.25                                   | 1 1/8                              | 24                              |

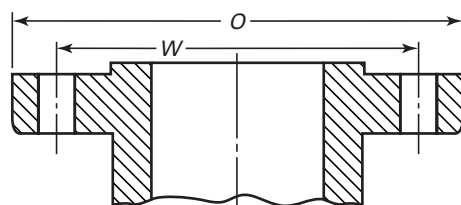
## GENERAL NOTES:

- Dimensions of Table F12 are in inches.
- For tolerances, see para. 7.
- For facings, see para. 6.4.
- For flange bolt holes, see para. 6.5 and Table F10.
- For spot facing, see para. 6.6.
- For intersecting centerlines, center-to-contact surface, and center-to-end dimensions of side outlet fittings, see para. 6.2.4.
- For center-to-contact surface and center-to-end dimensions of special degree elbows, see para. 6.2.5.
- For reinforcement of certain fittings, see para. 6.1.1.
- For drains, see para. 6.1.2.

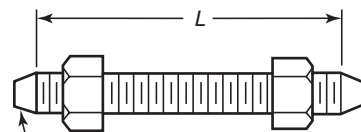
## NOTES:

- These fittings may be supplied with a flat face flange. The flat face may be either the full  $t_f$  dimension thickness plus 0.06 in. or the  $t_f$  dimension thickness without the raised face height. See para. 6.3.2 for additional restrictions.
- The thickness of flange dimension illustrated is for regularly furnished 0.06 in. raised face (except lapped); for thickness requirements of other facings, see Fig. F7.
- For center-to-contact surface and center-to-end dimensions of reducing fittings, see para. 6.2.3.
- For contact surface-to-contact surface and end-to-end dimensions of reducers and eccentric reducers, see para. 6.2.3.
- These dimensions apply to straight sizes only. See paras. 6.2.3 and 6.4.2.2. For center-to-end dimensions of reducing fittings or end-to-end dimensions of reducers, use center-to-contact surface or contact surface-to-contact surface dimensions of 0.06 in. raised face (flange edge) for largest opening and add the proper height to provide for ring joint groove applying to each flange. See Table F5 for ring joint facing dimensions.
- The base dimensions apply to all straight and reducing sizes.
- The reducing fittings, the size, and center-to-face dimension of base are determined by the size of the largest opening of fittings. In the case of reducing base elbows, orders shall specify whether the base shall be opposite the larger or smaller opening.
- Bases shall be plain faced unless otherwise specified, and the center-to-base dimension  $R$  shall be the finished dimension.
- Bases may be cast integral or attached as weldments at the option of the manufacturer.
- The bolt hole template for round base is the same as for Class 300 flanges (Table 11) of corresponding outside diameter, except using only four holes in all cases so placed as to straddle centerlines. The bases of these fittings are intended for support in compression and are not for anchors or supports in tension or shear.
- The thickness of flange minimum dimensions for loose flanges, Table 9, size NPS 3 1/2 and smaller are slightly heavier than for flanges on these fittings which are reinforced by being cast integral with the body of fitting.

## CLASS 400 PIPE FLANGES



Flange



Point height [Note (1)]

Stud Bolt With Nuts

Table F13 Templates for Drilling Class 400 Flanges

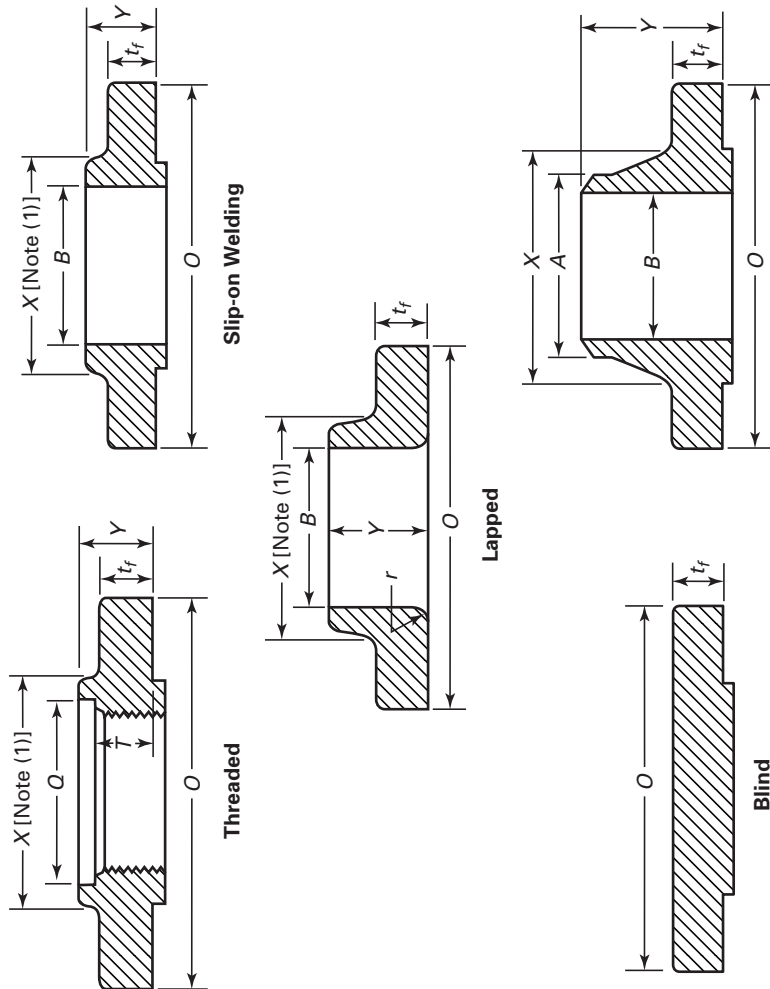
| 1                                        | 2                                         | 3                                | 4                         | 5                  | 6                    | 7                                         | 8                                           | 9             |
|------------------------------------------|-------------------------------------------|----------------------------------|---------------------------|--------------------|----------------------|-------------------------------------------|---------------------------------------------|---------------|
| Nominal<br>Pipe<br>Size                  | Outside<br>Diameter<br>of<br>Flange,<br>O | Drilling [Notes (2), (3)]        |                           |                    |                      | Length of Bolts,<br>L<br>[Notes (1), (4)] |                                             |               |
|                                          |                                           | Diameter of<br>Bolt Circle,<br>W | Diameter of<br>Bolt Holes | Number<br>of Bolts | Diameter<br>of Bolts | Raised<br>Face<br>0.25 in.                | Male and<br>Female/<br>Tongue<br>and Groove | Ring<br>Joint |
|                                          |                                           |                                  |                           |                    |                      |                                           |                                             |               |
| 1/2                                      |                                           |                                  |                           |                    |                      |                                           |                                             |               |
| 3/4                                      |                                           |                                  |                           |                    |                      |                                           |                                             |               |
| 1                                        |                                           |                                  |                           |                    |                      |                                           |                                             |               |
| 1 1/4                                    |                                           |                                  |                           |                    |                      |                                           |                                             |               |
| 1 1/2                                    |                                           |                                  |                           |                    |                      |                                           |                                             |               |
| Use Class 600 dimensions in these sizes. |                                           |                                  |                           |                    |                      |                                           |                                             |               |
| 2                                        |                                           |                                  |                           |                    |                      |                                           |                                             |               |
| 2 1/2                                    |                                           |                                  |                           |                    |                      |                                           |                                             |               |
| 3                                        |                                           |                                  |                           |                    |                      |                                           |                                             |               |
| 3 1/2                                    |                                           |                                  |                           |                    |                      |                                           |                                             |               |
| 4                                        | 10.00                                     | 7.88                             | 1                         | 8                  | 7/8                  | 5.50                                      | 5.25                                        | 5.50          |
| 5                                        | 11.00                                     | 9.25                             | 1                         | 8                  | 7/8                  | 5.75                                      | 5.25                                        | 5.75          |
| 6                                        | 12.50                                     | 10.62                            | 1                         | 12                 | 7/8                  | 6.00                                      | 5.75                                        | 6.00          |
| 8                                        | 15.00                                     | 13.00                            | 1 1/8                     | 12                 | 1                    | 6.75                                      | 6.50                                        | 6.75          |
| 10                                       | 17.50                                     | 15.25                            | 1 1/4                     | 16                 | 1 1/8                | 7.50                                      | 7.25                                        | 7.50          |
| 12                                       | 20.50                                     | 17.75                            | 1 3/8                     | 16                 | 1 1/4                | 8.00                                      | 7.75                                        | 8.00          |
| 14                                       | 23.00                                     | 20.25                            | 1 3/8                     | 20                 | 1 1/4                | 8.25                                      | 8.00                                        | 8.25          |
| 16                                       | 25.50                                     | 22.50                            | 1 1/2                     | 20                 | 1 3/8                | 8.75                                      | 8.50                                        | 8.75          |
| 18                                       | 28.00                                     | 24.75                            | 1 1/2                     | 24                 | 1 3/8                | 9.00                                      | 8.75                                        | 9.00          |
| 20                                       | 30.50                                     | 27.00                            | 1 5/8                     | 24                 | 1 1/2                | 9.50                                      | 9.25                                        | 9.75          |
| 24                                       | 36.00                                     | 32.00                            | 1 7/8                     | 24                 | 1 3/4                | 10.50                                     | 10.25                                       | 11.00         |

## GENERAL NOTES:

- (a) Dimensions are in inches.  
 (b) For other dimensions see Table F14.

## NOTES:

- (1) Length of stud bolt does not include the height of the points. See para. 6.10.2.  
 (2) For flange bolt holes see para. 6.5.  
 (3) For spot facing, see para. 6.6.  
 (4) Bolt lengths not shown in table may be determined in accordance with Annex D. See para. 6.10.2.



**Table F14 Dimensions of Class 400 Flanges**

| 1 | 2                               | 3                               | 4                    | 5                                                   | 6                     | 7           | 8                 | 9                                       | 10                | 11               | 12                | 13                                                   | 14                                     |
|---|---------------------------------|---------------------------------|----------------------|-----------------------------------------------------|-----------------------|-------------|-------------------|-----------------------------------------|-------------------|------------------|-------------------|------------------------------------------------------|----------------------------------------|
|   | Outside Diameter of Flange, $O$ | Thickness of Flange Min., $t_f$ | Diameter of Hub, $X$ | Hub Diameter Beginning of Chamfer Welding Neck, $A$ | Length Through Hub    |             |                   | Thread Length Threaded Flange Min., $T$ |                   | Bore             |                   | Corner Radius of Bore of Lapped Flange and Pipe, $r$ |                                        |
|   |                                 |                                 |                      |                                                     | Threaded Slip-on, $Y$ | Lapped, $Y$ | Welding Neck, $Y$ |                                         | Slip-on Min., $B$ | Lapped Min., $B$ | Welding Neck, $B$ |                                                      | Counter-bore Threaded Flange Min., $Q$ |
|   | Nominal Pipe Size               |                                 |                      | [Note (2)]                                          |                       |             |                   | [Note (3)]                              |                   |                  |                   |                                                      |                                        |

Use Class 600 dimensions in these sizes [Note (4)].



Table F14 Dimensions of Class 400 Flanges (Cont'd)

| 1                    | 2                                             | 3                                                       | 4                               | 5                                                                                  | 6                                | 7                   | 8                            | 9                                | 10                           | 11                          | 12                                    | 13                                                                       | 14                                                   |
|----------------------|-----------------------------------------------|---------------------------------------------------------|---------------------------------|------------------------------------------------------------------------------------|----------------------------------|---------------------|------------------------------|----------------------------------|------------------------------|-----------------------------|---------------------------------------|--------------------------------------------------------------------------|------------------------------------------------------|
| Nominal<br>Pipe Size | Outside<br>Diameter<br>of Flange,<br><i>O</i> | Thickness<br>of Flange<br>Min.,<br><i>t<sub>f</sub></i> | Diameter<br>of Hub,<br><i>X</i> | Hub Diameter<br>Beginning of<br>Chamfer Welding<br>Neck,<br><i>A</i><br>[Note (2)] | Length Through Hub               |                     |                              | Thread Length<br>Threaded Flange |                              | Bore                        |                                       | Corner Radius<br>of Bore of<br>Lapped<br>Flange and<br>Pipe,<br><i>r</i> | Counter-bore<br>Threaded<br>Flange Min.,<br><i>Q</i> |
|                      |                                               |                                                         |                                 |                                                                                    | Threaded<br>Slip-on,<br><i>Y</i> | Lapped,<br><i>Y</i> | Welding<br>Neck,<br><i>Y</i> | Min.,<br><i>T</i><br>[Note (3)]  | Slip-on<br>Min.,<br><i>B</i> | Lapped<br>Min.,<br><i>B</i> | Welding<br>Neck,<br><i>B</i>          |                                                                          |                                                      |
| 2<br>2½<br>3<br>3½   |                                               |                                                         |                                 |                                                                                    |                                  |                     |                              |                                  |                              |                             |                                       |                                                                          |                                                      |
| 4                    | 10.00                                         | 1.38                                                    | 5.75                            | 4.50                                                                               | 2.00                             | 2.00                | 3.50                         | 1.44                             | 4.57                         | 4.60                        | To be<br>specified<br>by<br>Purchaser | 0.44                                                                     | 4.63                                                 |
| 5                    | 11.00                                         | 1.50                                                    | 7.00                            | 5.56                                                                               | 2.12                             | 2.12                | 4.00                         | 1.69                             | 5.66                         | 5.69                        |                                       | 0.44                                                                     | 5.69                                                 |
| 6                    | 12.50                                         | 1.62                                                    | 8.12                            | 6.63                                                                               | 2.25                             | 2.25                | 4.06                         | 1.81                             | 6.72                         | 6.75                        |                                       | 0.50                                                                     | 6.75                                                 |
| 8                    | 15.00                                         | 1.88                                                    | 10.25                           | 8.63                                                                               | 2.69                             | 2.69                | 4.62                         | 2.00                             | 8.72                         | 8.75                        |                                       | 0.50                                                                     | 8.75                                                 |
| 10                   | 17.50                                         | 2.12                                                    | 12.62                           | 10.75                                                                              | 2.88                             | 4.00                | 4.88                         | 2.19                             | 10.88                        | 10.92                       |                                       | 0.50                                                                     | 10.88                                                |
| 12                   | 20.50                                         | 2.25                                                    | 14.75                           | 12.75                                                                              | 3.12                             | 4.25                | 5.38                         | 2.38                             | 12.88                        | 12.92                       |                                       | 0.50                                                                     | 12.94                                                |
| 14                   | 23.00                                         | 2.38                                                    | 16.75                           | 14.00                                                                              | 3.31                             | 4.62                | 5.88                         | 2.50                             | 14.14                        | 14.18                       |                                       | 0.50                                                                     | 14.19                                                |
| 16                   | 25.50                                         | 2.50                                                    | 19.00                           | 16.00                                                                              | 3.69                             | 5.00                | 6.00                         | 2.69                             | 16.16                        | 16.19                       |                                       | 0.50                                                                     | 16.19                                                |
| 18                   | 28.00                                         | 2.62                                                    | 21.00                           | 18.00                                                                              | 3.88                             | 5.38                | 6.50                         | 2.75                             | 18.18                        | 18.20                       |                                       | 0.50                                                                     | 18.19                                                |
| 20                   | 30.50                                         | 2.75                                                    | 23.12                           | 20.00                                                                              | 4.00                             | 5.75                | 6.62                         | 2.88                             | 20.20                        | 20.25                       |                                       | 0.50                                                                     | 20.19                                                |
| 24                   | 36.00                                         | 3.00                                                    | 27.62                           | 24.00                                                                              | 4.50                             | 6.25                | 6.88                         | 3.25                             | 24.25                        | 24.25                       |                                       | 0.50                                                                     | 24.19                                                |

Use Class 600 dimensions in these sizes [Note (4)].

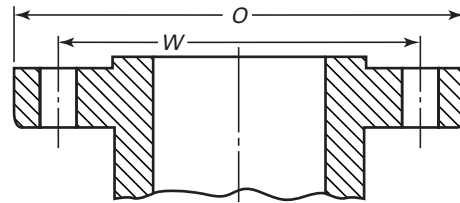
## GENERAL NOTES:

- Dimensions are in inches.
- For tolerances, see para. 7.
- For facings, see para. 6.4.
- For flange bolt holes, see para. 6.5 and Table F13.
- For spot facing, see para. 6.6.
- For reducing threaded and slip-on flanges, see Table F6.
- Blind flanges may be made with or without hubs at the manufacturer's option.
- For reducing welding neck flanges, see para. 6.8.

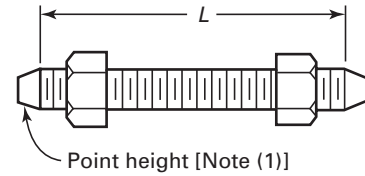
## NOTES:

- This dimension is for large end of hub, which may be straight or tapered. Taper shall not exceed 7 deg on threaded, slip-on, and lapped flanges.
- For welding end bevel, see para. 6.7.
- For thread in threaded flanges, see para. 6.9.
- Socket welding flanges may be provided in NPS ½ through 2½ using Class 600 dimensions.

## CLASS 600 PIPE FLANGES AND FLANGED FITTINGS



Flange



Stud Bolt With Nuts

Table F15 Templates for Drilling Class 600 Flanges

| 1                         | 2                                      | 3                                | 4                         | 5                  | 6                                         | 7                       | 8                                     | 9          |
|---------------------------|----------------------------------------|----------------------------------|---------------------------|--------------------|-------------------------------------------|-------------------------|---------------------------------------|------------|
| Drilling [Notes (2), (3)] |                                        |                                  |                           |                    | Length of Bolts,<br>L<br>[Notes (1), (4)] |                         |                                       |            |
| Nominal<br>Pipe Size      | Outside<br>Diameter<br>of Flange,<br>O | Diameter of<br>Bolt Circle,<br>W | Diameter of<br>Bolt Holes | Number of<br>Bolts | Diameter of<br>Bolts                      | Raised Face<br>0.25 in. | Male and Female/<br>Tongue and Groove | Ring Joint |
| 1/2                       | 3.75                                   | 2.62                             | 5/8                       | 4                  | 1/2                                       | 3.00                    | 2.75                                  | 3.00       |
| 3/4                       | 4.62                                   | 3.25                             | 3/4                       | 4                  | 5/8                                       | 3.50                    | 3.25                                  | 3.50       |
| 1                         | 4.88                                   | 3.50                             | 3/4                       | 4                  | 5/8                                       | 3.50                    | 3.25                                  | 3.50       |
| 1 1/4                     | 5.25                                   | 3.88                             | 3/4                       | 4                  | 5/8                                       | 3.75                    | 3.50                                  | 3.75       |
| 1 1/2                     | 6.12                                   | 4.50                             | 7/8                       | 4                  | 3/4                                       | 4.25                    | 4.00                                  | 4.25       |
| 2                         | 6.50                                   | 5.00                             | 3/4                       | 8                  | 5/8                                       | 4.25                    | 4.00                                  | 4.25       |
| 2 1/2                     | 7.50                                   | 5.88                             | 7/8                       | 8                  | 3/4                                       | 4.75                    | 4.50                                  | 4.75       |
| 3                         | 8.25                                   | 6.62                             | 7/8                       | 8                  | 3/4                                       | 5.00                    | 4.75                                  | 5.00       |
| 3 1/2                     | 9.00                                   | 7.25                             | 1                         | 8                  | 7/8                                       | 5.50                    | 5.25                                  | 5.50       |
| 4                         | 10.75                                  | 8.50                             | 1                         | 8                  | 7/8                                       | 5.75                    | 5.50                                  | 5.75       |
| 5                         | 13.00                                  | 10.50                            | 1 1/8                     | 8                  | 1                                         | 6.50                    | 6.25                                  | 6.50       |
| 6                         | 14.00                                  | 11.50                            | 1 1/8                     | 12                 | 1                                         | 6.75                    | 6.50                                  | 6.75       |
| 8                         | 16.50                                  | 13.75                            | 1 1/4                     | 12                 | 1 1/8                                     | 7.50                    | 7.25                                  | 7.75       |
| 10                        | 20.00                                  | 17.00                            | 1 3/8                     | 16                 | 1 1/4                                     | 8.50                    | 8.25                                  | 8.50       |
| 12                        | 22.00                                  | 19.25                            | 1 3/8                     | 20                 | 1 1/4                                     | 8.75                    | 8.50                                  | 8.75       |
| 14                        | 23.75                                  | 20.75                            | 1 1/2                     | 20                 | 1 3/8                                     | 9.25                    | 9.00                                  | 9.25       |
| 16                        | 27.00                                  | 23.75                            | 1 5/8                     | 20                 | 1 1/2                                     | 10.00                   | 9.75                                  | 10.00      |
| 18                        | 29.25                                  | 25.75                            | 1 3/4                     | 20                 | 1 5/8                                     | 10.75                   | 10.50                                 | 10.75      |
| 20                        | 32.00                                  | 28.50                            | 1 3/4                     | 24                 | 1 5/8                                     | 11.25                   | 11.00                                 | 11.50      |
| 24                        | 37.00                                  | 33.00                            | 2                         | 24                 | 1 7/8                                     | 13.00                   | 12.75                                 | 13.25      |

## GENERAL NOTES:

- (a) Dimensions are in inches.  
 (b) For other dimensions, see Table F16.

## NOTES:

- (1) Length of stud bolt does not include the height of the points. See para. 6.10.2.  
 (2) For flange bolt hole, see para. 6.5.  
 (3) For spot facing, see para. 6.6.  
 (4) Bolt lengths not shown in table may be determined in accordance with Annex D. See para. 6.10.2.

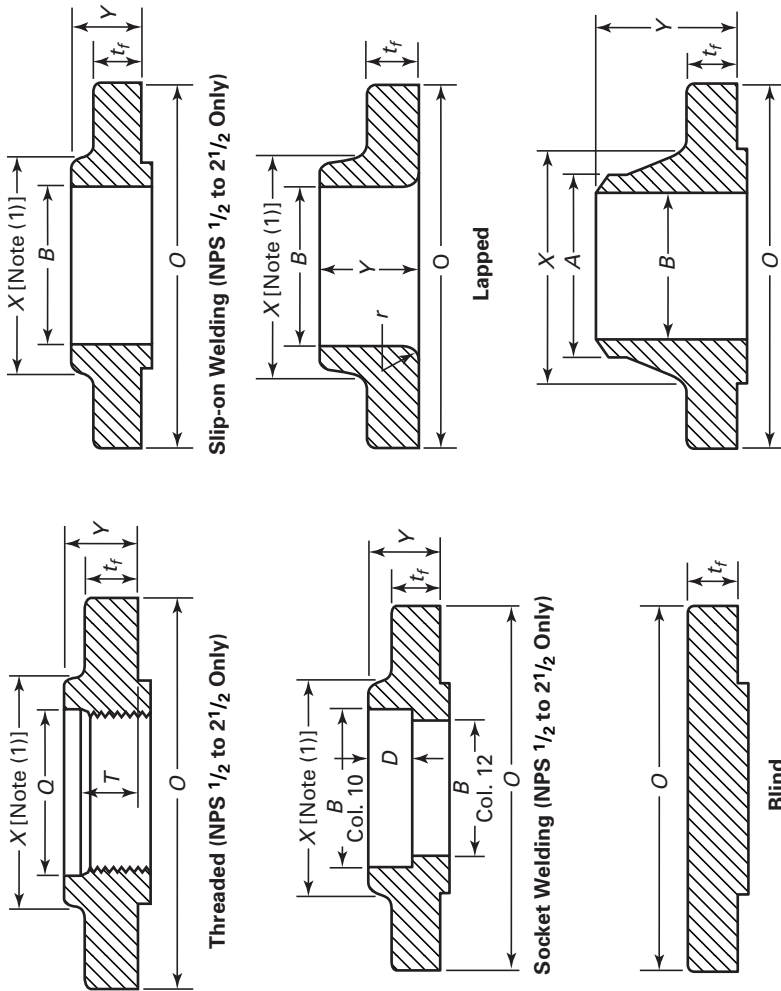


Table F16 Dimensions of Class 600 Flanges

| 1                         | 2                                             | 3                                                       | 4                               | 5                                                                                 | 6                    | 7                    | 8                    | 9      | 10                                                                        | 11                          | 12                   | 13                                                                          | 14                                                          | 15                                 |        |
|---------------------------|-----------------------------------------------|---------------------------------------------------------|---------------------------------|-----------------------------------------------------------------------------------|----------------------|----------------------|----------------------|--------|---------------------------------------------------------------------------|-----------------------------|----------------------|-----------------------------------------------------------------------------|-------------------------------------------------------------|------------------------------------|--------|
| Nominal<br>Pipe Size      | Outside<br>Diameter<br>of Flange,<br><i>O</i> | Thickness<br>of Flange<br>Min.,<br><i>t<sub>f</sub></i> | Diameter<br>of Hub,<br><i>X</i> | Diameter<br>Beginning of<br>Chamfer<br>Welding<br>Neck,<br><i>A</i><br>[Note (2)] | Length Through Hub   |                      |                      |        | Thread<br>Length<br>Threaded<br>Flange<br>Min.,<br><i>T</i><br>[Note (3)] | Bore                        |                      | Corner<br>Radius of<br>Bore of<br>Lapped<br>Flange<br>and Pipe,<br><i>r</i> | Counter-<br>bore<br>Threaded<br>Flange<br>Min.,<br><i>Q</i> | Depth<br>of<br>Socket,<br><i>D</i> |        |
|                           |                                               |                                                         |                                 |                                                                                   | Threaded             |                      | Slip-on              |        |                                                                           | Lapped<br>Min.,<br><i>B</i> |                      |                                                                             |                                                             |                                    |        |
|                           |                                               |                                                         |                                 |                                                                                   | Welding,<br><i>Y</i> | Socket               | Welding,<br><i>Y</i> | Socket |                                                                           |                             |                      |                                                                             |                                                             |                                    |        |
|                           |                                               |                                                         |                                 |                                                                                   |                      |                      |                      |        |                                                                           |                             | Welding,<br><i>Y</i> |                                                                             |                                                             |                                    | Socket |
|                           |                                               |                                                         |                                 |                                                                                   |                      |                      |                      |        |                                                                           |                             |                      |                                                                             |                                                             |                                    |        |
| Welding Neck,<br><i>Y</i> |                                               | Welding,<br><i>Y</i>                                    |                                 | Welding,<br><i>B</i>                                                              |                      | Welding,<br><i>B</i> |                      |        |                                                                           |                             |                      |                                                                             |                                                             |                                    |        |
| 1½                        | 3.75                                          | 0.56                                                    | 1.50                            | 0.84                                                                              | 0.88                 | 0.88                 | 2.06                 | 0.62   | 0.88                                                                      | 0.90                        | To be<br>specified   | 0.12                                                                        | 0.93                                                        | 0.38                               |        |
| ¾                         | 4.62                                          | 0.62                                                    | 1.88                            | 1.05                                                                              | 1.00                 | 1.00                 | 2.25                 | 0.62   | 1.09                                                                      | 1.11                        | by                   | 0.12                                                                        | 1.14                                                        | 0.44                               |        |
| 1                         | 4.88                                          | 0.69                                                    | 2.12                            | 1.32                                                                              | 1.06                 | 1.06                 | 2.44                 | 0.69   | 1.36                                                                      | 1.38                        |                      | 0.12                                                                        | 1.41                                                        | 0.50                               |        |
| 1¼                        | 5.25                                          | 0.81                                                    | 2.50                            | 1.66                                                                              | 1.12                 | 1.12                 | 2.62                 | 0.81   | 1.70                                                                      | 1.72                        | Purchaser            | 0.19                                                                        | 1.75                                                        | 0.56                               |        |
| 1½                        | 6.12                                          | 0.88                                                    | 2.75                            | 1.90                                                                              | 1.25                 | 1.25                 | 2.75                 | 0.88   | 1.95                                                                      | 1.97                        |                      | 0.25                                                                        | 1.99                                                        | 0.62                               |        |

