

ASME B16.5-2009
(Revision of ASME B16.5-2003)

Pipe Flanges and Flanged Fittings

NPS 1/2 Through NPS 24
Metric/Inch Standard

AN AMERICAN NATIONAL STANDARD



The American Society of
Mechanical Engineers



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FOREWORD

In 1920, the American Engineering Standards Committee [later the American Standards Associations (ASA)] organized Sectional Committee B16 to unify and further develop standards for pipe flanges and fittings (and later for valves and gaskets). Cosponsors of the B16 Committee were 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). Cosponsors were later designated as cosecretariat 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 3,200-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 1,350-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), 1,500-lb flanges in the 14-in. through 24-in. range, 2,500-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 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 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 the 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 the measurement of stud bolt length between thread ends instead of 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 the 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 valves 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 the addition of considerations for bolting and gaskets for flanged joints 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 the Standards Committee, cosponsors, 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 an 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 ASME B16.5-1996.

The 2003 Edition included metric units as the primary reference units while maintaining U.S. Customary units in either parenthetical or separate forms. New materials were added while some materials were shifted from one group to another, and new material groups were established.

All pressure–temperature ratings were recalculated using data from the latest edition of the ASME Boiler and Pressure Vessel Code, Section II, Part D. Annex F was 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 were prefixed by the letter F and corresponded to table and figure numbers in the main text for the metric version, with the exception of some table and figure numbers that were not used in Annex F. Of note, the flange thickness designations for Class 150 and 300 were revised with reference to their raised faces. For these classes, the flange thickness dimensional reference planes were altered; however, required flange thickness remained unchanged. The minimum flange thickness designation was changed from C to t_f , and it did 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 were listed only with U.S. Customary units in Annex G. In addition, straight hub welding flanges were incorporated as a new set of flanges in Classes 150 through 2500. Also, there were 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.

The 2009 Edition adds new materials, updates some pressure–temperature ratings, and designates the annexes as mandatory and nonmandatory appendices. The mandatory appendices have

been numbered using roman numerals, and the nonmandatory appendices are now referenced using capital letters.

Following approval of the Standards Committee and ASME, approval for the new edition was granted by the American National Standards Institute on February 19, 2009.

Requests for interpretations or suggestions for revisions should be sent to the Secretary, B16 Standards 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
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Three Park Avenue
New York, NY 10016-5990

As an alternative, inquiries may be submitted via e-mail to: SecretaryB16@asme.org.

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 that 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 ½ 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, and 1500 in sizes NPS ½ through NPS 24 and flanges with rating class designation 2500 in sizes NPS ½ through NPS 12, 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 ½ 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, and 1500 in sizes NPS ½ through NPS 24 and flanged fittings with rating class designation 2500 in sizes ½ through NPS 12 that are acknowledged in Nonmandatory Appendix E 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, gaskets, and 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 Mandatory Appendix III.

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 Nonmandatory Appendix D.

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 Selection of Materials

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 ≥ 4 , the related DN = 25 multiplied by the NPS number.

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 II-2-1.1 through II-2-3.17 of Mandatory Appendix II 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 interrelated components: the flanges, gasket, and 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°C (-20°F), the rating shall be no greater than the rating shown for -29°C (-20°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°C (400°F) for Class 150 and above 400°C (750°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°C (-20°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°C (100°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.¹ 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:

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

where

A_h = 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 A-1 and A-2 of Nonmandatory Appendix A

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 through 14 for weld end dimensional requirements.

2.8 Straight Hub Welding Flanges

2.8.1 Hub Dimensions. 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 II-8, II-11, II-14, II-16, II-20, and II-22 of Mandatory Appendix II) (see Fig. 15).

2.8.2 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 manufacturer.

2.8.3 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 manufacturer. In no case shall the bore diameter exceed the bore of the same size and class lapped flange.

2.8.4 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 II-6 of Mandatory Appendix II).

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:

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

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 | 2-1.1 | A 105 | A 216 Gr. WCB | A 515 Gr. 70 |
| | C–Mn–Si | 2-1.1 | A 350 Gr. LF2 | ... | A 516 Gr. 70 |
| | C–Mn–Si | 2-1.1 | ... | ... | A 537 Cl. 1 |
| | C–Mn–Si–V | 2-1.1 | A 350 Gr. LF6 Cl. 1 | ... | ... |
| | 3½ Ni | 2-1.1 | A 350 Gr. LF3 | ... | ... |
| 1.2 | C–Mn–Si | 2-1.2 | ... | A 216 Gr. WCC | ... |
| | C–Mn–Si | 2-1.2 | ... | A 352 Gr. LCC | ... |
| | C–Mn–Si–V | 2-1.2 | A 350 Gr. LF6 Cl. 2 | ... | ... |
| | 2½Ni | 2-1.2 | ... | A 352 Gr. LC2 | A 203 Gr. B |
| | 3½Ni | 2-1.2 | ... | A 352 Gr. LC3 | A 203 Gr. E |
| 1.3 | C–Si | 2-1.3 | ... | A 352 Gr. LCB | A 515 Gr. 65 |
| | C–Mn–Si | 2-1.3 | ... | ... | A 516 Gr. 65 |
| | 2½Ni | 2-1.3 | ... | ... | A 203 Gr. A |
| | 3½Ni | 2-1.3 | ... | ... | A 203 Gr. D |
| | C–½Mo | 2-1.3 | ... | A 217 Gr. WC1 | ... |
| | C–½Mo | 2-1.3 | ... | A 352 Gr. LC1 | ... |
| 1.4 | C–Si | 2-1.4 | ... | ... | A 515 Gr. 60 |
| | C–Mn–Si | 2-1.4 | A 350 Gr. LF1 Cl. 1 | ... | A 516 Gr. 60 |
| 1.5 | C–½Mo | 2-1.5 | A 182 Gr. F1 | ... | A 204 Gr. A |
| | C–½Mo | 2-1.5 | ... | ... | A 204 Gr. B |
| 1.7 | ½Cr–½Mo | 2-1.7 | A 182 Gr. F2 | ... | ... |
| | Ni–½Cr–½Mo | 2-1.7 | ... | A 217 Gr. WC4 | ... |
| | ¾Ni–¾Cr–1Mo | 2-1.7 | ... | A 217 Gr. WC5 | ... |
| 1.9 | 1¼Cr–½Mo | 2-1.9 | ... | A 217 Gr. WC6 | ... |
| | 1¼Cr–½Mo–Si | 2-1.9 | A 182 Gr. F11 CL.2 | ... | A 387 Gr. 11 Cl. 2 |
| 1.10 | 2¼Cr–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 | 2-1.17 | A 182 Gr. F12 Cl. 2 | ... | ... |
| | 5Cr–½Mo | 2-1.17 | A 182 Gr. F5 | ... | ... |
| 1.18 | 9Cr–2W–V | 2-1.18 | A 182 Gr. F92 | ... | ... |
| 2.1 | 18Cr–8Ni | 2-2.1 | A 182 Gr. F304 | A 351 Gr. CF3 | A 240 Gr. 304 |
| | 18Cr–8Ni | 2-2.1 | A 182 Gr. F304H | A 351 Gr. CF8 | A 240 Gr. 304H |
| 2.2 | 16Cr–12Ni–2Mo | 2-2.2 | A 182 Gr. F316 | A 351 Gr. CF3M | A 240 Gr. 316 |
| | 16Cr–12Ni–2Mo | 2-2.2 | A 182 Gr. F316H | A 351 Gr. CF8M | A 240 Gr. 316H |
| | 18Cr–13Ni–3Mo | 2-2.2 | A 182 Gr. F317 | ... | A 240 Gr. 317 |
| | 19Cr–10Ni–3Mo | 2-2.2 | ... | A 351 Gr. CG8M | ... |
| 2.3 | 18Cr–8Ni | 2-2.3 | A 182 Gr. F304L | ... | A 240 Gr. 304L |
| | 16Cr–12Ni–2Mo | 2-2.3 | A 182 Gr. F316L | ... | A 240 Gr. 316L |
| | 18Cr–13Ni–3Mo | 2-2.3 | A 182 Gr. F317L | ... | ... |

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

| Material Group | Nominal Designation | Pressure– Temperature Rating Table | Applicable ASTM Specifications [Note (1)] | | |
|----------------|----------------------------|--|---|--------------------|------------------|
| | | | Forgings | Castings | Plates |
| 2.4 | 18Cr–10Ni–Ti | 2-2.4 | A 182 Gr. F321 | ... | A 240 Gr. 321 |
| | 18Cr–10Ni–Ti | 2-2.4 | A 182 Gr. F321H | ... | A 240 Gr. 321H |
| 2.5 | 18Cr–10Ni–Cb | 2-2.5 | A 182 Gr. F347 | ... | A 240 Gr. 347 |
| | 18Cr–10Ni–Cb | 2-2.5 | A 182 Gr. F347H | ... | A 240 Gr. 347H |
| | 18Cr–10Ni–Cb | 2-2.5 | A 182 Gr. F348 | ... | A 240 Gr. 348 |
| | 18Cr–10Ni–Cb | 2-2.5 | A 182 Gr. F348H | ... | 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 | 2-2.8 | A 182 Gr. F44 | A 351 Gr. CK3MCuN | A 240 Gr. S31254 |
| | 22Cr–5Ni–3Mo–N | 2-2.8 | A 182 Gr. F51 | ... | A 240 Gr. S31803 |
| | 25Cr–7Ni–4Mo–N | 2-2.8 | A 182 Gr. F53 | ... | A 240 Gr. S32750 |
| | 24Cr–10Ni–4Mo–V | 2-2.8 | ... | A 351 Gr. CE8MN | ... |
| | 25Cr–5Ni–2Mo–3Cu | 2-2.8 | ... | A 995 Gr. CD4MCu | ... |
| | 25Cr–7Ni–3.5Mo–W–Cb | 2-2.8 | ... | A 995 Gr. CD3MWCuN | ... |
| | 25Cr–7.5Ni–3.5Mo–N–Cu–W | 2-2.8 | A 182 Gr. F55 | ... | A 240 Gr. S32760 |
| | | | | | |
| 2.9 | 23Cr–12Ni | 2-2.9 | ... | ... | A 240 Gr. 309S |
| | 25Cr–12Ni | 2-2.9 | ... | ... | A 240 Gr. 310S |
| 2.10 | 25Cr–12Ni | 2-2.10 | ... | A 351 Gr. CH8 | ... |
| | 25Cr–12Ni | 2-2.10 | ... | 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–20Cr–Cb | 2-3.1 | B 462 Gr. N08020 | ... | B 463 Gr. N08020 |
| 3.2 | 99.0Ni | 2-3.2 | B 564 Gr. N02200 | ... | B 162 Gr. N02200 |
| 3.3 | 99.0Ni–Low C | 2-3.3 | ... | ... | B 162 Gr. N02201 |
| 3.4 | 67Ni–30Cu | 2-3.4 | B 564 Gr. N04400 | ... | 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 | 2-3.7 | B 462 Gr. N10665 | ... | B 333 Gr. N10665 |
| | 64Ni–29.5Mo–2Cr–2Fe–Mn–W | 2-3.7 | B 462 Gr. N10675 | ... | B 333 Gr. N10675 |
| 3.8 | 54Ni–16Mo–15Cr | 2-3.8 | B 462 Gr. N10276 | ... | B 575 Gr. N10276 |
| | 60Ni–22Cr–9Mo–3.5Cb | 2-3.8 | B 564 Gr. N06625 | ... | B 443 Gr. N06625 |
| | 62Ni–28Mo–5Fe | 2-3.8 | ... | ... | B 333 Gr. N10001 |
| | 70Ni–16Mo–7Cr–5Fe | 2-3.8 | ... | ... | B 434 Gr. N10003 |
| | 61Ni–16Mo–16Cr | 2-3.8 | ... | ... | B 575 Gr. N06455 |
| | 42Ni–21.5Cr–3Mo–2.3Cu | 2-3.8 | B 564 Gr. N08825 | ... | B 424 Gr. N08825 |
| | 55Ni–21Cr–13.5Mo | 2-3.8 | B 462 Gr. N06022 | ... | B 575 Gr. N06022 |
| | 55Ni–23Cr–16Mo–1.6Cu | 2-3.8 | B 462 Gr. N06200 | ... | B 575 Gr. N06200 |
| 3.9 | 47Ni–22Cr–9Mo–18Fe | 2-3.9 | ... | ... | B 435 Gr. N06002 |
| | 21Ni–30Fe–22Cr–18Co–3Mo–3W | 2-3.9 | B 572 Gr. R30556 | ... | B 435 Gr. R30556 |
| 3.10 | 25Ni–47Fe–21Cr–5Mo | 2-3.10 | ... | ... | 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 | A 479 Gr. N08904 | ... | A 240 Gr. N08904 |
| 3.12 | 26Ni–43Fe–22Cr–5Mo | 2-3.12 | ... | ... | B 620 Gr. N08320 |
| | 47Ni–22Cr–20Fe–7Mo | 2-3.12 | ... | ... | B 582 Gr. N06985 |
| | 46Fe–24Ni–21Cr–6Mo–Cu–N | 2-3.12 | B 462 Gr. N08367 | A 351 Gr. CN3MN | B 688 Gr. N08367 |
| 3.13 | 49Ni–25Cr–18Fe–6Mo | 2-3.13 | ... | ... | B 582 Gr. N06975 |
| | Ni–Fe–Cr–Mo–Cu–Low C | 2-3.13 | B 564 Gr. N08031 | ... | B 625 Gr. N08031 |
| 3.14 | 47Ni–22Cr–19Fe–6Mo | 2-3.14 | ... | ... | B 582 Gr. N06007 |
| | 40Ni–29Cr–15Fe–5Mo | 2-3.14 | B 462 Gr. N06030 | ... | B 582 Gr. N06030 |
| | 58Ni–33Cr–8Mo | 2-3.14 | B 462 Gr. N06035 | ... | B 575 Gr. N06035 |
| 3.15 | 42Ni–42Fe–21Cr | 2-3.15 | B 564 Gr. N08810 | ... | B 409 Gr. N08810 |
| 3.16 | 35Ni–19Cr–1¼Si | 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 | ... |
| 3.19 | 57Ni–22Cr–14W–2Mo–La | 2-3.19 | B 564 Gr. N06230 | ... | B 435 Gr. N06230 |

GENERAL NOTES:

- (a) For temperature limitations, see notes in Tables II-2-1.1 through II-2-3.17 of Mandatory Appendix II.
- (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.

(a) Cast flanges and flanged fittings shall be marked with the ASTM specification,² 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.²

(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.

² 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.

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.

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 A; 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°C ($+20^{\circ}\text{F}$). It is the responsibility of the user to ensure 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°C ($1,000^{\circ}\text{F}$)], 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 II-2-1.1 through II-2-3.17 of Mandatory Appendix II).

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 through 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 conditions.

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°C (400°F) or below -29°C (-20°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 overstress 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 Nonmandatory Appendix B, Table B-1, 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 Nonmandatory Appendix B, Table B-1, Group No. 1a materials

(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

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

| Bolting Materials [Note (1)] | | | | | | | | | | | |
|------------------------------|-------|-------|-------------------------------------|-----------|-------|----------------------------|----------|-------|--|------------------|------------|
| High Strength [Note (2)] | | | Intermediate Strength [Note (3)] | | | Low Strength [Note (4)] | | | Nickel and Special Alloy [Note (5)] | | |
| Spec. No. | Grade | Notes | Spec. No. | Grade | Notes | Spec. No. | Grade | Notes | Spec. No. | Grade | Notes |
| A 193 | B7 | ... | A 193 | B5 | ... | A 193 | B8 Cl.1 | (6) | B164 | ... | (7)–(9) |
| A 193 | B16 | ... | A 193 | B6 | ... | A 193 | B8C Cl.1 | (6) | ... | ... | ... |
| A 193 | B16 | ... | A 193 | B6X | ... | A 193 | B8M Cl.1 | (6) | B166 | ... | (7)–(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 N10675 | (7) (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)–(9) |
| | | | A 193 | B8M Cl.2B | (11) | | | | | | |
| | | | A 193 | B8T Cl.2 | (11) | A 193 | B8TA | (6) | | | |
| A 354 | BC | ... | A 320 | B8 Cl.2 | (11) | A 307 | B | (12) | B473 | ... | (7) |
| A 354 | BD | ... | A 320 | B8C Cl.2 | (11) | | | | B574 | ... | (7) |
| | | | A 320 | B8F Cl.2 | (11) | A 320 | B8 Cl.1 | (6) | | | |
| A 540 | B21 | ... | A 320 | B8M Cl.2 | (11) | A 320 | B8C Cl.1 | (6) | | | |
| A 540 | B22 | ... | A 320 | B8T Cl.2 | (11) | A 320 | B8M Cl.1 | (6) | | | |
| A 540 | B23 | ... | | | | A 320 | B8T Cl.1 | (6) | | | |
| A 540 | B24 | ... | | | | | | | | | |
| | | | 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 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.

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 Nonmandatory Appendix B. The user is responsible for selection of gasket materials that will withstand the expected bolt loading without injurious crushing and that 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 Nonmandatory Appendix B, Table B-1, Group No. Ia are recommended.

5.4.3 Gaskets for Class 150 Flanged Joints. It is recommended that only Nonmandatory Appendix B, Table B-1, Group No. I 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 II-9 and II-12 of Mandatory Appendix II), except as provided in para. 6.1.2. The 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 subminimum 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 $0.75t_m$.

(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 II-9 and II-12 of Mandatory Appendix II).

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, tees, and 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. II-7 of Mandatory Appendix II) 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. II-7 of Mandatory Appendix II) shows dimensional relationships for various flange types and pipe lap facings to be used with lap joints. Table 4 (Table II-4 of Mandatory Appendix II) lists dimensions for facings other than ring joint. Table 5 (Table II-5 of Mandatory Appendix II) 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 II-8, II-11, II-14, II-16, II-18, II-20, and II-22 of Mandatory Appendix II). Lap joint stub ends shall be in accordance with Fig. 7 (Fig. II-7 of Mandatory Appendix II) 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 II-5 of Mandatory Appendix II), 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 II-5 of Mandatory Appendix II). 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 F-9 and F-12) 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 II-12 of Mandatory Appendix II). 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 μm (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 μm (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 μm to 6.3 μm (125 $\mu\text{in.}$ 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 II-3 of Mandatory Appendix II). 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 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 II-8, II-9,

II-11, II-12, II-14, II-16, II-18, II-20, and II-22 of Mandatory Appendix II). 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 through 11 (Figs. II-8 through II-11 of Mandatory Appendix II) and Figs. 12 through 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. II-8 and II-9 of Mandatory Appendix II) and Figs. 12 and 14.

6.7.3 Bores. Straight-through bores shown in Figs. 8 and 9 (Figs. II-8 and II-9 of Mandatory Appendix II) are standard unless specifically ordered to suit the special conditions illustrated in Figs. 10 and 11 (Figs. II-10 and II-11 of Mandatory Appendix II) and Figs. 13 and 14.

6.7.4 Other Welding Ends. Other welding end preparations furnished by an agreement of the 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 II-6 of Mandatory Appendix II).

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 II-4 of Mandatory Appendix II), 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 II-8, II-9, II-11, II-12, II-14, II-16, II-18, II-20, and II-22 of Mandatory Appendix II). Threads do not necessarily extend to the face of the flange. See Table 6 (Table II-6 of Mandatory Appendix II) 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 II-7, II-10, II-13, II-15, II-17, II-19, and II-21 of Mandatory Appendix II). 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 Nonmandatory Appendix C. 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

Table 1C Flange Bolting Dimensional Recommendations

| Product | Carbon Steel [Note (1)] | 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 |

NOTE:

(1) When B18.2.1 bolting is used, it should be threaded as close to the head as applicable to continuous and double-end stud bolts.

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 Nonmandatory Appendix B, Group III gaskets.

6.11.3 Bearing Surface. For flanges with small male-and-female face, care must be taken to ensure that adequate bearing surface is provided for the gaskets. In particular, care is necessary when the joint is made on the end of the pipe as shown in Fig. 7 (Fig. II-7 of Mandatory Appendix II).

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. II-3 of Mandatory Appendix II). 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. II-4 of Mandatory Appendix II). Where the wall thickness is insufficient, or the size of the connection requires opening reinforcement, a boss shall be added [see Fig. 6 (Fig. II-6 of Mandatory Appendix II)].

6.12.4 Butt Welding. Connections may be attached by butt welding directly to the wall of the fitting [see Fig. 5 (Fig. II-5 of Mandatory Appendix II)]. 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. II-6 of Mandatory Appendix II), and the height shall provide lengths as specified in Fig. 3 or 4 (Fig. II-3 or II-4 of Mandatory Appendix II).

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

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

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

| Size | Tolerance |
|----------|---------------------|
| 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

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

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

| Size | Tolerance |
|----------|---------------------|
| 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 II-5 of Mandatory Appendix II).

7.4 Flange Thickness

Required tolerances for flange thickness are as follows:

| Size | Tolerance |
|----------|---------------------------------|
| 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. II-8 and II-9 of Mandatory Appendix II) of welding ends of welding neck flanges are as follows:

| Size | Tolerance |
|---------|----------------------------------|
| 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:

(a) For Figs. 8 and 9 (Figs. II-8 and II-9 of Mandatory Appendix II) and Fig. 15, the tolerances are

| Size | Tolerance |
|---------------|----------------------------------|
| 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.) |

(b) For Fig. 10 (Fig. II-10 of Mandatory Appendix II), the tolerances are

| Size | Tolerance |
|----------|---------------------------------|
| 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. II-10 and II-11 of Mandatory Appendix II) are as follows:

| Size | Tolerance |
|--------------|-----------------------------------|
| 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:

| Size | Tolerance |
|--------------|----------------------------------|
| 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 Diameter

7.7.1 Lapped and Slip-On Flange Bores. The required tolerances for lapped and slip-on flange bore diameters are as follows:

| Size | Tolerance |
|----------|---------------------------------|
| 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:

| Size | Tolerance |
|----------|---------------------------------|
| 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 tolerance for socket end counterbores is as follows:

| Size | Tolerance |
|--------------------------------------|-----------------------|
| $\frac{1}{2} \leq \text{NPS} \leq 3$ | ±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 as follows:

$$\pm 1.5 \text{ mm } (\pm 0.06 \text{ in.})$$

7.8.2 Bolt Hole to Bolt Hole. The required tolerance for the center-to-center of adjacent bolt holes is as follows:

$$\pm 0.8 \text{ mm } (\pm 0.03 \text{ in.})$$

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

| Size | Tolerance |
|----------|-------------------|
| 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.

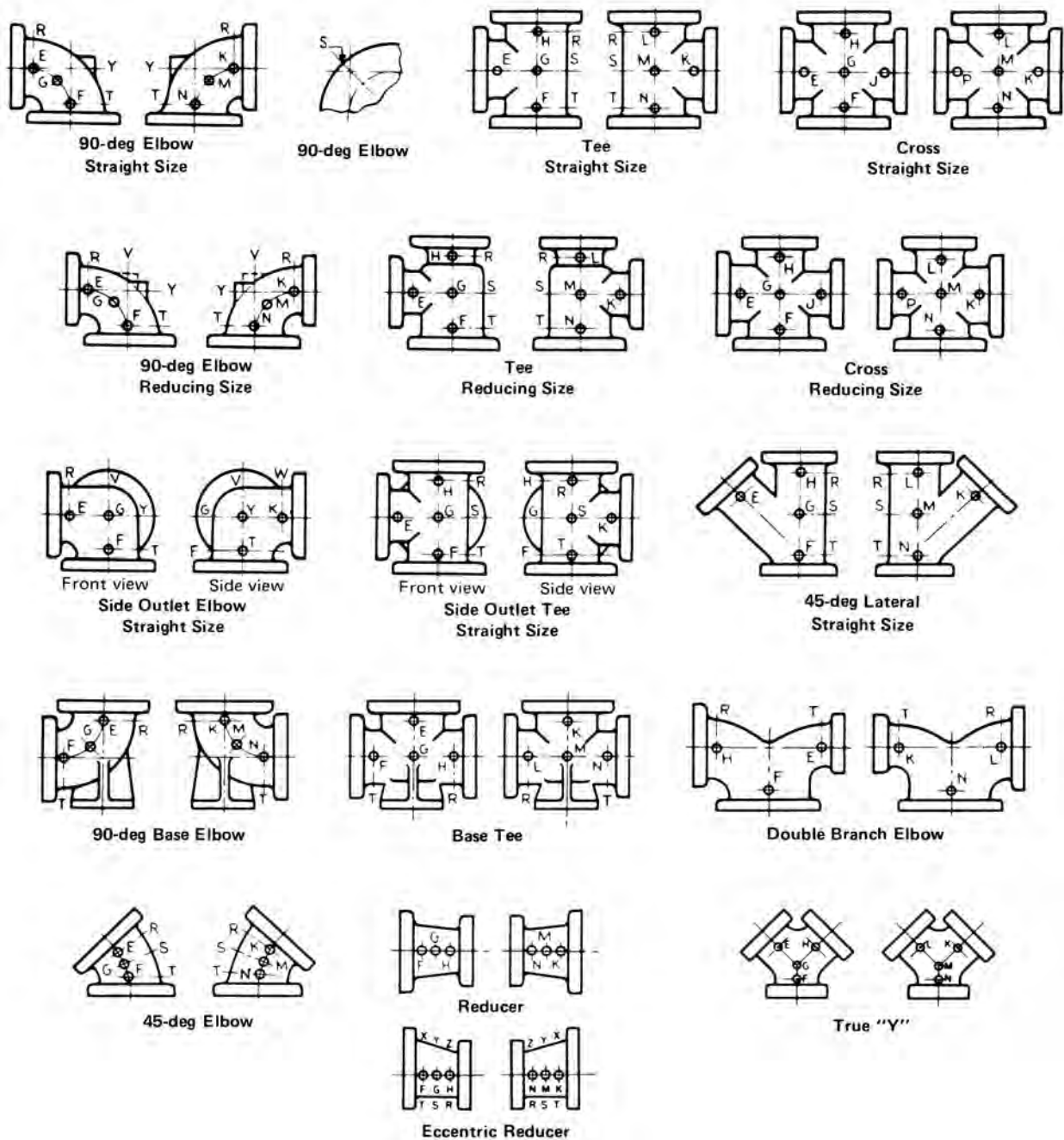
8.2.3 Test Fluid. The pressure test shall be made using water, which may contain a corrosion inhibitor or kerosene as the test fluid. Other suitable test fluids may be used provided their viscosity is no greater than that of water. The test fluid temperature shall not exceed 50°C (125°F).

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 |

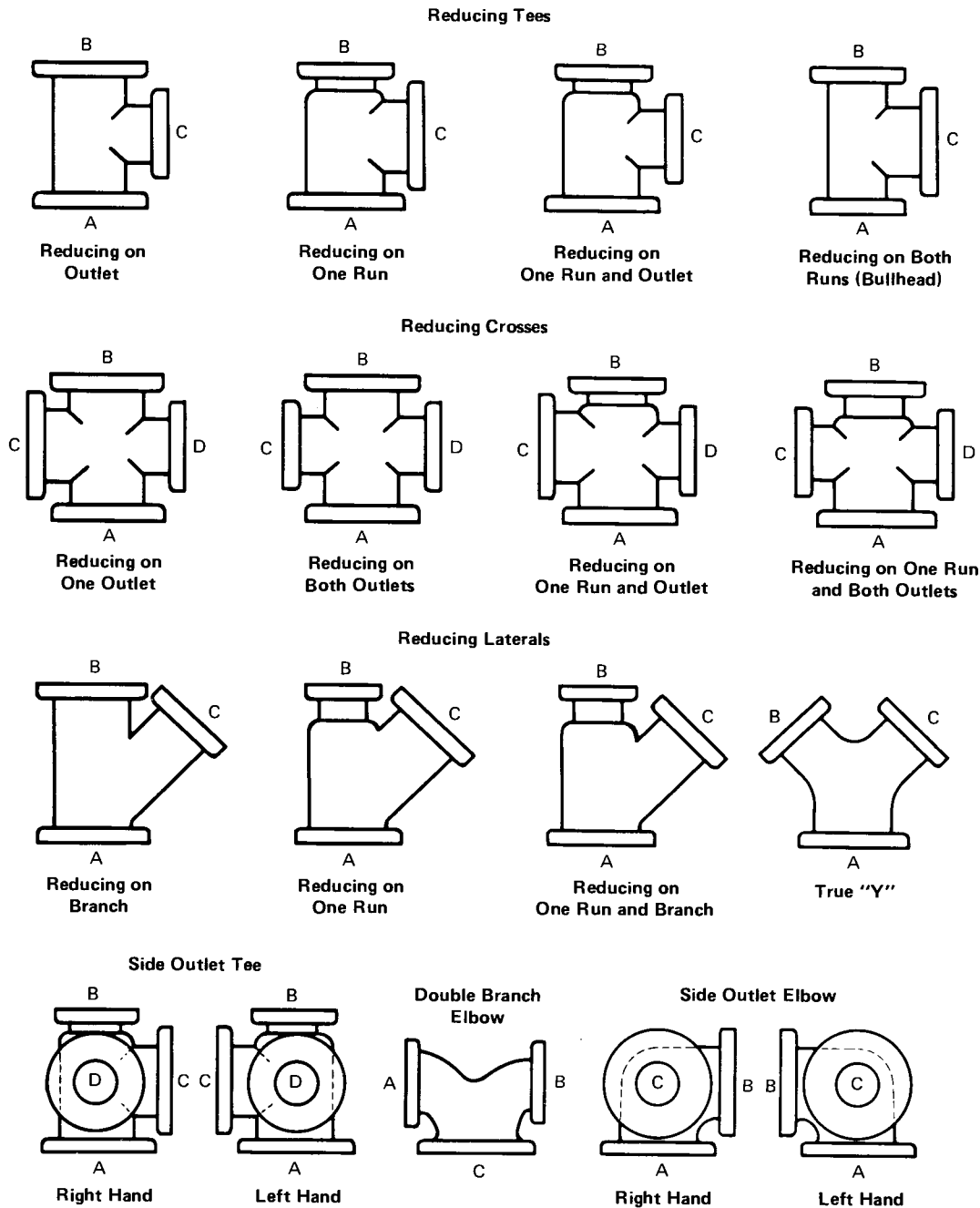
8.2.5 Acceptance. No visible leakage is permitted through the pressure boundary wall.

Fig. 1 Method of Designating Location of Auxiliary Connections When Specified (Flanged Fittings)



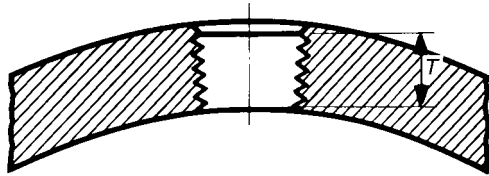
GENERAL NOTE: The above sketches show views of the same fitting and represent fittings with symmetrical shapes, with the exception of the side outlet elbow and side outlet tee (straight sizes). Sketches are illustrative only and do not imply required design (see para. 6.12).

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



GENERAL NOTES:

- (a) 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.
- (b) 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.
- (c) Sketches are illustrative only and do not imply required design (see para. 3.2).

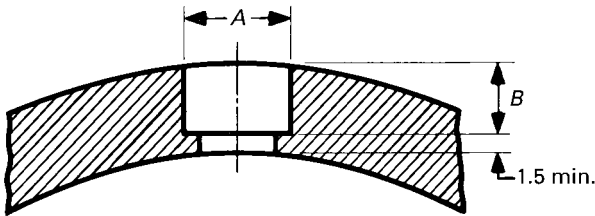
Fig. 3 Thread Length for Connection Tapping

| Connection Size, NPS | $\frac{3}{8}$ | $\frac{1}{2}$ | $\frac{3}{4}$ | 1 | $1\frac{1}{4}$ | $1\frac{1}{2}$ | 2 |
|---------------------------------------|---------------|---------------|---------------|------|----------------|----------------|------|
| 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.

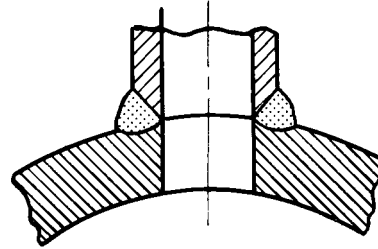
NOTE:

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

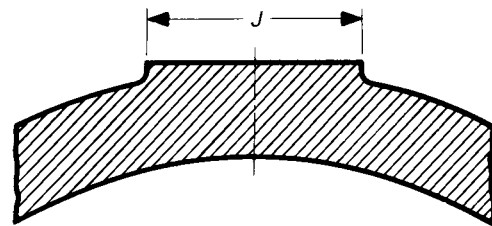
Fig. 4 Socket Welding for Connections

| Connection Size, NPS | $\frac{3}{8}$ | $\frac{1}{2}$ | $\frac{3}{4}$ | 1 | $1\frac{1}{4}$ | $1\frac{1}{2}$ | 2 |
|--------------------------------------|---------------|---------------|---------------|------|----------------|----------------|------|
| Minimum 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. 5 Butt Welding for Connections

GENERAL NOTE: See paras. 6.12.4 and 6.12.5.

Fig. 6 Bosses 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 Mandatory Appendix II, Figs. II-3 through II-6.

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

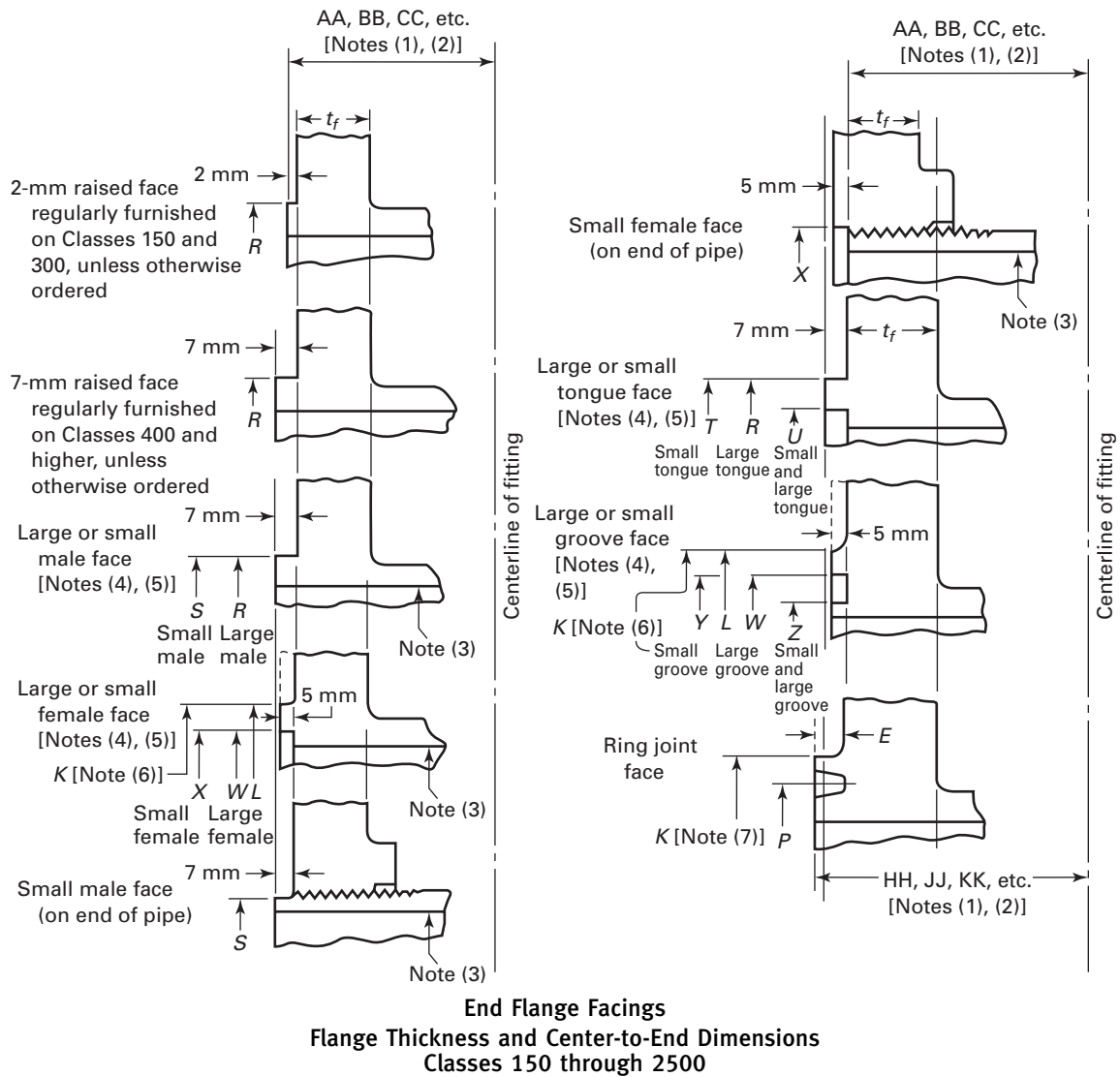
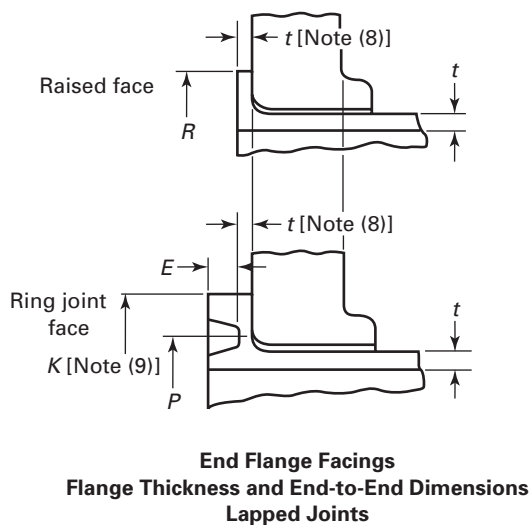


Fig. 7 End Flange Facings and Their Relationship to Flange Thickness and Center-to-End and End-to-End Dimensions (Cont'd)

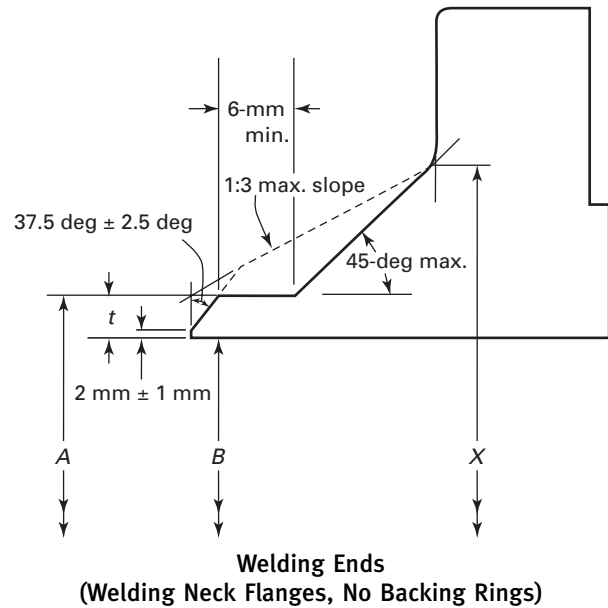


GENERAL NOTE: Dimensions are in millimeters. For dimensions in inches, refer to Mandatory Appendix II, Fig. II-7.