Table F16 Dimensions of Class 600 Flanges (Cont'd)

| 1                    | 2                                             | 3                                                       | 4                               | 5                                                                                        | 6                                                     | 7                   | 8                            | 9                                                                         | 10                                                | 11                          | 12                                                                          | 13                                                          | 14                                 | 15 |
|----------------------|-----------------------------------------------|---------------------------------------------------------|---------------------------------|------------------------------------------------------------------------------------------|-------------------------------------------------------|---------------------|------------------------------|---------------------------------------------------------------------------|---------------------------------------------------|-----------------------------|-----------------------------------------------------------------------------|-------------------------------------------------------------|------------------------------------|----|
| Nominal<br>Pipe Size | Outside<br>Diameter<br>of Flange,<br><i>O</i> | Thickness<br>of Flange<br>Min.,<br><i>t<sub>f</sub></i> | Diameter<br>of Hub,<br><i>X</i> | Hub<br>Diameter<br>Beginning of<br>Chamfer<br>Welding<br>Neck,<br><i>A</i><br>[Note (2)] | Length Through Hub                                    |                     |                              | Thread<br>Length<br>Threaded<br>Flange<br>Min.,<br><i>T</i><br>[Note (3)] | Bore                                              |                             | Corner<br>Radius of<br>Bore of<br>Lapped<br>Flange<br>and Pipe,<br><i>r</i> | Counter-<br>bore<br>Threaded<br>Flange<br>Min.,<br><i>Q</i> | Depth<br>of<br>Socket,<br><i>D</i> |    |
|                      |                                               |                                                         |                                 |                                                                                          | Threaded                                              |                     |                              |                                                                           | Slip-on<br>Socket<br>Welding<br>Min.,<br><i>B</i> | Lapped<br>Min.,<br><i>B</i> |                                                                             |                                                             |                                    |    |
|                      |                                               |                                                         |                                 |                                                                                          | Threaded<br>Slip-on<br>Socket<br>Welding,<br><i>Y</i> | Lapped,<br><i>Y</i> | Welding<br>Neck,<br><i>Y</i> |                                                                           |                                                   |                             |                                                                             |                                                             |                                    |    |
|                      |                                               |                                                         |                                 |                                                                                          |                                                       |                     |                              |                                                                           |                                                   |                             |                                                                             |                                                             |                                    |    |
| 2                    | 6.50                                          | 1.00                                                    | 3.31                            | 2.38                                                                                     | 1.44                                                  | 1.44                | 2.88                         | 1.12                                                                      | 2.44                                              | 2.46                        | 0.31                                                                        | 2.50                                                        | 0.69                               |    |
| 2½                   | 7.50                                          | 1.12                                                    | 3.94                            | 2.88                                                                                     | 1.62                                                  | 1.62                | 3.12                         | 1.25                                                                      | 2.94                                              | 2.97                        | 0.31                                                                        | 3.00                                                        | 0.75                               |    |
| 3                    | 8.25                                          | 1.25                                                    | 4.62                            | 3.50                                                                                     | 1.81                                                  | 1.81                | 3.25                         | 1.38                                                                      | 3.57                                              | 3.60                        | 0.38                                                                        | 3.63                                                        | 0.81                               |    |
| 3½                   | 9.00                                          | 1.38                                                    | 5.25                            | 4.00                                                                                     | 1.94                                                  | 1.94                | 3.38                         | 1.56                                                                      | 4.07                                              | 4.10                        | 0.38                                                                        | 4.13                                                        | ...                                |    |
| 4                    | 10.75                                         | 1.50                                                    | 6.00                            | 4.50                                                                                     | 2.12                                                  | 2.12                | 4.00                         | 1.62                                                                      | 4.57                                              | 4.60                        | 0.44                                                                        | 4.63                                                        | ...                                |    |
| 5                    | 13.00                                         | 1.75                                                    | 7.44                            | 5.56                                                                                     | 2.38                                                  | 2.38                | 4.50                         | 1.88                                                                      | 5.66                                              | 5.69                        | 0.44                                                                        | 5.69                                                        | ...                                |    |
| 6                    | 14.00                                         | 1.88                                                    | 8.75                            | 6.63                                                                                     | 2.62                                                  | 2.62                | 4.62                         | 2.00                                                                      | 6.72                                              | 6.75                        | 0.50                                                                        | 6.75                                                        | ...                                |    |
| 8                    | 16.50                                         | 2.19                                                    | 10.75                           | 8.63                                                                                     | 3.00                                                  | 3.00                | 5.25                         | 2.25                                                                      | 8.72                                              | 8.75                        | 0.50                                                                        | 8.75                                                        | ...                                |    |
| 10                   | 20.00                                         | 2.50                                                    | 13.50                           | 10.75                                                                                    | 3.38                                                  | 4.38                | 6.00                         | 2.56                                                                      | 10.88                                             | 10.92                       | 0.50                                                                        | 10.88                                                       | ...                                |    |
| 12                   | 22.00                                         | 2.62                                                    | 15.75                           | 12.75                                                                                    | 3.62                                                  | 4.62                | 6.12                         | 2.75                                                                      | 12.88                                             | 12.92                       | 0.50                                                                        | 12.94                                                       | ...                                |    |
| 14                   | 23.75                                         | 2.75                                                    | 17.00                           | 14.00                                                                                    | 3.69                                                  | 5.00                | 6.50                         | 2.88                                                                      | 14.14                                             | 14.18                       | 0.50                                                                        | 14.19                                                       | ...                                |    |
| 16                   | 27.00                                         | 3.00                                                    | 19.50                           | 16.00                                                                                    | 4.19                                                  | 5.50                | 7.00                         | 3.06                                                                      | 16.16                                             | 16.19                       | 0.50                                                                        | 16.19                                                       | ...                                |    |
| 18                   | 29.25                                         | 3.25                                                    | 21.50                           | 18.00                                                                                    | 4.62                                                  | 6.00                | 7.25                         | 3.12                                                                      | 18.18                                             | 18.20                       | 0.50                                                                        | 18.19                                                       | ...                                |    |
| 20                   | 32.00                                         | 3.50                                                    | 24.00                           | 20.00                                                                                    | 5.00                                                  | 6.50                | 7.50                         | 3.25                                                                      | 20.20                                             | 20.25                       | 0.50                                                                        | 20.19                                                       | ...                                |    |
| 24                   | 37.00                                         | 4.00                                                    | 28.25                           | 24.00                                                                                    | 5.50                                                  | 7.25                | 8.00                         | 3.62                                                                      | 24.25                                             | 24.25                       | 0.50                                                                        | 24.19                                                       | ...                                |    |

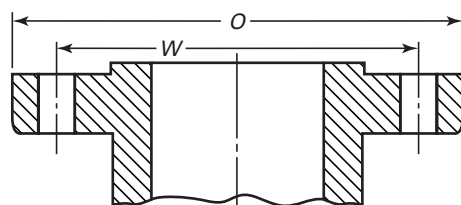
## GENERAL NOTES:

- Dimensions are in inches.
- For tolerances, see para. 7.
- For facings, see para. 6.4.
- For flange bolt holes, see para. 6.5 and Table F15.
- For spot facing, see para. 6.6.
- For reducing threaded and slip-on flanges, see Table F6.
- Blind flanges may be made with or without hubs at the manufacturer's option.
- For reducing welding neck flanges, see para. 6.8.

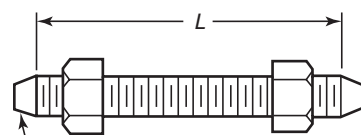
## NOTES:

- This dimension is for large end of hub, which may be straight or tapered. Taper shall not exceed 7 deg on threaded, slip-on, socket-welding, and lapped flanges.
- For welding end bevel, see para. 6.7.
- For threads in threaded flanges, see para. 6.9.

## CLASS 900 PIPE FLANGES AND FLANGED FITTINGS



Flange



Point height [Note (1)]

Stud Bolt With Nuts

Table F17 Templates for Drilling Class 900 Flanges

| 1                         | 2                             | 3                          | 4                      | 5               | 6                                   | 7                    | 8                                 | 9          |
|---------------------------|-------------------------------|----------------------------|------------------------|-----------------|-------------------------------------|----------------------|-----------------------------------|------------|
| Drilling [Notes (2), (3)] |                               |                            |                        |                 | Length of Bolts, L [Notes (1), (4)] |                      |                                   |            |
| Nominal Pipe Size         | Outside Diameter of Flange, O | Diameter of Bolt Circle, W | Diameter of Bolt Holes | Number of Bolts | Diameter of Bolts                   | Raised Face 0.25 in. | Male and Female/Tongue and Groove | Ring Joint |
| $\frac{1}{2}$             |                               |                            |                        |                 |                                     |                      |                                   |            |
| $\frac{3}{4}$             |                               |                            |                        |                 |                                     |                      |                                   |            |
| 1                         |                               |                            |                        |                 |                                     |                      |                                   |            |
| $1\frac{1}{4}$            |                               |                            |                        |                 |                                     |                      |                                   |            |
| $1\frac{1}{2}$            |                               |                            |                        |                 |                                     |                      |                                   |            |
| 2                         |                               |                            |                        |                 |                                     |                      |                                   |            |
| $2\frac{1}{2}$            |                               |                            |                        |                 |                                     |                      |                                   |            |
| 3                         | 9.50                          | 7.50                       | 1                      | 8               | $\frac{7}{8}$                       | 5.75                 | 5.50                              | 5.75       |
| 4                         | 11.50                         | 9.25                       | $1\frac{1}{4}$         | 8               | $1\frac{1}{8}$                      | 6.75                 | 6.50                              | 6.75       |
| 5                         | 13.75                         | 11.00                      | $1\frac{3}{8}$         | 8               | $1\frac{1}{4}$                      | 7.50                 | 7.25                              | 7.50       |
| 6                         | 15.00                         | 12.50                      | $1\frac{1}{4}$         | 12              | $1\frac{1}{8}$                      | 7.50                 | 7.25                              | 7.75       |
| 8                         | 18.50                         | 15.50                      | $1\frac{1}{2}$         | 12              | $1\frac{3}{8}$                      | 8.75                 | 8.50                              | 8.75       |
| 10                        | 21.50                         | 18.50                      | $1\frac{1}{2}$         | 16              | $1\frac{3}{8}$                      | 9.25                 | 9.00                              | 9.25       |
| 12                        | 24.00                         | 21.00                      | $1\frac{1}{2}$         | 20              | $1\frac{3}{8}$                      | 10.00                | 9.75                              | 10.00      |
| 14                        | 25.25                         | 22.00                      | $1\frac{5}{8}$         | 20              | $1\frac{1}{2}$                      | 10.75                | 10.50                             | 11.00      |
| 16                        | 27.75                         | 24.25                      | $1\frac{3}{4}$         | 20              | $1\frac{5}{8}$                      | 11.25                | 11.00                             | 11.50      |
| 18                        | 31.00                         | 27.00                      | 2                      | 20              | $1\frac{7}{8}$                      | 12.75                | 12.50                             | 13.25      |
| 20                        | 33.75                         | 29.50                      | $2\frac{1}{8}$         | 20              | 2                                   | 13.75                | 13.50                             | 14.25      |
| 24                        | 41.00                         | 35.50                      | $2\frac{5}{8}$         | 20              | $2\frac{1}{2}$                      | 17.25                | 17.00                             | 18.00      |

Use Class 1500 dimensions in these sizes.

## GENERAL NOTES:

- (a) Dimensions are in inches.  
 (b) For other dimensions, see Table F18 and F19.

## NOTES:

- (1) Length of stud bolt does not include the height of the points. See para. 6.10.2.  
 (2) For flange bolt holes, see para. 6.5.  
 (3) For spot facing, see para. 6.6.  
 (4) Bolt lengths not shown in table may be determined in accordance with Annex D. See para. 6.10.2.

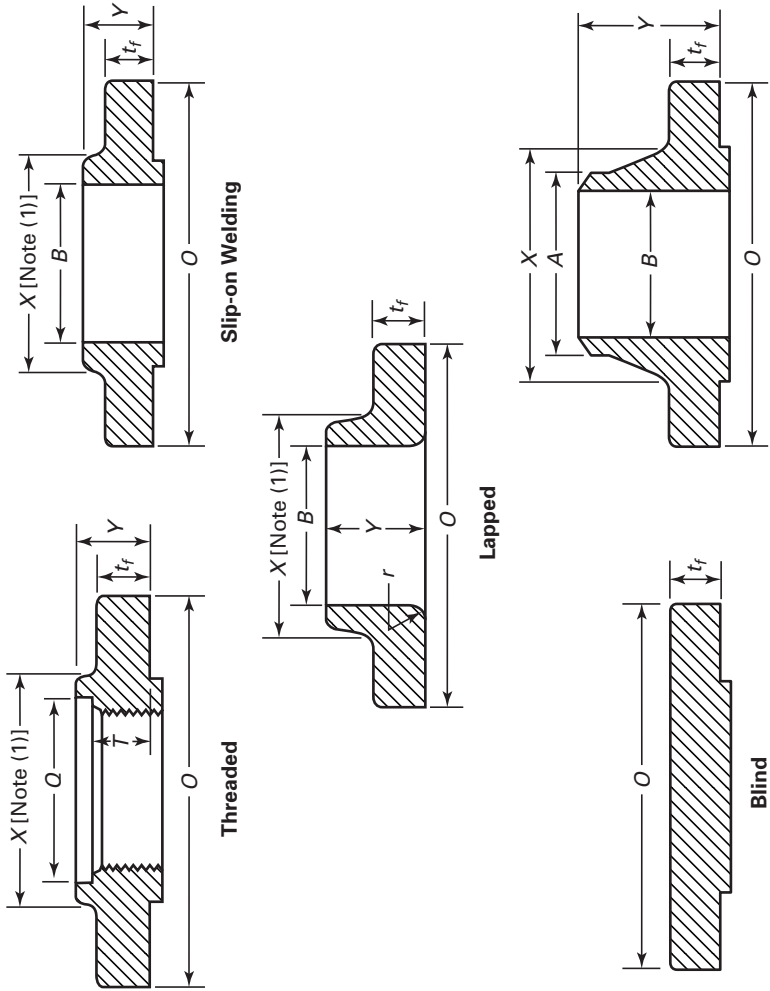


Table F18 Dimensions of Class 900 Flanges

| 1                    | 2                                           | 3                                        | 4                          | 5                       | 6                    | 7                           | 8                           | 9                       | 10                                               | 11                          | 12                     | 13                      | 14                                                                |
|----------------------|---------------------------------------------|------------------------------------------|----------------------------|-------------------------|----------------------|-----------------------------|-----------------------------|-------------------------|--------------------------------------------------|-----------------------------|------------------------|-------------------------|-------------------------------------------------------------------|
| Nominal<br>Pipe Size | Outside<br>Diameter<br>of<br>Flange,<br>$O$ | Thickness<br>of Flange<br>Min.,<br>$t_f$ | Diameter<br>of Hub,<br>$X$ | Hub Diameter            |                      | Length Through Hub          |                             |                         | Thread Length                                    |                             | Bore                   |                         | Counterbore<br>of Bore of<br>Lapped<br>Flange and<br>Pipe,<br>$r$ |
|                      |                                             |                                          |                            | Beginning of<br>Chamfer | Welding Neck,<br>$A$ | Threaded<br>Slip-on,<br>$Y$ | Threaded<br>Slip-on,<br>$Y$ | Welding<br>Neck,<br>$Y$ | Threaded<br>Flange<br>Min.,<br>$T$<br>[Note (3)] | Slip-<br>on<br>Min.,<br>$B$ | Lapped<br>Min.,<br>$B$ | Welding<br>Neck,<br>$B$ |                                                                   |
|                      |                                             |                                          |                            | [Note (2)]              |                      |                             |                             |                         |                                                  |                             |                        |                         | Threaded<br>Flange<br>Min.,<br>$Q$                                |

1/2  
3/4  
1  
1 1/4  
1 1/2  
2  
2 1/2

Use Class 1500 dimensions in these sizes [Note (4)].

Table F18 Dimensions of Class 900 Flanges (Cont'd)

| 1                    | 2                                      | 3                                                 | 4                        | 5                                       | 6          | 7                         | 8            | 9                     | 10                                                              | 11                        | 12                   | 13                                                                | 14                                              |
|----------------------|----------------------------------------|---------------------------------------------------|--------------------------|-----------------------------------------|------------|---------------------------|--------------|-----------------------|-----------------------------------------------------------------|---------------------------|----------------------|-------------------------------------------------------------------|-------------------------------------------------|
| Nominal<br>Pipe Size | Outside<br>Diameter<br>of Flange,<br>O | Thickness<br>of Flange<br>Min.,<br>t <sub>f</sub> | Diameter<br>of Hub,<br>X | Hub Diameter<br>Beginning of<br>Chamfer |            | Length Through Hub        |              |                       | Thread Length<br>Threaded<br>Flange<br>Min.,<br>T<br>[Note (3)] | Bore                      |                      | Corner Radius<br>of Bore of<br>Lapped<br>Flange and<br>Pipe,<br>r | Counterbore<br>Threaded<br>Flange<br>Min.,<br>Q |
|                      |                                        |                                                   |                          | Welding Neck,<br>A                      | [Note (2)] | Threaded<br>Slip-on,<br>Y | Lapped,<br>Y | Welding<br>Neck,<br>Y |                                                                 | Slip-<br>on<br>Min.,<br>B | Lapped<br>Min.,<br>B |                                                                   |                                                 |
| 3                    | 9.50                                   | 1.50                                              | 5.00                     | 3.50                                    | 3.50       | 2.12                      | 2.12         | 4.00                  | 1.62                                                            | 3.57                      | 3.60                 | 0.38                                                              | 3.63                                            |
| 4                    | 11.50                                  | 1.75                                              | 6.25                     | 4.50                                    | 4.50       | 2.75                      | 2.75         | 4.50                  | 1.88                                                            | 4.57                      | 4.60                 | 0.44                                                              | 4.63                                            |
| 5                    | 13.75                                  | 2.00                                              | 7.50                     | 5.56                                    | 5.56       | 3.12                      | 3.12         | 5.00                  | 2.12                                                            | 5.66                      | 5.69                 | 0.44                                                              | 5.69                                            |
| 6                    | 15.00                                  | 2.19                                              | 9.25                     | 6.63                                    | 6.63       | 3.38                      | 3.38         | 5.50                  | 2.25                                                            | 6.72                      | 6.75                 | 0.50                                                              | 6.75                                            |
| 8                    | 18.50                                  | 2.50                                              | 11.75                    | 8.63                                    | 8.63       | 4.00                      | 4.50         | 6.38                  | 2.50                                                            | 8.72                      | 8.75                 | 0.50                                                              | 8.75                                            |
| 10                   | 21.50                                  | 2.75                                              | 14.50                    | 10.75                                   | 10.75      | 4.25                      | 5.00         | 7.25                  | 2.81                                                            | 10.88                     | 10.92                | 0.50                                                              | 10.88                                           |
| 12                   | 24.00                                  | 3.12                                              | 16.50                    | 12.75                                   | 12.75      | 4.62                      | 5.62         | 7.88                  | 3.00                                                            | 12.88                     | 12.92                | 0.50                                                              | 12.94                                           |
| 14                   | 25.25                                  | 3.38                                              | 17.75                    | 14.00                                   | 14.00      | 5.12                      | 6.12         | 8.38                  | 3.25                                                            | 14.14                     | 14.18                | 0.50                                                              | 14.19                                           |
| 16                   | 27.75                                  | 3.50                                              | 20.00                    | 16.00                                   | 16.00      | 5.25                      | 6.50         | 8.50                  | 3.38                                                            | 16.16                     | 16.19                | 0.50                                                              | 16.19                                           |
| 18                   | 31.00                                  | 4.00                                              | 22.25                    | 18.00                                   | 18.00      | 6.00                      | 7.50         | 9.00                  | 3.50                                                            | 18.18                     | 18.20                | 0.50                                                              | 18.19                                           |
| 20                   | 33.75                                  | 4.25                                              | 24.50                    | 20.00                                   | 20.00      | 6.25                      | 8.25         | 9.75                  | 3.62                                                            | 20.20                     | 20.25                | 0.50                                                              | 20.19                                           |
| 24                   | 41.00                                  | 5.50                                              | 29.50                    | 24.00                                   | 24.00      | 8.00                      | 10.50        | 11.50                 | 4.00                                                            | 24.25                     | 24.25                | 0.50                                                              | 24.19                                           |

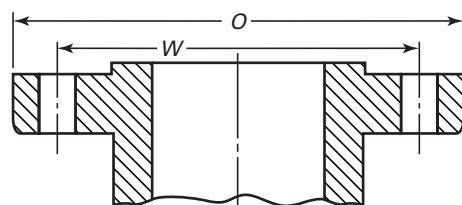
## GENERAL NOTES:

- Dimensions are in inches.
- For tolerances, see para. 7.
- For facings, see para. 6.4.
- For flange bolt holes, see para. 6.5 and Table F17.
- For spot facing, see para. 6.6.
- For reducing threaded and slip-on flanges, see Table F6.
- Blind flanges may be made with or without hubs at the manufacturer's option.
- For reducing welding neck flanges, see para. 6.8.

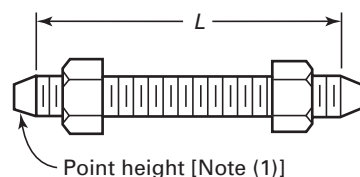
## NOTES:

- This dimension is for large end of hub, which may be straight or tapered. Taper shall not exceed 7 deg on threaded, slip-on, socket-welding, and lapped flanges.
- For welding end bevel, see para. 6.7.
- For threads in threaded flanges, see para. 6.9.
- Socket welding flanges may be provided in NPS 1/2 through 2 1/2 using Class 1500 dimensions.

## CLASS 1500 PIPE FLANGES



Flange



Stud Bolt With Nuts

Table F19 Templates for Drilling Class 1500 Flanges

| 1                    | 2                                      | 3                                | 4                         | 5                  | 6                                         | 7                       | 8                                     | 9          |
|----------------------|----------------------------------------|----------------------------------|---------------------------|--------------------|-------------------------------------------|-------------------------|---------------------------------------|------------|
|                      |                                        |                                  |                           |                    | Length of Bolts,<br>L<br>[Notes (1), (4)] |                         |                                       |            |
| Nominal<br>Pipe Size | Outside<br>Diameter of<br>Flange,<br>O | Drilling [Notes (2), (3)]        |                           |                    |                                           |                         |                                       |            |
|                      |                                        | Diameter of<br>Bolt Circle,<br>W | Diameter of<br>Bolt Holes | Number of<br>Bolts | Diameter of<br>Bolts                      | Raised Face<br>0.25 in. | Male and Female/<br>Tongue and Groove | Ring Joint |
| 1/2                  | 4.75                                   | 3.25                             | 7/8                       | 4                  | 3/4                                       | 4.25                    | 4.00                                  | 4.25       |
| 3/4                  | 5.12                                   | 3.50                             | 7/8                       | 4                  | 3/4                                       | 4.50                    | 4.25                                  | 4.50       |
| 1                    | 5.88                                   | 4.00                             | 1                         | 4                  | 7/8                                       | 5.00                    | 4.75                                  | 5.00       |
| 1 1/4                | 6.25                                   | 4.38                             | 1                         | 4                  | 7/8                                       | 5.00                    | 4.75                                  | 5.00       |
| 1 1/2                | 7.00                                   | 4.88                             | 1 1/8                     | 4                  | 1                                         | 5.50                    | 5.25                                  | 5.50       |
| 2                    | 8.50                                   | 6.50                             | 1                         | 8                  | 7/8                                       | 5.75                    | 5.50                                  | 5.75       |
| 2 1/2                | 9.62                                   | 7.50                             | 1 1/8                     | 8                  | 1                                         | 6.25                    | 6.00                                  | 6.25       |
| 3                    | 10.50                                  | 8.00                             | 1 1/4                     | 8                  | 1 1/8                                     | 7.00                    | 6.75                                  | 7.00       |
| 4                    | 12.25                                  | 9.50                             | 1 3/8                     | 8                  | 1 1/4                                     | 7.75                    | 7.50                                  | 7.75       |
| 5                    | 14.75                                  | 11.50                            | 1 5/8                     | 8                  | 1 1/2                                     | 9.75                    | 9.50                                  | 9.75       |
| 6                    | 15.50                                  | 12.50                            | 1 1/2                     | 12                 | 1 3/8                                     | 10.25                   | 10.00                                 | 10.50      |
| 8                    | 19.00                                  | 15.50                            | 1 3/4                     | 12                 | 1 5/8                                     | 11.50                   | 11.25                                 | 12.75      |
| 10                   | 23.00                                  | 19.00                            | 2                         | 12                 | 1 7/8                                     | 13.25                   | 13.00                                 | 13.50      |
| 12                   | 26.50                                  | 22.50                            | 2 1/8                     | 16                 | 2                                         | 14.75                   | 14.50                                 | 15.25      |
| 14                   | 29.50                                  | 25.00                            | 2 3/8                     | 16                 | 2 1/4                                     | 16.00                   | 15.75                                 | 16.75      |
| 16                   | 32.50                                  | 27.75                            | 2 5/8                     | 16                 | 2 1/2                                     | 17.50                   | 17.25                                 | 18.50      |
| 18                   | 36.00                                  | 30.50                            | 2 7/8                     | 16                 | 2 3/4                                     | 19.50                   | 19.25                                 | 20.75      |
| 20                   | 38.75                                  | 32.75                            | 3 1/8                     | 16                 | 3                                         | 21.25                   | 21.00                                 | 22.25      |
| 24                   | 46.00                                  | 39.00                            | 3 5/8                     | 16                 | 3 1/2                                     | 24.25                   | 24.00                                 | 25.50      |

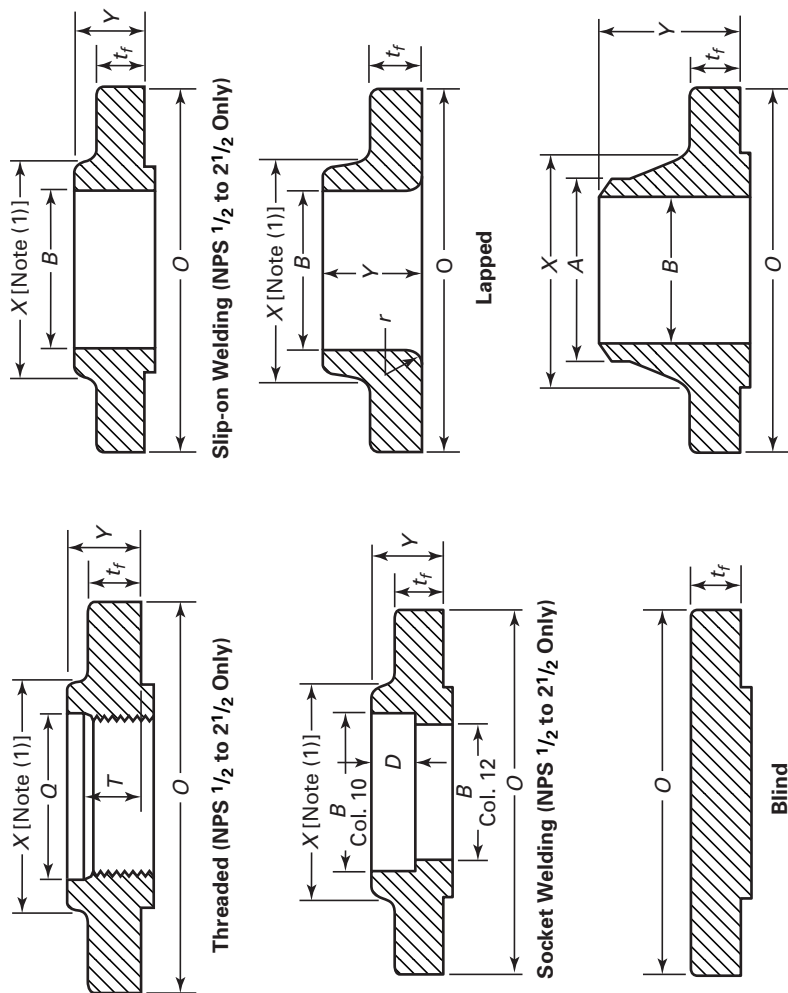
## GENERAL NOTES:

- (a) Dimensions are in inches.  
 (b) For other dimensions, see Table F20.