NOTES:

- (1) See paras. 6.2 and 6.4.
- (2) See Tables 7 through 22.
- (3) For small male and female joints, care should be taken in the use of these dimensions to ensure that the inside diameter of the pipe fitting 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 threaded with American National Standard Locknut Thread (NPSL).
- (4) See Table 4 for dimensions of facings (other than ring joint) and Table 5 for ring joint facing.
- (5) Large male and female faces and large tongue and groove are not applicable to Class 150 because of potential dimensional conflicts.
- (6) See Table 4.
- (7) See Table 5.
- (8) See para. 6.4.3.
- (9) See para. 6.4.3.5 and Table 5.

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

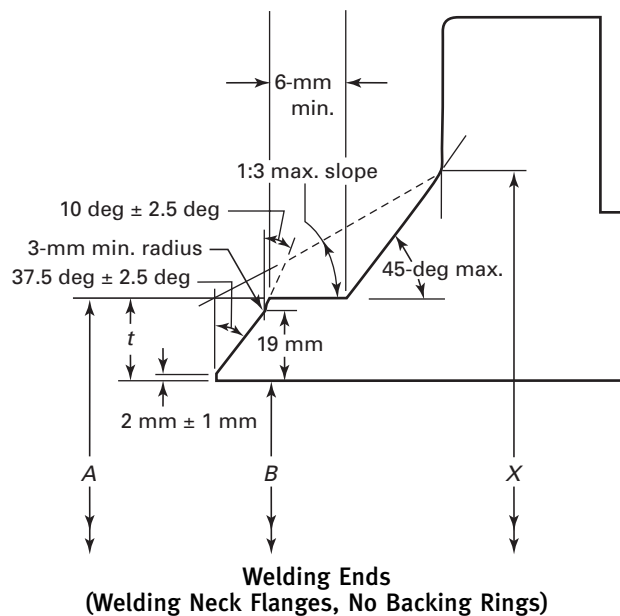


- A = nominal outside diameter of pipe
 B = nominal inside diameter of pipe
 t = nominal wall thickness of pipe
 x = diameter of hub (see dimensional tables)

GENERAL NOTES:

- (a) Dimensions are in millimeters. For dimensions in inches, refer to Mandatory Appendix II, Figs. II-8 and II-9.
- (b) See paras. 6.7, 6.8, and 7.4 for details and tolerances.
- (c) See Figs. 10 and 11 for additional details of welding ends.
- (d) 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 used, 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. 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 through 14).
- (e) 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 solid line.
- (f) For welding end dimensions, refer to ASME B16.25.
- (g) The 6-mm min. dimension applies only to the solid line configuration.

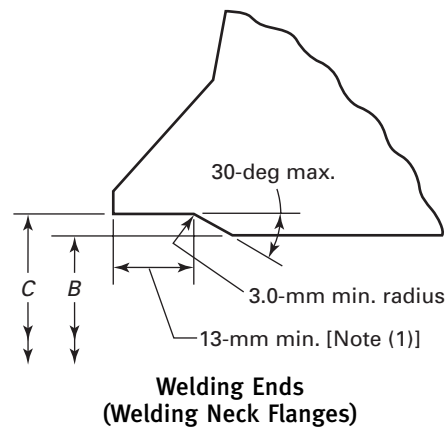
Fig. 9 Bevel for Wall Thicknesses t Greater Than 22 mm



A = nominal outside diameter of pipe
 B = nominal inside diameter of pipe
 t = nominal wall thickness of pipe
 x = diameter of hub (see dimensional tables)

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

Fig. 10 Inside Contour for Use With Rectangular Backing Ring



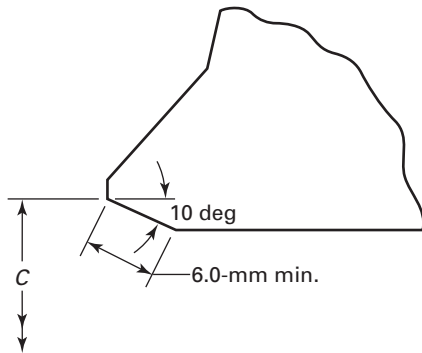
A = nominal outside diameter of welding end, mm
 B = nominal inside diameter of pipe ($= A - 2t$), mm
 $C = A - 0.79 - 1.75t - 0.25$, mm
 t = nominal wall thickness of pipe, mm
0.79 mm = minus tolerance on outside diameter of pipe to ASTM A 106, etc.
 $1.75t$ = $87\frac{1}{2}\%$ of nominal wall (permitted 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 Mandatory Appendix II, Fig. II-10.
- (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.

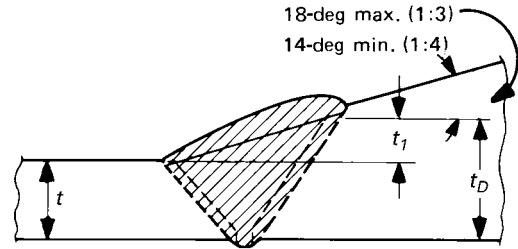
Fig. 11 Inside Contour for Use With Taper Backing Ring

**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:

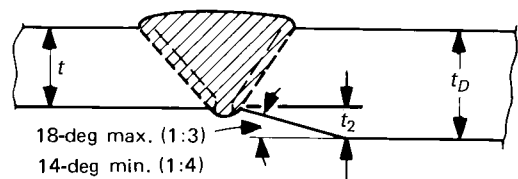
- Dimensions are in millimeters. For dimensions in inches, refer to Mandatory Appendix II, Fig. II-11.
- See paras. 6.7, 6.8, and 7.5 for details and tolerances.
- See Figs. 8 and 9 for welding end details of welding neck flanges.
- For dimensions, see ASME B16.25.

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.

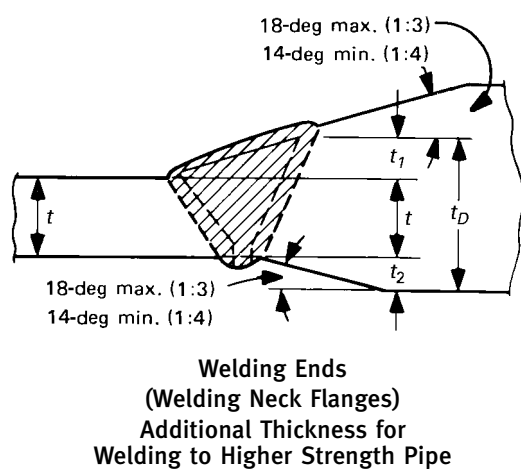
Fig. 13 Bevel for Inside Thickness

**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.

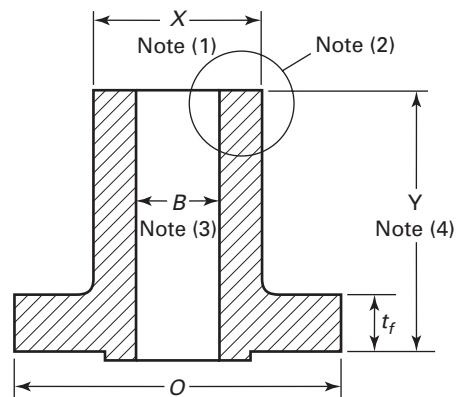
Fig. 14 Bevel for Combined Thickness



GENERAL NOTES:

- 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. 15 Straight Hub Welding Flanges



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 tolerance = 3 mm - 0 (see para. 2.8)
- Hub end (see para. 2.8.3)
- B = bore (see para. 2.8.2 and 7.5.2)
- Y = length through hub (see para. 2.8.1)

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 1 (3) | | | ... | | A 537 Cl. 1 (4) | |
| 3 ¹ / ₂ Ni | A 350 Gr. LF3 | | | ... | | ... | |
| 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 260°C.
- (4) Not to be used over 370°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) | | ... | | | |
| C–Mn–Si | ... | 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 (2) | | A 203 Gr. E (1) | | | |
| Working Pressure by Classes, bar | | | | | | | |
| Temp., °C | Class | | | | | | |
| | 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 (1) | | A 515 Gr. 65 (2) | | | | |
| C–Mn–Si | ... | | A 516 Gr. 65 (2), (3) | | | | |
| C– $\frac{1}{2}$ Mo | A 217 Gr. WC1 (4)–(6) | | ... | | | | |
| C– $\frac{1}{2}$ Mo | A 352 Gr. LC1 (1) | | ... | | | | |
| 2 $\frac{1}{2}$ Ni | ... | | A 203 Gr. A (2) | | | | |
| 3 $\frac{1}{2}$ Ni | ... | | A 203 Gr. D (2) | | | | |
| Working Pressures by Classes, bar | | | | | | | |
| | Class | | | | | | |
| 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) Not to be used over 340°C.
- (2) 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.
- (3) Not to be used over 455°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.
- (6) The deliberate addition of any element not listed in ASTM A 217, Table 1 is prohibited, except that Ca and Mg may be added for deoxidation.

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

| Nominal Designation | Forgings | | | Castings | | Plates | |
|-----------------------------------|--------------------------|------|------|----------|-------|-----------------------|-------|
| C–Si | ... | | | ... | | A 515 Gr. 60 (1) | |
| C–Mn–Si | A 350 Gr. LF1, Cl. 1 (1) | | | ... | | A 516 Gr. 60 (1), (2) | |
| Working Pressures by Classes, bar | | | | | | | |
| | Class | | | | | | |
| Temp., °C | 150 | 300 | 400 | 600 | 900 | 1500 | 2500 |
| –29 to 38 | 16.3 | 42.6 | 56.7 | 85.1 | 127.7 | 212.8 | 354.6 |
| 50 | 16.0 | 41.8 | 55.7 | 83.5 | 125.3 | 208.9 | 348.1 |
| 100 | 14.9 | 38.8 | 51.8 | 77.7 | 116.5 | 194.2 | 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- $\frac{1}{2}$ Mo | A 182 Gr. F1 (1) | | | ... | | A 204 Gr. A (1) | |
| C- $\frac{1}{2}$ Mo | ... | | | ... | | A 204 Gr. B (1) | |
| Working Pressures by Classes, bar | | | | | | | |
| Temp., °C | Class | | | | | | |
| | 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 (1) | | | ... | | ... | |
| $\text{Ni}-\frac{1}{2}\text{Cr}-\frac{1}{2}\text{Mo}$ | ... | | | A 217 Gr. WC4 (1)–(3) | | ... | |
| $\frac{3}{4}\text{Ni}-\frac{3}{4}\text{Cr}-1\text{Mo}$ | ... | | | A 217 Gr. WC5 (2), (3) | | ... | |
| Working Pressures By Classes, bar | | | | | | | |
| Temp., °C | Class | | | | | | |
| | 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) Not to be used over 538°C.
- (2) Use normalized and tempered material only.
- (3) The deliberate addition of any element not listed in ASTM A 217, Table 1 is prohibited, except that Ca and Mg may be added for deoxidation.

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

| Nominal Designation | Forgings | | | Castings | | Plates | |
|--|---------------------------------|------|------|--------------------------|-------|---------------------------|-------|
| 1 ¹ / ₄ Cr–1 ¹ / ₂ Mo | ... | | | A 217 Gr. WC6 (1)–(3) | | ... | |
| 1 ¹ / ₄ Cr–1 ¹ / ₂ Mo–Si | A 182 Gr. F11 Cl. 2 (1), (4) | | | ... | | A 387 Gr. 11 Cl. 2 (4) | |
| Working Pressures by Classes, bar | | | | | | | |
| Temp., °C | Class | | | | | | |
| | 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) Not to be used over 590°C.
- (3) The deliberate addition of any element not listed in ASTM A 217, Table 1 is prohibited, except that Ca and Mg may be added for deoxidation.
- (4) Permissible but not recommended for prolonged use above 590°C.

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

| Nominal Designation | Forgings | | | Castings | | Plates | |
|--------------------------------------|-------------------------|------|------|--------------------------|-------|------------------------|-------|
| 2 ¹ / ₄ Cr–1Mo | A 182 Gr. F22 Cl. 3 (1) | | | A 217 Gr. WC9 (2)–(4) | | A 387 Gr. 22 Cl. 2 (1) | |
| Working Pressures by Classes, bar | | | | | | | |
| | Class | | | | | | |
| 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) Permissible but not recommended for prolonged use above 590°C.
- (2) Use normalized and tempered material only.
- (3) Not to be used over 590°C.
- (4) The deliberate addition of any element not listed in ASTM A 217, Table 1 is prohibited, except that Ca and Mg may be added for deoxidation.

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

| Nominal Designation | Forgings | | | Castings | | Plates | |
|------------------------------------|----------|------|------|----------|-------|------------------|-------|
| C- ⁻¹ / ₂ Mo | ... | | | ... | | A 204, Gr. C (1) | |
| Working Pressures by Classes, bar | | | | | | | |
| Temp., °C | Class | | | | | | |
| | 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– $\frac{1}{2}$ Mo | A 182 Gr. F5a | | | A 217 Gr. C5 (1), (2) | | | ... |
| Working Pressures by Classes, bar | | | | | | | |
| Temp., °C | Class | | | | | | |
| | 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 |

NOTES:

- (1) Use normalized and tempered material only.
- (2) The deliberate addition of any element not listed in ASTM A 217, Table 1 is prohibited, except that Ca and Mg may be added for deoxidation.

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), (2) | | | ... |
| Working Pressures by Classes, bar | | | | | | | |
| Temp., °C | Class | | | | | | |
| | 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 |

NOTES:

- (1) Use normalized and tempered material only.
- (2) The deliberate addition of any element not listed in ASTM A 217, Table 1 is prohibited, except that Ca and Mg may be added for deoxidation.

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 (1) | | A 387 Gr. 91 Cl. 2 | |
| Working Pressures by Classes, bar | | | | | | | |
| Temp., °C | Class | | | | | | |
| | 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 |

NOTE

(1) The deliberate addition of any element not listed in ASTM A 217, Table 1 is prohibited, except that Ca and Mg may be added for deoxidation.

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 | | | | | | |
| 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 2-1.18 Pressure–Temperature Ratings for Group 1.18 Materials

| Nominal Designation | Forgings | | | Castings | | Plates | |
|---------------------------------|-------------------|------|------|----------|-------|--------|-------|
| 9Cr–2W–V | A 182 Gr. F92 (1) | | | ... | | ... | |
| Working Pressures by Class, bar | | | | | | | |
| Temp., °C | Class | | | | | | |
| | 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 | 1.4 | 25.0 | 33.3 | 49.8 | 74.8 | 124.9 | 208.0 |
| 575 | 1.4 | 24.0 | 31.9 | 47.9 | 71.8 | 119.7 | 199.5 |
| 600 | 1.4 | 21.6 | 28.6 | 42.9 | 64.2 | 107.0 | 178.5 |
| 625 | 1.4 | 18.3 | 24.3 | 36.6 | 54.9 | 91.2 | 152.0 |
| 650 | 1.4 | 14.1 | 18.9 | 28.1 | 42.5 | 70.7 | 117.7 |

NOTE:

(1) Applications above 620°C are limited to tubing of maximum outside diameter of 3½ in.

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) | |
| 18Cr–8Ni | A 182 Gr. F304H | | | A 351 Gr. CF8 (1) | | A 240 Gr. 304H | |
| Working Pressures by Classes, bar | | | | | | | |
| Temp., °C | Class | | | | | | |
| | 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 | | | | | | | |
| Temp., °C | Class | | | | | | |
| | 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–13Ni–3Mo | A 182 Gr. F317L | | | ... | ... | | |
| 18Cr–8Ni | A 182 Gr. F304L (1) | | | ... | A 240 Gr. 304L (1) | | |
| Working Pressures by Classes, bar | | | | | | | |
| Temp., °C | Class | | | | | | |
| | 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) | | | ... | A 240 Gr. 321 (1) | | |
| 18Cr–10Ni–Ti | A 182 Gr. F321H (2) | | | ... | A 240 Gr. 321H (2) | | |
| Working Pressures by Classes, bar | | | | | | | |
| Temp., °C | Class | | | | | | |
| | 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 1 095°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) | | |
| 18Cr–10Ni–Cb | A 182 Gr. F347H (2) | | ... | | A 240 Gr. 347H (2) | | |
| 18Cr–10Ni–Cb | A 182 Gr. F348 (1) | | ... | | A 240 Gr. 348 (1) | | |
| 18Cr–10Ni–Cb | A 182 Gr. F348H (2) | | ... | | A 240 Gr. 348H (2) | | |
| Working Pressures by Classes, bar | | | | | | | |
| Temp., °C | Class | | | | | | |
| | 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 1 095°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 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 | | | | | | | |
| Temp., °C | Class | | | | | | |
| | 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 | | | | | | |
| 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)–(3) | | |
| 25Cr–20Ni | ... | | ... | | A 240 Gr. 310S (1)–(3) | | |
| Working Pressures by Classes, bar | | | | | | | |
| Temp., °C | Class | | | | | | |
| | 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 1 035°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) | | | ... |
| 25Cr–12Ni | ... | | | A 351 Gr. CH20 (1) | | | ... |
| Working Pressures by Classes, bar | | | | | | | |
| Temp., °C | Class | | | | | | |
| | 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 | | | | | | | |
| Temp., °C | Class | | | | | | |
| | 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 | | | | | | | |
| Temp., °C | Class | | | | | | |
| | 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–20Cr–Cb | B 462 Gr. N08020 (1) | | | . . . | | B 463 Gr. N08020 (1) | |
| Working Pressures by Classes, bar | | | | | | | |
| Temp., °C | Class | | | | | | |
| | 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 564 Gr. N02200 (1), (2) | | | . . . | | B 162 Gr. N02200 (1) | |
| Working Pressures by Classes, bar | | | | | | | |
| | Class | | | | | | |
| 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 162 Gr. N02201 (1) | |
| Working Pressures by Classes, bar | | | | | | | |
| Temp., °C | Class | | | | | | |
| | 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 |

NOTE:

(1) Use annealed material only.

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) | | |
| Working Pressures by Classes, bar | | | | | | | |
| Temp., °C | Class | | | | | | |
| | 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 |

NOTE:

(1) Use annealed material only.

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 | | | | | | |
| 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 | | | | | | |
| 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. | | ... | | B 333 Gr. | | |
| | N10665 (1) | | | | N10665 (1) | | |
| 64Ni–29.5Mo–2Cr–2Fe–Mn–W | B 462 Gr. | | ... | | B 333 Gr. | | |
| | N10675 (1) | | | | 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)–(5) | ... | B 443 Gr. N06625 (3)–(5) | | | | |
| 62Ni–28Mo–5Fe | ... | ... | B 333 Gr. N10001 (1), (6) | | | | |
| 70Ni–16Mo–7Cr–5Fe | ... | ... | B 434 Gr. N10003 (3) | | | | |
| 61Ni–16Mo–16Cr | ... | ... | 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, 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 | 48.3 | 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) Grade 1.
- (6) Not to be used over 425°C.
- (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) | | |
| 21Ni–30Fe–22Cr–18Co–3Mo–3W | B 572 Gr. R30556 (1), (2) | | ... | | B435 Gr. R30556 (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 | 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–47Fe–21Cr–5Mo | ... | | | ... | | B 599 Gr. N08700 (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 | 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 |

NOTE:

(1) Use solution annealed material only.

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

| Nominal Designation | Forgings | | | Castings | | Plates | |
|-----------------------------------|------------------------------|------|------|----------|-------|-------------------------|-------|
| 44Fe–25Ni–21Cr–Mo | A 479 Gr. N08904 (1), (2) | | | ... | | A 240 Gr. N08904 (1) | |
| Working Pressures by Classes, bar | | | | | | | |
| | Class | | | | | | |
| 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 620 Gr. N08320 (1) | | | | |
| 47Ni–22Cr–20Fe–7Mo | ... | ... | 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 | | | | | | |
| 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 |

NOTE:

(1) Use solution annealed material only.

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

| Nominal Designation | Forgings | Castings | Plates | | | | |
|-----------------------------------|-------------------------|----------|-------------------------|-------|-------|-------|-------|
| 49Ni–25Cr–18Fe–6Mo | ... | ... | B 582 Gr. N06975 (1) | | | | |
| Ni–Fe–Cr–Mo–Cu–Low C | B 564 Gr. N08031 (2) | ... | B 625 Gr. N08031 (2) | | | | |
| Working Pressures by Classes, bar | | | | | | | |
| Temp., °C | Class | | | | | | |
| | 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) 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 582 Gr. N06007 (1) | | | | |
| 58Ni–33Cr–8Mo | B 462 Gr. N06035 (1), (2) | ... | B 575 Gr. N06035 (1), (2) | | | | |
| 40Ni–29Cr–15Fe–5Mo | B 462 Gr. N06030 (1), (2) | ... | B 582 Gr. N06030 (1), (2) | | | | |
| Working Pressures by Classes, bar | | | | | | | |
| | Class | | | | | | |
| Temp., °C | 150 | 300 | 400 | 600 | 900 | 1500 | 2500 |
| –29 to 38 | 19.0 | 49.6 | 66.2 | 99.3 | 148.9 | 248.2 | 413.7 |
| 50 | 18.6 | 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) 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 | | | | | | | |
| Temp., °C | Class | | | | | | |
| | 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–1 ¹ / ₄ Si | ... | | | ... | | B 536 Gr. N08330 (1) | |
| Working Pressures by Classes, bar | | | | | | | |
| Temp., °C | Class | | | | | | |
| | 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 |

NOTE:

(1) Use solution annealed material only.

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 | | | | | | | |
| Temp., °C | Class | | | | | | |
| | 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 2-3.19 Pressure–Temperature Ratings for Group 3.19 Materials

| Nominal Designation | Forgings | | | Castings | | Plates | |
|---------------------------------|------------------|------|------|----------|-------|------------------|-------|
| 57Ni–22Cr–14W–2Mo–La | B 564 Gr. N06230 | | | ... | | B 435 Gr. N06230 | |
| Working Pressures by Class, bar | | | | | | | |
| Temp., °C | Class | | | | | | |
| | 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 | 1.4 | 25.0 | 33.3 | 49.8 | 74.8 | 124.9 | 208.0 |
| 575 | 1.4 | 24.0 | 31.9 | 47.9 | 71.8 | 119.7 | 199.5 |
| 600 | 1.4 | 21.6 | 28.6 | 42.9 | 64.2 | 107.0 | 178.5 |
| 625 | 1.4 | 18.3 | 24.3 | 36.6 | 54.9 | 91.2 | 152.0 |
| 650 | 1.4 | 14.1 | 18.9 | 28.1 | 42.5 | 70.7 | 117.7 |
| 675 | 1.4 | 12.4 | 16.9 | 25.2 | 37.6 | 62.7 | 104.5 |
| 700 | 1.4 | 10.1 | 13.4 | 20.0 | 29.8 | 49.7 | 83.0 |
| 725 | 1.4 | 7.9 | 10.5 | 15.4 | 23.2 | 38.6 | 64.4 |
| 750 | 1.4 | 5.9 | 7.9 | 11.5 | 17.6 | 29.6 | 49.1 |
| 775 | 1.4 | 4.6 | 6.2 | 9.0 | 13.7 | 22.8 | 38.0 |
| 800 | 1.4 | 3.5 | 4.8 | 7.0 | 10.5 | 17.4 | 29.2 |
| 816 | 1.4 | 2.8 | 3.8 | 5.9 | 8.6 | 14.1 | 23.8 |

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

| NPS | Maximum Radial Projection of Imperfections That Are No Deeper Than the Bottom of the Serrations, mm | Maximum Depth and Radial Projection of Imperfections That Are Deeper Than the Bottom of the Serrations, mm |
|----------------|---|--|
| $\frac{1}{2}$ | 3.0 | 1.5 |
| $\frac{3}{4}$ | 3.0 | 1.5 |
| 1 | 3.0 | 1.5 |
| $1\frac{1}{4}$ | 3.0 | 1.5 |
| $1\frac{1}{2}$ | 3.0 | 1.5 |
| 2 | 3.0 | 1.5 |
| $2\frac{1}{2}$ | 3.0 | 1.5 |
| 3 | 4.5 | 1.5 |
| $3\frac{1}{2}$ | 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 Mandatory Appendix II, Table II-3.

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 Size, NPS | Outside Diameter | | | | | Outside Diameter | | | | | Height | | | Minimum Outside Diameter of Raised Portion [Notes (6), (7)] | | Nominal Size, NPS |
| | Raised Face | | Small Male, S [Note (1)] | Inside Diameter of Large and Small Tongue, U | | Inside Diameter of Small Tongue [Note (1)] | | Outside Diameter | | Inside Diameter of Large and Small Groove, Z | | Raised Face [Notes (2), (3)] | Large and Small Male and Tongue [Notes (2), (4)] | | Depth of Groove or Female [Notes (1), (5)] | |
| | Large Tongue, R | Male and Large Tongue, M | | Small Tongue, T | Large Female and Large Groove, W | Small Female, X [Note (1)] | Small Groove, Y | Large Female and Small Tongue [Note (1)] | Large Female and Small Tongue [Note (1)] | Large Male and Tongue [Notes (2), (4)] | | | | | | |
| | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | |
| 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 | |

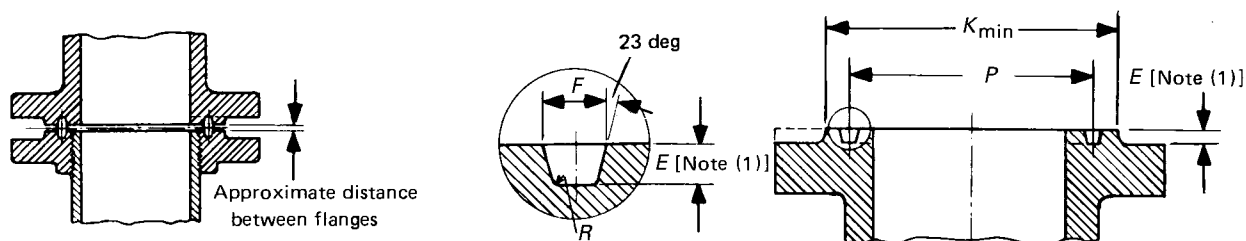
Table 4 Dimensions of Facings (Other Than Ring Joints, All Pressure Rating Classes) (Cont'd)

GENERAL NOTES:

- (a) Dimensions are in millimeters. For dimensions in inch units, refer to Table II-4 of Mandatory Appendix II.
- (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 ensure that the inside diameter of the 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. The inside diameter of the fitting should match the inside diameter of the pipe as specified by the purchaser. Threaded companion flanges for small male and female joints are furnished with plain face and are threaded with American National Standard Locknut Thread (NPSL).
- (2) See para. 6.4.3 and Fig. 7 for thickness and outside diameters of laps.
- (3) The height of the raised face is either 2 mm or 7 mm (see para. 6.4.1).
- (4) The height of the large and small male and tongue is 7 mm.
- (5) The depth of the groove or female is 5 mm.
- (6) The raised portion of the full face may be furnished unless otherwise specified on order.
- (7) Large male and female faces and large tongue and groove are not applicable to Class 150 because of potential dimensional conflicts.

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

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
|---------------|---------------|---------------|---------------|---------------|----------------|----------------|-------------------|---------------------|-----------------------|------------|-----------------------|
| Nominal Size | | | | | | | Groove Dimensions | | | | |
| 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 | Radius at Bottom, R |
| ... | 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 | 9.53 | 13.49 | 1.5 |
| 3 | ... | ... | ... | ... | ... | ... | 29 | 114.30 | 6.35 | 8.74 | 0.8 |
| ... | [Note (2)] | ... | [Note (2)] | ... | ... | ... | 30 | 117.48 | 7.92 | 11.91 | 0.8 |
| ... | 3 [Note (2)] | ... | 3 [Note (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, <i>K</i> | | | | | Approximate Distance Between Flanges | | | | | | |
| Class 150 | Class 300 400 600 | Class 900 | Class 1500 | Class 2500 | Class 150 | Class 300 | Class 400 | Class 600 | Class 900 | Class 1500 | Class 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 at Bottom, <i>R</i> |
| 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, <i>P</i> | Depth, <i>E</i> | Width, <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 150 | Class 300 400 600 | Class 900 | Class 1500 | Class 2500 | Class 150 | Class 300 | Class 400 | Class 600 | Class 900 | Class 1500 | Class 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:

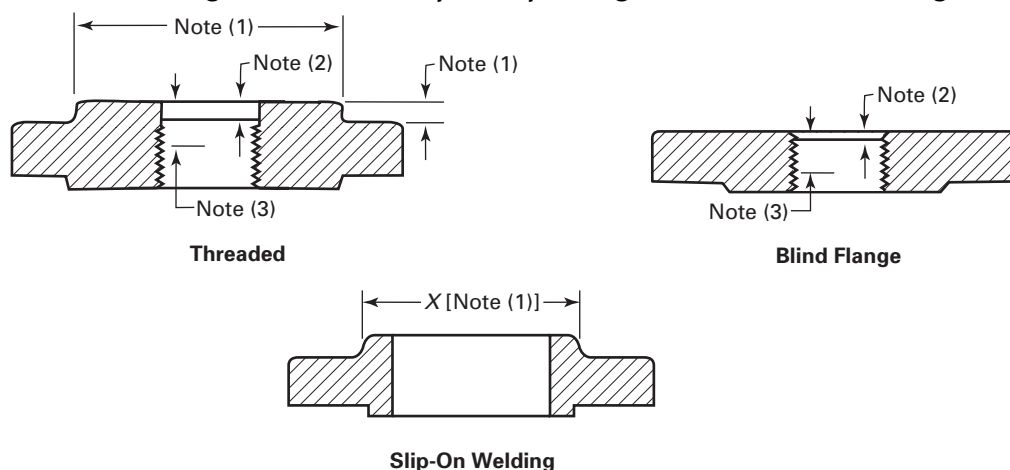
- (a) Dimensions are in millimeters. For dimensions in inch units, refer to Table II-5 of Mandatory Appendix II.
 (b) For facing requirements for flanges and flanged fitting, see para. 6.4.1 and Fig. 7.
 (c) For facing requirements for lapped joints, see para. 6.4.3 and Fig. 7.
 (d) See para. 4.2.7 for 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) The height of the raised portion is equal to the depth of the 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)
 $R \leq 2 + 0.8, -0.0$
 $R > 2 \pm 0.8$
 23 deg (angle) $\pm \frac{1}{2}$ deg

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

| 1 | 2 | 3 | 4 | 5 | 6 |
|------------------------------------|--|------------------------------------|--|------------------------------------|--|
| Nominal Pipe Size [Note (4)] | Smallest Size of Reducing Outlet Requiring Hub Flanges [Note (1)] | Nominal Pipe Size [Note (4)] | Smallest Size of Reducing Outlet Requiring Hub Flanges [Note (1)] | Nominal Pipe Size [Note (4)] | Smallest Size of Reducing Outlet Requiring Hub Flanges [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 |

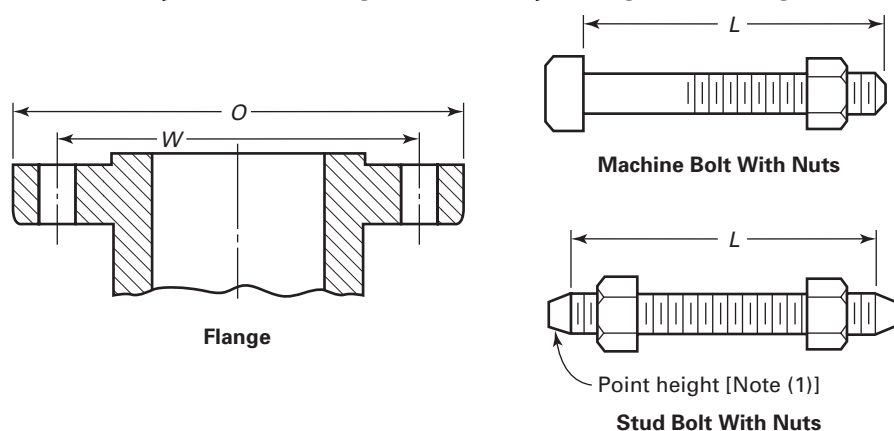
GENERAL NOTE: Dimensions are in millimeters. For dimensions in inches, refer to Mandatory Appendix II, Table II-6.

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:

- (1) 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
- (2) 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).

Table 7 Templates for Drilling Class 150 Pipe Flanges and Flanged Fittings

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|---------------------------------|---|-------------------------------------|--------------------------------------|-----------------------|------------------------------|---|---------------|------------------------|
| | | | | | | Length of Bolts, L [Notes (1), (4)] | | |
| Nominal Pipe Size, NPS | Outside Diameter of Flange, O | Drilling [Notes (2), (3)] | | | | Stud Bolts [Note (1)] | | Machine Bolts |
| | | Diameter of Bolt Circle, W | Diameter of Bolt Holes, in. | Number of Bolts | Diameter of Bolts, in. | 2-mm Raised Face | Ring Joint | 2-mm Raised 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 Mandatory Appendix II, Table II-7.
- (b) For other dimensions, see Tables 8 and 9.

NOTES:

- (1) The length of the 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 Nonmandatory Appendix C (see para. 6.10.2).

Table 8 Dimensions of Class 150 Flanges

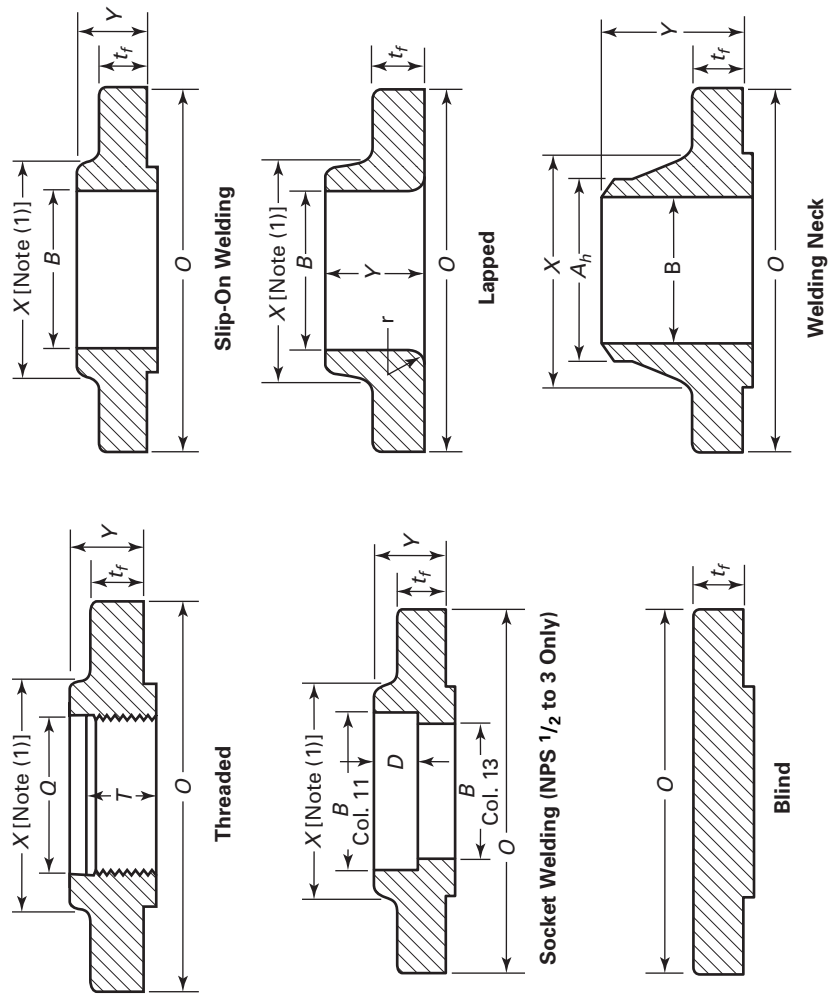


Table 8 Dimensions of Class 150 Flanges (Cont'd)

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
|---------------------------------|---|---|--|--------------------------|---|--|--------------|-----------------------|---|--|-------------------------|---|---|--------------------------|
| Nominal Pipe Size, NPS | Outside Diameter of Flange, O | Minimum Thickness of Flange, t _f [Notes (2)-(4)] | Minimum Thickness Lap Joint, t _l | Diameter of Hub, X | Chamfer Welding Neck, A _h [Note (5)] | Length Through Hub | | | Minimum Thread Length Threaded, T [Note (6)] | Bore | | Welding Neck/ Socket Welding, B [Note (7)] | Corner Bore Radius of Lapped Flange and Pipe, r | Depth of Socket, D |
| | | | | | | Threaded/ Slip-on/ Socket Welding, Y | Lapped, Y | Welding Neck, Y | | Minimum Slip-on/ Socket Welding, B | Minimum Lapped, B | | | |
| | | | | | | | | | | | | | | |
| 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 | Note (8) | 13 | ... |
| 16 | 595 | 35.0 | 36.6 | 457 | 406.4 | 62 | 87 | 125 | 64 | 410.5 | 411.2 | Note (8) | 13 | ... |
| 18 | 635 | 38.1 | 39.7 | 505 | 457.0 | 67 | 97 | 138 | 68 | 461.8 | 462.3 | Note (8) | 13 | ... |
| 20 | 700 | 41.3 | 42.9 | 559 | 508.0 | 71 | 103 | 143 | 73 | 513.1 | 514.4 | Note (8) | 13 | ... |
| 24 | 815 | 46.1 | 47.7 | 663 | 610.0 | 81 | 111 | 151 | 83 | 616.0 | 616.0 | Note (8) | 13 | ... |

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

GENERAL NOTES:

- (a) Dimensions of Table 8 are in millimeters. For dimensions in inches, refer to Table II-8 of Mandatory Appendix II.
- (b) For tolerance, see section 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 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.
- (8) To be specified by the Purchaser.

The technical drawings illustrate the following fittings and their dimensions:

- Tee:** Dimensions include AA, HH, BB, JJ, CC, KK, GG, NN, EE, LL, FF, MM.
- Cross:** Dimensions include AA, HH, BB, JJ, CC, KK, GG, NN, EE, LL, FF, MM.
- 45-deg Elbow:** Dimensions include AA, HH, BB, JJ, CC, KK, GG, NN, EE, LL, FF, MM.
- Long Radius Elbow:** Dimensions include AA, HH, BB, JJ, CC, KK, GG, NN, EE, LL, FF, MM.
- Eccentric Reducer:** Dimensions include GG, NN, EE, LL, FF, MM.
- Reducer:** Dimensions include GG, NN, EE, LL, FF, MM.
- 45-deg Lateral:** Dimensions include AA, HH, BB, JJ, CC, KK, GG, NN, EE, LL, FF, MM.