## NOTES:

- (1) Length of stud bolt does not include the height of the points. See para. 6.10.2.  
 (2) For flange bolt holes, see para. 6.5.  
 (3) For spot facing, see para. 6.6.  
 (4) Bolt lengths not shown in Table determined in accordance with Annex D. See para. 6.10.2.





Welding Neck

Table F20 Dimensions of Class 1500 Flanges

| 1                 | 2                             | 3                                         | 4                  | 5                                    | 6                  | 7                                  | 8               | 9                            | 10                              | 11                  | 12                             | 13                                                 | 14                                  | 15                 |
|-------------------|-------------------------------|-------------------------------------------|--------------------|--------------------------------------|--------------------|------------------------------------|-----------------|------------------------------|---------------------------------|---------------------|--------------------------------|----------------------------------------------------|-------------------------------------|--------------------|
| Nominal Pipe Size | Outside Diameter of Flange, O | Thickness of Flange, Min., t <sub>f</sub> | Diameter of Hub, X | Hub Diameter Beginning of Chamfer, A | Length Through Hub | Threaded Slip-on Socket Welding, Y | Welding Neck, Y | Thread Length Flange Min., T | Slip-on Socket Welding, Min., B | Bore Lapped Min., B | Welding Neck/Socket Welding, B | Corner Radius of Bore of Lapped Flange and Pipe, r | Counterbore Threaded Flange Min., Q | Depth of Socket, D |
| 1/2               | 4.75                          | 0.88                                      | 1.50               | 0.84                                 | 1.25               | 1.25                               | 2.38            | 0.88                         | 0.88                            | 0.90                | To be specified                | 0.12                                               | 0.93                                | 0.38               |
| 3/4               | 5.12                          | 1.00                                      | 1.75               | 1.05                                 | 1.38               | 1.38                               | 2.75            | 1.00                         | 1.09                            | 1.11                | specified by                   | 0.12                                               | 1.14                                | 0.44               |
| 1                 | 5.88                          | 1.12                                      | 2.06               | 1.32                                 | 1.62               | 1.62                               | 2.88            | 1.12                         | 1.36                            | 1.38                | by                             | 0.12                                               | 1.41                                | 0.50               |
| 1 1/4             | 6.25                          | 1.12                                      | 2.50               | 1.66                                 | 1.62               | 1.62                               | 2.88            | 1.19                         | 1.70                            | 1.72                | Purchaser                      | 0.19                                               | 1.75                                | 0.56               |

Table F20 Dimensions of Class 1500 Flanges (Cont'd)

| 1                    | 2                                             | 3                                                       | 4                               | 5                                                    | 6          | 7                  | 8                 | 9                            | 10                                      | 11         | 12                                                 | 13                          | 14                                        | 15                              |                                 |                                                        |
|----------------------|-----------------------------------------------|---------------------------------------------------------|---------------------------------|------------------------------------------------------|------------|--------------------|-------------------|------------------------------|-----------------------------------------|------------|----------------------------------------------------|-----------------------------|-------------------------------------------|---------------------------------|---------------------------------|--------------------------------------------------------|
| Nominal<br>Pipe Size | Outside<br>Diameter<br>of Flange,<br><i>O</i> | Thickness<br>of Flange<br>Min.,<br><i>t<sub>f</sub></i> | Diameter<br>of Hub,<br><i>X</i> | Hub Diameter                                         |            | Length Through Hub |                   |                              | Thread Length                           |            | Bore                                               |                             | Corner Radius<br>of Bore of               |                                 | Depth of<br>Socket,<br><i>D</i> |                                                        |
|                      |                                               |                                                         |                                 | Beginning of<br>Chamfer<br>Welding Neck,<br><i>A</i> | [Note (2)] | Threaded           | Slip-on<br>Socket | Welding<br>Neck,<br><i>Y</i> | Threaded<br>Flange<br>Min.,<br><i>T</i> | [Note (3)] | Slip-on<br>Socket<br>Welding,<br>Min.,<br><i>B</i> | Lapped<br>Min.,<br><i>B</i> | Welding<br>Socket<br>Welding,<br><i>B</i> | Flange and<br>Pipe,<br><i>r</i> |                                 | Counterbore<br>Threaded<br>Flange<br>Min.,<br><i>Q</i> |
|                      |                                               |                                                         |                                 |                                                      |            |                    |                   |                              |                                         |            |                                                    |                             |                                           |                                 |                                 |                                                        |
| 1½                   | 7.00                                          | 1.25                                                    | 2.75                            | 1.90                                                 | 1.75       | 1.75               | 3.25              | 1.25                         | 1.95                                    | 1.97       |                                                    | 0.25                        | 1.99                                      | 0.62                            |                                 |                                                        |
| 2                    | 8.50                                          | 1.50                                                    | 4.12                            | 2.38                                                 | 2.25       | 2.25               | 4.00              | 1.50                         | 2.44                                    | 2.46       |                                                    | 0.31                        | 2.50                                      | 0.69                            |                                 |                                                        |
| 2½                   | 9.62                                          | 1.62                                                    | 4.88                            | 2.88                                                 | 2.50       | 2.50               | 4.12              | 1.88                         | 2.94                                    | 2.97       |                                                    | 0.31                        | 3.00                                      | 0.75                            |                                 |                                                        |
| 3                    | 10.50                                         | 1.88                                                    | 5.25                            | 3.50                                                 | ...        | 2.88               | 4.62              | ...                          | ...                                     | 3.60       |                                                    | 0.38                        | ...                                       | ...                             |                                 |                                                        |
| 4                    | 12.25                                         | 2.12                                                    | 6.38                            | 4.50                                                 | ...        | 3.56               | 4.88              | ...                          | ...                                     | 4.60       |                                                    | 0.44                        | ...                                       | ...                             |                                 |                                                        |
| 5                    | 14.75                                         | 2.88                                                    | 7.75                            | 5.56                                                 | ...        | 4.12               | 6.12              | ...                          | ...                                     | 5.69       |                                                    | 0.44                        | ...                                       | ...                             |                                 |                                                        |
| 6                    | 15.50                                         | 3.25                                                    | 9.00                            | 6.63                                                 | ...        | 4.69               | 6.75              | ...                          | ...                                     | 6.75       |                                                    | 0.50                        | ...                                       | ...                             |                                 |                                                        |
| 8                    | 19.00                                         | 3.62                                                    | 11.50                           | 8.63                                                 | ...        | 5.62               | 8.38              | ...                          | ...                                     | 8.75       |                                                    | 0.50                        | ...                                       | ...                             |                                 |                                                        |
| 10                   | 23.00                                         | 4.25                                                    | 14.50                           | 10.75                                                | ...        | 7.00               | 10.00             | ...                          | ...                                     | 10.92      |                                                    | 0.50                        | ...                                       | ...                             |                                 |                                                        |
| 12                   | 26.50                                         | 4.88                                                    | 17.75                           | 12.75                                                | ...        | 8.62               | 11.12             | ...                          | ...                                     | 12.92      |                                                    | 0.50                        | ...                                       | ...                             |                                 |                                                        |
| 14                   | 29.50                                         | 5.25                                                    | 19.50                           | 14.00                                                | ...        | 9.50               | 11.75             | ...                          | ...                                     | 14.18      |                                                    | 0.50                        | ...                                       | ...                             |                                 |                                                        |
| 16                   | 32.50                                         | 5.75                                                    | 21.75                           | 16.00                                                | ...        | 10.25              | 12.25             | ...                          | ...                                     | 16.19      |                                                    | 0.50                        | ...                                       | ...                             |                                 |                                                        |
| 18                   | 36.00                                         | 6.38                                                    | 23.50                           | 18.00                                                | ...        | 10.88              | 12.88             | ...                          | ...                                     | 18.20      |                                                    | 0.50                        | ...                                       | ...                             |                                 |                                                        |
| 20                   | 38.75                                         | 7.00                                                    | 25.25                           | 20.00                                                | ...        | 11.50              | 14.00             | ...                          | ...                                     | 20.25      |                                                    | 0.50                        | ...                                       | ...                             |                                 |                                                        |
| 24                   | 46.00                                         | 8.00                                                    | 30.00                           | 24.00                                                | ...        | 13.00              | 16.00             | ...                          | ...                                     | 24.25      |                                                    | 0.50                        | ...                                       | ...                             |                                 |                                                        |

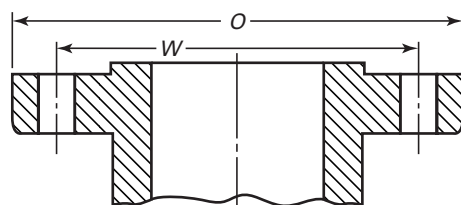
## GENERAL NOTES:

- Dimensions are in inches.
- For tolerances, see para. 7.
- For facings, see para. 6.4.
- For flange bolt holes, see para. 6.5 and Table F19.
- For spot facing, see para. 6.6.
- For reducing threaded and slip-on flanges, see Table F6.
- Blind flanges may be made with or without hubs at the manufacturer's option.
- For reducing welding neck flanges, see para. 6.8.

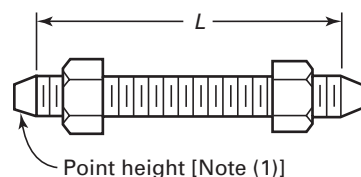
## NOTES:

- This dimension is for large end of hub, which may be straight or tapered. Taper shall not exceed 7 deg on threaded, slip-on, socket-welding, and lapped flanges.
- For welding end bevel, see para. 6.7.
- For threads in threaded flanges, see para. 6.9.

## CLASS 2500 PIPE FLANGES



Flange



Point height [Note (1)]

Stud Bolt With Nuts

Table F21 Templates for Drilling Class 2500 Flanges

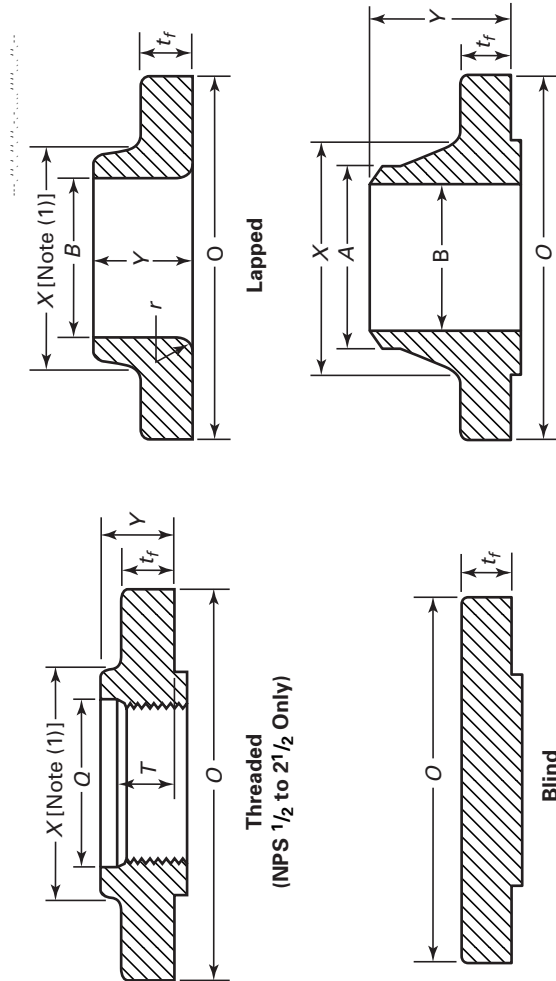
| 1                    | 2                                      | 3                                | 4                         | 5                  | 6                                         | 7                       | 8                                     | 9          |
|----------------------|----------------------------------------|----------------------------------|---------------------------|--------------------|-------------------------------------------|-------------------------|---------------------------------------|------------|
|                      |                                        |                                  |                           |                    | Length of Bolts,<br>L<br>[Notes (1), (4)] |                         |                                       |            |
| Nominal<br>Pipe Size | Outside<br>Diameter of<br>Flange,<br>O | Drilling [Notes (2), (3)]        |                           |                    |                                           | Raised Face<br>0.25 in. | Male and Female/<br>Tongue and Groove | Ring Joint |
|                      |                                        | Diameter of<br>Bolt Circle,<br>W | Diameter of<br>Bolt Holes | Number of<br>Bolts | Diameter of<br>Bolts                      |                         |                                       |            |
| 1/2                  | 5.25                                   | 3.50                             | 7/8                       | 4                  | 3/4                                       | 4.75                    | 4.50                                  | 4.75       |
| 3/4                  | 5.50                                   | 3.75                             | 7/8                       | 4                  | 3/4                                       | 5.00                    | 4.75                                  | 5.00       |
| 1                    | 6.25                                   | 4.25                             | 1                         | 4                  | 7/8                                       | 5.50                    | 5.25                                  | 5.50       |
| 1 1/4                | 7.25                                   | 5.12                             | 1 1/8                     | 4                  | 1                                         | 6.00                    | 5.75                                  | 6.00       |
| 1 1/2                | 8.00                                   | 5.75                             | 1 1/4                     | 4                  | 1 1/8                                     | 6.75                    | 6.50                                  | 6.75       |
| 2                    | 9.25                                   | 6.75                             | 1 1/8                     | 8                  | 1                                         | 7.00                    | 6.75                                  | 7.00       |
| 2 1/2                | 10.50                                  | 7.75                             | 1 1/4                     | 8                  | 1 1/8                                     | 7.75                    | 7.50                                  | 8.00       |
| 3                    | 12.00                                  | 9.00                             | 1 3/8                     | 8                  | 1 1/4                                     | 8.75                    | 8.50                                  | 9.00       |
| 4                    | 14.00                                  | 10.75                            | 1 5/8                     | 8                  | 1 1/2                                     | 10.00                   | 9.75                                  | 10.25      |
| 5                    | 16.50                                  | 12.75                            | 1 7/8                     | 8                  | 1 3/4                                     | 11.75                   | 11.50                                 | 12.25      |
| 6                    | 19.00                                  | 14.50                            | 2 1/8                     | 8                  | 2                                         | 13.50                   | 13.25                                 | 14.00      |
| 8                    | 21.75                                  | 17.25                            | 2 1/8                     | 12                 | 2                                         | 15.00                   | 14.75                                 | 15.50      |
| 10                   | 26.50                                  | 21.25                            | 2 5/8                     | 12                 | 2 1/2                                     | 19.25                   | 19.00                                 | 20.00      |
| 12                   | 30.00                                  | 24.38                            | 2 7/8                     | 12                 | 2 3/4                                     | 21.25                   | 21.00                                 | 22.00      |

## GENERAL NOTES:

- (a) Dimensions are in inches.  
 (b) For other dimensions, see Table F22.

## NOTES:

- (1) Length of stud bolt does not include the height of the points. See para. 6.10.2.  
 (2) For flange bolt holes, see para. 6.5.  
 (3) For spot facing, see para. 6.6.  
 (4) Bolt lengths not shown in Table may be determined in accordance with Annex D. See para. 6.10.2.



Welding Neck

Table F22 Dimensions of Class 2500 Flanges

| 1                 | 2                             | 3                                        | 4                  | 5                                                            | 6                  | 7         | 8            | 9     | 10                                              | 11              | 12                                                 | 13                                  |
|-------------------|-------------------------------|------------------------------------------|--------------------|--------------------------------------------------------------|--------------------|-----------|--------------|-------|-------------------------------------------------|-----------------|----------------------------------------------------|-------------------------------------|
| Nominal Pipe Size | Outside Diameter of Flange, O | Thickness of Flange Min., t <sub>f</sub> | Diameter of Hub, X | Hub Diameter Beginning of Chamfer Welding Neck, A [Note (2)] | Length Through Hub |           | Welding Neck |       | Thread Length Threaded Flange Min. T [Note (3)] |                 | Corner Radius of Bore of Lapped Flange and Pipe, r | Counterbore Threaded Flange Min., Q |
|                   |                               |                                          |                    |                                                              | Threaded, Y        | Lapped, Y | Y            | Y     | Lapped Min., B                                  | Welding Neck, B |                                                    |                                     |
| 1/2               | 5.25                          | 1.19                                     | 1.69               | 0.84                                                         | 1.56               | 1.56      | 2.88         | 2.88  | 1.12                                            | 1.12            | 0.12                                               | 0.93                                |
| 3/4               | 5.50                          | 1.25                                     | 2.00               | 1.05                                                         | 1.69               | 1.69      | 3.12         | 3.12  | 1.25                                            | 1.25            | 0.12                                               | 1.14                                |
| 1                 | 6.25                          | 1.38                                     | 2.25               | 1.32                                                         | 1.88               | 1.88      | 3.50         | 3.50  | 1.38                                            | 1.38            | 0.12                                               | 1.41                                |
| 1 1/4             | 7.25                          | 1.50                                     | 2.88               | 1.66                                                         | 2.06               | 2.06      | 3.75         | 3.75  | 1.50                                            | 1.50            | 0.19                                               | 1.75                                |
| 1 1/2             | 8.00                          | 1.75                                     | 3.12               | 1.90                                                         | 2.38               | 2.38      | 4.38         | 4.38  | 1.75                                            | 1.75            | 0.25                                               | 1.99                                |
| 2                 | 9.25                          | 2.00                                     | 3.75               | 2.38                                                         | 2.75               | 2.75      | 5.00         | 5.00  | 2.00                                            | 2.00            | 0.31                                               | 2.50                                |
| 2 1/2             | 10.50                         | 2.25                                     | 4.50               | 2.88                                                         | 3.12               | 3.12      | 5.62         | 5.62  | 2.25                                            | 2.25            | 0.31                                               | 3.00                                |
| 3                 | 12.00                         | 2.62                                     | 5.25               | 3.50                                                         | ...                | 3.62      | 6.62         | 6.62  | ...                                             | 3.60            | 0.38                                               | ...                                 |
| 4                 | 14.00                         | 3.00                                     | 6.50               | 4.50                                                         | ...                | 4.25      | 7.50         | 7.50  | ...                                             | 4.60            | 0.44                                               | ...                                 |
| 5                 | 16.50                         | 3.62                                     | 8.00               | 5.56                                                         | ...                | 5.12      | 9.00         | 9.00  | ...                                             | 5.69            | 0.44                                               | ...                                 |
| 6                 | 19.00                         | 4.25                                     | 9.25               | 6.63                                                         | ...                | 6.00      | 10.75        | 10.75 | ...                                             | 6.75            | 0.50                                               | ...                                 |
| 8                 | 21.75                         | 5.00                                     | 12.00              | 8.63                                                         | ...                | 7.00      | 12.50        | 12.50 | ...                                             | 8.75            | 0.50                                               | ...                                 |
| 10                | 26.50                         | 6.50                                     | 14.75              | 10.75                                                        | ...                | 9.00      | 16.50        | 16.50 | ...                                             | 10.92           | 0.50                                               | ...                                 |
| 12                | 30.00                         | 7.25                                     | 17.38              | 12.75                                                        | ...                | 10.00     | 18.25        | 18.25 | ...                                             | 12.92           | 0.50                                               | ...                                 |

## Notes to Table F22

### GENERAL NOTES:

- (a) Dimensions are in inches.
- (b) For tolerances, see para. 7.
- (c) For facings, see para. 6.4.
- (d) For flange bolt holes, see para. 6.5 and Table F21.
- (e) For spot facing, see para. 6.6.
- (f) For reducing threaded and slip-on flanges, see Table F6.
- (g) Blind flanges may be made with or without hubs at the manufacturer's option.
- (h) For reducing welding neck flanges, see para. 6.8.

### NOTES:

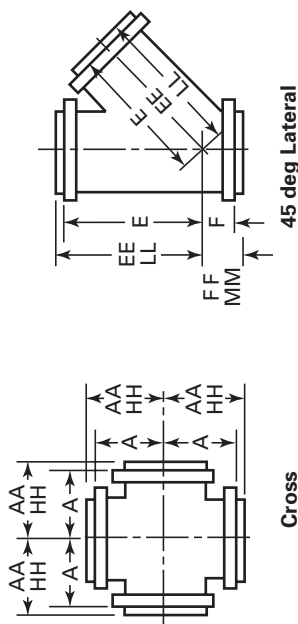
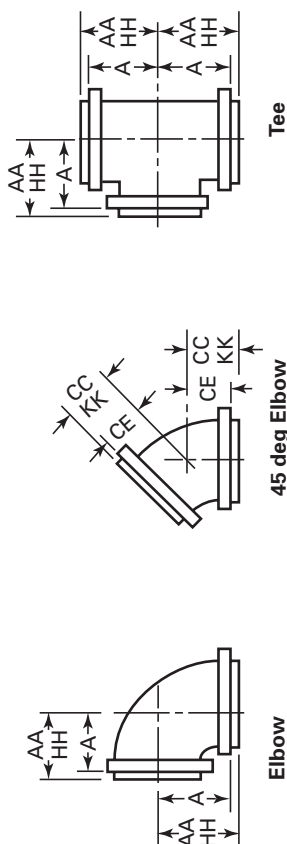
- (1) This dimension is for large end of hub, which may be straight or tapered. Taper shall not exceed 7 deg on threaded, slip-on, socket-welding, and lapped flanges.
- (2) For welding end bevel, see para. 6.7.
- (3) For threads in threaded flanges, see para. 6.9.

## **ANNEX G**

# **DIMENSIONS OF CLASSES 400, 600, 900, 1500, AND 2500 FLANGED FITTINGS IN U.S. CUSTOMARY UNITS**

This Annex is not a mandatory annex of B16.5-2003,  
and is placed after the main text for information.

This Annex contains Tables G1 through G5.



**Table G1 Dimensions of Class 400 Flanged Fittings**

| 1                               | 2                                             | 3                                                       | 4                                                        | 5                                             | 6                                                  | 7                                        | 8                                                                                             | 9                                                                              | 10                                                                                                | 11                                  | 12 | 13 | 14 |
|---------------------------------|-----------------------------------------------|---------------------------------------------------------|----------------------------------------------------------|-----------------------------------------------|----------------------------------------------------|------------------------------------------|-----------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------|-------------------------------------|----|----|----|
| Raised Face 0.25 in. [Note (1)] |                                               |                                                         |                                                          |                                               |                                                    |                                          |                                                                                               |                                                                                |                                                                                                   |                                     |    |    |    |
| Nominal<br>Pipe<br>Size         | Outside<br>Diameter<br>of Flange,<br><i>O</i> | Thickness<br>of Flange<br>Min.,<br><i>t<sub>f</sub></i> | Thickness<br>of Fitting<br>Min.,<br><i>t<sub>m</sub></i> | Inside<br>Diameter<br>of Fitting,<br><i>d</i> | Elbow, Tee,<br>Cross, and<br>True “Y”,<br><i>A</i> | Center-to-<br>Flange<br>Edge<br><i>C</i> | Long<br>Center-to-<br>Flange<br>Edge,<br>Lateral,<br>Tee, Cross,<br>and True “Y”,<br><i>E</i> | Short<br>Center-to-<br>Flange<br>Edge,<br>Lateral and<br>True “Y”,<br><i>F</i> | Flange<br>Edge-<br>to-<br>Flange<br>Edge,<br>Reducer,<br>Tee, Cross,<br>and True “Y”,<br><i>G</i> | Center-to-<br>Contact<br>Surface of |    |    |    |
|                                 |                                               |                                                         |                                                          |                                               |                                                    |                                          |                                                                                               |                                                                                |                                                                                                   | Raised Face                         |    |    |    |
|                                 |                                               |                                                         |                                                          |                                               |                                                    |                                          |                                                                                               |                                                                                |                                                                                                   | Center-to-<br>Contact<br>Surface of |    |    |    |
|                                 |                                               |                                                         |                                                          |                                               |                                                    |                                          |                                                                                               |                                                                                |                                                                                                   | Center-to-<br>Contact<br>Surface of |    |    |    |
|                                 |                                               |                                                         |                                                          |                                               |                                                    |                                          |                                                                                               |                                                                                |                                                                                                   | Center-to-<br>Contact<br>Surface of |    |    |    |
|                                 |                                               |                                                         |                                                          |                                               |                                                    |                                          |                                                                                               |                                                                                |                                                                                                   |                                     |    |    |    |
|                                 |                                               |                                                         |                                                          |                                               |                                                    |                                          |                                                                                               |                                                                                |                                                                                                   |                                     |    |    |    |
|                                 |                                               |                                                         |                                                          |                                               |                                                    |                                          |                                                                                               |                                                                                |                                                                                                   |                                     |    |    |    |
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Use Class 600 dimensions in these sizes.