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

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | |
|---------------------------------|--|---|---|--|--|--|--|-------------------------------|--|-----|---|---|
| Nominal Pipe Size, NPS | Outside Diameter of Flange, <i>O</i> | Minimum Thickness of Flange, <i>t_f</i> [Notes (1)–(3)] | Minimum Wall Thickness of Fitting, <i>t_m</i> | Inside diameter of Fitting, <i>d</i> | 2-mm Raised Face [Note (4)] | | | | | | | |
| | | | | | Center-to- Contact Surface of Raised Face | | Center-to- Contact Surface of Raised Face | | Long Center-to- Contact Surface of Raised Face | | Short Center-to- Contact Surface of Raised Face Lateral and True “Y,” FF | Contact Surface-to- Contact Surface of Raised Face Reducer, GG [Note (5)] |
| | | | | | Elbow, Tee, Cross, and True “Y,” AA | Elbow, Tee, Cross, and Long Radius Elbow, BB | Raised Face 45-deg Elbow, CC | Raised Face Lateral, EE | | | | |
| | | | | | | | | | | | | |
| 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 | |

The diagrams illustrate the geometry of a flanged fitting. The top diagram shows a 'Square Base' with side length S , width W , and four bolt holes. The middle diagram shows a 'Round Base' with diameter S and width W , also with four bolt holes. The bottom diagram shows a 'Flanged Fitting' with dimensions O , d , t , and t_f .

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

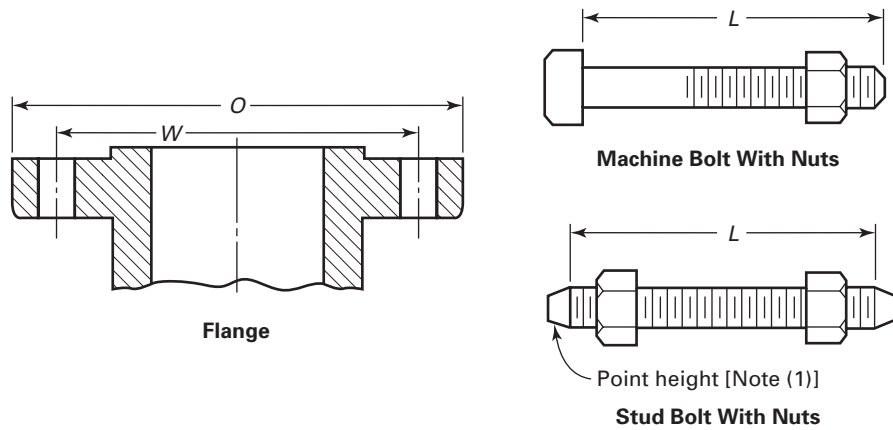
| 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 1 |
|-------------------------------------|--------------------------------|--------------------------------|--|---------------------------|-------------------|---|----------------------|----------------------|--------------------------------|---------------------------|------------------------|
| 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 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 |
| | | | | | | | | | | | |
| [Note (6)] | [Note (6)] | [Note (6)] | [Note (6)] | [Notes (5), (6)] | [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 |

Table 9 Dimensions of Class 150 Flanged Fittings (Cont'd)**GENERAL NOTES:**

- (a) Dimensions of Table 9 are in millimeters. For dimensions in inch units, refer to Mandatory Appendix II, Table II-9.
- (b) For tolerances, see section 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 the 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.

Table 10 Templates for Drilling Class 300 Pipe Flanges and Flanged Fittings

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|---------------------------------|---|-------------------------------------|--------------------------------------|-----------------------|------------------------------|---|---------------|------------------------|
| Nominal Pipe Size, NPS | Outside Diameter of Flange, O | Drilling [Notes (2), (3)] | | | | Length of Bolts, L [Notes (1), (4)] | | |
| | | Diameter of Bolt Circle, W | Diameter of Bolt Holes, in. | Number of Bolts | Diameter of Bolts, in. | Stud Bolts [Note (1)] | | Machine Bolts |
| | | | | | | 2-mm Raised Face | Ring Joint | 2-mm Raised 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 Mandatory Appendix II, Table II-10.
- (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 the table may be determined in accordance with Nonmandatory Appendix C (see para. 6.10.2).

Table 11 Dimensions of Class 300 Flanges

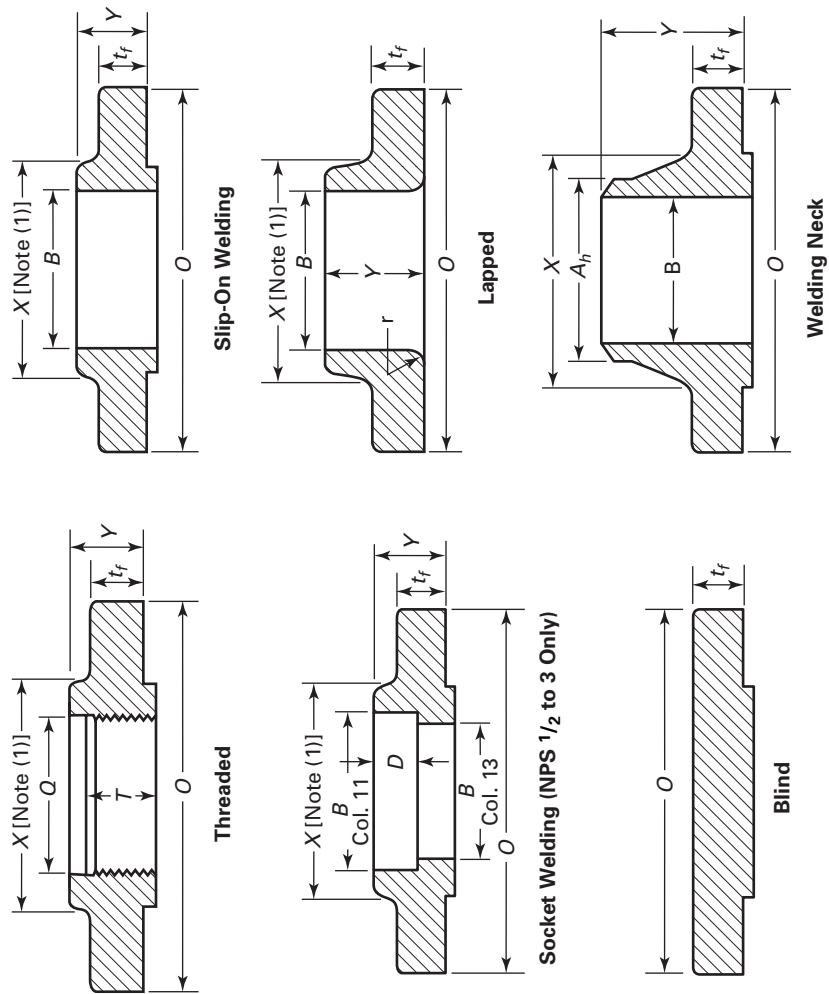


Table 11 Dimensions of Class 300 Flanges (Cont'd)

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 |
|------------------------|-------------------------------|---|------------------------------------|--------------------|---|------------------------------------|-----------|-----------------|--|-----------------------------------|-------------------|---|--|---|--------------------|
| Nominal Pipe Size, NPS | Outside Diameter of Flange, O | Minimum Thickness of Flange, t_f [Notes (2), (3)] | Minimum Thickness Lap Joint, t_f | Diameter of Hub, X | Hub Diameter Beginning of Chamfer Welding, Neck, A_h [Note (4)] | Length Through Hub | | | Minimum Thread Length Threaded, T [Note (5)] | Bore | | Welding Neck/Socket Welding, B [Note (6)] | Corner Radius of Bore of Lapped Flange and Pipe, r | Minimum Counter-bore Threaded Flange, Q | Depth of Socket, D |
| | | | | | | Threaded/Slip-On/Socket Welding, Y | Lapped, Y | Welding Neck, Y | | Minimum Slip-On/Socket Welding, B | Minimum Lapped, B | | | | |
| $1\frac{1}{2}$ | 95 | 12.7 | 14.3 | 38 | 21.3 | 21 | 22 | 51 | 16 | 22.2 | 22.9 | 15.8 | 3 | 23.6 | 10 |
| $3\frac{1}{4}$ | 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 |
| $1\frac{1}{4}$ | 135 | 17.5 | 19.1 | 64 | 42.2 | 25 | 27 | 64 | 21 | 43.2 | 43.7 | 35.1 | 5 | 44.4 | 14 |
| $1\frac{1}{2}$ | 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 |
| $2\frac{1}{2}$ | 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 |
| $3\frac{1}{2}$ | 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 | Note (7) | 13 | 360.4 | ... |
| 16 | 650 | 55.6 | 57.2 | 483 | 406.4 | 81 | 121 | 144 | 69 | 410.5 | 411.2 | Note (7) | 13 | 411.2 | ... |
| 18 | 710 | 58.8 | 60.4 | 533 | 457.0 | 87 | 130 | 157 | 70 | 461.8 | 462.3 | Note (7) | 13 | 462.0 | ... |
| 20 | 775 | 62.0 | 63.5 | 587 | 508.0 | 94 | 140 | 160 | 74 | 513.1 | 514.4 | Note (7) | 13 | 512.8 | ... |
| 24 | 915 | 68.3 | 69.9 | 702 | 610.0 | 105 | 152 | 167 | 83 | 616.0 | 616.0 | Note (7) | 13 | 614.4 | ... |

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

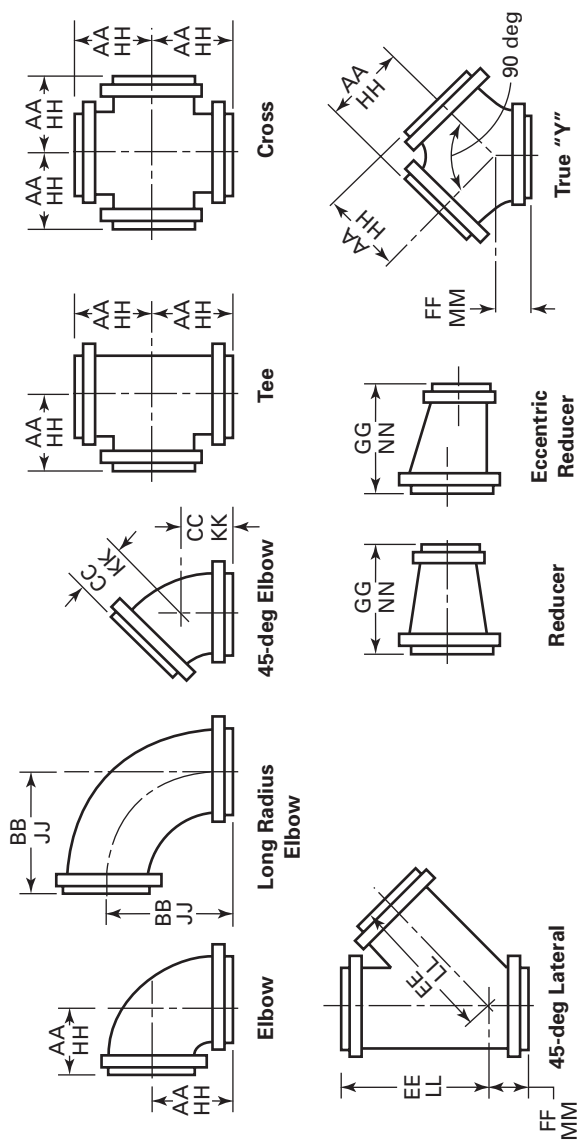
GENERAL NOTES:

- (a) Dimensions of Table 11 are in millimeters. For dimensions in inch units, refer to Mandatory Appendix II, Table II-11.
- (b) For tolerances, see section 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 the large end of the 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 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 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 13 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.
- (7) To be specified by the Purchaser.

Table 12 Dimensions of Class 300 Flanged Fittings

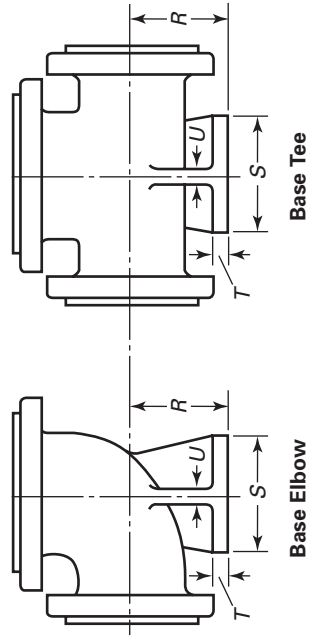
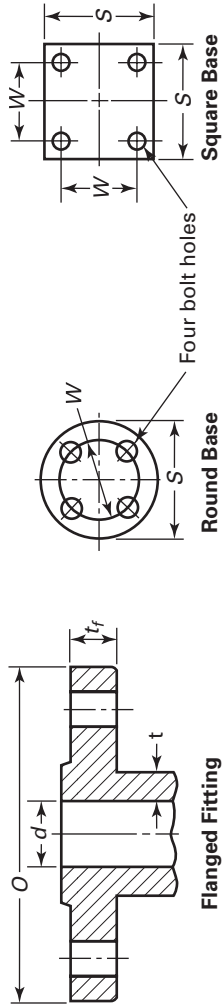


| Nominal Pipe Size, NPS | Outside Diameter of Flange, <i>O</i> | Minimum Thickness of Flange, <i>t_f</i> [Notes (1)–(3)] | Minimum Wall Thickness of Fitting, <i>t_m</i> | Inside Diameter of Fitting, <i>d</i> | 2-mm Raised Face (Flange Edge) [Note (4)] | | | | | Contact Surface- to- Contact Surface of Raised Face Reducer, GG [Note (5)] | Ring Joint [Note (2)] | Center-to-End Elbow, Tee, Cross, and True “Y,” HH [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 and True “Y,” EE | Short Center-to- Contact Surface of Raised Face Lateral and True “Y,” FF | | | |
| 1 | 125 | 15.9 | 4.8 | 25 | 102 | 127 | 57 | 165 | 51 | 114 | 108 | |
| 1 1/4 | 135 | 17.5 | 4.8 | 32 | 108 | 140 | 64 | 184 | 57 | 114 | 114 | |
| 1 1/2 | 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 | |
| 2 1/2 | 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 | |
| 3 1/2 | 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 |
|---------------------------------|---|--|--|---|---|---|---|--|--|--|---|
| Nominal Pipe Size, NPS | Outside Diameter of Flange, O | Minimum Thickness of Flange, t_f [Notes (1)–(3)] | Minimum Wall Thickness of Fitting, t_m | Inside Diameter of Fitting, d | 2-mm Raised Face (Flange Edge) [Note (4)] | | | | | | |
| | | | | | Center-to- Contact | Center-to- Contact | Center-to- Contact | Long Center- to- Contact | Short Center-to- Contact | Contact Surface- to- Contact | Ring Joint [Note (2)] |
| | | | | | Surface of Raised Face Elbow, Tee, Cross, and True “Y,” AA | Surface of Raised Face Long Radius Elbow, BB | Surface of Raised Face 45-deg Elbow, CC | Surface of Raised Face Lateral, EE | Surface of Raised Face Lateral and True “Y,” FF | Surface of Raised Face Reducer, GG [Note (5)] | Center-to-End Elbow, Tee, Cross, and True “Y,” HH [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)



| | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 1 |
|--|--|---|--|---|---|--|--|--|--|------------------------------------|---------------------------------|---|
| Ring Joint [Note (4)] | | | | | | | | | | | | |
| Center-to-End Long Radius Elbow, JJ [Note (6)] | Center-to-End 45-deg Elbow, KK [Note (6)] | Long Center-to-End Lateral, LL [Note (6)] | Short Center-to-End Lateral and True "V," MM [Note (6)] | End-to-End Reducer, NN [Notes (4), (6)] | Center-to-Base, R [Notes (7)–(9)] | Diameter of Round Base or Width of Square Base, S Note (7)] | Thickness of Base, T [Notes (7)–(10)] | Thickness of Ribs, U [Note (7)] | Bolt Circle or Bolt Spacing, W [Note (7)] | Diameter of Drilled Holes | Nominal Pipe Size, NPS | |
| | | | | | | | | | | | | |
| 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)

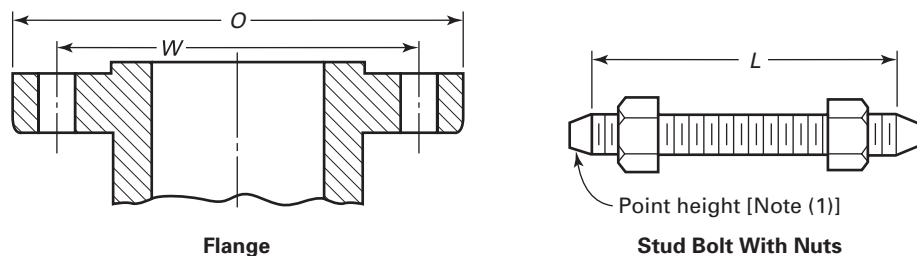
| 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 1 |
|--|---|---|--|---|---|---|--|--|--|------------------------------------|---------------------------------|
| Ring Joint [Note (5)] | | | | Base Drilling [Note (11)] | | | | | | | |
| Center-to-End Long Radius Elbow, JJ [Note (6)] | Center-to-End 45-deg Elbow, KK [Note (6)] | Long Center-to-End Lateral, LL [Note (6)] | Short Center-to-End Lateral and True "Y," MM [Note (6)] | End-to-End Reducer, NN [Notes (4), (6)] | Center-to-Base, R [Notes (7)–(9)] | Diameter of Round Base or Width of Square Base, S [Note (7)] | Thickness of Base, T [Notes (7)–(10)] | Thickness of Ribs, U [Note (7)] | Bolt Circle or Bolt Spacing, W [Note (7)] | Diameter of Drilled Holes | Nominal Pipe Size, NPS |
| | | | | | | | | | | | |
| 554 | 224 | 795 | 173 | ... | 343 | 318 | 36 | 25 | 269.9 | $\frac{7}{8}$ | 14 |
| 618 | 249 | 884 | 198 | ... | 375 | 318 | 36 | 29 | 269.9 | $\frac{7}{8}$ | 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 | $1\frac{1}{8}$ | 24 |

GENERAL NOTES:

- Dimensions of Table 12 are in millimeters. For dimensions in inch units, refer to Mandatory Appendix II, Table II-12.
- For tolerances, see section 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 the flange dimension illustrated is for regularly furnished 2-mm raised face (except lapped); for thickness requirements of other facings, see Fig. 7.
- 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 that are reinforced by being cast integral with the body of fitting.
- For contact surface-to-contact surface and end-to-end dimensions of reducers and eccentric reducers, see para. 6.2.3.
- 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 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 the largest opening, and add the proper height to provide for the 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.

Table 13 Templates for Drilling Class 400 Pipe Flanges

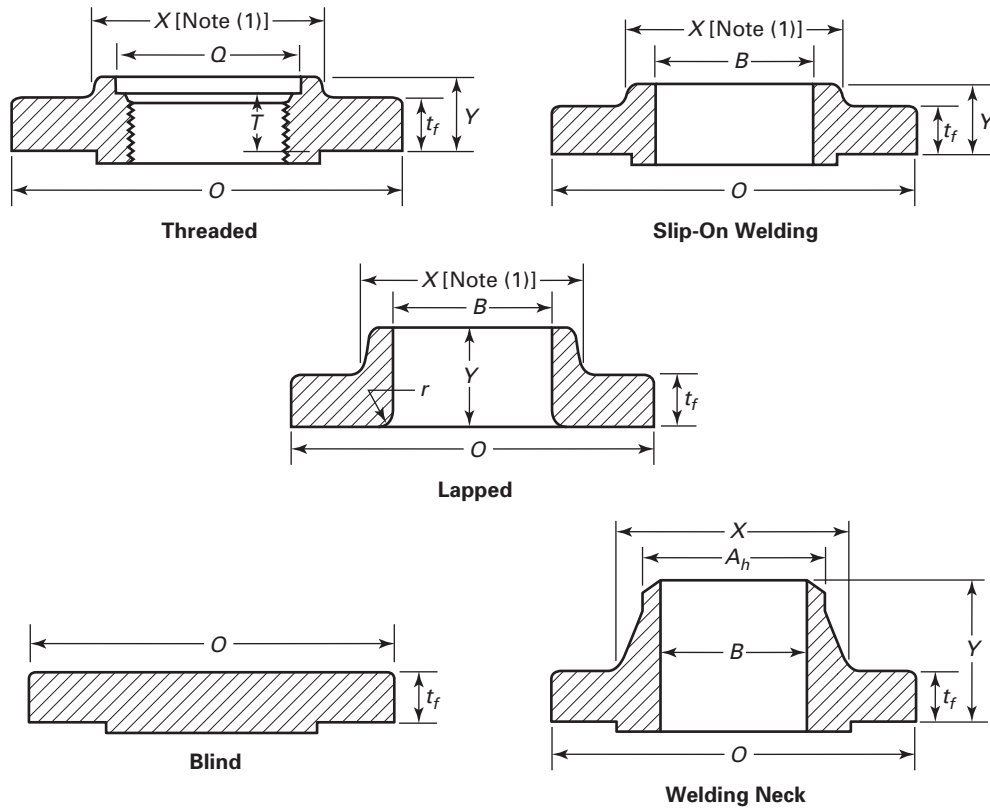
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|---|-------------------------------|----------------------------|-----------------------------|-----------------|------------------------|-------------------------------------|-----------------------------------|------------|
| | | Drilling [Notes (2), (3)] | | | | 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 | | | | | | | | |
| 2 | | | | | | | | |
| 2 1/2 | | | | | | | | |
| 3 | | | | | | | | |
| 3 1/2 | | | | | | | | |
| Use Class 600 dimensions in these sizes | | | | | | | | |
| 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 the diameter of bolts and bolt holes, which are in inch units. For dimensions in inch units, refer to Mandatory Appendix II, Table II-13.
- (b) For other dimensions, see Table 14.

NOTES:

- (1) The length of the 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 Nonmandatory Appendix C (see para. 6.10.2).

Table 14 Dimensions of Class 400 Flanges

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

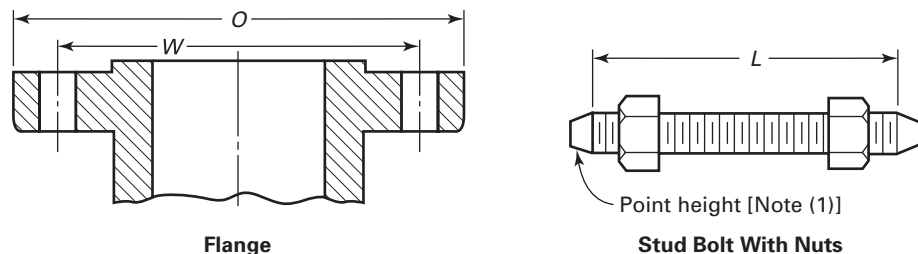
Table 14 Dimensions of Class 400 Flanges (Cont'd)

GENERAL NOTES:

- (a) Dimensions of Table 14 are in millimeters, except for the diameter of bolts and bolt holes, which are in inch units. For dimensions in inch units, refer to Mandatory Appendix II, Table II-7.
- (b) For tolerances, see section 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 the large end of the 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 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 $\frac{1}{2}$ through NPS $2\frac{1}{2}$, using Class 600 dimensions.
- (5) To be specified by the Purchaser.

Table 15 Templates for Drilling Class 600 Pipe Flanges and Flanged Fittings

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|---------------------------------|---|--|--------------------------------------|-----------------------|------------------------------|--|---|---------------|
| Nominal Pipe Size, NPS | Outside Diameter of Flange, <i>O</i> | Drilling [Notes (2), (3)] | | | | Length of Bolts, <i>L</i> [Notes (1), (4)] | | |
| | | Diameter of Bolt Circle, <i>W</i> | 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 | 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 |

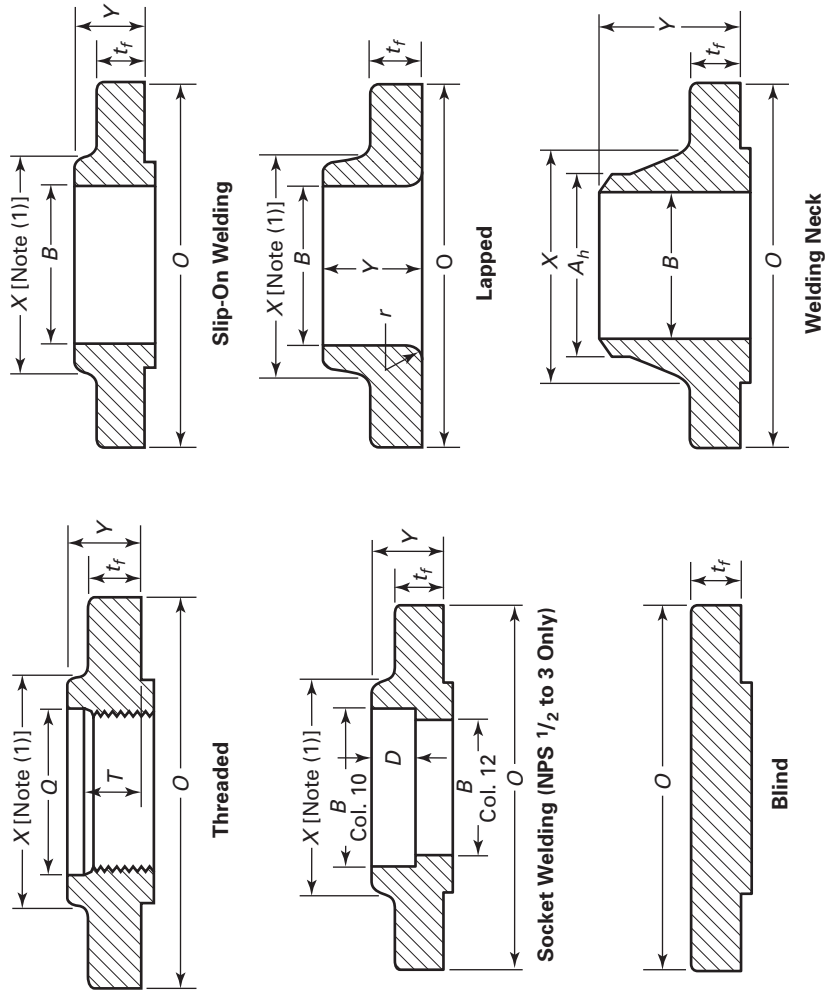
GENERAL NOTES:

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

NOTES:

- (1) The length of the 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 in accordance with Nonmandatory Appendix C (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 Pipe Size, NPS | Outside Diameter of Flange, O | Minimum Thickness of Flange, t_f | Diameter of Hub, X | Hub Diameter Beginning of Chamfer, A_h | Length Through Hub | Length Through Hub | Length Through Hub | Minimum Thread Length Threaded Flange, T [Note (3)] | Minimum Slip-On/Socket Welding, B | Minimum Bore, B | Welding Neck/Socket Welding, B | Corner Bore Radius of Lapped Flange and Pipe, r | Minimum Counterbore Threaded Flange, Q | Depth of Socket, D |
| $\frac{1}{2}$ | 95 | 14.3 | 38 | 21.3 | 22 | 22 | 52 | 16 | 22.2 | 22.9 | Note (4) | 3 | 23.6 | 10 |
| $\frac{3}{4}$ | 115 | 15.9 | 48 | 26.7 | 25 | 25 | 57 | 16 | 27.7 | 28.2 | Note (4) | 3 | 29.0 | 11 |
| 1 | 125 | 17.5 | 54 | 33.4 | 27 | 27 | 62 | 18 | 34.5 | 34.9 | Note (4) | 3 | 35.8 | 13 |
| $1\frac{1}{4}$ | 135 | 20.7 | 64 | 42.2 | 29 | 29 | 67 | 21 | 43.2 | 43.7 | Note (4) | 5 | 44.4 | 14 |
| $1\frac{1}{2}$ | 155 | 22.3 | 70 | 48.3 | 32 | 32 | 70 | 23 | 49.5 | 50.0 | Note (4) | 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 Pipe Size, NPS | Outside Diameter of Flange, O | Minimum Thickness of Flange, t _f | Diameter of Hub, X | Hub Diameter Beginning of Chamber Welding Neck, A _h [Note (2)] | Length Through Hub | | | Minimum Thread Length Threaded Flange, T [Note (3)] | Bore | | Welding Neck/ Socket Welding, B | Corner Bore Radius of Lapped Flange and Pipe, r | Minimum Counterbore Flange, Q | Depth of Socket, D |
| | | | | | Threaded/ Slip-On/ Welding, Y | Lapped, Y | Welding Neck, Y | | Minimum Slip-On/ Socket Welding, B | Minimum Lapped, B | | | | |
| 2 | 165 | 25.4 | 84 | 60.3 | 37 | 37 | 73 | 29 | 61.9 | 62.5 | Note (4) | 8 | 63.5 | 17 |
| 2½ | 190 | 28.6 | 100 | 73.0 | 41 | 41 | 79 | 32 | 74.6 | 75.4 | Note (4) | 8 | 76.2 | 19 |
| 3 | 210 | 31.8 | 117 | 88.9 | 46 | 46 | 83 | 35 | 90.7 | 91.4 | Note (4) | 10 | 92.2 | 21 |
| 3½ | 230 | 35.0 | 133 | 101.6 | 49 | 49 | 86 | 40 | 103.4 | 104.1 | Note (4) | 10 | 104.9 | ... |
| 4 | 275 | 38.1 | 152 | 114.3 | 54 | 54 | 102 | 42 | 116.1 | 116.8 | Note (4) | 11 | 117.6 | ... |
| 5 | 330 | 44.5 | 189 | 141.3 | 60 | 60 | 114 | 48 | 143.8 | 144.4 | Note (4) | 11 | 144.4 | ... |
| 6 | 355 | 47.7 | 222 | 168.3 | 67 | 67 | 117 | 51 | 170.7 | 171.4 | Note (4) | 13 | 171.4 | ... |
| 8 | 420 | 55.6 | 273 | 219.1 | 76 | 76 | 133 | 58 | 221.5 | 222.2 | Note (4) | 13 | 222.2 | ... |
| 10 | 510 | 63.5 | 343 | 273.0 | 86 | 111 | 152 | 66 | 276.2 | 277.4 | Note (4) | 13 | 276.2 | ... |
| 12 | 560 | 66.7 | 400 | 323.8 | 92 | 117 | 156 | 70 | 327.0 | 328.2 | Note (4) | 13 | 328.6 | ... |
| 14 | 605 | 69.9 | 432 | 355.6 | 94 | 127 | 165 | 74 | 359.2 | 360.2 | Note (4) | 13 | 360.4 | ... |
| 16 | 685 | 76.2 | 495 | 406.4 | 106 | 140 | 178 | 78 | 410.5 | 411.2 | Note (4) | 13 | 411.2 | ... |
| 18 | 745 | 82.6 | 546 | 457.0 | 117 | 152 | 184 | 80 | 461.8 | 462.3 | Note (4) | 13 | 462.0 | ... |
| 20 | 815 | 88.9 | 610 | 508.0 | 127 | 165 | 190 | 83 | 513.1 | 514.4 | Note (4) | 13 | 512.8 | ... |
| 24 | 940 | 101.6 | 718 | 610.0 | 140 | 184 | 203 | 93 | 616.0 | 616.0 | Note (4) | 13 | 614.4 | ... |

GENERAL NOTES:

(a) Dimensions of Table 16 are in millimeters, except for the diameter of the bolts and bolt holes, which are in inch units. For dimensions in inch units, refer to Mandatory Appendix II, Table II-16.

(b) For tolerance, see section 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.

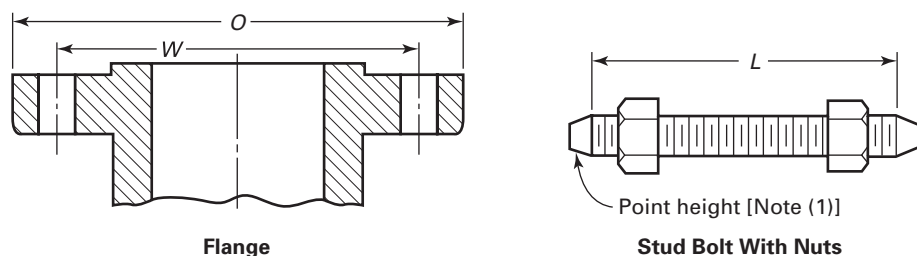
NOTES:

(1) This dimension is for the large end of the 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 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) To be specified by the Purchaser.

Table 17 Templates for Drilling Class 900 Pipe Flanges and Flanged Fittings

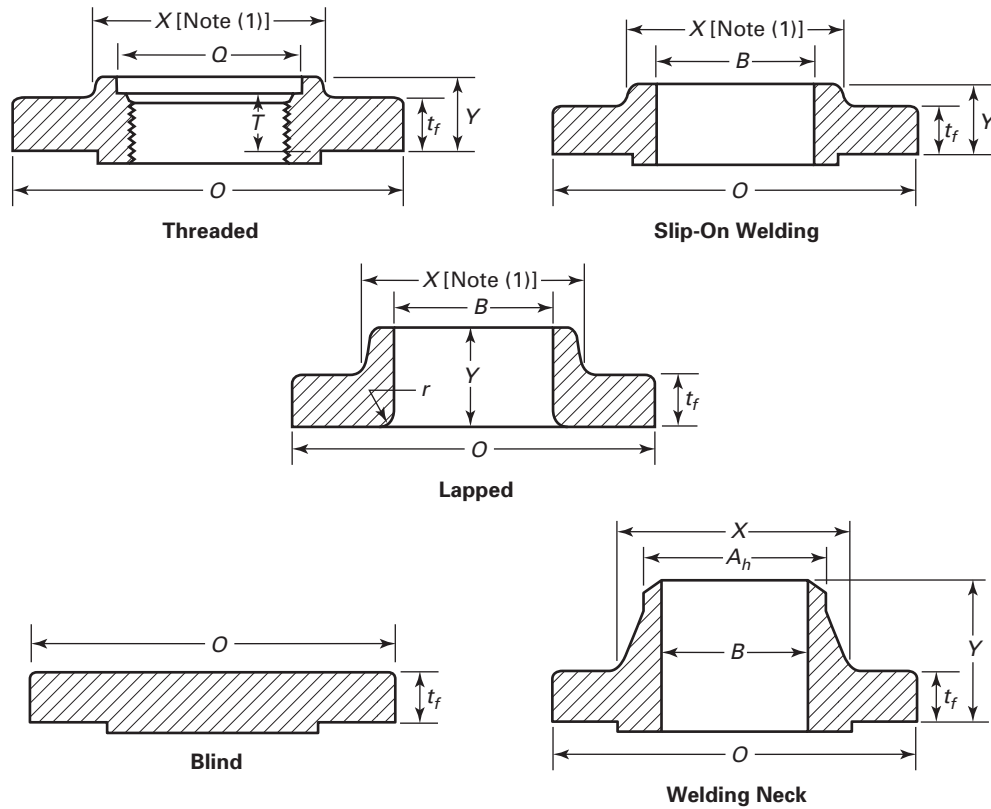
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|--|---|---|-----------------------------------|--------------------|---------------------------|--|---------------------------------------|------------|
| Nominal Pipe Size, NPS | Outside Diameter of Flange, <i>O</i> | Drilling [Notes (2), (3)] | | | | Length of Bolts, <i>L</i> [Notes (1), (4)] | | |
| | | Diameter of Bolt Circle, <i>W</i> | 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 | | | | | | | | |
| 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 Mandatory Appendix II, Table II-17.
- (b) For other dimensions, see Tables 18 and 19.

NOTES:

- (1) The length of the 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 Nonmandatory Appendix C (see para. 6.10.2).

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

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 |
|---|----------------------------|--|-----------------|--|----------------------|-----------|-----------------|---|-----------------|----------------|-----------------|---|--|
| Nom. Pipe Size, NPS | Outside Diam. of Flange, O | Min. Thickness of Flange, t _f | Diam. of Hub, X | Hub Diam. Beginning of Chamfer Welding Neck, A _h [Note (2)] | Length Through Hub | | | Minimum Thread Length Threaded Flange, T [Note (3)] | Bore | | | Corner Bore Radius of Lapped Flange and Pipe, r | Minimum Counterbore Threaded Flange, Q |
| | | | | | Threaded/ Slip-On, Y | Lapped, Y | Welding Neck, Y | | Min. Slip-On, B | Min. Lapped, B | Welding Neck, B | | |
| 1/2 | | | | | | | | | | | | | |
| 3/4 | | | | | | | | | | | | | |
| 1 | | | | | | | | | | | | | |
| 1 1/4 | | | | | | | | | | | | | |
| 1 1/2 | | | | | | | | | | | | | |
| 2 | | | | | | | | | | | | | |
| 2 1/2 | | | | | | | | | | | | | |
| Use Class 1500 dimensions in these sizes [Note (4)] | | | | | | | | | | | | | |
| 3 | 240 | 38.1 | 127 | 88.9 | 54 | 54 | 102 | 42 | 90.7 | 91.4 | Note (5) | 10 | 92.2 |
| 4 | 290 | 44.5 | 159 | 114.3 | 70 | 70 | 114 | 48 | 116.1 | 116.8 | Note (5) | 11 | 117.6 |
| 5 | 350 | 50.8 | 190 | 141.3 | 79 | 79 | 127 | 54 | 143.8 | 144.4 | Note (5) | 11 | 144.4 |
| 6 | 380 | 55.6 | 235 | 168.3 | 86 | 86 | 140 | 58 | 170.7 | 171.4 | Note (5) | 13 | 171.4 |
| 8 | 470 | 63.5 | 298 | 219.1 | 102 | 114 | 162 | 64 | 221.5 | 222.2 | Note (5) | 13 | 222.2 |
| 10 | 545 | 69.9 | 368 | 273.0 | 108 | 127 | 184 | 72 | 276.2 | 277.4 | Note (5) | 13 | 276.2 |
| 12 | 610 | 79.4 | 419 | 323.8 | 117 | 143 | 200 | 77 | 327.0 | 328.2 | Note (5) | 13 | 328.6 |
| 14 | 640 | 85.8 | 451 | 355.6 | 130 | 156 | 213 | 83 | 359.2 | 360.2 | Note (5) | 13 | 360.4 |
| 16 | 705 | 88.9 | 508 | 406.4 | 133 | 165 | 216 | 86 | 410.5 | 411.2 | Note (5) | 13 | 411.2 |
| 18 | 785 | 101.6 | 565 | 457.0 | 152 | 190 | 229 | 89 | 461.8 | 462.3 | Note (5) | 13 | 462.0 |
| 20 | 855 | 108.0 | 622 | 508.0 | 159 | 210 | 248 | 93 | 513.1 | 514.4 | Note (5) | 13 | 512.8 |
| 24 | 1,040 | 139.7 | 749 | 610.0 | 203 | 267 | 292 | 102 | 616.0 | 616.0 | Note (5) | 13 | 614.4 |

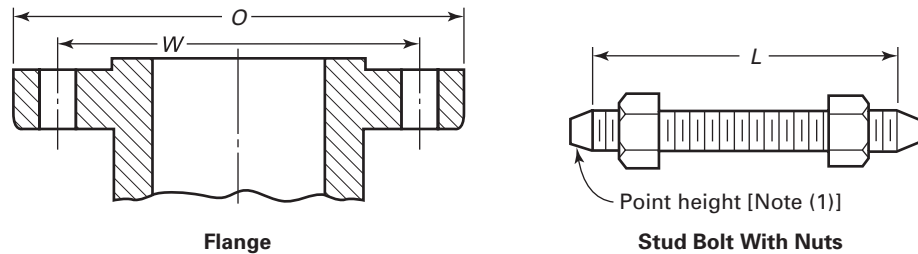
Table 18 Dimensions of Class 900 Flanges (Cont'd)

GENERAL NOTES:

- (a) Dimensions of Table 18 are in millimeters. For dimensions in inch units, refer to Mandatory Appendix II, Table II-18.
- (b) For tolerances, see section 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 the large end of the 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 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 $\frac{1}{2}$ through NPS $2\frac{1}{2}$, using Class 1500 dimensions.
- (5) To be specified by the Purchaser.