Table G1 Dimensions of Class 400 Flanged Fittings (Cont'd)

| 1                       | 2                                             | 3                                                       | 4                                                                | 5                                             | 6                                                                         | 7                                                             | 8                                                             | 9                                                                           | 10                                                            | 11                                                                                                        | 12                                                                                      | 13                                                                                   | 14                                                                                                    |  |
|-------------------------|-----------------------------------------------|---------------------------------------------------------|------------------------------------------------------------------|-----------------------------------------------|---------------------------------------------------------------------------|---------------------------------------------------------------|---------------------------------------------------------------|-----------------------------------------------------------------------------|---------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------|--|
| Nominal<br>Pipe<br>Size | Outside<br>Diameter<br>of Flange,<br><i>O</i> | Thickness<br>of Flange<br>Min.,<br><i>t<sub>f</sub></i> | Wall<br>Thickness<br>of Fitting<br>Min.,<br><i>t<sub>m</sub></i> | Inside<br>Diameter<br>of Fitting,<br><i>d</i> | Flange Edge                                                               |                                                               |                                                               |                                                                             |                                                               |                                                                                                           |                                                                                         |                                                                                      | Raised Face 0.25 in. [Note (1)]                                                                       |  |
|                         |                                               |                                                         |                                                                  |                                               | Center-to-<br>Flange<br>Edge                                              |                                                               | Long<br>Center-to-<br>Flange<br>Edge                          |                                                                             | Short<br>Center-to-<br>Flange Edge                            |                                                                                                           | Flange<br>Edge-to-<br>Flange<br>Edge,<br>Reducer,<br><i>G</i>                           |                                                                                      |                                                                                                       |  |
|                         |                                               |                                                         |                                                                  |                                               | Center-to-<br>Flange<br>Edge, Tee,<br>Cross, and<br>True “Y”,<br><i>A</i> | Center-to-<br>Flange<br>Edge, 45<br>deg<br>Elbow,<br><i>C</i> | Long<br>Center-to-<br>Flange<br>Edge,<br>Lateral,<br><i>E</i> | Short<br>Center-to-<br>Flange Edge<br>Lateral, and<br>True “Y”,<br><i>F</i> | Flange<br>Edge-to-<br>Flange<br>Edge,<br>Reducer,<br><i>G</i> | Center-to-<br>Contact<br>Surface of<br>Raised Face<br>Elbow, Tee,<br>Cross, and<br>True “Y”,<br><i>AA</i> | Center-to-<br>Contact<br>Surface<br>of Raised<br>Face,<br>45 deg<br>Elbow,<br><i>CC</i> | Long<br>Center-to-<br>Contact<br>Surface of<br>Raised Face,<br>Lateral,<br><i>EE</i> | Short<br>Center-to-<br>Contact<br>Surface of<br>Raised Face,<br>Lateral and<br>True “Y”,<br><i>FF</i> |  |
| 4                       | 10.00                                         | 1.38                                                    | 0.38                                                             | 4.00                                          | 7.75                                                                      | 5.25                                                          | 15.75                                                         | 4.25                                                                        | 7.75                                                          | 8.00                                                                                                      | 5.50                                                                                    | 16.00                                                                                | 4.50                                                                                                  |  |
| 5                       | 11.00                                         | 1.50                                                    | 0.44                                                             | 5.00                                          | 8.75                                                                      | 5.75                                                          | 16.50                                                         | 4.75                                                                        | 8.75                                                          | 9.00                                                                                                      | 6.00                                                                                    | 16.75                                                                                | 5.00                                                                                                  |  |
| 6                       | 12.50                                         | 1.62                                                    | 0.44                                                             | 6.00                                          | 9.50                                                                      | 6.00                                                          | 18.50                                                         | 5.00                                                                        | 9.50                                                          | 9.75                                                                                                      | 6.25                                                                                    | 18.75                                                                                | 5.25                                                                                                  |  |
| 8                       | 15.00                                         | 1.88                                                    | 0.56                                                             | 8.00                                          | 11.50                                                                     | 6.50                                                          | 22.00                                                         | 5.50                                                                        | 11.50                                                         | 11.75                                                                                                     | 6.75                                                                                    | 22.25                                                                                | 5.75                                                                                                  |  |
| 10                      | 17.50                                         | 2.12                                                    | 0.69                                                             | 10.00                                         | 13.00                                                                     | 7.50                                                          | 25.50                                                         | 6.00                                                                        | 13.00                                                         | 13.25                                                                                                     | 7.75                                                                                    | 25.75                                                                                | 6.25                                                                                                  |  |
| 12                      | 20.50                                         | 2.25                                                    | 0.75                                                             | 12.00                                         | 14.75                                                                     | 8.50                                                          | 29.50                                                         | 6.25                                                                        | 14.75                                                         | 15.00                                                                                                     | 8.75                                                                                    | 29.75                                                                                | 6.50                                                                                                  |  |
| 14                      | 23.00                                         | 2.38                                                    | 0.81                                                             | 13.12                                         | 16.00                                                                     | 9.00                                                          | 32.50                                                         | 6.75                                                                        | 16.00                                                         | 16.25                                                                                                     | 9.25                                                                                    | 32.75                                                                                | 7.00                                                                                                  |  |
| 16                      | 25.50                                         | 2.50                                                    | 0.88                                                             | 15.00                                         | 17.50                                                                     | 10.00                                                         | 36.00                                                         | 7.75                                                                        | 18.00                                                         | 17.75                                                                                                     | 10.25                                                                                   | 36.25                                                                                | 8.00                                                                                                  |  |
| 18                      | 28.00                                         | 2.62                                                    | 0.94                                                             | 17.00                                         | 19.00                                                                     | 10.50                                                         | 39.00                                                         | 8.25                                                                        | 19.00                                                         | 19.25                                                                                                     | 10.75                                                                                   | 39.25                                                                                | 8.50                                                                                                  |  |
| 20                      | 30.50                                         | 2.75                                                    | 1.06                                                             | 18.88                                         | 20.50                                                                     | 11.00                                                         | 42.50                                                         | 8.75                                                                        | 20.50                                                         | 20.75                                                                                                     | 11.25                                                                                   | 42.75                                                                                | 9.00                                                                                                  |  |
| 24                      | 36.00                                         | 3.00                                                    | 1.19                                                             | 22.62                                         | 24.00                                                                     | 12.50                                                         | 50.00                                                         | 10.25                                                                       | 24.00                                                         | 24.25                                                                                                     | 12.75                                                                                   | 50.25                                                                                | 10.50                                                                                                 |  |



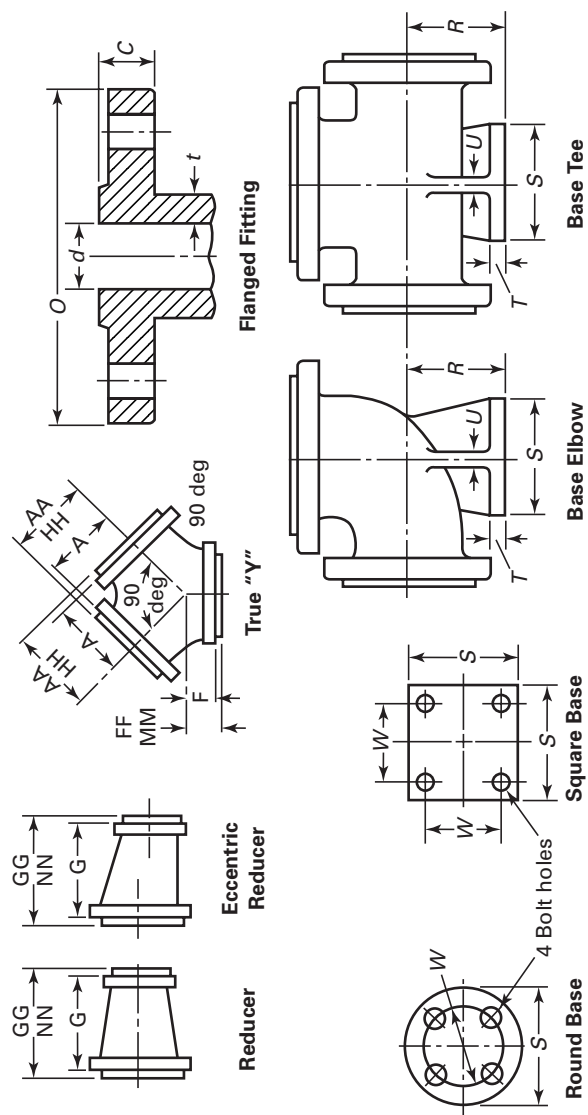


Table G1 Dimensions of Class 400 Flanged Fittings (Cont'd)

| 15                                                            | 16                                                | 17                              | 18                                            | 19                                            | 20                     | 21                | 22                                                | 23                   | 24                   | 25                             | 26                        | 1                 |
|---------------------------------------------------------------|---------------------------------------------------|---------------------------------|-----------------------------------------------|-----------------------------------------------|------------------------|-------------------|---------------------------------------------------|----------------------|----------------------|--------------------------------|---------------------------|-------------------|
| Raised Face<br>0.25 in. [Note (1)]                            |                                                   |                                 |                                               |                                               |                        |                   |                                                   |                      |                      |                                |                           |                   |
| Contact Surface-to-Contact Surface of Raised Face Reducer, GG | Ring Joint [Note (1)]                             |                                 |                                               |                                               | End-to-End Reducer, NN | Center-to-Base, R | Diameter of Round Base or Width of Square Base, S | Thickness of Base, T | Thickness of Ribs, U | Base Drilling [Note (8)]       |                           | Nominal Pipe Size |
|                                                               | Center-to-End Elbow, Tee, Cross, and True "Y", HH | Center-to-End, 45 deg Elbow, KK | Long Center-to-End, Lateral, and True "Y", LL | Short Center-to-End, Lateral and True "Y", MM |                        |                   |                                                   |                      |                      | Bolt Circle or Bolt Spacing, W | Diameter of Drilled Holes |                   |
|                                                               |                                                   |                                 |                                               |                                               |                        |                   |                                                   |                      |                      |                                |                           |                   |
| [Note (2)]                                                    | [Note (3)]                                        | [Note (3)]                      | [Note (3)]                                    | [Note (3)]                                    |                        | [Notes (4)–(6)]   | [Note (4)]                                        | [Notes (4), (7)]     | [Note (4)]           |                                |                           |                   |

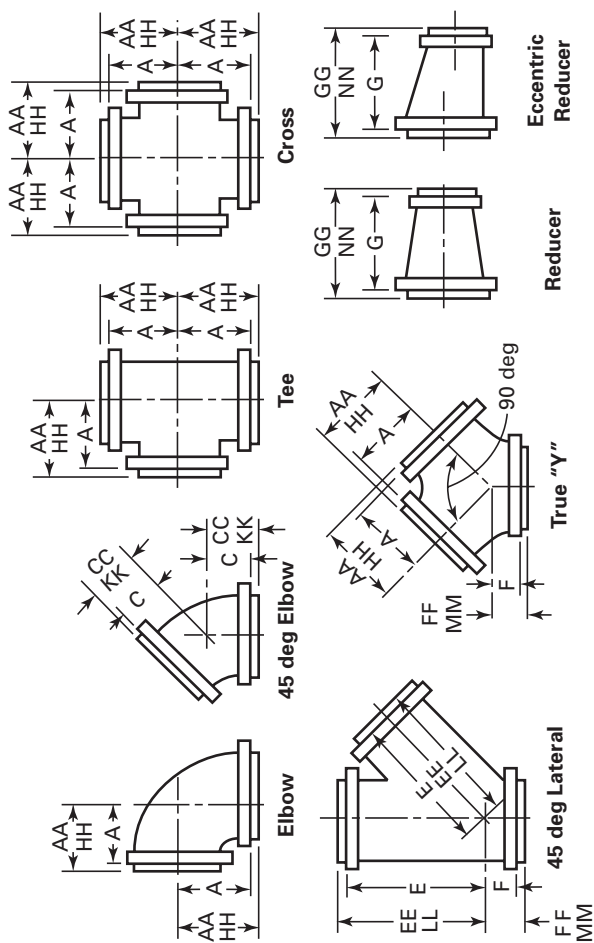
Use Class 600 dimensions in these sizes.

Table G1 Dimensions of Class 400 Flanged Fittings (Cont'd)

| 15                                                            | 16                                                                      | 17                                                    | 18                                  | 19                               | 20                              | 21                                | 22                                | 23                                                                      | 24                              | 25                      | 26 | 1 |
|---------------------------------------------------------------|-------------------------------------------------------------------------|-------------------------------------------------------|-------------------------------------|----------------------------------|---------------------------------|-----------------------------------|-----------------------------------|-------------------------------------------------------------------------|---------------------------------|-------------------------|----|---|
| Ring Joint [Note (1)]                                         |                                                                         |                                                       |                                     |                                  |                                 |                                   |                                   |                                                                         |                                 |                         |    |   |
| Raised Face<br>0.25 in. [Note (1)]                            | Diameter<br>of Round<br>Base or<br>Width of<br>Square<br>Base, <i>S</i> |                                                       |                                     |                                  |                                 |                                   |                                   |                                                                         |                                 |                         |    |   |
| Center-to-End<br>Elbow, Tee,<br>Cross, and<br>True "Y",<br>HH | Center-<br>to-End,<br>45 deg<br>Elbow,<br>KK                            | Center-<br>to-End,<br>Lateral,<br>and True "Y",<br>MM | Short<br>Center-to-<br>End, Lateral | End-to-<br>End<br>Reducer,<br>NN | Center-to-<br>Base,<br><i>R</i> | Thickness of<br>Base,<br><i>T</i> | Thickness<br>of Ribs,<br><i>U</i> | Base Drilling [Note (8)]<br>Bolt Circle or<br>Bolt Spacing,<br><i>W</i> | Diameter of<br>Drilled<br>Holes | Nominal<br>Pipe<br>Size |    |   |
| [Note (2)]                                                    | [Note (3)]                                                              | [Note (3)]                                            | [Note (3)]                          | [Note (3)]                       | [Notes (4)–(6)]                 | [Notes (4), (7)]                  | [Note (4)]                        |                                                                         |                                 |                         |    |   |
| 8.25                                                          | 8.06                                                                    | 5.56                                                  | 16.06                               | 4.56                             | 6.00                            | 0.88                              | 0.62                              | 5.00                                                                    | 0.75                            | 4                       |    |   |
| 9.25                                                          | 9.06                                                                    | 6.06                                                  | 16.81                               | 5.06                             | 6.75                            | 1.00                              | 0.75                              | 5.88                                                                    | 0.88                            | 5                       |    |   |
| 10.00                                                         | 9.81                                                                    | 6.31                                                  | 18.81                               | 5.31                             | 7.50                            | 1.00                              | 0.75                              | 5.88                                                                    | 0.88                            | 6                       |    |   |
| 12.00                                                         | 11.81                                                                   | 6.81                                                  | 22.31                               | 5.81                             | 9.00                            | 1.25                              | 0.88                              | 7.88                                                                    | 0.88                            | 8                       |    |   |
| 13.50                                                         | 13.31                                                                   | 7.81                                                  | 25.81                               | 6.31                             | 10.50                           | 1.25                              | 0.88                              | 7.88                                                                    | 0.88                            | 10                      |    |   |
| 15.25                                                         | 15.06                                                                   | 8.81                                                  | 29.81                               | 6.56                             | 12.00                           | 1.44                              | 1.00                              | 10.62                                                                   | 0.88                            | 12                      |    |   |
| 16.50                                                         | 16.31                                                                   | 9.31                                                  | 32.81                               | 7.06                             | 13.50                           | 1.44                              | 1.00                              | 10.62                                                                   | 0.88                            | 14                      |    |   |
| 18.50                                                         | 17.81                                                                   | 10.31                                                 | 36.31                               | 8.06                             | 14.75                           | 1.44                              | 1.12                              | 10.62                                                                   | 0.88                            | 16                      |    |   |
| 19.50                                                         | 19.31                                                                   | 10.81                                                 | 39.31                               | 8.56                             | 16.25                           | 1.62                              | 1.12                              | 13.00                                                                   | 1.00                            | 18                      |    |   |
| 21.00                                                         | 20.88                                                                   | 11.38                                                 | 42.88                               | 9.12                             | 17.88                           | 1.62                              | 1.25                              | 13.00                                                                   | 1.00                            | 20                      |    |   |
| 24.50                                                         | 24.44                                                                   | 12.94                                                 | 50.44                               | 10.69                            | 20.75                           | 1.88                              | 1.25                              | 15.25                                                                   | 1.12                            | 24                      |    |   |

## GENERAL NOTES:

- Dimensions are in inches.
  - For tolerances, see para. 7.
  - For facings, see para. 6.4.
  - For flange bolt holes, see para. 6.5 and Table F13 of Annex F.
  - For spot facing, see para. 6.6.
  - For intersecting centerlines, center-to-contact surface, and center-to-end dimensions of side outlet fittings, see para. 6.2.4.
  - For center-to-contact surface and center-to-end dimensions of special degree elbows, see para. 6.2.5.
  - For reinforcement of certain fittings, see para. 6.1.
  - For drains, see para. 6.12.
- NOTES:
- For center-to-contact surface and center-to-end dimensions of reducing fittings, see para. 6.2.3.
  - These dimensions apply to straight sizes only. (See paras. 6.2.3 and 6.4.2.2). For the center-to-end dimensions of reducing fittings or end-to-end dimensions of reducers, use center-to-flange edge or flange edge-to-flange edge dimensions for largest opening, and add the proper height to provide for ring joint groove applying to each flange. See Table F5 of Annex F for ring joint facing dimensions.
  - The base dimensions apply to all straight and reducing sizes.
  - For reducing fittings, the size and center-to-face dimensions of base are determined by the size of the largest opening of fitting. In the case of reducing base elbows, orders shall specify whether the base shall be opposite the larger or smaller opening.
  - Bases shall be plain faced unless otherwise specified, and the center-to-base face dimension *R* shall be the finished dimension.
  - Bases may be cast integral or attached as weldments at the option of the manufacturer.
  - The bases of these fittings are intended for support in compression and are not to be used for anchors or supports in tension or shear.

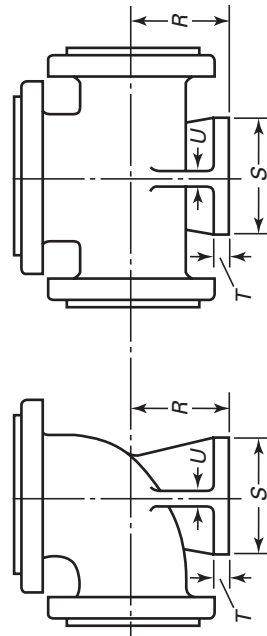
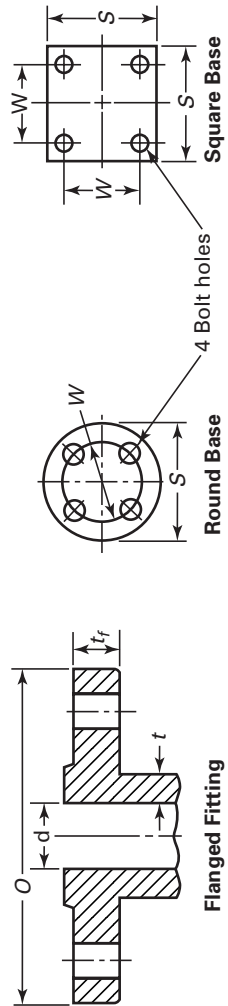


### Table G2 Dimensions of Class 600 Flanged Fittings

| 1                               | 2                                             | 3                                                        | 4                                                                | 5                                             | 6                                                                            | 7                                                      | 8                                                          | 9                                                                        | 10                                                         | 11                                                                                              | 12                                                                        | 13                                                                         | 14                                                                                          |
|---------------------------------|-----------------------------------------------|----------------------------------------------------------|------------------------------------------------------------------|-----------------------------------------------|------------------------------------------------------------------------------|--------------------------------------------------------|------------------------------------------------------------|--------------------------------------------------------------------------|------------------------------------------------------------|-------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------|----------------------------------------------------------------------------|---------------------------------------------------------------------------------------------|
| Raised Face 0.25 in. [Note (1)] |                                               |                                                          |                                                                  |                                               |                                                                              |                                                        |                                                            |                                                                          |                                                            |                                                                                                 |                                                                           |                                                                            |                                                                                             |
| Flange Edge                     |                                               |                                                          |                                                                  |                                               |                                                                              |                                                        |                                                            |                                                                          |                                                            |                                                                                                 |                                                                           |                                                                            |                                                                                             |
|                                 |                                               |                                                          |                                                                  |                                               |                                                                              |                                                        |                                                            |                                                                          |                                                            |                                                                                                 |                                                                           |                                                                            |                                                                                             |
| Nominal<br>Pipe Size            | Outside<br>Diameter<br>of Flange,<br><i>O</i> | Thickness<br>of Flange,<br>Min.,<br><i>t<sub>m</sub></i> | Wall<br>Thickness<br>of Fitting<br>Min.,<br><i>t<sub>m</sub></i> | Inside<br>Diameter of<br>Fitting,<br><i>d</i> | Center-to-Flange<br>Edge, Elbow,<br>Tee, Cross, and<br>True "Y",<br><i>A</i> | Center-to-Flange<br>Edge, 45 deg<br>Elbow,<br><i>C</i> | Long Center-<br>to Flange<br>Edge,<br>Lateral,<br><i>E</i> | Short Center-to-<br>Flange Edge,<br>Lateral and<br>True "Y",<br><i>F</i> | Flange Edge-<br>to-Flange<br>Edge,<br>Reducer,<br><i>G</i> | Center-to-Contact<br>Surface of<br>Raised Face,<br>Elbow, Tee,<br>Cross, and<br>True "Y",<br>AA | Center-to-Contact<br>Surface of<br>Raised Face,<br>45 deg<br>Elbow,<br>CC | Long Center-<br>to-Contact<br>Surface of<br>Raised Face,<br>Lateral,<br>EE | Short Center-<br>to-Contact<br>Surface of<br>Raised Face,<br>Lateral and<br>True "Y",<br>FF |
| 1½                              | 3.75                                          | 0.56                                                     | 0.16                                                             | 0.50                                          | 3.00                                                                         | 1.75                                                   | 5.50                                                       | 1.50                                                                     | 4.50                                                       | 3.25                                                                                            | 2.00                                                                      | 5.75                                                                       | 1.75                                                                                        |
| ¾                               | 4.62                                          | 0.62                                                     | 0.16                                                             | 0.75                                          | 3.50                                                                         | 2.25                                                   | 6.50                                                       | 1.75                                                                     | 4.50                                                       | 3.75                                                                                            | 2.50                                                                      | 6.75                                                                       | 2.00                                                                                        |
| 1                               | 4.88                                          | 0.69                                                     | 0.19                                                             | 1.00                                          | 4.00                                                                         | 2.25                                                   | 7.00                                                       | 2.00                                                                     | 4.50                                                       | 4.25                                                                                            | 2.50                                                                      | 7.25                                                                       | 2.25                                                                                        |
| 1¼                              | 5.25                                          | 0.81                                                     | 0.19                                                             | 1.25                                          | 4.25                                                                         | 2.50                                                   | 7.75                                                       | 2.25                                                                     | 4.50                                                       | 4.50                                                                                            | 2.75                                                                      | 8.00                                                                       | 2.50                                                                                        |
| 1½                              | 6.12                                          | 0.88                                                     | 0.22                                                             | 1.50                                          | 4.50                                                                         | 2.75                                                   | 8.75                                                       | 2.50                                                                     | 4.50                                                       | 4.75                                                                                            | 3.00                                                                      | 9.00                                                                       | 2.75                                                                                        |
| 2                               | 6.50                                          | 1.00                                                     | 0.25                                                             | 2.00                                          | 5.50                                                                         | 4.00                                                   | 10.00                                                      | 3.25                                                                     | 5.50                                                       | 5.75                                                                                            | 4.25                                                                      | 10.25                                                                      | 3.50                                                                                        |
| 2½                              | 7.50                                          | 1.12                                                     | 0.28                                                             | 2.50                                          | 6.25                                                                         | 4.25                                                   | 11.25                                                      | 3.25                                                                     | 6.25                                                       | 6.50                                                                                            | 4.50                                                                      | 11.50                                                                      | 3.50                                                                                        |
| 3                               | 8.25                                          | 1.25                                                     | 0.31                                                             | 3.00                                          | 6.75                                                                         | 4.75                                                   | 12.50                                                      | 3.75                                                                     | 6.75                                                       | 7.00                                                                                            | 5.00                                                                      | 12.75                                                                      | 4.00                                                                                        |
| 3½                              | 9.00                                          | 1.38                                                     | 0.34                                                             | 3.50                                          | 7.25                                                                         | 5.25                                                   | 13.75                                                      | 4.25                                                                     | 7.25                                                       | 7.50                                                                                            | 5.50                                                                      | 14.00                                                                      | 4.50                                                                                        |
| 4                               | 10.75                                         | 1.50                                                     | 0.38                                                             | 4.00                                          | 8.25                                                                         | 5.75                                                   | 16.25                                                      | 4.25                                                                     | 8.25                                                       | 8.50                                                                                            | 6.00                                                                      | 16.50                                                                      | 4.50                                                                                        |