Table 19 Templates for Drilling Class 1500 Pipe Flanges

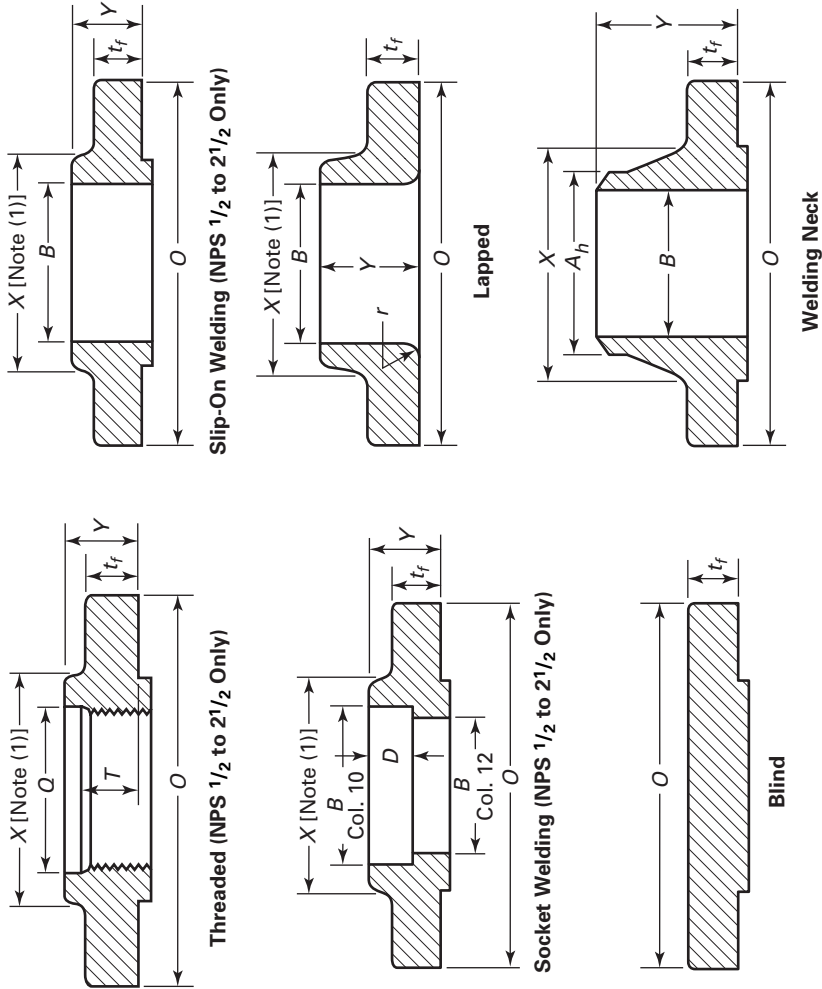
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|------------------------------|---|---|-----------------------------------|--------------------|------------------------------|--|---------------------------------------|------------|
| | | | | | | Length of Bolts, <i>L</i> [Notes (1), (4)] | | |
| Nominal Pipe Size, NPS | Outside Diameter of Flange, <i>O</i> | Drilling [Notes (2), (3)] | | | Diameter of Bolts, in. | | | |
| | | Diameter of Bolt Circle, <i>W</i> | Diameter of Bolt Holes, in. | Number of Bolts | | 7-mm Raised Face | Male and Female/ Tongue and Groove | Ring Joint |
| 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 | 300 |
| 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 the diameters of the bolts and bolt holes, which are in inch units. For dimensions in inch units, refer to Mandatory Appendix II, Table II-19.
- (b) For other dimensions, see Table 20.

NOTES:

- (1) The length of the 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 Nonmandatory Appendix C (see para. 6.10.2).

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 | Minimum Thickness of Flange, t _f | Diameter of Hub, X | Hub Diameter Beginning of Chamfer Welding Neck, A _h | Length Through Hub Threaded/ Slip-On/ Socket Welding, Y | Length Through Hub Welding Neck, Y | Minimum Thread Length Flange, T [Note (3)] | Minimum Slip-On/ Socket Welding, B | Minimum Slip-On/ Socket Welding, B | Bore Minimum Slip-On/ Socket Welding, B | Welding Neck/ Socket Welding, B | Corner Bore Radius of Lapped Flange and Pipe, r | Minimum Counterbore Threaded Flange, Q | Depth of Socket, D |
| 1/2 | 120 | 22.3 | 38 | 21.3 | 32 | 32 | 23 | 22.2 | 22.2 | 22.9 | Note (4) | 3 | 23.6 | 10 |
| 3/4 | 130 | 25.4 | 44 | 26.7 | 35 | 35 | 26 | 27.7 | 27.7 | 28.2 | Note (4) | 3 | 29.0 | 11 |
| 1 | 150 | 28.6 | 52 | 33.4 | 41 | 41 | 29 | 34.5 | 34.5 | 34.9 | Note (4) | 3 | 35.8 | 13 |
| 1 1/4 | 160 | 28.6 | 64 | 42.2 | 41 | 41 | 31 | 43.2 | 43.2 | 43.7 | Note (4) | 5 | 44.4 | 14 |

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

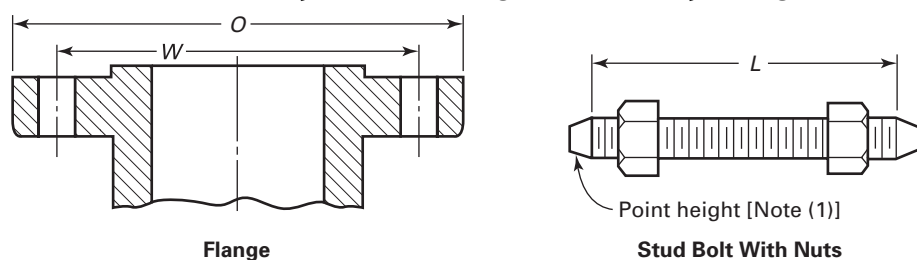
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
|------------------------------|--|--|--------------------------|--|---|--------------|------------|--|------|--|---------------|---|--|--------------------------|
| Nominal Pipe Size, NPS | Outside Diameter of Flange, O | Minimum Thickness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

GENERAL NOTES:

- (a) Dimensions of Table 20 are in millimeters. For dimensions in inch units, refer to Mandatory Appendix II, Table II-20.
 (b) For tolerances, see section 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 the large end of the 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 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) To be specified by the Purchaser.

Table 21 Templates for Drilling Class 2500 Pipe Flanges

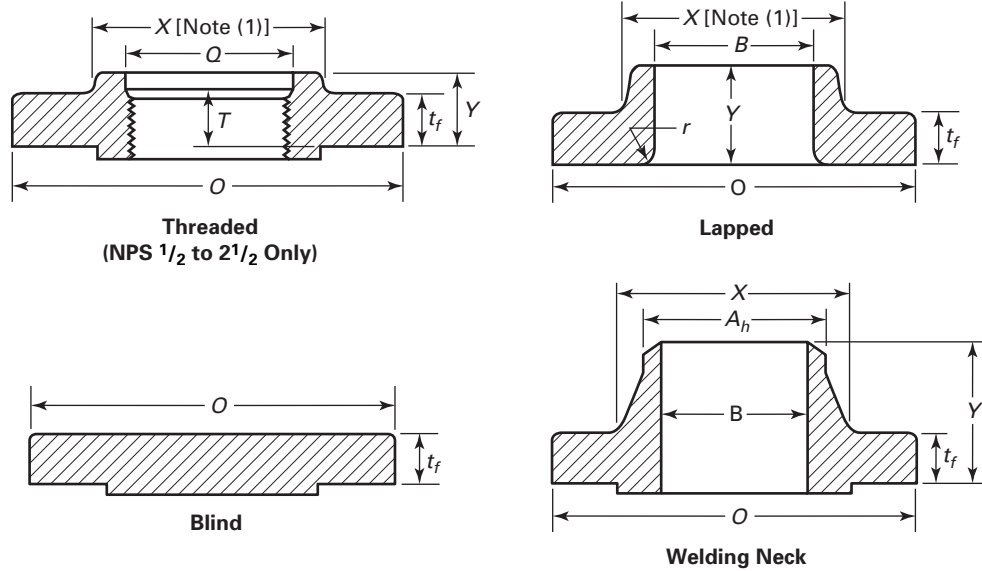
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|------------------------------|--|----------------------------------|-----------------------------------|--------------------|------------------------------|---|---------------------------------------|------------|
| Nominal Pipe Size, NPS | Outside Diameter of Flange, O | Drilling [Notes (2), (3)] | | | | Length of Bolts, L [Notes (1), (4)] | | |
| | | 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 | 135 | 88.9 | 7/8 | 4 | 3/4 | 120 | 115 | 120 |
| 3/4 | 140 | 95.2 | 7/8 | 4 | 3/4 | 125 | 120 | 125 |
| 1 | 160 | 108.0 | 1 | 4 | 7/8 | 140 | 135 | 140 |
| 1 1/4 | 185 | 130.2 | 1 1/8 | 4 | 1 | 150 | 145 | 150 |
| 1 1/2 | 205 | 146.0 | 1 1/4 | 4 | 1 1/8 | 170 | 165 | 170 |
| 2 | 235 | 171.4 | 1 1/8 | 8 | 1 | 180 | 170 | 180 |
| 2 1/2 | 265 | 196.8 | 1 1/4 | 8 | 1 1/8 | 195 | 190 | 205 |
| 3 | 305 | 228.6 | 1 3/8 | 8 | 1 1/4 | 220 | 215 | 230 |
| 4 | 355 | 273.0 | 1 5/8 | 8 | 1 1/2 | 255 | 250 | 260 |
| 5 | 420 | 323.8 | 1 7/8 | 8 | 1 3/4 | 300 | 290 | 310 |
| 6 | 485 | 368.3 | 2 1/8 | 8 | 2 | 345 | 335 | 355 |
| 8 | 550 | 438.2 | 2 1/8 | 12 | 2 | 380 | 375 | 395 |
| 10 | 675 | 539.8 | 2 5/8 | 12 | 2 1/2 | 490 | 485 | 510 |
| 12 | 760 | 619.1 | 2 7/8 | 12 | 2 3/4 | 540 | 535 | 560 |

GENERAL NOTES:

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

NOTES:

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

Table 22 Dimensions of Class 2500 Flanges (Cont'd)

GENERAL NOTES:

- (a) Dimensions of Table 22 are in millimeters, except for the diameter of the bolts and bolt holes, which are in inch units. For dimensions in inch units, refer to Mandatory Appendix II, Table II-22.
- (b) For tolerances, see section 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 the large end of the 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 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) To be specified by the Purchaser.

MANDATORY APPENDIX I

THREADING OF PIPE FOR AMERICAN NATIONAL STANDARD THREADED FLANGES

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 Classes 150, 300, and 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 I-1, 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.

Table I-1 Projection of Threaded Pipe End Through a Ring Gage

| NPS | Class 150, 300, 400 | | Class 600 | | Class 900 | | | Class 1500 | | | Class 2500 | | |
|-------|------------------------|---|------------|-----|-----------------------|------------|------|-----------------------|------------|------|-----------------------|------------|------|
| | Number of Turns | Number of Turns | Projection | | Number Of Turns | Projection | | Number of Turns | Projection | | Number of Turns | Projection | |
| | | | mm | in. | | mm | in. | | mm | in. | | mm | in. |
| 1/2 | ... | Use taper pipe thread per ASME B1.20.1 for these sizes | ... | ... | ... | ... | ... | 3 1/2 | 6.4 | 0.25 | 7 | 12.7 | 0.50 |
| 3/4 | ... | | ... | ... | ... | ... | ... | 5 | 9.5 | 0.38 | 7 | 12.7 | 0.50 |
| 1 | ... | | ... | ... | ... | ... | ... | 5 | 11.1 | 0.44 | 7 1/2 | 16.5 | 0.65 |
| 1 1/4 | ... | | ... | ... | ... | ... | ... | 5 | 11.1 | 0.44 | 7 1/2 | 16.5 | 0.65 |
| 1 1/2 | ... | | ... | ... | ... | ... | ... | 5 | 11.1 | 0.44 | 7 1/2 | 16.5 | 0.65 |
| 2 | ... | Use taper pipe thread per ASME B1.20.1 for these sizes | ... | ... | ... | ... | 11.1 | 5 | 11.1 | 0.44 | 7 1/2 | 16.5 | 0.65 |
| 2 1/2 | ... | | ... | ... | ... | ... | ... | 5 | 15.9 | 0.62 | 8 | 25.4 | 1.00 |
| 3 | ... | | 1 | 3.2 | 0.12 | 3 | 9.5 | 0.38 | ... | ... | ... | ... | ... |
| 3 1/2 | ... | | 1 | 3.2 | 0.12 | ... | ... | ... | ... | ... | ... | ... | ... |
| 4 | ... | | 1 1/2 | 4.8 | 0.19 | 3 1/2 | 11.1 | 0.44 | ... | ... | ... | ... | ... |
| 5 | ... | Use taper pipe thread per ASME B1.20.1 for these sizes | 1 1/2 | 4.8 | 0.19 | 3 1/2 | 11.1 | 0.44 | ... | ... | ... | ... | ... |
| 6 | ... | | 1 1/2 | 4.8 | 0.19 | 3 1/2 | 11.1 | 0.44 | ... | ... | ... | ... | ... |
| 8 | ... | | 2 | 6.4 | 0.25 | 4 | 12.7 | 0.50 | ... | ... | ... | ... | ... |
| 10 | ... | | 3 | 9.5 | 0.38 | 5 | 15.9 | 0.62 | ... | ... | ... | ... | ... |
| 12 | ... | | 3 | 9.5 | 0.38 | 5 | 15.9 | 0.62 | ... | ... | ... | ... | ... |
| 14 | ... | Use taper pipe thread per ASME B1.20.1 for these sizes | 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 | ... | ... | ... | ... | ... |

MANDATORY APPENDIX II

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

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 2-3.19 and Tables II-2-1.1 through II-2-3.19 of of this Mandatory Appendix.

Tables 2-1.1 through 2-3.19 have pressure-temperature ratings using bar units for pressure (1 bar = 100 kPa) and degrees Celsius units for temperature.

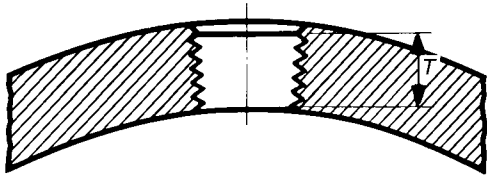
Tables II-2-1.1 through II-2-3.19 of this Mandatory Appendix have coterminous pressure-temperature ratings using psi units for pressure and degrees Fahrenheit units for temperature.

All tabulated pressures are gage pressures. Other tables and figures included in this Mandatory Appendix 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

Nonmandatory Appendix E includes dimensional data for Classes 400, 600, 900, 1500, and 2500 flanged fittings for information.

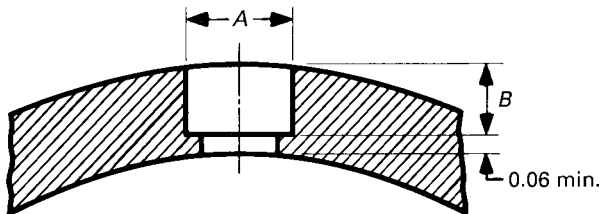
Fig. II-3 Thread for Connection Tapping

| Connection Size, NPS | $\frac{3}{8}$ | $\frac{1}{2}$ | $\frac{3}{4}$ | 1 | $1\frac{1}{4}$ | $1\frac{1}{2}$ | 2 |
|--------------------------|---------------|---------------|---------------|------|----------------|----------------|------|
| 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.

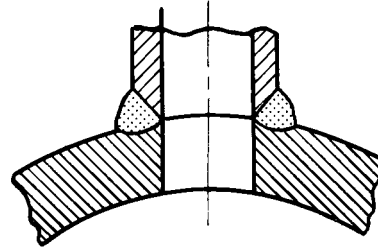
NOTE:

- (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).

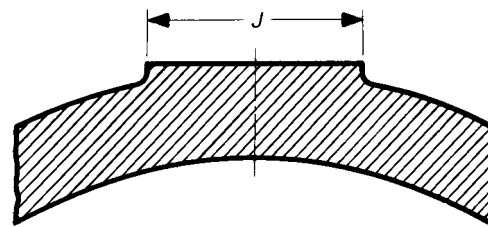
Fig. II-4 Socket Welding for Connections

| Connection Size, NPS | $\frac{3}{8}$ | $\frac{1}{2}$ | $\frac{3}{4}$ | 1 | $1\frac{1}{4}$ | $1\frac{1}{2}$ | 2 |
|---------------------------------------|---------------|---------------|---------------|------|----------------|----------------|------|
| Minimum 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. II-5 Butt Welding for Connections

GENERAL NOTE: See paras. 6.12.4 and 6.12.5.