Table G2 Dimensions of Class 600 Flanged Fittings (Cont'd)

| 1                    | 2                                             | 3                                                       | 4                                                                | 5                                             | 6                                                                            | 7                                                         | 8                                                          | 9                                                                         | 10                                                         | 11                                                                                                            | 12                                                                                   | 13                                                                                   | 14                                                                                                    |
|----------------------|-----------------------------------------------|---------------------------------------------------------|------------------------------------------------------------------|-----------------------------------------------|------------------------------------------------------------------------------|-----------------------------------------------------------|------------------------------------------------------------|---------------------------------------------------------------------------|------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------|
| Nominal<br>Pipe Size | Outside<br>Diameter<br>of Flange,<br><i>O</i> | Thickness<br>of Flange<br>Min.,<br><i>t<sub>f</sub></i> | Wall<br>Thickness<br>of Fitting<br>Min.,<br><i>t<sub>m</sub></i> | Inside<br>Diameter of<br>Fitting,<br><i>d</i> | Flange Edge                                                                  |                                                           |                                                            |                                                                           |                                                            | Raised Face 0.25 in. [Note (1)]                                                                               |                                                                                      |                                                                                      |                                                                                                       |
|                      |                                               |                                                         |                                                                  |                                               | Center-to-Flange<br>Edge, Elbow,<br>Tee, Cross, and<br>True “Y”,<br><i>A</i> | Center-to-Flange<br>Edge, 45<br>deg<br>Elbow,<br><i>C</i> | Long Center-<br>to Flange<br>Edge,<br>Lateral,<br><i>E</i> | Short Center-to-<br>Flange Edge,<br>Lateral, and<br>True “Y”,<br><i>F</i> | Flange Edge-<br>to-Flange<br>Edge,<br>Reducer,<br><i>G</i> | Center-to-<br>Contact<br>Surface of<br>Raised<br>Face,<br>Elbow, Tee,<br>Cross, and<br>True “Y”,<br><i>AA</i> | Center-to-<br>Contact<br>Surface of<br>Raised Face,<br>45 deg<br>Elbow,<br><i>CC</i> | Long<br>Center-to-<br>Contact<br>Surface of<br>Raised Face,<br>Lateral,<br><i>EE</i> | Short<br>Center-to-<br>Contact<br>Surface of<br>Raised Face,<br>Lateral and<br>True “Y”,<br><i>FF</i> |
| 5                    | 13.00                                         | 1.75                                                    | 0.44                                                             | 5.00                                          | 9.75                                                                         | 6.75                                                      | 19.25                                                      | 5.75                                                                      | 9.75                                                       | 10.00                                                                                                         | 7.00                                                                                 | 19.50                                                                                | 6.00                                                                                                  |
| 6                    | 14.00                                         | 1.88                                                    | 0.50                                                             | 6.00                                          | 10.75                                                                        | 7.25                                                      | 20.75                                                      | 6.25                                                                      | 10.75                                                      | 11.00                                                                                                         | 7.50                                                                                 | 21.00                                                                                | 6.50                                                                                                  |
| 8                    | 16.50                                         | 2.19                                                    | 0.62                                                             | 7.88                                          | 12.75                                                                        | 8.25                                                      | 24.25                                                      | 6.75                                                                      | 12.75                                                      | 13.00                                                                                                         | 8.50                                                                                 | 24.50                                                                                | 7.00                                                                                                  |
| 10                   | 20.00                                         | 2.50                                                    | 0.75                                                             | 9.75                                          | 15.25                                                                        | 9.25                                                      | 29.25                                                      | 7.75                                                                      | 15.25                                                      | 15.50                                                                                                         | 9.50                                                                                 | 29.50                                                                                | 8.00                                                                                                  |
| 12                   | 22.00                                         | 2.62                                                    | 0.91                                                             | 11.75                                         | 16.25                                                                        | 9.75                                                      | 31.25                                                      | 8.25                                                                      | 16.25                                                      | 16.50                                                                                                         | 10.00                                                                                | 31.50                                                                                | 8.50                                                                                                  |
| 14                   | 23.75                                         | 2.75                                                    | 0.97                                                             | 12.88                                         | 17.25                                                                        | 10.50                                                     | 34.00                                                      | 8.75                                                                      | 17.25                                                      | 17.50                                                                                                         | 10.75                                                                                | 34.25                                                                                | 9.00                                                                                                  |
| 16                   | 27.00                                         | 3.00                                                    | 1.09                                                             | 14.75                                         | 19.25                                                                        | 11.50                                                     | 38.25                                                      | 9.75                                                                      | 19.25                                                      | 19.50                                                                                                         | 11.75                                                                                | 38.50                                                                                | 10.00                                                                                                 |
| 18                   | 29.25                                         | 3.25                                                    | 1.22                                                             | 16.50                                         | 21.25                                                                        | 12.00                                                     | 41.75                                                      | 10.25                                                                     | 21.25                                                      | 21.50                                                                                                         | 12.25                                                                                | 42.00                                                                                | 10.50                                                                                                 |
| 20                   | 32.00                                         | 3.50                                                    | 1.34                                                             | 18.25                                         | 23.25                                                                        | 12.75                                                     | 45.25                                                      | 10.75                                                                     | 23.25                                                      | 23.50                                                                                                         | 13.00                                                                                | 45.50                                                                                | 11.00                                                                                                 |
| 24                   | 37.00                                         | 4.00                                                    | 1.59                                                             | 22.00                                         | 27.25                                                                        | 14.50                                                     | 52.75                                                      | 12.75                                                                     | 27.25                                                      | 27.50                                                                                                         | 14.75                                                                                | 53.00                                                                                | 13.00                                                                                                 |



**Table G2 Dimensions of Class 600 Flanged Fittings (Cont'd)**

| 15                                                                       | 16                                                           | 17 | 18 | 19 | 20                                        | 21 | 22 | 23 | 24                                   | 25 | 26 | 1 |                                                          |  |  |  |                                   |  |  |  |                                   |  |  |  |                                                              |  |  |  |                                       |  |  |  |                                 |  |  |  |                                |  |  |  |                           |  |  |  |                   |  |  |  |            |  |  |  |            |  |  |  |            |  |  |  |            |  |  |  |            |  |  |  |            |  |  |  |            |  |  |  |            |  |  |  |            |  |  |  |            |  |  |  |            |  |  |  |            |  |  |  |            |  |  |  |            |  |  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| Contact Surface-to-Contact Surface of Raised Face Reducer, GG [Note (2)] | Center-to-End Elbow, Tee, Cross, and True "Y", HH [Note (3)] |    |    |    | Center-to-End 45 deg Elbow, KK [Note (3)] |    |    |    | Center-to-End Lateral, LL [Note (3)] |    |    |   | Short Center-to-End, Lateral And True "Y", MM [Note (3)] |  |  |  | End-to-End Reducer, NN [Note (3)] |  |  |  | Center-to-Base, R [Notes (4)–(6)] |  |  |  | Diameter of Round Base or Width of Square Base, S [Note (4)] |  |  |  | Thickness of Base, T [Notes (4), (7)] |  |  |  | Thickness of Ribs, U [Note (4)] |  |  |  | Bolt Circle or Bolt Spacing, W |  |  |  | Diameter of Drilled Holes |  |  |  | Nominal Pipe Size |  |  |  |            |  |  |  |            |  |  |  |            |  |  |  |            |  |  |  |            |  |  |  |            |  |  |  |            |  |  |  |            |  |  |  |            |  |  |  |            |  |  |  |            |  |  |  |            |  |  |  |            |  |  |  |            |  |  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|                                                                          | [Note (2)]                                                   |    |    |    | [Note (3)]                                |    |    |    | [Note (3)]                           |    |    |   | [Note (3)]                                               |  |  |  | [Note (3)]                        |  |  |  | [Note (3)]                        |  |  |  | [Note (4)]                                                   |  |  |  | [Note (4)]                            |  |  |  | [Note (4)]                      |  |  |  | [Note (4)]                     |  |  |  | [Note (4)]                |  |  |  | [Note (4)]        |  |  |  | [Note (4)] |  |  |  | [Note (4)] |  |  |  | [Note (4)] |  |  |  | [Note (4)] |  |  |  | [Note (4)] |  |  |  | [Note (4)] |  |  |  | [Note (4)] |  |  |  | [Note (4)] |  |  |  | [Note (4)] |  |  |  | [Note (4)] |  |  |  | [Note (4)] |  |  |  | [Note (4)] |  |  |  | [Note (4)] |  |  |  | [Note (4)] |  |  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|  | [Note (4)] |  |  |  | [Note (4)] |  |  |  | [Note (4)] |  |  |  | [Note (4)] |  |  |  | [Note (4)] |  |  |  | [Note (4)] |  |  |  | [Note (4)] |  |  |  | [Note (4)] |  |  |  | [Note (4)] |  |  |  | [Note (4)] |  |  |  | [Note (4)] |  |  |  | [Note (4)] |  |  |  | [Note (4)] |  |  |  | [Note (4)] |  |  |  | [Note (4)] |  |  |  | [Note (4)] |  |  |  | [Note (4)] |  |  |  | [Note (4)] |  |  |  | [Note (4)] |  |  |  | [Note (4)] |  |  |  | [Note (4)] |  |  |  | [Note (4)] |  |  |  | [Note (4)] |  |  |  | [Note (4)] |  |  |  | [Note (4)] |  |  |  | [Note (4)] |  |  |  | [Note (4)] |  |  |  | [Note (4)] |  |  |  | [Note (4)] |  |  |  | [Note (4)] |  |  |  | [Note (4)] |  |  |  | [Note (4)] |  |  |  | [Note (4)] |  |  |  | [Note (4)] |  |  |  | [Note (4)] |  |  |  | [Note (4)] |  |  |  | [Note (4)] |  |  |  | [Note (4)] |  |  |  | [Note (4)] |  |  |  | [Note (4)] |  |  |  | [Note (4)] |  |  |  | [Note (4)] |  |  |  | [Note (4)] |  |  |  | [Note (4)] |  |  |  | [Note (4)] |  |  |  | [Note (4)] |  |  |  | [Note (4)] |  |  |  | [Note (4)] |  |  |  | [Note (4)] |  |  |  | [Note (4)] |  |  |  | [Note (4)] |  |  |  | [Note (4)] |  |  |  | [Note (4)] |  |  |  | [Note (4)] |  |  |  | [Note (4)] |  |  |  | [Note (4)] |  |  |  | [Note (4)] |  |  |  | [Note (4)] |  |  |  | [Note (4)] |  |  |  | [Note (4)] |  |  |  | [Note (4)] |  |  |  | [Note (4)] |  |  |  | [Note (4)] |  |  |  | [Note (4)] |  |  |  | [Note (4)] |  |  |  | [Note (4)] |  |  |  | [Note (4)] |  |  |  | [Note (4)] |  |  |  | [Note (4)] |  |  |  | [Note (4)] |  |  |  | [Note (4)] |  |  |  | [Note (4)] |  |  |  | [Note (4)] |  |  |  | [Note (4)] |  |  |  | [Note (4)] |  |  |  | [Note (4)] |  |  |  | [Note (4)] |  |  |  | [Note (4)] |  |  |  | [Note (4)] |  |  |  | [Note (4)] |  |  |  | [Note (4)] |  |  |  | [Note (4)] |  |  |  | [Note (4)] |  |  |  | [Note (4)] |  |  |  | [Note (4)] |  |  |  | [Note (4)] |  |  |  | [Note (4)] |  |  |  | [Note (4)] |  |  |  | [Note (4)] |  |  |  | [Note (4)] |  |  |  | [Note (4)] |  |  |  | [Note (4)] |  |  |  | [Note (4)] |  |  |  | [Note (4)] |  |  |  | [Note (4)] |  |  |  | [Note (4)] |  |  |  | [Note (4)] |  |  |  | [Note (4)] |  |  |  | [Note (4)] |  |  |  | [Note (4)] |  |  |  | [Note (4)] |  |  |  | [Note (4)] |  |  |  | [Note (4)] |  |  |  | [Note (4)] |  |  |  | [Note (4)] |  |  |  | [Note (4)] |  |  |  | [Note (4)] |  |  |  | [Note (4)] |  |  |  | [Note (4)] |  |  |  | [Note (4)] |  |  |  | [Note (4)] |  |  |  | [Note (4)] |  |  |  | [Note (4)] |  |  |  | [Note (4)] |  |  |  | [Note (4)] |  |  |  | [Note (4)] |  |  |  | [Note (4)] |  |  |  | [Note (4)] |  |  |  | [Note (4)] |  |  |  | [Note (4)] |  |  |  | [Note (4)] |  |  |  | [Note (4)] |  |  |  | [Note (4)] |  |  |  | [Note (4)] |  |  |  | [Note (4)] |  |  |  | [Note (4)] |  |  |  | [Note (4)] |  |  |  | [Note (4)] |  |  |  | [Note (4)] |  |  |  | [Note (4)] |  |  |  | [Note (4)] |  |  |  | [Note (4)] |  |  |  | [Note (4)] |  |  |  | [Note (4)] |  |  |  | [Note (4)] |  |  |  | [Note (4)] |  |  |  | [Note (4)] |  |  |  | [Note (4)] |  |  |  | [Note (4)] |  |  |  | [Note (4)] |  |  |  | [Note (4)] |  |  |  | [Note (4)] |  |  |  | [Note (4)] |  |  |  | [Note (4)] |  |  |  | [Note (4)] |  |  |  | [Note (4)] |  |  |  | [Note (4)] |  |  |  | [Note (4)] |  |  |  | [Note (4)] |  |  |  | [Note (4)] |  |  |  | [Note (4)] |  |  |  | [Note (4)] |  |  |  | [Note (4)] |  |  |  | [Note (4)] |  |  |  | [Note (4)] |  |  |  | [Note (4)] |  |  |  | [Note (4)] |  |  |  | [Note (4)] |  |  |  | [Note (4)] |  |  |  | [Note (4)] |  |  |  | [Note (4)] |  |  |  | [Note (4)] |  |  |  | [Note (4)] |  |  |  | [Note (4)] |  |  |  | [Note (4)] |  |  |  | [Note (4)] |  |  |  | [Note (4)] |  |  |  | [Note (4)] |  |  |  | [Note (4)] |  |  |  | [Note (4)] |  |  |  | [Note (4)] |  |  |  | [Note (4)] |  |  |  | [Note (4)] |  |  |  | [Note (4)] |  |  |  | [Note (4)] |  |  |  | [Note (4)] |  |  |  | [Note (4)] |  |  |  | [Note (4)] |  |  |  | [Note (4)] |  |  |  | [Note (4)] |  |  |  | [Note (4)] |  |  |  | [Note (4)] |  |  |  | [Note (4)] |  |  |  | [Note (4)] |  |  |  | [Note (4)] |  |  |  | [Note (4)] |  |  |  | [Note (4)] |  |  |  | [Note (4)] |  |  |  | [Note (4)] |  |  |  | [Note (4)] |  |  |  | [Note (4)] |  |  |  | [Note (4)] |  |  |  | [Note (4)] |  |  |  | [Note (4)] |  |  |  | [Note (4)] |  |  |  | [Note (4)] |  |  |  | [Note (4)] |  |  |  | [Note (4)] |  |  |  | [Note (4)] |  |  |  | [Note (4)] |  |  |  | [Note (4)] |  |  |  | [Note (4)] |  |  |  | [Note (4)] |  |  |  | [Note (4)] |  |  |  | [Note (4)] |  |  |  | [Note (4)] |  |  |  | [Note (4)] |  |  |  | [Note (4)] |  |  |  | [Note (4)] |  |  |  | [Note (4)] |  |  |  | [Note (4)] |  |  |  | [Note (4)] |  |  |  | [Note (4)] |  |  |  | [Note (4)] |  |  |  | [Note (4)] |  |  |  | [Note (4)] |  |  |  | [Note (4)] |  |  |  | [Note (4)] |  |  |  | [Note (4)] |  |  |  | [Note (4)] |  |  |  | [Note (4)] |  |  |  | [Note (4)] |  |  |  | [Note (4)] |  |  |  | [Note (4)] |  |  |  | [Note (4)] |  |  |  | [Note (4)] |  |  |  | [Note (4)] |  |  |  | [Note (4)] |  |  |  | [Note (4)] |  |  |  | [Note (4)] |  |  |  | [Note (4)] |  |  |  | [Note (4)] |  |  |  | [Note (4)] |  |  |  | [Note (4)] |  |  |  | [Note (4)] |  |  |  | [Note (4)] |  |  |  | [Note (4)] |  |  |  | [Note (4)] |  |  |  | [Note (4)] |  |  |  | [Note (4)] |  |  |  | [Note (4)] |  |  |  | [Note (4)] |  |  |  | [Note (4)] |  |  |  | [Note (4)] |  |  |  | [Note (4)] |  |  |  | [Note (4)] |  |  |  | [Note (4)] |  |  |  | [Note (4)] |  |  |  | [Note (4)] |  |  |  | [Note (4)] |  |  |  | [Note (4 |  |  |  |

Table G2 Dimensions of Class 600 Flanged Fittings (Cont'd)

| 15                                                                       | 16                                                           | 17    | 18                                                           | 19    | 20                                                           | 21    | 22                                                           | 23    | 24                                                           | 25    | 26                                                           | 1     |
|--------------------------------------------------------------------------|--------------------------------------------------------------|-------|--------------------------------------------------------------|-------|--------------------------------------------------------------|-------|--------------------------------------------------------------|-------|--------------------------------------------------------------|-------|--------------------------------------------------------------|-------|
| Ring Joint [Note (1)]                                                    |                                                              |       |                                                              |       |                                                              |       |                                                              |       |                                                              |       |                                                              |       |
| Raised Face                                                              |                                                              |       |                                                              |       |                                                              |       |                                                              |       |                                                              |       |                                                              |       |
| 0.25 in. [Note (1)]                                                      |                                                              |       |                                                              |       |                                                              |       |                                                              |       |                                                              |       |                                                              |       |
| Contact Surface-to-Contact Surface of Raised Face Reducer, GG [Note (2)] | Center-to-End Elbow, Tee, Cross, and True "Y", HH [Note (3)] |       | Center-to-End, 45 deg Elbow, KK [Note (3)]                   |       | Long Center-to-End, Lateral, LL [Note (3)]                   |       | Short Center-to-End, Lateral And True "Y", MM [Note (3)]     |       | End-to-End Reducer, NN [Note (3)]                            |       | Center-to-Base, R [Notes (4)–(6)]                            |       |
|                                                                          | [Note (3)]                                                   |       | [Note (3)]                                                   |       | [Note (3)]                                                   |       | [Note (3)]                                                   |       | [Note (3)]                                                   |       | [Notes (4), (7)]                                             |       |
| Thickness of Base, T [Note (4)]                                          | Thickness of Base, T [Note (4)]                              |       | Thickness of Base, T [Note (4)]                              |       | Thickness of Base, T [Note (4)]                              |       | Thickness of Base, T [Note (4)]                              |       | Thickness of Base, T [Note (4)]                              |       | Thickness of Base, T [Note (4)]                              |       |
|                                                                          | [Note (4)]                                                   |       | [Note (4)]                                                   |       | [Note (4)]                                                   |       | [Note (4)]                                                   |       | [Note (4)]                                                   |       | [Note (4)]                                                   |       |
| Diameter of Round Base or Width of Square Base, S [Note (4)]             | Diameter of Round Base or Width of Square Base, S [Note (4)] |       | Diameter of Round Base or Width of Square Base, S [Note (4)] |       | Diameter of Round Base or Width of Square Base, S [Note (4)] |       | Diameter of Round Base or Width of Square Base, S [Note (4)] |       | Diameter of Round Base or Width of Square Base, S [Note (4)] |       | Diameter of Round Base or Width of Square Base, S [Note (4)] |       |
|                                                                          | [Note (4)]                                                   |       | [Note (4)]                                                   |       | [Note (4)]                                                   |       | [Note (4)]                                                   |       | [Note (4)]                                                   |       | [Note (4)]                                                   |       |
| Thickness of Ribs, U [Note (4)]                                          | Thickness of Ribs, U [Note (4)]                              |       | Thickness of Ribs, U [Note (4)]                              |       | Thickness of Ribs, U [Note (4)]                              |       | Thickness of Ribs, U [Note (4)]                              |       | Thickness of Ribs, U [Note (4)]                              |       | Thickness of Ribs, U [Note (4)]                              |       |
|                                                                          | [Note (4)]                                                   |       | [Note (4)]                                                   |       | [Note (4)]                                                   |       | [Note (4)]                                                   |       | [Note (4)]                                                   |       | [Note (4)]                                                   |       |
| Bolt Circle or Bolt Spacing, W [Note (8)]                                | Bolt Circle or Bolt Spacing, W [Note (8)]                    |       | Bolt Circle or Bolt Spacing, W [Note (8)]                    |       | Bolt Circle or Bolt Spacing, W [Note (8)]                    |       | Bolt Circle or Bolt Spacing, W [Note (8)]                    |       | Bolt Circle or Bolt Spacing, W [Note (8)]                    |       | Bolt Circle or Bolt Spacing, W [Note (8)]                    |       |
|                                                                          | [Note (8)]                                                   |       | [Note (8)]                                                   |       | [Note (8)]                                                   |       | [Note (8)]                                                   |       | [Note (8)]                                                   |       | [Note (8)]                                                   |       |
| Nominal Pipe Size                                                        | Nominal Pipe Size                                            |       | Nominal Pipe Size                                            |       | Nominal Pipe Size                                            |       | Nominal Pipe Size                                            |       | Nominal Pipe Size                                            |       | Nominal Pipe Size                                            |       |
|                                                                          | [Note (8)]                                                   |       | [Note (8)]                                                   |       | [Note (8)]                                                   |       | [Note (8)]                                                   |       | [Note (8)]                                                   |       | [Note (8)]                                                   |       |
| 10.25                                                                    | 10.06                                                        | 7.06  | 19.56                                                        | 6.06  | 19.56                                                        | 6.06  | 19.56                                                        | 6.06  | 19.56                                                        | 6.06  | 19.56                                                        | 6.06  |
| 11.25                                                                    | 11.06                                                        | 7.56  | 21.06                                                        | 6.56  | 21.06                                                        | 6.56  | 21.06                                                        | 6.56  | 21.06                                                        | 6.56  | 21.06                                                        | 6.56  |
| 13.25                                                                    | 13.06                                                        | 8.56  | 24.56                                                        | 7.06  | 24.56                                                        | 7.06  | 24.56                                                        | 7.06  | 24.56                                                        | 7.06  | 24.56                                                        | 7.06  |
| 15.75                                                                    | 15.56                                                        | 9.56  | 29.56                                                        | 8.06  | 29.56                                                        | 8.06  | 29.56                                                        | 8.06  | 29.56                                                        | 8.06  | 29.56                                                        | 8.06  |
| 16.75                                                                    | 16.56                                                        | 10.06 | 31.56                                                        | 8.56  | 31.56                                                        | 8.56  | 31.56                                                        | 8.56  | 31.56                                                        | 8.56  | 31.56                                                        | 8.56  |
| 17.75                                                                    | 17.56                                                        | 10.81 | 34.31                                                        | 9.06  | 34.31                                                        | 9.06  | 34.31                                                        | 9.06  | 34.31                                                        | 9.06  | 34.31                                                        | 9.06  |
| 19.75                                                                    | 19.56                                                        | 11.81 | 38.56                                                        | 10.06 | 38.56                                                        | 10.06 | 38.56                                                        | 10.06 | 38.56                                                        | 10.06 | 38.56                                                        | 10.06 |
| 21.75                                                                    | 21.56                                                        | 12.31 | 42.06                                                        | 10.56 | 42.06                                                        | 10.56 | 42.06                                                        | 10.56 | 42.06                                                        | 10.56 | 42.06                                                        | 10.56 |
| 23.75                                                                    | 23.62                                                        | 13.12 | 45.62                                                        | 11.12 | 45.62                                                        | 11.12 | 45.62                                                        | 11.12 | 45.62                                                        | 11.12 | 45.62                                                        | 11.12 |
| 27.75                                                                    | 27.69                                                        | 14.94 | 53.19                                                        | 13.19 | 53.19                                                        | 13.19 | 53.19                                                        | 13.19 | 53.19                                                        | 13.19 | 53.19                                                        | 13.19 |

## GENERAL NOTES:

- Dimensions are in inches.
- For tolerances, see para. 7.
- For facings, see para. 6.4.
- For flange bolt holes, see para. 6.5 and Table F15 of Annex F.
- For spot facing, see para. 6.6.
- For intersecting centerlines, center-to-contact surface, and center-to-end dimensions of side outlet fittings, see para. 6.2.4.
- For center-to-contact surface and center-to-end dimensions of special degree elbows, see para. 6.2.5.
- For reinforcement of certain fittings, see para. 6.1.
- For drains, see para. 6.12.

## NOTES:

- For center-to-contact surface and center-to-end dimensions of reducing fittings, see para. 6.2.3.
- For contact surface-to-contact surface and end-to-end dimensions of reducers and eccentric reducers, see para. 6.2.3.
- These dimensions apply to straight sizes only. (See paras. 6.2.3 and 6.4.2.2.) For the center-to-end dimensions of reducing fittings or end-to-end dimensions of reducers, use center-to-flange edge or flange edge-to-flange edge dimensions for largest opening, and add the proper height to provide for ring joint groove applying to each flange. See Table F5 of Annex F for ring joint facing dimensions.
- The base dimensions apply to all straight and reducing sizes.
- For reducing fittings, the size and center-to-face dimensions of base are determined by the size of the largest opening of fitting. In the case of reducing base elbows, orders shall specify whether the base shall be opposite the larger or smaller opening.
- Bases shall be plain faced unless otherwise specified, and the center-to-base face dimension *R* shall be the finished dimension.
- Bases may be cast integral or attached as weldments at the option of the manufacturer.
- The bases of these fittings are intended for support in compression and are not to be used for anchors or supports in tension or shear.

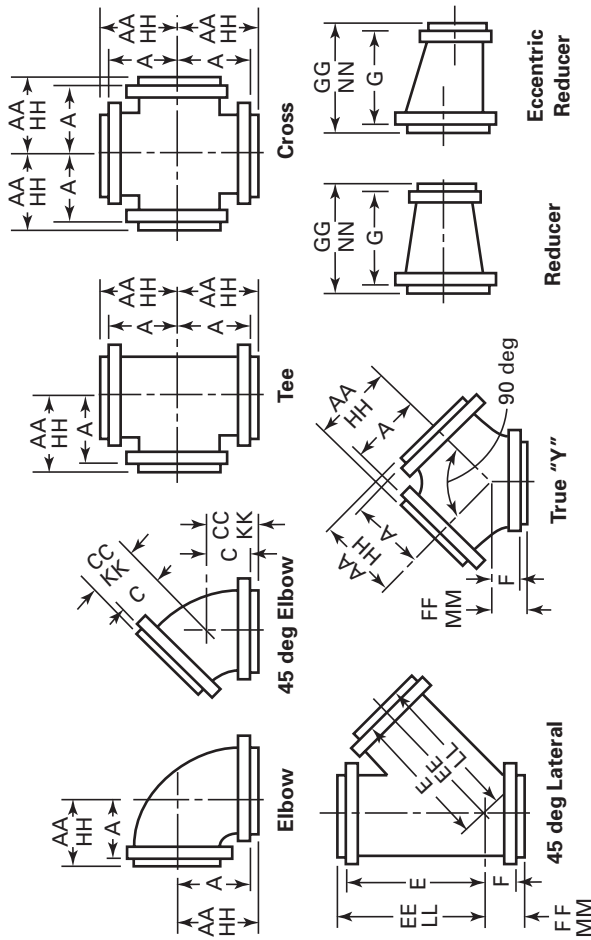


Table G3 Dimensions of Class 900 Flanged Fittings

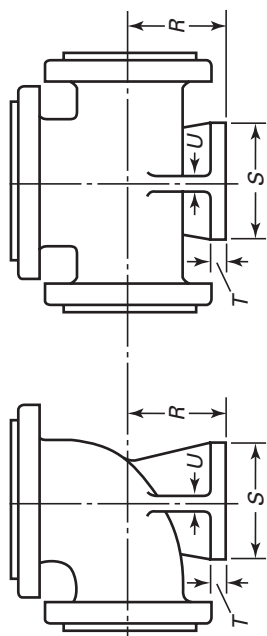
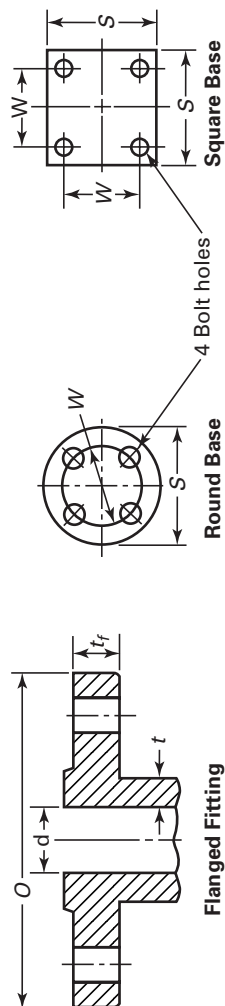
| 1                               | 2                                         | 3                                                 | 4                                                          | 5                                         | 6                         | 7                         | 8                                                   | 9                                                                    | 10                                                     | 11                                                                                             | 12                                                                        | 13                                                                         | 14 |                             |
|---------------------------------|-------------------------------------------|---------------------------------------------------|------------------------------------------------------------|-------------------------------------------|---------------------------|---------------------------|-----------------------------------------------------|----------------------------------------------------------------------|--------------------------------------------------------|------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------|----------------------------------------------------------------------------|----|-----------------------------|
| Raised Face 0.25 in. [Note (1)] |                                           |                                                   |                                                            |                                           |                           |                           |                                                     |                                                                      |                                                        |                                                                                                |                                                                           |                                                                            |    |                             |
| Nominal<br>Pipe<br>Size         | Outside<br>Diameter<br>of<br>Flange,<br>O | Thickness<br>of Flange<br>Min.,<br>t <sub>f</sub> | Wall<br>Thickness<br>of Fitting<br>Min.,<br>t <sub>m</sub> | Inside<br>Diameter<br>of<br>Fitting,<br>d | Flange Edge               |                           |                                                     |                                                                      | Center-to-Contact                                      |                                                                                                |                                                                           |                                                                            |    | Short Center-<br>to-Contact |
|                                 |                                           |                                                   |                                                            |                                           | Center-to-<br>Flange Edge | Flange<br>Edge, 45<br>deg | Long Center-<br>to-Flange<br>Edge,<br>Lateral,<br>E | Short Center-<br>to-Flange<br>Edge, Lateral<br>and<br>True "Y",<br>F | Flange<br>Edge-to-<br>Flange<br>Edge,<br>Reducer,<br>G | Center-to-Contact<br>Surface of<br>Raised Face<br>Elbow, Tee,<br>Cross, and<br>True "Y",<br>AA | Center-to-Contact<br>Surface of<br>Raised Face,<br>45 deg<br>Elbow,<br>CC | Long Center-<br>to-Contact<br>Surface of<br>Raised Face,<br>Lateral,<br>EE |    |                             |
|                                 | 1½                                        | 4.75                                              | 0.88                                                       | 0.16                                      | 0.50                      |                           |                                                     |                                                                      |                                                        |                                                                                                |                                                                           |                                                                            |    |                             |
|                                 | ¾                                         | 5.12                                              | 1.00                                                       | 0.19                                      | 0.69                      |                           |                                                     |                                                                      |                                                        |                                                                                                |                                                                           |                                                                            |    |                             |
|                                 | 1                                         | 5.88                                              | 1.12                                                       | 0.22                                      | 0.88                      |                           |                                                     |                                                                      |                                                        |                                                                                                |                                                                           |                                                                            |    |                             |
|                                 | 1¼                                        | 6.25                                              | 1.12                                                       | 0.25                                      | 1.12                      |                           |                                                     |                                                                      |                                                        |                                                                                                |                                                                           |                                                                            |    |                             |
|                                 | 1½                                        | 7.00                                              | 1.25                                                       | 0.28                                      | 1.38                      |                           |                                                     |                                                                      |                                                        |                                                                                                |                                                                           |                                                                            |    |                             |
|                                 | 2                                         | 8.50                                              | 1.50                                                       | 0.31                                      | 1.88                      |                           |                                                     |                                                                      |                                                        |                                                                                                |                                                                           |                                                                            |    |                             |
|                                 | 2½                                        | 9.62                                              | 1.62                                                       | 0.34                                      | 2.25                      |                           |                                                     |                                                                      |                                                        |                                                                                                |                                                                           |                                                                            |    |                             |
|                                 | Use Class 1500 dimensions in these sizes. |                                                   |                                                            |                                           |                           |                           |                                                     |                                                                      |                                                        |                                                                                                |                                                                           |                                                                            |    |                             |

Use Class 1500 dimensions in these sizes.

Table G3 Dimensions of Class 900 Flanged Fittings (Cont'd)

| 1                       | 2                                         | 3                                                    | 4                                                          | 5                                         | 6                                                                   | 7                                                      | 8                                                   | 9                                                                    | 10                                                    | 11                                                                        | 12                                                                        | 13                                                                         | 14                                                                                          |
|-------------------------|-------------------------------------------|------------------------------------------------------|------------------------------------------------------------|-------------------------------------------|---------------------------------------------------------------------|--------------------------------------------------------|-----------------------------------------------------|----------------------------------------------------------------------|-------------------------------------------------------|---------------------------------------------------------------------------|---------------------------------------------------------------------------|----------------------------------------------------------------------------|---------------------------------------------------------------------------------------------|
| Nominal<br>Pipe<br>Size | Outside<br>Diameter<br>of<br>Flange,<br>O | Thickness<br>of<br>Flange<br>Min.,<br>t <sub>f</sub> | Wall<br>Thickness<br>of Fitting<br>Min.,<br>t <sub>m</sub> | Inside<br>Diameter<br>of<br>Fitting,<br>d | Center-to-<br>Flange<br>Elbow, Tee,<br>Cross, and<br>True “y”,<br>A | Center-to-<br>Flange<br>Edge, 45<br>deg<br>Elbow,<br>C | Flange Edge                                         |                                                                      |                                                       |                                                                           |                                                                           |                                                                            |                                                                                             |
|                         |                                           |                                                      |                                                            |                                           |                                                                     |                                                        | Long Center-<br>to-Flange<br>Edge,<br>Lateral,<br>E | Short Center-<br>to-Flange<br>Edge, Lateral<br>and<br>True “y”,<br>F | Flange<br>Edge-to-<br>Flange<br>Edge<br>Reducer,<br>G | Center-to-Contact                                                         |                                                                           |                                                                            |                                                                                             |
|                         |                                           |                                                      |                                                            |                                           |                                                                     |                                                        |                                                     |                                                                      |                                                       | Surface of<br>Raised Face<br>Elbow, Tee,<br>Cross, and<br>True “y”,<br>AA | Center-to-Contact<br>Surface of<br>Raised Face,<br>45 deg<br>Elbow,<br>CC | Long Center-<br>to-Contact<br>Surface of<br>Raised Face,<br>Lateral,<br>EE | Short Center-<br>to-Contact<br>Surface of<br>Raised Face,<br>Lateral and<br>True “y”,<br>FF |
|                         |                                           |                                                      |                                                            |                                           |                                                                     |                                                        |                                                     |                                                                      |                                                       |                                                                           |                                                                           |                                                                            |                                                                                             |
| 3                       | 9.50                                      | 1.50                                                 | 0.41                                                       | 2.88                                      | 7.25                                                                | 5.25                                                   | 14.25                                               | 4.25                                                                 | 7.25                                                  | 7.50                                                                      | 5.50                                                                      | 14.50                                                                      | 4.50                                                                                        |
| 4                       | 11.50                                     | 1.75                                                 | 0.50                                                       | 3.88                                      | 8.75                                                                | 6.25                                                   | 17.25                                               | 5.25                                                                 | 8.75                                                  | 9.00                                                                      | 6.50                                                                      | 17.50                                                                      | 5.50                                                                                        |
| 5                       | 13.75                                     | 2.00                                                 | 0.59                                                       | 4.75                                      | 10.75                                                               | 7.25                                                   | 20.75                                               | 6.25                                                                 | 10.75                                                 | 11.00                                                                     | 7.50                                                                      | 21.00                                                                      | 6.50                                                                                        |
| 6                       | 15.00                                     | 2.19                                                 | 0.72                                                       | 5.75                                      | 11.75                                                               | 7.75                                                   | 22.25                                               | 6.25                                                                 | 11.75                                                 | 12.00                                                                     | 8.00                                                                      | 22.50                                                                      | 6.50                                                                                        |
| 8                       | 18.50                                     | 2.50                                                 | 0.88                                                       | 7.50                                      | 14.25                                                               | 8.75                                                   | 27.25                                               | 7.25                                                                 | 14.25                                                 | 14.50                                                                     | 9.00                                                                      | 27.50                                                                      | 7.50                                                                                        |
| 10                      | 21.50                                     | 2.75                                                 | 1.06                                                       | 9.38                                      | 16.25                                                               | 9.75                                                   | 31.25                                               | 8.25                                                                 | 16.25                                                 | 16.50                                                                     | 10.00                                                                     | 31.50                                                                      | 8.50                                                                                        |
| 12                      | 24.00                                     | 3.12                                                 | 1.25                                                       | 11.12                                     | 18.75                                                               | 10.75                                                  | 34.25                                               | 8.75                                                                 | 17.25                                                 | 19.00                                                                     | 11.00                                                                     | 34.50                                                                      | 9.00                                                                                        |
| 14                      | 25.25                                     | 3.38                                                 | 1.38                                                       | 12.25                                     | 20.00                                                               | 11.25                                                  | 36.25                                               | 9.25                                                                 | 18.50                                                 | 20.25                                                                     | 11.50                                                                     | 36.50                                                                      | 9.50                                                                                        |
| 16                      | 27.75                                     | 3.50                                                 | 1.56                                                       | 14.00                                     | 22.00                                                               | 12.25                                                  | 40.50                                               | 10.25                                                                | 20.50                                                 | 22.25                                                                     | 12.50                                                                     | 40.75                                                                      | 10.25                                                                                       |
| 18                      | 31.00                                     | 4.00                                                 | 1.75                                                       | 15.75                                     | 23.75                                                               | 13.00                                                  | 45.25                                               | 11.75                                                                | 24.00                                                 | 24.00                                                                     | 13.25                                                                     | 45.50                                                                      | 12.00                                                                                       |
| 20                      | 33.75                                     | 4.25                                                 | 1.91                                                       | 17.50                                     | 25.75                                                               | 14.25                                                  | 50.00                                               | 12.75                                                                | 26.00                                                 | 26.00                                                                     | 14.50                                                                     | 50.25                                                                      | 13.00                                                                                       |
| 24                      | 41.00                                     | 5.50                                                 | 2.28                                                       | 21.00                                     | 30.25                                                               | 17.75                                                  | 59.75                                               | 15.25                                                                | 30.00                                                 | 30.50                                                                     | 18.00                                                                     | 60.00                                                                      | 15.50                                                                                       |





**Table G3 Dimensions of Class 900 Flanged Fittings (Cont'd)**

| 15                                                                       | 16                                                           | 17                                         | 18                                         | 19                                                       | 20                     | 21                                 | 22                                                           | 23                                    | 24                              | 25                        | 26                | 1 |
|--------------------------------------------------------------------------|--------------------------------------------------------------|--------------------------------------------|--------------------------------------------|----------------------------------------------------------|------------------------|------------------------------------|--------------------------------------------------------------|---------------------------------------|---------------------------------|---------------------------|-------------------|---|
| Raised Face                                                              |                                                              |                                            |                                            |                                                          |                        |                                    |                                                              |                                       |                                 |                           |                   |   |
| 0.25 in. [Note (1)]                                                      |                                                              |                                            |                                            |                                                          |                        |                                    |                                                              |                                       |                                 |                           |                   |   |
| Ring Joint [Note (1)]                                                    |                                                              |                                            |                                            |                                                          |                        |                                    |                                                              |                                       |                                 |                           |                   |   |
| Contact Surface-to-Contact Surface of Raised Face Reducer, GG [Note (2)] | Center-to-End Elbow, Tee, Cross, and True "Y", HH [Note (3)] | Center-to-End, 45 deg Elbow, KK [Note (3)] | Long Center-to-End, Lateral, LL [Note (3)] | Short Center-to-End, Lateral and True "Y", MM [Note (3)] | End-to-End Reducer, NN | Center-to-Base, S [Notes (4), (5)] | Diameter of Round Base or Width of Square Base, S [Note (6)] | Thickness of Base, T [Notes (6), (7)] | Thickness of Ribs, U [Note (6)] | Base Drilling [Note (8)]  | Nominal Pipe Size |   |
|                                                                          |                                                              |                                            |                                            |                                                          |                        |                                    | Bolt Circle or Bolt Spacing, W                               |                                       |                                 | Diameter of Drilled Holes |                   |   |
|                                                                          |                                                              |                                            |                                            |                                                          |                        |                                    |                                                              |                                       |                                 |                           |                   |   |
|                                                                          |                                                              |                                            |                                            |                                                          |                        |                                    |                                                              |                                       |                                 |                           |                   |   |
| Use Class 1500 dimensions in these sizes.                                |                                                              |                                            |                                            |                                                          |                        |                                    |                                                              |                                       |                                 |                           |                   |   |
| 7.75                                                                     | 7.56                                                         | 5.56                                       | 14.56                                      | 4.56                                                     | Please see Note (2)    | 5.75                               | 6.50                                                         | 0.88                                  | 0.75                            | 5.00                      | 0.75              | 3 |
| 9.25                                                                     | 9.06                                                         | 6.56                                       | 17.56                                      | 5.56                                                     |                        | 7.00                               | 7.50                                                         | 1.00                                  | 0.75                            | 5.88                      | 0.88              | 4 |
| 11.25                                                                    | 11.06                                                        | 7.56                                       | 21.06                                      | 6.56                                                     | and Note (3)           | 8.25                               | 10.00                                                        | 1.25                                  | 0.75                            | 7.88                      | 0.88              | 5 |
| 12.25                                                                    | 12.06                                                        | 8.06                                       | 22.56                                      | 6.56                                                     |                        | 9.00                               | 10.00                                                        | 1.25                                  | 0.75                            | 7.88                      | 0.88              | 6 |

Use Class 1500 dimensions in these sizes.

Table G3 Dimensions of Class 900 Flanged Fittings (Cont'd)

| 15                                                            | 16                                                | 17                              | 18                             | 19                                           | 20                     | 21                | 22                   | 23                   | 24                                                | 25                        | 26                | 1          |
|---------------------------------------------------------------|---------------------------------------------------|---------------------------------|--------------------------------|----------------------------------------------|------------------------|-------------------|----------------------|----------------------|---------------------------------------------------|---------------------------|-------------------|------------|
| Raised Face                                                   |                                                   |                                 |                                |                                              |                        |                   |                      |                      |                                                   |                           |                   |            |
| 0.25 in. [Note (1)]                                           |                                                   |                                 |                                |                                              |                        |                   |                      |                      |                                                   |                           |                   |            |
| Contact Surface-to-Contact Surface of Raised Face Reducer, GG | Ring Joint [Note (1)]                             |                                 |                                |                                              |                        |                   |                      |                      | Diameter of Round Base or Width of Square Base, S |                           |                   |            |
|                                                               | Center-to-End Elbow, Tee, Cross, and True "Y", HH | Center-to-End, 45 deg Elbow, KK | Long Center-to-End Lateral, LL | Short Center-to-End Lateral and True "Y", MM | End-to-End Reducer, NN | Center-to-Base, S | Notes (4), (5)       | [Note (6)]           |                                                   |                           |                   |            |
|                                                               | [Note (3)]                                        | [Note (3)]                      | [Note (3)]                     | [Note (3)]                                   | [Note (3)]             | [Notes (6), (7)]  | Thickness of Base, T | Thickness of Ribs, U | Bolt Circle or Bolt Spacing, W                    | Diameter of Drilled Holes | Nominal Pipe Size |            |
|                                                               | [Note (2)]                                        | [Note (3)]                      | [Note (3)]                     | [Note (3)]                                   | [Note (3)]             | [Notes (6), (7)]  | [Note (6)]           | [Note (6)]           | [Note (6)]                                        | [Note (6)]                | [Note (6)]        |            |
|                                                               | [Note (2)]                                        | [Note (3)]                      | [Note (3)]                     | [Note (3)]                                   | [Note (3)]             | [Note (3)]        | [Note (3)]           | [Note (6)]           | [Note (6)]                                        | [Note (6)]                | [Note (6)]        | [Note (6)] |
| 14.75                                                         | 14.56                                             | 9.06                            | 27.56                          | 7.56                                         |                        | 11.00             | 12.50                | 1.44                 | 1.00                                              | 10.62                     | 0.88              | 8          |
| 16.75                                                         | 16.56                                             | 10.06                           | 31.56                          | 8.56                                         |                        | 12.50             | 12.50                | 1.44                 | 1.00                                              | 10.62                     | 0.88              | 10         |
| 17.75                                                         | 19.06                                             | 11.06                           | 34.56                          | 9.06                                         |                        | 13.25             | 15.00                | 1.62                 | 1.12                                              | 13.00                     | 1.00              | 12         |
| 19.00                                                         | 20.44                                             | 11.69                           | 36.69                          | 9.69                                         |                        | 14.75             | 15.00                | 1.62                 | 1.12                                              | 13.00                     | 1.00              | 14         |
| 21.00                                                         | 22.44                                             | 12.69                           | 40.94                          | 10.69                                        |                        | 16.00             | 15.00                | 1.62                 | 1.25                                              | 13.00                     | 1.00              | 16         |
| 24.50                                                         | 24.25                                             | 13.50                           | 45.75                          | 12.25                                        |                        | ...               | ...                  | ...                  | ...                                               | ...                       | ...               | 18         |
| 26.50                                                         | 26.25                                             | 14.75                           | 50.50                          | 13.25                                        |                        | ...               | ...                  | ...                  | ...                                               | ...                       | ...               | 20         |
| 30.50                                                         | 30.88                                             | 18.38                           | 60.38                          | 15.88                                        |                        | ...               | ...                  | ...                  | ...                                               | ...                       | ...               | 24         |

## GENERAL NOTES:

- Dimensions are in inches.
- For tolerances, see para. 7.
- For facings, see para. 6.4.
- For flange bolt holes, see para. 6.5 and Table F17 of Annex F.
- For spot facing, see para. 6.6.
- For intersecting center lines, center-to-contact surface, and center-to-end dimensions of side outlet fittings, see para. 6.2.4
- For center-to-contact surface and center-to-end dimensions of special degree elbows, see para. 6.2.5.
- For reinforcement of certain fittings, see para. 6.1.
- For drains, see para. 6.12.

## NOTES:

- For center-to-contact surface and center-to-end dimensions of reducing fittings, see para. 6.2.3.
- For contact surface-to-contact surface and center-to-end dimensions of reducers and eccentric reducers, see para. 6.2.3.
- These dimensions apply to straight sizes only. (See paras. 6.2.3 and 6.4.2.2). For the center-to-end dimensions of reducing fittings or end-to-end dimensions of reducers, use center-to-flange edge or flange edge-to-flange edge dimensions for largest opening, and add the proper height to provide for ring joint groove applying to each flange. See Table F5 of Annex F for ring joint facing dimensions.
- For reducing fittings, the size and center-to-face dimensions of base are determined by the size of the largest opening fitting. In the case of reducing base elbows, orders shall specify whether the base shall be opposite the larger or smaller opening.
- Bases shall be plain faced unless otherwise specified, and the center-to-base face dimension R shall be the finished dimension.
- The base dimensions apply to all straight and reducing sizes.
- Bases may be cast integral or attached as weldments at the option of the manufacturer.
- The bases of these fittings are intended for support in compression and are not to be used for anchors or supports in tension or shear.

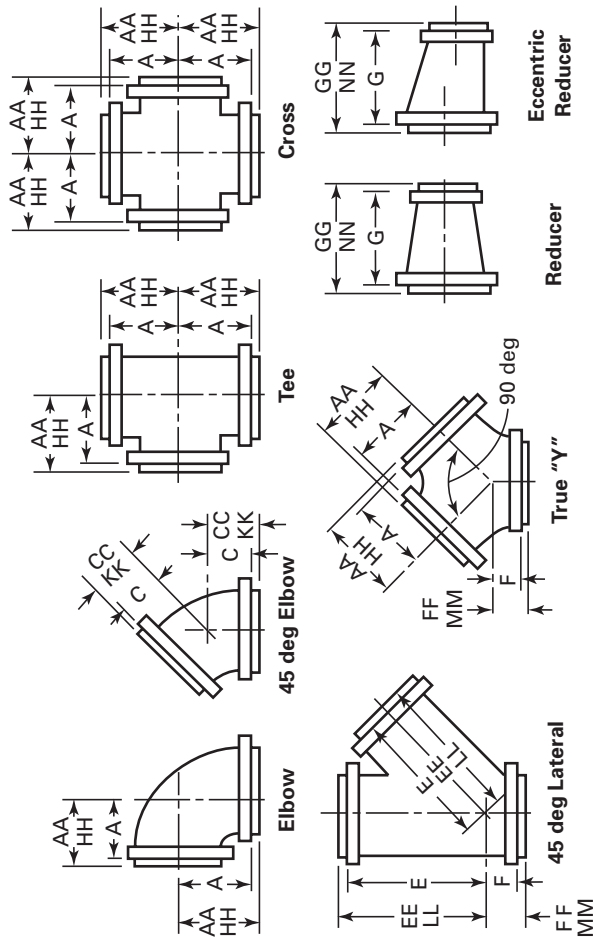


Table G4 Dimensions of Class 1500 Flanged Fittings

| 1                       | 2                                         | 3                                                 | 4                                                          | 5                                         | 6                                                                        | 7                                                   | 8                                                   | 9                                                                    | 10                                                | 11                                                                                              | 12                                                                            | 13                                                                         | 14   |  |                                                                                             |
|-------------------------|-------------------------------------------|---------------------------------------------------|------------------------------------------------------------|-------------------------------------------|--------------------------------------------------------------------------|-----------------------------------------------------|-----------------------------------------------------|----------------------------------------------------------------------|---------------------------------------------------|-------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------|----------------------------------------------------------------------------|------|--|---------------------------------------------------------------------------------------------|
| Nominal<br>Pipe<br>Size | Outside<br>Diameter<br>of<br>Flange,<br>O | Thickness<br>of Flange<br>Min.,<br>t <sub>f</sub> | Wall<br>Thickness<br>of Fitting<br>Min.,<br>t <sub>m</sub> | Inside<br>Diameter<br>of<br>Fitting,<br>d | Raised Face 0.25 in. [Note (1)]                                          |                                                     |                                                     |                                                                      |                                                   |                                                                                                 |                                                                               |                                                                            |      |  |                                                                                             |
|                         |                                           |                                                   |                                                            |                                           | Flange Edge                                                              |                                                     |                                                     |                                                                      |                                                   | Center-to-Contact                                                                               |                                                                               |                                                                            |      |  | Short Center-<br>to-Contact<br>Surface of<br>Raised Face,<br>Lateral and<br>True “Y”,<br>FF |
|                         |                                           |                                                   |                                                            |                                           | Center-to-<br>Flange Edge<br>Elbow, Tee,<br>Cross, and<br>True “Y”,<br>A | Center-to-<br>Flange Edge,<br>45 deg<br>Elbow,<br>C | Long Center-<br>to-Flange<br>Edge,<br>Lateral,<br>E | Short Center-<br>to-Flange<br>Edge, Lateral<br>and<br>True “Y”,<br>F | Flange Edge<br>to Flange<br>Edge<br>Reducer,<br>G | Center-to-Contact<br>Surface of<br>Raised Face,<br>Elbow, Tee,<br>Cross, and<br>True “Y”,<br>AA | Center-to-<br>Contact<br>Surface of<br>Raised Face,<br>45 deg<br>Elbow,<br>CC | Long Center-<br>to-Contact<br>Surface of<br>Raised Face,<br>Lateral,<br>EE |      |  |                                                                                             |
| 1½                      | 4.75                                      | 0.88                                              | 0.19                                                       | 0.50                                      | 4.00                                                                     | 2.75                                                | ...                                                 | ...                                                                  | ...                                               | 4.25                                                                                            | 3.00                                                                          | ...                                                                        | ...  |  |                                                                                             |
| ¾                       | 5.12                                      | 1.00                                              | 0.23                                                       | 0.69                                      | 4.25                                                                     | 3.00                                                | ...                                                 | ...                                                                  | ...                                               | 4.50                                                                                            | 3.25                                                                          | ...                                                                        | ...  |  |                                                                                             |
| 1                       | 5.88                                      | 1.12                                              | 0.26                                                       | 0.88                                      | 4.75                                                                     | 3.25                                                | 8.75                                                | 2.25                                                                 | 4.50                                              | 5.00                                                                                            | 3.50                                                                          | 9.00                                                                       | 2.50 |  |                                                                                             |
| 1¼                      | 6.25                                      | 1.12                                              | 0.31                                                       | 1.12                                      | 5.25                                                                     | 3.75                                                | 9.75                                                | 2.75                                                                 | 5.25                                              | 5.50                                                                                            | 4.00                                                                          | 10.00                                                                      | 3.00 |  |                                                                                             |
| 1½                      | 7.00                                      | 1.25                                              | 0.38                                                       | 1.38                                      | 5.75                                                                     | 4.00                                                | 10.75                                               | 3.25                                                                 | 5.75                                              | 6.00                                                                                            | 4.25                                                                          | 11.00                                                                      | 3.50 |  |                                                                                             |
| 2                       | 8.50                                      | 1.50                                              | 0.44                                                       | 1.88                                      | 7.00                                                                     | 4.50                                                | 13.00                                               | 3.75                                                                 | 6.75                                              | 7.25                                                                                            | 4.75                                                                          | 13.25                                                                      | 4.00 |  |                                                                                             |
| 2½                      | 9.62                                      | 1.62                                              | 0.50                                                       | 2.25                                      | 8.00                                                                     | 5.00                                                | 15.00                                               | 4.25                                                                 | 7.75                                              | 8.25                                                                                            | 5.25                                                                          | 15.25                                                                      | 4.50 |  |                                                                                             |
| 3                       | 10.50                                     | 1.88                                              | 0.62                                                       | 2.75                                      | 9.00                                                                     | 5.50                                                | 17.00                                               | 4.75                                                                 | 8.75                                              | 9.25                                                                                            | 5.75                                                                          | 17.25                                                                      | 5.00 |  |                                                                                             |
| 4                       | 12.25                                     | 2.12                                              | 0.75                                                       | 3.62                                      | 10.50                                                                    | 7.00                                                | 19.00                                               | 5.75                                                                 | 10.25                                             | 10.75                                                                                           | 7.25                                                                          | 19.25                                                                      | 6.00 |  |                                                                                             |

Table G4 Dimensions of Class 1500 Flanged Fittings (Cont'd)

|                         | 1                                                | 2                                                       | 3                                                                | 4                                                | 5                                                                 | 6                                            | 7                                                                | 8                                                         | 9                                                                    | 10                                                                            | 11                                                                          | 12    | 13                                                                            | 14    |                                                                                             |
|-------------------------|--------------------------------------------------|---------------------------------------------------------|------------------------------------------------------------------|--------------------------------------------------|-------------------------------------------------------------------|----------------------------------------------|------------------------------------------------------------------|-----------------------------------------------------------|----------------------------------------------------------------------|-------------------------------------------------------------------------------|-----------------------------------------------------------------------------|-------|-------------------------------------------------------------------------------|-------|---------------------------------------------------------------------------------------------|
| Nominal<br>Pipe<br>Size | Raised Face 0.25 in. [Note (1)]                  |                                                         |                                                                  |                                                  |                                                                   |                                              |                                                                  |                                                           |                                                                      |                                                                               |                                                                             |       |                                                                               |       |                                                                                             |
|                         | Flange Edge                                      |                                                         |                                                                  |                                                  |                                                                   |                                              |                                                                  |                                                           |                                                                      |                                                                               |                                                                             |       |                                                                               |       |                                                                                             |
|                         | Outside<br>Diameter<br>of<br>Flange,<br><i>O</i> | Thickness<br>of Flange<br>Min.,<br><i>t<sub>f</sub></i> | Wall<br>Thickness<br>of Fitting<br>Min.,<br><i>t<sub>m</sub></i> | Inside<br>Diameter<br>of<br>Fitting,<br><i>d</i> | Center-to-<br>Flange Edge                                         |                                              | Center-to-<br>to-Flange<br>Edge, 45<br>deg<br>Elbow,<br><i>C</i> |                                                           | Long Center-<br>to-Flange<br>Edge, Lateral,<br>True "Y",<br><i>E</i> |                                                                               | Short Center-<br>to-Flange<br>Edge, Lateral<br>and<br>True "Y",<br><i>F</i> |       | Center-to-<br>Contact<br>Surface of<br>Raised Face,<br>45 deg<br>Elbow,<br>CC |       | Short Center-<br>to-Contact<br>Surface of<br>Raised Face,<br>Lateral and<br>True "Y",<br>FF |
|                         |                                                  |                                                         |                                                                  |                                                  | Flange Edge<br>Elbow, Tee,<br>Cross, and<br>True "Y",<br><i>A</i> | Flange Edge,<br>45 deg<br>Elbow,<br><i>C</i> | Long Center-<br>to-Flange<br>Edge,<br>Lateral,<br><i>E</i>       | Flange Edge<br>to Flange<br>Edge,<br>Reducer,<br><i>G</i> | Flange Edge,<br>Lateral<br>and<br>True "Y",<br><i>F</i>              | Center-to-<br>Contact<br>Surface of<br>Raised Face,<br>45 deg<br>Elbow,<br>CC | Long Center-<br>to-Contact<br>Surface of<br>Raised Face,<br>Lateral,<br>EE  |       |                                                                               |       |                                                                                             |
| 5                       | 14.75                                            | 2.88                                                    | 0.91                                                             | 4.38                                             | 8.50                                                              | 13.00                                        | 8.50                                                             | 23.00                                                     | 7.25                                                                 | 13.25                                                                         | 13.25                                                                       | 8.75  | 23.25                                                                         | 7.50  |                                                                                             |
| 6                       | 15.50                                            | 3.25                                                    | 1.09                                                             | 5.38                                             | 9.12                                                              | 13.62                                        | 9.12                                                             | 24.62                                                     | 7.88                                                                 | 14.00                                                                         | 13.88                                                                       | 9.38  | 24.88                                                                         | 8.12  |                                                                                             |
| 8                       | 19.00                                            | 3.62                                                    | 1.41                                                             | 7.00                                             | 10.62                                                             | 16.12                                        | 10.62                                                            | 29.62                                                     | 8.88                                                                 | 16.50                                                                         | 16.38                                                                       | 10.88 | 29.88                                                                         | 9.12  |                                                                                             |
| 10                      | 23.00                                            | 4.25                                                    | 1.72                                                             | 8.75                                             | 11.75                                                             | 19.25                                        | 11.75                                                            | 35.75                                                     | 10.00                                                                | 19.75                                                                         | 19.50                                                                       | 12.00 | 36.00                                                                         | 10.25 |                                                                                             |
| 12                      | 26.50                                            | 4.88                                                    | 2.00                                                             | 10.38                                            | 13.00                                                             | 22.00                                        | 13.00                                                            | 40.50                                                     | 11.75                                                                | 22.50                                                                         | 22.25                                                                       | 13.25 | 40.75                                                                         | 12.00 |                                                                                             |
| 14                      | 29.50                                            | 5.25                                                    | 2.19                                                             | 11.38                                            | 14.00                                                             | 24.50                                        | 14.00                                                            | 43.75                                                     | 12.25                                                                | 25.25                                                                         | 24.75                                                                       | 14.25 | 44.00                                                                         | 12.50 |                                                                                             |
| 16                      | 32.50                                            | 5.75                                                    | 2.50                                                             | 13.00                                            | 16.00                                                             | 27.00                                        | 16.00                                                            | 48.00                                                     | 14.50                                                                | 27.75                                                                         | 27.25                                                                       | 16.25 | 48.25                                                                         | 14.75 |                                                                                             |
| 18                      | 36.00                                            | 6.38                                                    | 2.81                                                             | 14.62                                            | 17.50                                                             | 30.00                                        | 17.50                                                            | 53.00                                                     | 16.25                                                                | 31.00                                                                         | 30.25                                                                       | 17.75 | 53.25                                                                         | 16.50 |                                                                                             |
| 20                      | 38.75                                            | 7.00                                                    | 3.12                                                             | 16.38                                            | 18.50                                                             | 32.50                                        | 18.50                                                            | 57.50                                                     | 17.50                                                                | 33.50                                                                         | 32.75                                                                       | 18.75 | 57.75                                                                         | 17.75 |                                                                                             |
| 24                      | 46.00                                            | 8.00                                                    | 3.72                                                             | 19.62                                            | 20.50                                                             | 38.00                                        | 20.50                                                            | 67.00                                                     | 20.25                                                                | 39.25                                                                         | 38.75                                                                       | 20.75 | 67.25                                                                         | 20.50 |                                                                                             |

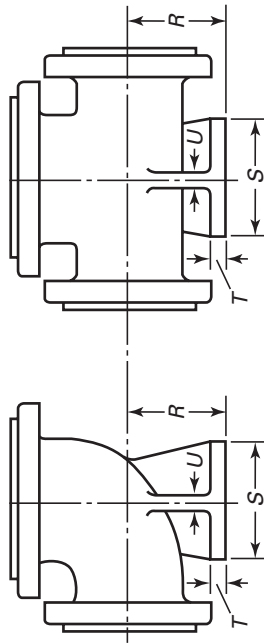
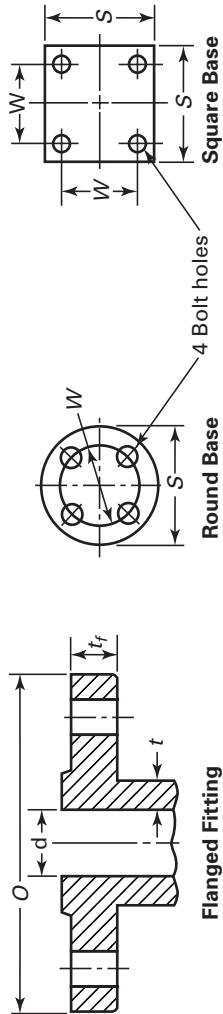


Table G4 Dimensions of Class 1500 Flanged Fittings (Cont'd)

| 15                                                                                       | 16                                                                              | 17                                                         | 18                                                      | 19                                                                       | 20                                             | 21                                          | 22                                                                          | 23                                             | 24                                       | 25                                      | 26                              | 1                       |
|------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------|------------------------------------------------------------|---------------------------------------------------------|--------------------------------------------------------------------------|------------------------------------------------|---------------------------------------------|-----------------------------------------------------------------------------|------------------------------------------------|------------------------------------------|-----------------------------------------|---------------------------------|-------------------------|
| Raised Face<br>0.25 in. [Note (1)]                                                       |                                                                                 |                                                            | Ring Joint [Note (1)]                                   |                                                                          |                                                |                                             |                                                                             |                                                |                                          |                                         |                                 |                         |
| Contact Surface-to-<br>Contact Surface of<br>Raised Face<br>Reducer,<br>GG<br>[Note (2)] | Center-to-<br>End Elbow,<br>Tee, Cross,<br>and True<br>"Y",<br>HH<br>[Note (3)] | Center-to-<br>End, 45<br>deg<br>Elbow,<br>KK<br>[Note (3)] | Long Center-<br>to-End,<br>Lateral,<br>LL<br>[Note (3)] | Short Center-<br>to-End,<br>Lateral and<br>True "Y",<br>MM<br>[Note (3)] | End-to-<br>End<br>Reducer,<br>NN<br>[Note (3)] | Center-to-<br>Base,<br>R<br>[Notes (4)–(6)] | Diameter of<br>Round Base<br>or Width of<br>Square Base,<br>S<br>[Note (4)] | Thickness of<br>Base,<br>T<br>[Notes (4), (7)] | Thickness<br>of Ribs,<br>U<br>[Note (4)] | Bolt Circle<br>or Bolt<br>Spacing,<br>W | Diameter of<br>Drilled<br>Holes | Nominal<br>Pipe<br>Size |
|                                                                                          | [Note (2)]                                                                      | [Note (3)]                                                 | [Note (3)]                                              | [Note (3)]                                                               | [Note (3)]                                     | [Notes (4)–(6)]                             | [Note (4)]                                                                  | [Notes (4), (7)]                               | [Note (4)]                               |                                         |                                 |                         |
| ...                                                                                      | 4.25                                                                            | 3.00                                                       | ...                                                     | ...                                                                      | Please                                         | ...                                         | ...                                                                         | ...                                            | ...                                      | ...                                     | ...                             | 1/2                     |
| ...                                                                                      | 4.50                                                                            | 3.25                                                       | ...                                                     | ...                                                                      | see                                            | ...                                         | ...                                                                         | ...                                            | ...                                      | ...                                     | ...                             | 3/4                     |
| 5.00                                                                                     | 5.00                                                                            | 3.50                                                       | 9.00                                                    | 2.50                                                                     | Note (2)                                       | ...                                         | ...                                                                         | ...                                            | ...                                      | ...                                     | ...                             | 1                       |
| 5.75                                                                                     | 5.50                                                                            | 4.00                                                       | 10.00                                                   | 3.00                                                                     | and<br>Note (3)                                | ...                                         | ...                                                                         | ...                                            | ...                                      | ...                                     | ...                             | 1 1/4                   |
| 6.25                                                                                     | 6.00                                                                            | 4.25                                                       | 11.00                                                   | 3.50                                                                     |                                                | ...                                         | ...                                                                         | ...                                            | ...                                      | ...                                     | ...                             | 1 1/2                   |
| 7.25                                                                                     | 7.31                                                                            | 4.81                                                       | 13.31                                                   | 4.06                                                                     |                                                | 5.50                                        | 6.50                                                                        | 0.88                                           | 0.75                                     | 5.00                                    | 0.75                            | 2                       |
| 8.25                                                                                     | 8.31                                                                            | 5.31                                                       | 15.31                                                   | 4.56                                                                     |                                                | 6.00                                        | 6.50                                                                        | 0.88                                           | 0.75                                     | 5.00                                    | 0.75                            | 2 1/2                   |
| 9.25                                                                                     | 9.31                                                                            | 5.81                                                       | 17.31                                                   | 5.06                                                                     |                                                | 6.50                                        | 7.50                                                                        | 1.00                                           | 0.75                                     | 5.88                                    | 0.88                            | 3                       |
| 10.75                                                                                    | 10.81                                                                           | 7.31                                                       | 19.31                                                   | 6.06                                                                     |                                                | 7.75                                        | 10.00                                                                       | 1.25                                           | 0.75                                     | 7.88                                    | 0.88                            | 4                       |
| 13.75                                                                                    | 13.31                                                                           | 8.81                                                       | 23.31                                                   | 7.56                                                                     |                                                | 9.00                                        | 10.00                                                                       | 1.25                                           | 0.75                                     | 7.88                                    | 0.88                            | 5                       |
| 14.50                                                                                    | 14.00                                                                           | 9.50                                                       | 25.00                                                   | 8.25                                                                     |                                                | 9.75                                        | 12.50                                                                       | 1.44                                           | 1.00                                     | 10.62                                   | 0.88                            | 6                       |
| 17.00                                                                                    | 16.56                                                                           | 11.06                                                      | 30.06                                                   | 9.31                                                                     |                                                | 11.50                                       | 12.50                                                                       | 1.44                                           | 1.00                                     | 10.62                                   | 0.88                            | 8                       |

**Table G4 Dimensions of Class 1500 Flanged Fittings (Cont'd)**

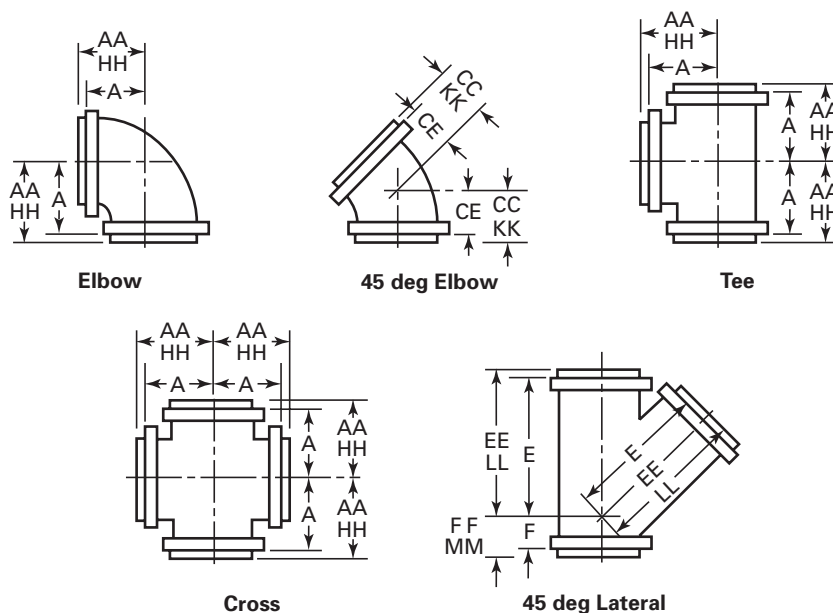
| 15                                                                                                      | 16                                                                              | 17    | 18                                                         | 19    | 20                                                     | 21    | 22                                                                       | 23   | 24                                                  | 25    | 26                                                                          | 1  |                                                |  |                                          |  |                                                       |  |                         |
|---------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------|-------|------------------------------------------------------------|-------|--------------------------------------------------------|-------|--------------------------------------------------------------------------|------|-----------------------------------------------------|-------|-----------------------------------------------------------------------------|----|------------------------------------------------|--|------------------------------------------|--|-------------------------------------------------------|--|-------------------------|
| Ring Joint [Note (1)]                                                                                   |                                                                                 |       |                                                            |       |                                                        |       |                                                                          |      |                                                     |       |                                                                             |    |                                                |  |                                          |  |                                                       |  |                         |
| Raised Face<br>Contact Surface-to-<br>Contact Surface of<br>Raised Face<br>Reducer,<br>GG<br>[Note (2)] | Center-to-<br>End Elbow,<br>Tee, Cross,<br>and True<br>"Y",<br>HH<br>[Note (3)] |       | Center-to-<br>End, 45<br>deg<br>Elbow,<br>KK<br>[Note (3)] |       | Long Center-<br>to-End<br>Lateral,<br>LL<br>[Note (3)] |       | Short Center-<br>to-End,<br>Lateral and<br>True "Y",<br>MM<br>[Note (3)] |      | End-to-<br>End<br>Reducer,<br>NN<br>[Notes (4)–(6)] |       | Diameter of<br>Round Base<br>or Width of<br>Square Base,<br>S<br>[Note (4)] |    | Thickness of<br>Base,<br>T<br>[Notes (4), (7)] |  | Thickness<br>of Ribs,<br>U<br>[Note (4)] |  | Base Drilling [Note (8)]                              |  | Nominal<br>Pipe<br>Size |
|                                                                                                         | [Note (3)]                                                                      |       | [Note (3)]                                                 |       | [Note (3)]                                             |       | [Note (3)]                                                               |      | [Notes (4)–(6)]                                     |       | [Note (4)]                                                                  |    | [Notes (4), (7)]                               |  | [Note (4)]                               |  | Bolt Circle<br>or Bolt<br>Spacing,<br>W<br>[Note (4)] |  |                         |
| 20.25                                                                                                   | 19.69                                                                           | 12.19 | 36.19                                                      | 10.44 |                                                        | 13.75 | 15.00                                                                    | 1.62 | 1.12                                                | 13.00 | 1.00                                                                        | 10 |                                                |  |                                          |  |                                                       |  |                         |
| 23.00                                                                                                   | 22.56                                                                           | 13.56 | 41.06                                                      | 12.31 |                                                        | 15.50 | 15.00                                                                    | 1.62 | 1.12                                                | 13.00 | 1.00                                                                        | 12 |                                                |  |                                          |  |                                                       |  |                         |
| 25.75                                                                                                   | 25.12                                                                           | 14.62 | 44.38                                                      | 12.88 |                                                        | 17.25 | 17.50                                                                    | 1.88 | 1.25                                                | 15.25 | 1.12                                                                        | 14 |                                                |  |                                          |  |                                                       |  |                         |
| 28.25                                                                                                   | 27.69                                                                           | 16.69 | 48.69                                                      | 15.19 |                                                        | 18.75 | 17.50                                                                    | 1.88 | 1.25                                                | 15.25 | 1.12                                                                        | 16 |                                                |  |                                          |  |                                                       |  |                         |
| 31.50                                                                                                   | 30.69                                                                           | 18.19 | 53.69                                                      | 16.94 |                                                        | ...   | ...                                                                      | ...  | ...                                                 | ...   | ...                                                                         | 18 |                                                |  |                                          |  |                                                       |  |                         |
| 34.00                                                                                                   | 33.19                                                                           | 19.19 | 58.19                                                      | 18.19 |                                                        | ...   | ...                                                                      | ...  | ...                                                 | ...   | ...                                                                         | 20 |                                                |  |                                          |  |                                                       |  |                         |
| 39.75                                                                                                   | 38.81                                                                           | 21.31 | 67.81                                                      | 21.06 |                                                        | ...   | ...                                                                      | ...  | ...                                                 | ...   | ...                                                                         | 24 |                                                |  |                                          |  |                                                       |  |                         |

**GENERAL NOTES:**

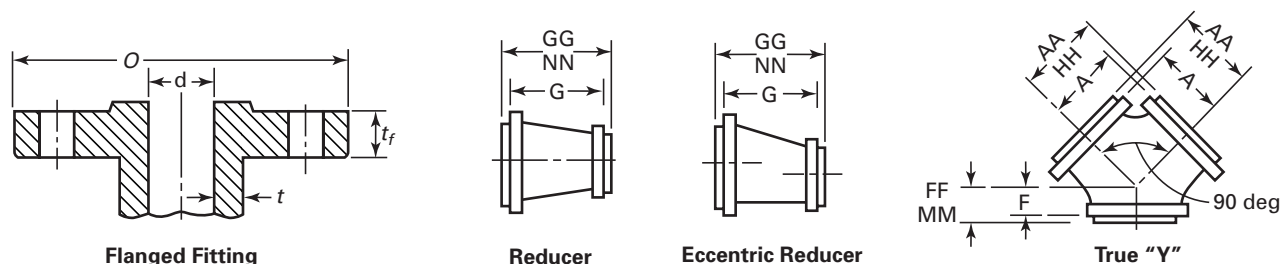
- Dimensions are in inches.
- For tolerances, see para. 7.
- For facings, see para. 6.4.
- For flange bolt holes, see para. 6.5 and Table F19 of Annex F.
- For spot facing, see para. 6.6.
- For intersecting centerlines, center-to-contact surface, and center-to-end dimensions of side outlet fittings, see para. 6.2.4.
- For center-to-contact surface and center-to-end dimensions of special degree elbows, see para. 6.2.5.
- For reinforcement of certain fittings, see para. 6.1.
- For drains, see para. 6.12.

**NOTES:**

- For center-to-contact surface and center-to-end dimensions of reducing fittings, see para. 6.2.3.
- For contact surface-to-contact surface and end-to-end dimensions of reducers and eccentric reducers, see para. 6.2.3.
- These dimensions apply to straight sizes only. (See paras. 6.2.3 and 6.4.2.2). For the center-to-end dimensions of reducing fittings or end-to-end dimensions of reducers, use center-to-flange edge or flange edge-to-flange edge dimensions for largest opening, and add the proper height to provide for ring joint groove applying to each flange. See Table F5 of Annex F for ring joint facing dimensions.
- The base dimensions apply to all straight and reducing sizes.
- For reducing fittings, the size and center-to-face dimensions of base are determined by the size of the largest opening fitting. In the case of reducing base elbows, orders shall specify whether the base shall be opposite the larger or smaller opening.
- Bases shall be plain faced unless otherwise specified, and the center-to-base dimension *R* shall be the finished dimension.
- Bases may be cast integral or attached as weldments at the option of the manufacturer.
- The bases of these fittings are intended for support in compression and are not to be used for anchors or supports in tension or shear.

**Table G5 Dimensions of Class 2500 Flanged Fittings**

| 1                    | 2                                                | 3                                                       | 4                                                                | 5                                                | 6                                                                                | 7                                                           | 8                                                         | 9                                                                           | 10                                                            |
|----------------------|--------------------------------------------------|---------------------------------------------------------|------------------------------------------------------------------|--------------------------------------------------|----------------------------------------------------------------------------------|-------------------------------------------------------------|-----------------------------------------------------------|-----------------------------------------------------------------------------|---------------------------------------------------------------|
| Nominal<br>Pipe Size | Outside<br>Diameter<br>of<br>Flange,<br><i>O</i> | Thickness<br>of Flange<br>Min.,<br><i>t<sub>f</sub></i> | Wall<br>Thickness<br>of Fitting<br>Min.,<br><i>t<sub>m</sub></i> | Inside<br>Diameter<br>of<br>Fitting,<br><i>d</i> | Flange Edge                                                                      |                                                             |                                                           |                                                                             |                                                               |
|                      |                                                  |                                                         |                                                                  |                                                  | Center-to-<br>Flange Edge,<br>Elbow, Tee,<br>Cross, and<br>True "Y",<br><i>A</i> | Center-to-<br>Flange Edge,<br>45 deg<br>Elbow,<br><i>CE</i> | Long Center-<br>to-Flange<br>Edge<br>Lateral,<br><i>E</i> | Short Center-<br>to-Flange<br>Edge, Lateral<br>and<br>True "Y",<br><i>F</i> | Flange<br>Edge-to-<br>Flange<br>Edge,<br>Reducer,<br><i>G</i> |
| 1/2                  | 5.25                                             | 1.19                                                    | 0.25                                                             | 0.44                                             | 4.94                                                                             | ...                                                         | ...                                                       | ...                                                                         | ...                                                           |
| 3/4                  | 5.50                                             | 1.25                                                    | 0.28                                                             | 0.56                                             | 5.12                                                                             | ...                                                         | ...                                                       | ...                                                                         | ...                                                           |
| 1                    | 6.25                                             | 1.38                                                    | 0.34                                                             | 0.75                                             | 5.81                                                                             | 3.75                                                        | ...                                                       | ...                                                                         | ...                                                           |
| 1 1/4                | 7.25                                             | 1.50                                                    | 0.44                                                             | 1.00                                             | 6.62                                                                             | 4.00                                                        | ...                                                       | ...                                                                         | ...                                                           |
| 1 1/2                | 8.00                                             | 1.75                                                    | 0.50                                                             | 1.12                                             | 7.31                                                                             | 4.50                                                        | ...                                                       | ...                                                                         | ...                                                           |
| 2                    | 9.25                                             | 2.00                                                    | 0.62                                                             | 1.50                                             | 8.62                                                                             | 5.50                                                        | 15.00                                                     | 5.00                                                                        | 9.00                                                          |
| 2 1/2                | 10.50                                            | 2.25                                                    | 0.75                                                             | 1.88                                             | 9.75                                                                             | 6.00                                                        | 17.00                                                     | 5.50                                                                        | 10.00                                                         |
| 3                    | 12.00                                            | 2.62                                                    | 0.88                                                             | 2.25                                             | 11.12                                                                            | 7.00                                                        | 19.50                                                     | 6.50                                                                        | 11.25                                                         |
| 4                    | 14.00                                            | 3.00                                                    | 1.09                                                             | 2.88                                             | 13.00                                                                            | 8.25                                                        | 22.75                                                     | 7.50                                                                        | 13.00                                                         |
| 5                    | 16.50                                            | 3.62                                                    | 1.34                                                             | 3.62                                             | 15.38                                                                            | 9.75                                                        | 27.00                                                     | 9.00                                                                        | 15.25                                                         |
| 6                    | 19.00                                            | 4.25                                                    | 1.59                                                             | 4.38                                             | 17.75                                                                            | 11.25                                                       | 31.00                                                     | 10.25                                                                       | 17.50                                                         |
| 8                    | 21.75                                            | 5.00                                                    | 2.06                                                             | 5.75                                             | 19.88                                                                            | 12.50                                                       | 35.00                                                     | 11.50                                                                       | 20.00                                                         |
| 10                   | 26.50                                            | 6.50                                                    | 2.59                                                             | 7.25                                             | 24.75                                                                            | 15.75                                                       | 43.00                                                     | 14.50                                                                       | 25.00                                                         |
| 12                   | 30.00                                            | 7.25                                                    | 3.03                                                             | 8.62                                             | 27.75                                                                            | 17.50                                                       | 49.00                                                     | 16.00                                                                       | 28.50                                                         |

**Table G5 Dimensions of Class 2500 Flanged Fittings (Cont'd)**

| 11                                                                           | 12                                                        | 13                                                        | 14                                                                      | 15                                                                       | 16                                                     | 17                                         | 18                                        | 19                                                      | 20                                      | 1                 |
|------------------------------------------------------------------------------|-----------------------------------------------------------|-----------------------------------------------------------|-------------------------------------------------------------------------|--------------------------------------------------------------------------|--------------------------------------------------------|--------------------------------------------|-------------------------------------------|---------------------------------------------------------|-----------------------------------------|-------------------|
| Raised Face 0.25 in. [Note (1)]                                              |                                                           |                                                           |                                                                         |                                                                          | Ring Joint [Note (1)]                                  |                                            |                                           |                                                         |                                         |                   |
| Center-to-Contact Surface of Raised Face Elbow, Tee, Cross, and True "Y", AA | Center-to-Contact Surface of Raised Face 45 deg Elbow, CC | Long Center-to-Contact Surface of Raised Face Lateral, EE | Short Center-to-Contact Surface of Raised Face Lateral and True "Y", FF | Contact Surface-to-Contact Surface of Raised Face Reducer, GG [Note (2)] | Center-to-End, Tee, Cross, and True "Y", HH [Note (3)] | Center-to-End, 45 deg Elbow, KK [Note (3)] | Long Center-to-End Lateral, LL [Note (3)] | Short Center-to-End Lateral and True "Y", MM [Note (3)] | End-to-End Reducer, NN [Notes (2), (3)] | Nominal Pipe Size |
| 5.19                                                                         | ...                                                       | ...                                                       | ...                                                                     | ...                                                                      | 5.19                                                   | ...                                        | ...                                       | ...                                                     | ...                                     | 1/2               |
| 5.37                                                                         | ...                                                       | ...                                                       | ...                                                                     | ...                                                                      | 5.19                                                   | ...                                        | ...                                       | ...                                                     | ...                                     | 3/4               |
| 6.06                                                                         | 4.00                                                      | ...                                                       | ...                                                                     | ...                                                                      | 6.06                                                   | 4.00                                       | ...                                       | ...                                                     | ...                                     | 1                 |
| 6.87                                                                         | 4.25                                                      | ...                                                       | ...                                                                     | ...                                                                      | 6.94                                                   | 4.31                                       | ...                                       | ...                                                     | ...                                     | 1 1/4             |
| 7.56                                                                         | 4.75                                                      | ...                                                       | ...                                                                     | ...                                                                      | 7.62                                                   | 4.81                                       | ...                                       | ...                                                     | ...                                     | 1 1/2             |
| 8.87                                                                         | 5.75                                                      | 15.25                                                     | 5.25                                                                    | 9.50                                                                     | 8.94                                                   | 5.81                                       | 15.31                                     | 5.31                                                    | ...                                     | 2                 |
| 10.00                                                                        | 6.25                                                      | 17.25                                                     | 5.75                                                                    | 10.50                                                                    | 10.12                                                  | 6.38                                       | 17.38                                     | 5.88                                                    | ...                                     | 2 1/2             |
| 11.37                                                                        | 7.25                                                      | 19.75                                                     | 6.75                                                                    | 11.75                                                                    | 11.50                                                  | 7.38                                       | 19.88                                     | 6.88                                                    | ...                                     | 3                 |
| 13.25                                                                        | 8.50                                                      | 23.00                                                     | 7.75                                                                    | 13.50                                                                    | 13.44                                                  | 8.69                                       | 23.19                                     | 7.94                                                    | ...                                     | 4                 |
| 15.62                                                                        | 10.00                                                     | 27.25                                                     | 9.25                                                                    | 15.75                                                                    | 15.88                                                  | 10.25                                      | 27.50                                     | 9.50                                                    | ...                                     | 5                 |
| 18.00                                                                        | 11.50                                                     | 31.25                                                     | 10.50                                                                   | 18.00                                                                    | 18.25                                                  | 11.75                                      | 31.50                                     | 10.75                                                   | ...                                     | 6                 |
| 20.12                                                                        | 12.75                                                     | 35.25                                                     | 11.75                                                                   | 20.50                                                                    | 20.44                                                  | 13.06                                      | 35.56                                     | 12.06                                                   | ...                                     | 8                 |
| 25.00                                                                        | 16.00                                                     | 43.25                                                     | 14.75                                                                   | 25.50                                                                    | 25.44                                                  | 16.44                                      | 43.69                                     | 15.19                                                   | ...                                     | 10                |
| 28.00                                                                        | 17.75                                                     | 49.25                                                     | 16.25                                                                   | 29.00                                                                    | 28.44                                                  | 18.19                                      | 49.69                                     | 16.62                                                   | ...                                     | 12                |

**GENERAL NOTES:**

- Dimensions are in inches.
- For tolerances, see para. 7.
- For facings, see para. 6.4.
- For flange bolt holes, see para 6.5 and Table F21 of Annex F.
- For spot facing, see para. 6.6
- For intersecting centerlines, center-to-contact surface, and center-to-end dimensions of side outlet fittings, see para. 6.2.4.
- For center-to-contact surface and center-to-end dimensions of special degree elbows, see para. 6.2.5.
- For reinforcement of certain fittings, see para. 6.1.
- For drains, see para. 6.12.

**NOTES:**

- For center-to-contact surface and center-to-end dimensions of reducing fittings, see para. 6.2.3.
- For contact surface-to-contact surface and end-to-end dimensions of reducers and eccentric reducers, see para. 6.2.3.
- These dimensions apply to straight sizes only (See paras. 6.2.3 and 6.4.2.2). For the center-to-end dimensions of reducing fittings or end-to-end dimensions of reducers, use center-to-flange edge or flange edge-to-flange edge dimensions for largest opening, and add the proper height to provide for ring joint groove applying to each flange. See Table F5 of Annex F for ring joint facing dimensions.



# ANNEX H

## REFERENCES<sup>1</sup>

### H1 GENERAL

The following is a list of standards and specifications referenced in this Standard, showing the year of approval. Products covered by each ASTM specification are listed for convenience. (See specifications for exact titles and detailed contents.)

### H2 ASME PUBLICATIONS

ASME B1.1-1989 (R2001), Unified Inch Screw Threads (UN and UNR Thread Form)  
 ASME B1.20.1-1983 (R2001), Pipe Threads, General Purpose (Inch)  
 ASME B16.20-1998, Metallic Gaskets for Pipe Flanges—Ring-Joint, Spiral-Wound and Jacketed  
 ASME B16.21-1992, Nonmetallic Flat Gaskets for Pipe Flanges  
 ASME B16.25-1997, Buttwelding Ends  
 ASME B16.34-2002, Valves—Flanged, Threaded, and Welding End  
 ASME B18.2.1-1996, Square and Hex Bolts and Screws—Inch Series  
 ASME B18.2.2-1987 (R1999), Square and Hex Nuts (Inch Series)  
 ASME PCC-1-2000, Guidelines for Pressure Boundary Bolted Flange Joint Assembly  
 ASME B36.10M-2000, Welded and Seamless Wrought Steel Pipe  
 ASME B46.1-2002, Surface Texture (Surface Roughness, Waviness, and Lay)

#### H2.1 ASME Boiler and Pressure Vessel Code, 2001 Edition (Including Addenda through 2002)

Section I, Power Boilers  
 Section II, Materials  
 Section III, Rules for Construction of Nuclear Power Plant Components  
 Section VIII, Div. 1 and 2, Pressure Vessels  
 Section IX, Welding and Brazing Qualifications  
 Publisher: The American Society of Mechanical Engineers (ASME International) Three Park Avenue, New York, NY 10016-5990; ASME Order Department: 22 Law Drive, Box 2300, Fairfield, NJ 07007-2300

<sup>1</sup> This Annex is an integral part of ASME B16.5-2003, and is placed after the main text for convenience.

### H3 ASTM PUBLICATIONS

A 105-2001, Carbon Steel Forgings for Piping Components  
 A 106-1999e1, Seamless Carbon Steel Pipe for High-Temperature Service  
 A 182-2001e1, Forged or Rolled Alloy-Steel Pipe Flanges, Forged Fittings, and Valves and Parts for High Temperature Service  
 A 193-2001b, Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service  
 A 194-2001a, Carbon and Alloy Steel Nuts for Bolts for High-Pressure and High-Temperature Service, or Both  
 A 203-1997, Pressure Vessel Plates, Alloy Steel, Nickel  
 A 204-1993 (R1999), Pressure Vessel Plates, Alloy Steel, Molybdenum  
 A 216-1993 (1998), Steel Castings, Carbon, Suitable for Fusion Welding, for High-Temperature Service  
 A 217-2002, Steel Castings, Martensitic Stainless and Alloy, for Pressure Containing Parts, Suitable for High-Temperature Service  
 A 240-2002, Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications  
 A 307-2000, Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength  
 A 320-2001, Alloy/Steel Bolting Materials for Low-Temperature Service  
 A 350-2000c Carbon and Low-Alloy Steel Forgings, Requiring Notch Toughness Testing for Piping Components  
 A 351-2000, Castings, Austenitic, Austenitic-Ferritic (Duplex), for Pressure Containing Parts  
 A 352-1993 (R1998), Steel Castings, Ferritic and Martensitic, for Pressure-Containing Parts, Suitable for Low-Temperature Service  
 A 354-2001, Quenched and Tempered Alloy Steel Bolts, Studs and Other Externally Threaded Fasteners  
 A 387-1999e1, Pressure Vessel Plates, Alloy Steel, Chromium-Molybdenum  
 A 449-2000, Quenched and Tempered Steel Bolts and Studs  
 A 453-2000e1, High-Temperature Bolting Materials, with Expansion Coefficients Comparable to Austenitic Stainless Steels  
 A 515-2001, Pressure Vessel Plates, Carbon Steel, for Intermediate- and Higher-Temperature Service  
 A 516-2001, Pressure Vessel Plates, Carbon Steel, For Moderated- and Lower-Temperature Service

- A 537-1995 (R2000), Pressure Vessel Plates, Heat-Treated, Carbon-Manganese-Silicon-Steel
- A 540-2000, Alloy-Steel Bolting Materials for Special Applications
- B 127-1998, Nickel-Copper Alloy (UNS N04400) Plate, Sheet, and Strip
- B 160-1999, Nickel Rod and Bar
- B 162-1999, Nickel Plate, Sheet and Strip
- B 164-1998, Nickel-Copper Alloy Rod, Bar, and Wire
- B 166-2001, Nickel-Chromium-Iron Alloys (UNS N06600, N06601, N06603, N06690, N06693, N06025, and N06045) and Nickel-Chromium-Cobalt-Molybdenum Alloy (UNS N06617) Rod, Bar, and Wire
- B 168-2001, Nickel-Chromium-Iron Alloys (UNS N06600, N06601, N06603, N06690, N06693, N06025, and N06045) and Nickel-Chromium-Cobalt-Molybdenum Alloy (UNS N06617) Plate, Sheet, and Strip
- B 333-1998, Nickel-Molybdenum Alloy Plate, Sheet, and Strip
- B 335-2001, Seamless Ferritic Alloy-Steel Pipe for High Temperature Service
- B 408-2001, Nickel-Iron-Chromium Alloy Rod and Bar
- B 409-2001, Nickel-Iron-Chromium Alloy, Plate, Sheet, Strip
- B 424-1998a, Ni-Fe-Cr-Mo-Cu Alloy (UNS N08825 and N08821) Plate, Sheet, and Strip
- B 425-1999, Ni-Fe-Cr-Mo-Cu Alloy (UNS N08825 and UNS N08221) Rod and Bar
- B 434-2000, Nickel-Molybdenum-Chromium-Iron Alloys (UNS N10003, UNS N10242) Plate, Sheet, and Strip
- B 435-1998a, UNS N06002, UNS N06230, UNS N12160, and UNS R30556 Plate, Sheet, and Strip
- B 443-2000e1, Nickel-Chromium-Molybdenum-Columbium Alloy (UNS N06625) and Nickel-Chromium-Molybdenum-Silicon Alloy (UNS N06219) Plate, Sheet, and Strip
- B 446-2000e1, Nickel-Chromium-Molybdenum-Columbium Alloy (N06625), Nickel-Chromium-Molybdenum-Silicon Alloy (UNS N06219) Rod and Bar, and Nickel-Chromium-Molybdenum-Tungsten Alloy (UNS N06650) Rod and Bar
- B 462-2000a, Forged or Rolled UNS N06030, UNS N06022, UNS N06200, UNS N08020, UNS N08024, UNS N08026, UNS N08367, UNS N10276, UNS N10665, UNS N10675 and UNS R20033 Alloy Pipe Flanges, Forged Fittings and Valves and Parts for Corrosive High-Temperature Service
- B 463-1999, UNS N08020, UNS N08024, and UNS N08026 Alloy Plate, Sheet, and Strip
- B 473-1996, UNS N08020, UNS N08024, and UNS N08026 Nickel Alloy Bar and Wire
- B 511-2001, Nickel-Iron-Chromium-Silicon Alloy Bars and Shapes
- B 536-1995 Nickel-Iron-Chromium-Silicon Alloy (UNS N08330 and N08332) Plate, Sheet, and Strip
- B 564-2000a, Nickel Alloy Forgings
- B 572-1998a, UNS N06002, UNS N06230, UNS N12160, and UNS R30556 Rod
- B 573-2000, Nickel-Molybdenum-Chromium-Iron Alloy (UNS N10003, N10242) Rod
- B 574-1999a, Low-Carbon Nickel-Molybdenum-Chromium, Low-Carbon Nickel-Chromium-Molybdenum, Low Carbon Nickel Molybdenum-Chromium-Tantalum, Low-Carbon Nickel Chromium-Molybdenum-Copper, Low-Carbon Nickel-Chromium-Molybdenum-Tungsten Alloy Rod
- B 575-1999a, Low-Carbon Nickel-Molybdenum-Chromium, Low-Carbon Nickel-Chromium-Molybdenum, Low-Carbon Nickel-Chromium Molybdenum-Copper, Low-Carbon Nickel-Chromium-Tantalum, Low-Carbon Nickel-Chromium-Molybdenum-Tungsten Alloy Plate, Sheet, and Strip
- B 581-1997, Nickel-Chromium-Iron-Molybdenum-Copper Alloy Rod
- B 582-1997, Nickel-Chromium-Iron-Molybdenum-Copper Alloy Plate, Sheet, and Strip
- B 599-1992 (R1997), Nickel-Iron-Chromium-Molybdenum-Columbium Stabilized Alloy (UNS N08700) Plate, Sheet, and Strip
- B 620-1998a, Nickel-Iron-Chromium-Molybdenum Alloy (UNS N08320) Plate, Sheet, and Strip
- B 621-1995a, Nickel-Iron-Chromium-Molybdenum Alloy (UNS N08320) Rod
- B 625-1999, UNS N08904, UNS N08925, UNS N08031, UNS N08932, UNS N08926, and UNS R20033 Plate, Sheet, and Strip
- B 649-1995, Ni-Fe-Cr-Mo-Cu Low Carbon Alloy (UNS N08904) and Ni-Fe Cr-Mo-Cu-N Low Carbon Alloys (UNS N08925, UNS N08031, and UNS N08926), and Cr-Ni-Fe-N Low-Carbon Alloy (UNS R20033) Bar and Wire
- B 672-1995, Nickel-Iron-Chromium-Molybdenum-Columbium Stabilized Alloy (UNS N08700) Bar and Wire
- B 688-1996, Chromium-Nickel-Molybdenum-Iron (UNS N08366 and UNS N08367) Plate, Sheet, and Strip
- E 29-1993a (1999), Using Significant Digits in Test Data to Determine Conformance with Specifications
- Publisher: The American Society for Testing and Materials (ASTM), 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959

#### H4 ISO PUBLICATIONS<sup>2</sup>

ISO 9000-1:1994, Quality management and quality assurance standards — Part 1: Guidelines for selection and use

<sup>2</sup> ISO documents are available from The American National Standards Institute, Inc. (ANSI), 25 West 43rd Street, New York, New York 10036. Publications appearing above, which have been approved as American National Standards may also be obtained from ANSI.

ISO 9000-2:1997, Quality management and quality assurance standard — Part 2: Generic guidelines for the application of ISO 9001, ISO 9002m and ISO 9003

ISO 9000-3:1997, Quality management and quality assurance standards — Part 3: Guidelines for the application of ISO 9001 to the development, supply and maintenance of software

ISO 9000-4:1993, Quality management and quality assurance standards — Part 4: Guide to Dependability programme management

ISO 9002:1994, Quality system — Model for quality assurance in production and servicing

ISO 9003:1994, Quality systems — Model for quality assurance in final inspection and test

Publisher: International Organization for Standardization (ISO), 1 rue de Varembe, Case Postale 56, CH-1211 Genève 20, Switzerland/Suisse

## H5 MSS PUBLICATIONS

MSS SP-6-2001, Finishes for Contact Faces of Pipe Flanges and Connecting-End Flanges of Valves and Fittings

MSS SP-9-2001, Spot Facing for Bronze, Iron and Steel Flanges

MSS SP-25-1998, Standard Marking System for Valves, Fittings, Flanges, and Unions

MSS SP-44-R2001, Steel Pipeline Flanges

MSS SP-45-1998, Bypass and Drain Connections

MSS SP-55-2001, Quality Standard for Steel Casting for Valves, Flanges and Fittings

MSS SP-61-1999, Pressure Testing of Steel Valves

Publisher: Manufacturers Standardization Society of the Valve & Fittings Industry (MSS), 127 Park Street, NE, Vienna, VA 22180-4602

# **ASME B16.5-2003 INTERPRETATIONS**

## **Interpretation No. 4**

**Replies to Technical Inquiries**  
**January 1, 1998 through December 31, 2002**

### **FOREWORD**

This publication includes all of the written replies issued between the indicated dates by the Secretary, speaking for the ASME B16 Committee, Standardization of Valves, Flanges, Fittings, Gaskets, and Valve Actuators, to inquiries concerning interpretations of technical aspects of B16.5, Pipe Flanges and Flanged Fittings NPS  $\frac{1}{2}$  Through NPS 24 Metric/Inch Standard.

These replies are taken verbatim from the original letters except for a few typographical corrections and some minor editorial corrections made for the purpose of improved clarity. In some few instances, a review of the interpretation revealed a need for corrections of a technical nature; in these cases, a corrected interpretation follows immediately after the original reply.

These interpretations were prepared in accordance with the accredited ASME procedures. ASME procedures provide for reconsideration of these interpretations when or if additional information is available which the inquirer believes might affect the interpretation. Further, persons aggrieved by this interpretation may appeal to the cognizant ASME Committee or Subcommittee. ASME does not "approve," "certify," "rate," or "endorse" any item, construction, proprietary device, or activity.

**Interpretation: 4-1**

Subject: Hub Diameter

Date Issued: March 13, 1998

File: B16-97-011

Question: According to ASME B16.5-1996, does the diameter of hub dimension “X” as shown in Table 9, Fig. 9, correspond to the theoretical intersection of the angles line that represents the outside of the hub with the line that represents the back of the flange?

Reply: Yes. However, note this is a dimension without a tolerance.

**Interpretation: 4-2**

Subject: Tolerance

Date Issued: March 24, 1998

File: B16-98-003

Question: Does ASME B16.5-1996 have required tolerances for a lapped, slip-on, or socket-welding flange for the overall length through hub?

Reply: No.

**Interpretation: 4-3**

Subject: Blind Flange Material

Date Issued: March 24, 1998

File: B16-98-004

Question (1): May blind flanges covered by ASME B16.5-1996 be produced from plate?

Reply (1): Yes.

Question (2): May blind flanges produced from plate be marked in accordance with ASME B16.5-1996?

Reply (2): Yes, provided that they meet all the requirements of ASME B16.5-1996.

Question (3): Does ASME B16.5-1996 have criteria for the selection of materials?

Reply (3): No. See para. 5.1.1.

**Interpretation: 4-4**

Subject: Implementation of the Standard, Flange Face Finish

Date Issued: July 21, 1998

File: B16-097-015

Question (1): Is there a mandatory date for the implementation of ASME B16.5-1996?

Reply (1): No. Implementation may be required by reference in a code, specification, sales contract, or public law.

Question (2): May a flange not meeting the flange facing finish requirements of ASME B16.5-1996 but meeting those of an earlier edition be supplied as being in accordance with the 1996 edition?

Reply (2): Yes, provided that the flange face finish is supplied by arrangement with the purchaser. (See para. 6.4.4.)

Question (3): According to ASME B16.5-1996, para. 6.4.4.3, may a flange with less than 45 grooves per inch or more than 55 grooves per inch meet the flange facing finish requirements as long as the resultant surface finish has a 125 to 250  $\mu\text{in.}$  average roughness?

Reply (3): Yes.

**Interpretation: 4-5**

Subject: Welding Neck Flanges

Date Issued: June 18, 1999

File: B16-99-004

Question (1): Does ASME B16.5-1996 cover welding neck flanges that have the overall length through hub dimension  $y$  greater than the specified values (e.g., long weld neck)?

Reply (1): No.

Question (2): Does para. 6.7.4 of ASME B16.5-1996 allow the conformance designation "B16" to be applied to long weld neck flanges having overall length through hub dimensions greater than specified values?

Reply (2): No. This paragraph applies to only end preparations.

**Interpretation: 4-6**

Subject: Blind Flange Material

Date Issued: October 15, 2001

File: B16-98-013

Question (1): Does ASME B16.5-1996 allow blind flange made from a plate material listed in Table 1A to be designated as a forging material in Table 1A?

Reply (1): No.

Question (2): Does ASME B16.5-1996 permit blind flanges to be of a plate material as listed in Table 1A for all pressure classes covered in ASME B16.5-1996 (150, 300, 400, 600, 900, 1500, and 2500)?

Reply (2): Yes.

**Interpretation: 4-7**

Subject: Materials Conformance

Date Issued: January 31, 2001

File: B16-98-017

Question: In accordance with ASME B16.5-1996, may a flange made from a material other than that of a material specification listed in Table 1A be identified as being manufactured in accordance with ASME B16.5?

Reply: No.

**Interpretation: 4-8**

Subject: Material Conformance

Date Issued: January 31, 2001

File: B16-99-03

Question: May a flange meeting all of the relevant dimensional requirements of ASME B16.5-1996 that is integrally forged or cast to another product be marked as in para. 4.1.1 to indicate conformance to the B16.5 Standard?

Reply: No.

**Interpretation: 4-9**

Subject: Dual Markings

Date Issued: January 31, 2001

File: B16-99-12

Question: In accordance with ASME B16.5-1996, para. 4.14, may flanges NPS  $\frac{1}{2}$  through NPS  $3\frac{1}{2}$  meeting all of the requirements for Class 600 be marked to show conformance with both Class 400 and Class 600?

Reply: Yes.

**Interpretation: 4-10**

Subject: Welding End Preparation for Welding Neck Flanges

Date Issued: January 31, 2001

File: B16-99-14

Question: In ASME B16.5-1996, para. 6.7.1, the referenced figures are for attachment of flanges to pipe with wall thickness 0.19 in. and larger. May weld preparations for pipe wall thickness less than 0.19 in. be used in accordance with para. 6.7.4?

Reply: Yes.

**Interpretation: 4-11**

Subject: Socket Weld Flanges

Date Issued: January 31, 2001

File: B16-00-03

Question (1): In ASME B16.5-1996, including 1998 Addenda (a), various tables (for example Table 9) have illustrations that show the location of the applicable tabulated dimensions. For socket welding flanges, these illustrations note a limiting flange size range. Are socket-welding flanges in sizes outside this range, covered by ASME B16.5?

Reply (1): No.

Question (2): May socket welding flanges, in sizes greater than NPS 3 (NPS 2½ for class 1500), which conform to the requirements of ASME B16.5-1996, including 1998 Addenda (a), with all dimensions listed in the applicable tables met, be stamped "B16" in accordance with para. 4.14?

Reply (2): No. Socket welding flanges in these larger sizes are not included in the requirement of B16.5.

**Interpretation: 4-12**

Subject: Dimensional Requirements

Date Issued: January 31, 2001

File: B16-00-004

Question: In accordance with ASME B16.5-1996, including 1998 Addenda (a), are there requirements for the geometry of the shoulder at the circumference defined by diameters designated R in Fig. 7?

Reply: No.

**Interpretation: 4-13**

Subject: Marking for Welding Neck Flanges

Date Issued: January 31, 2001

File: B16-00-12

Question: Does ASME B16.5-1996 require marking in addition to that described in para. 4 for socket welding or welding neck flanges?

Reply: No.

**Interpretation: 4-14**

Subject: Material Conformance

Date Issued: February 1, 2002

File: B16-C-01-01

Question: In accordance with ASME B16.5-1996 Edition, 1998 Addenda (a), may flanges manufactured of materials other than those listed in Table 1A be marked as being in conformance with ASME B16.5 as required by para. 4.14?

Reply: No. See para. 5.1.



**Interpretation: 4-15**

Subject: Lapped Joint Flanges Thickness

Date Issued: February 1, 2002

File: B16-C-01-02

Question: What minimum thickness does ASME B16.5-1996, 1998 Addenda (a), require for lapped joint flanges?

Reply: Dimension "C" as shown in Tables 9, 12, 15, 18, 21, 24, and 27. See para. 7.4 for tolerance.

**Interpretation: 4-16**

Subject: Marking Requirements

Date Issued: February 20, 2002

File: B16-C-01-03

Question (1): According to B16.5-1996, 1998 Addenda (a), is it required that the designation "B16" or the designation "B16.5" be marked on the flange?

Reply (1): It is required that "B16" be marked on the flange. See para. 4.1.4.

Question (2): Does marking "B16.5" in lieu of "B16", as required, render the flange nonconforming to ASME B16.5-1996, 1998 Addenda (a)?

Reply (2): No.

**Interpretation: 4-17**

Subject: Flange Thickness

Date Issued: September 2, 2002

File: 02-02830

Question: According to ASME B16.5-1996 edition, 1998 Addenda (a), is it acceptable for the flange thickness to taper to the edge and be thinner than the flange thickness "C" dimension listed in the dimensional tables?

Reply: No. See para. 7, Tolerances.

# ASME B16.5-2003

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