Fig. II-6 Bosses 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. II-7 End Flange Facings and Their Relationship to Flange Thickness and Center-to-End and End-to-End Dimensions

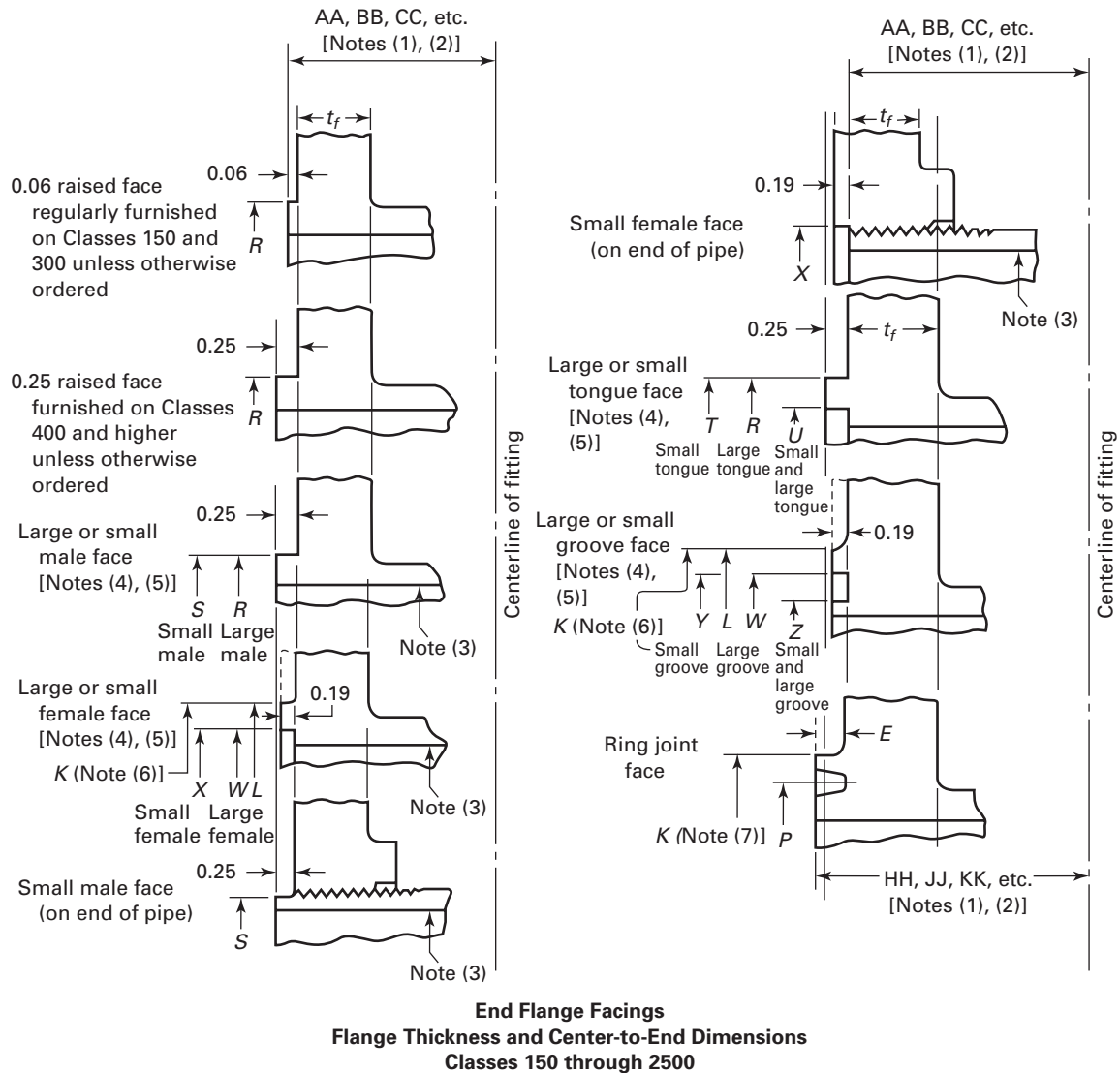
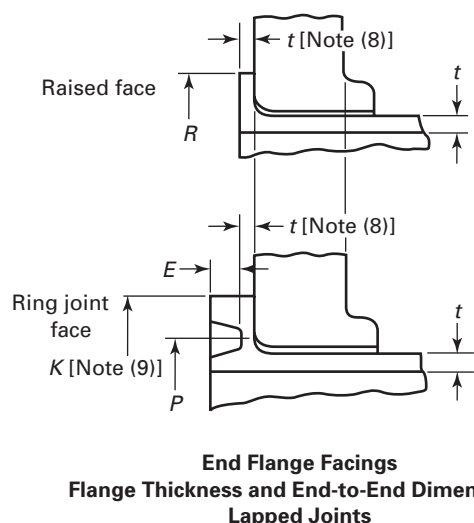


Fig. II-7 End Flange Facings and Their Relationship to Flange Thickness and Center-to-End and End-to-End Dimensions (Cont'd)

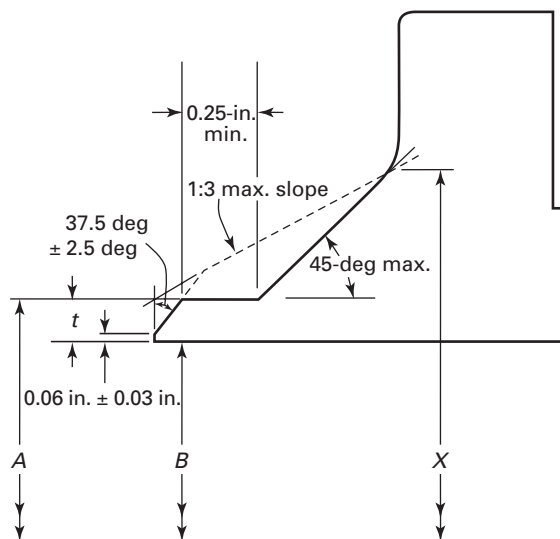


GENERAL NOTE: Dimensions are in inches. For dimensions in millimeters, refer to Fig. 7.

NOTES:

- (1) See paras. 6.2 and 6.4.
- (2) See Tables II-7 through II-22.
- (3) For small male and female joints, care should be taken in the use of these dimensions to ensure that the inside diameter of the pipe fitting is small enough to permit sufficient bearing surface to prevent crushing of the gasket (see Table II-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).
- (4) See Table II-4 for dimensions of facings (other than ring joint) and Table II-5 for ring joint facing.
- (5) Large male and female faces and large tongue and groove are not applicable to Class 150 because of potential dimensional conflicts.
- (6) See Table II-4.
- (7) See Table II-5.
- (8) See para. 6.4.3.
- (9) See para. 6.4.3.5 and Table II-5.

Fig. II-8 Bevel for Wall Thicknesses t from 0.19 in. to 0.88 in. Inclusive



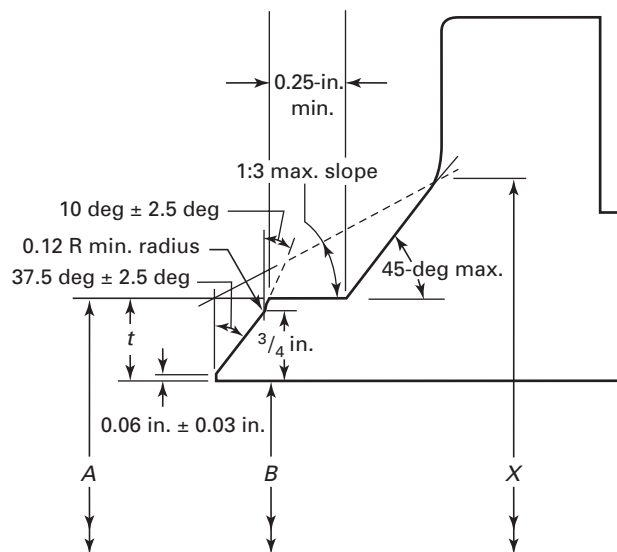
**Welding Ends
(Welding Neck Flanges, No Backing Rings)**

- A = nominal outside diameter of pipe
 B = nominal inside diameter of pipe
 t = nominal wall thickness of pipe
 x = diameter of hub (see dimensional tables)

GENERAL NOTES:

- (a) Dimensions are in inches. For dimensions in millimeters, refer to Figs. 8 and 9.
- (b) See paras. 6.7, 6.8, and 7.4 for details and tolerances.
- (c) See Figs. II-10 and II-11 for additional details of welding ends.
- (d) 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 used, 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 through 14).
- (e) 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 solid line.
- (f) For welding end dimensions, refer to ASME B16.25.
- (g) The 0.25-in. min. dimension applies only to the solid line configuration.

Fig. II-9 Bevel for Wall Thicknesses t Greater Than 0.88 in.

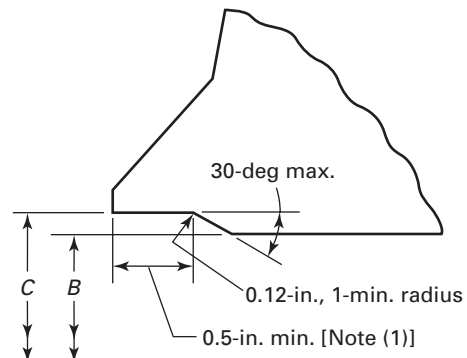


**Welding Ends
(Welding Neck Flanges, No Backing Rings)**

A = nominal outside diameter of pipe
 B = nominal inside diameter of pipe
 t = nominal wall thickness of pipe
 x = diameter of hub (see dimensional tables)

GENERAL NOTE: Please see Fig. II-8 General Notes.

Fig. II-10 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 2 to convert into terms of diameter
 0.010 in. = plus tolerance on diameter C (see para. 7.5.3)

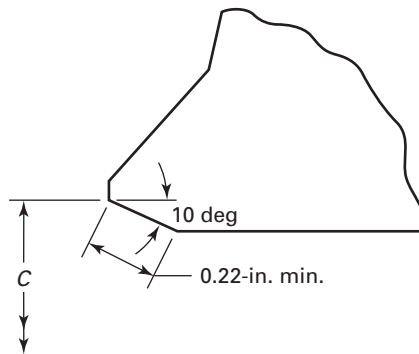
GENERAL NOTES:

- 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. II-8 and II-9 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. II-11 Inside Contour for Use With Taper 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 2 to convert into terms of diameter
- 0.010 in. = plus tolerance on diameter C (see para. 7.5.3)

GENERAL NOTES:

- (a) Dimensions are in inches. For dimensions in millimeters, refer to Figs. 10 and 11.
- (b) 0.5-in. depth based on use of 0.75-in.-wide backing ring.
- (c) See Figs. 6.7, 6.8, and 7.5 for details and tolerances.
- (d) See Figs. II-8 and II-9 for welding end details of welding neck flanges.
- (e) For dimensions, see ASME B16.25.

Table II-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) A 537 Cl. 1 (4) | | | | |
| C–Mn–Si–V | A 350 Gr. LF6 Cl. 1 (3) | ... | ... | | | | |
| 3 ¹ / ₂ Ni | A 350 Gr. LF 3 | ... | ... | | | | |
| Working Pressures by Classes, psig | | | | | | | |
| Temp., °F | Class | | | | | | |
| | 150 | 300 | 400 | 600 | 900 | 1500 | 2500 |
| –20 to 100 | 285 | 740 | 985 | 1,480 | 2,220 | 3,705 | 6,170 |
| 200 | 260 | 680 | 905 | 1,360 | 2,035 | 3,395 | 5,655 |
| 300 | 230 | 655 | 870 | 1,310 | 1,965 | 3,270 | 5,450 |
| 400 | 200 | 635 | 845 | 1,265 | 1,900 | 3,170 | 5,280 |
| 500 | 170 | 605 | 805 | 1,205 | 1,810 | 3,015 | 5,025 |
| 600 | 140 | 570 | 755 | 1,135 | 1,705 | 2,840 | 4,730 |
| 650 | 125 | 550 | 730 | 1,100 | 1,650 | 2,745 | 4,575 |
| 700 | 110 | 530 | 710 | 1,060 | 1,590 | 2,655 | 4,425 |
| 750 | 95 | 505 | 675 | 1,015 | 1,520 | 2,535 | 4,230 |
| 800 | 80 | 410 | 550 | 825 | 1,235 | 2,055 | 3,430 |
| 850 | 65 | 320 | 425 | 640 | 955 | 1,595 | 2,655 |
| 900 | 50 | 230 | 305 | 460 | 690 | 1,150 | 1,915 |
| 950 | 35 | 135 | 185 | 275 | 410 | 685 | 1,145 |
| 1,000 | 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 500°F.
- (4) Not to be used over 700°F.

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

| Nominal Designation | Forgings | Castings | Plates | | | | |
|------------------------------------|-------------------------|-------------------|-----------------|-------|-------|-------|-------|
| C–Mn–Si | ... | A 216 Gr. WCC (1) | ... | | | | |
| C–Mn–Si | ... | 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 (2) | A 203 Gr. E (1) | | | | |
| Working Pressures by Classes, psig | | | | | | | |
| Temp., °F | Class | | | | | | |
| | 150 | 300 | 400 | 600 | 900 | 1500 | 2500 |
| –20 to 100 | 290 | 750 | 1,000 | 1,500 | 2,250 | 3,750 | 6,250 |
| 200 | 260 | 750 | 1,000 | 1,500 | 2,250 | 3,750 | 6,250 |
| 300 | 230 | 730 | 970 | 1,455 | 2,185 | 3,640 | 6,070 |
| 400 | 200 | 705 | 940 | 1,405 | 2,110 | 3,520 | 5,865 |
| 500 | 170 | 665 | 885 | 1,330 | 1,995 | 3,325 | 5,540 |
| 600 | 140 | 605 | 805 | 1,210 | 1,815 | 3,025 | 5,040 |
| 650 | 125 | 590 | 785 | 1,175 | 1,765 | 2,940 | 4,905 |
| 700 | 110 | 555 | 740 | 1,110 | 1,665 | 2,775 | 4,630 |
| 750 | 95 | 505 | 675 | 1,015 | 1,520 | 2,535 | 4,230 |
| 800 | 80 | 410 | 550 | 825 | 1,235 | 2,055 | 3,430 |
| 850 | 65 | 320 | 425 | 640 | 955 | 1,595 | 2,655 |
| 900 | 50 | 225 | 295 | 445 | 670 | 1,115 | 1,855 |
| 950 | 35 | 135 | 185 | 275 | 410 | 685 | 1,145 |
| 1,000 | 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 II-2-1.3 Pressure–Temperature Ratings for Group 1.3 Materials

| Nominal Designation | Forgings | Castings | Plates | | | | |
|------------------------------------|----------|-----------------------|-----------------------|-------|-------|-------|-------|
| C–Si | ... | A 352 Gr. LCB (1) | A 515 Gr. 65 (2) | | | | |
| C–Mn–Si | ... | ... | A 516 Gr. 65 (2), (3) | | | | |
| C– ¹ / ₂ Mo | ... | A 217 Gr. WC1 (4)–(6) | ... | | | | |
| C– ¹ / ₂ Mo | ... | A 352 Gr. LC1 (1) | ... | | | | |
| 2 ¹ / ₂ Ni | ... | ... | A 203 Gr. A (2) | | | | |
| 3 ¹ / ₂ Ni | ... | ... | A 203 Gr. D (2) | | | | |
| Working Pressures by Classes, psig | | | | | | | |
| | Class | | | | | | |
| Temp., °F | 150 | 300 | 400 | 600 | 900 | 1500 | 2500 |
| –20 to 100 | 265 | 695 | 930 | 1,395 | 2,090 | 3,480 | 5,805 |
| 200 | 255 | 660 | 880 | 1,320 | 1,980 | 3,300 | 5,505 |
| 300 | 230 | 640 | 850 | 1,275 | 1,915 | 3,190 | 5,315 |
| 400 | 200 | 615 | 820 | 1,230 | 1,845 | 3,075 | 5,125 |
| 500 | 170 | 585 | 780 | 1,175 | 1,760 | 2,930 | 4,885 |
| 600 | 140 | 550 | 735 | 1,105 | 1,655 | 2,755 | 4,595 |
| 650 | 125 | 535 | 710 | 1,065 | 1,600 | 2,665 | 4,440 |
| 700 | 110 | 510 | 685 | 1,025 | 1,535 | 2,560 | 4,270 |
| 750 | 95 | 475 | 635 | 955 | 1,430 | 2,385 | 3,970 |
| 800 | 80 | 390 | 520 | 780 | 1,175 | 1,955 | 3,255 |
| 850 | 65 | 300 | 400 | 595 | 895 | 1,490 | 2,485 |
| 900 | 50 | 200 | 270 | 405 | 605 | 1,010 | 1,685 |
| 950 | 35 | 135 | 185 | 275 | 410 | 685 | 1,145 |
| 1,000 | 20 | 85 | 115 | 170 | 255 | 430 | 715 |

NOTES:

- (1) Not to be used over 650°F.
- (2) 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.
- (3) Not to be used over 850°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.
- (6) The deliberate addition of any element not listed in ASTM A 217, Table 1 is prohibited, except that Ca and Mg may be added for deoxidation.

Table II-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, psig | | | | | | | |
| | Class | | | | | | |
| Temp., °F | 150 | 300 | 400 | 600 | 900 | 1500 | 2500 |
| –20 to 100 | 235 | 615 | 825 | 1,235 | 1,850 | 3,085 | 5,145 |
| 200 | 215 | 565 | 755 | 1,130 | 1,695 | 2,830 | 4,715 |
| 300 | 210 | 545 | 725 | 1,090 | 1,635 | 2,725 | 4,545 |
| 400 | 200 | 525 | 700 | 1,055 | 1,580 | 2,635 | 4,390 |
| 500 | 170 | 500 | 670 | 1,005 | 1,505 | 2,510 | 4,185 |
| 600 | 140 | 475 | 630 | 945 | 1,420 | 2,365 | 3,945 |
| 650 | 125 | 455 | 610 | 915 | 1,370 | 2,285 | 3,805 |
| 700 | 110 | 440 | 590 | 885 | 1,325 | 2,210 | 3,685 |
| 750 | 95 | 430 | 570 | 855 | 1,285 | 2,140 | 3,565 |
| 800 | 80 | 370 | 495 | 740 | 1,110 | 1,850 | 3,085 |
| 850 | 65 | 300 | 400 | 595 | 895 | 1,490 | 2,485 |
| 900 | 50 | 170 | 230 | 345 | 515 | 855 | 1,430 |
| 950 | 35 | 135 | 185 | 275 | 410 | 685 | 1,145 |
| 1,000 | 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 II-2-1.5 Pressure–Temperature Ratings for Group 1.5 Materials

| Nominal Designation | Forgings | Castings | | | | Plates | |
|------------------------------------|------------------|----------|-----|-------|-------|-----------------|-------|
| C- $\frac{1}{2}$ Mo | A 182 Gr. F1 (1) | . . . | | | | A 204 Gr. A (1) | |
| C- $\frac{1}{2}$ Mo | . . . | . . . | | | | A 204 Gr. B (1) | |
| Working Pressures by Classes, psig | | | | | | | |
| Temp., °F | Class | | | | | | |
| | 150 | 300 | 400 | 600 | 900 | 1500 | 2500 |
| -20 to 100 | 265 | 695 | 930 | 1,395 | 2,090 | 3,480 | 5,805 |
| 200 | 260 | 695 | 930 | 1,395 | 2,090 | 3,480 | 5,805 |
| 300 | 230 | 685 | 915 | 1,375 | 2,060 | 3,435 | 5,725 |
| 400 | 200 | 660 | 885 | 1,325 | 1,985 | 3,310 | 5,520 |
| 500 | 170 | 640 | 855 | 1,285 | 1,925 | 3,210 | 5,350 |
| 600 | 140 | 605 | 805 | 1,210 | 1,815 | 3,025 | 5,040 |
| 650 | 125 | 590 | 785 | 1,175 | 1,765 | 2,940 | 4,905 |
| 700 | 110 | 570 | 755 | 1,135 | 1,705 | 2,840 | 4,730 |
| 750 | 95 | 530 | 710 | 1,065 | 1,595 | 2,660 | 4,430 |
| 800 | 80 | 510 | 675 | 1,015 | 1,525 | 2,540 | 4,230 |
| 850 | 65 | 485 | 650 | 975 | 1,460 | 2,435 | 4,060 |
| 900 | 50 | 450 | 600 | 900 | 1,350 | 2,245 | 3,745 |
| 950 | 35 | 280 | 375 | 560 | 845 | 1,405 | 2,345 |
| 1,000 | 20 | 165 | 220 | 330 | 495 | 825 | 1,370 |

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 II-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 (1) | | | ... | | | ... |
| $\text{Ni}-\frac{1}{2}\text{Cr}-\frac{1}{2}\text{Mo}$ | ... | | | A 217 Gr. WC4 (1)–(3) | | | ... |
| $\frac{3}{4}\text{Ni}-\frac{3}{4}\text{Cr}-1\text{Mo}$ | ... | | | A 217 Gr. WC5 (2), (3) | | | ... |
| Working Pressures by Classes, psig | | | | | | | |
| Temp., °F | Class | | | | | | |
| | 150 | 300 | 400 | 600 | 900 | 1500 | 2500 |
| –20 to 100 | 290 | 750 | 1,000 | 1,500 | 2,250 | 3,750 | 6,250 |
| 200 | 260 | 750 | 1,000 | 1,500 | 2,250 | 3,750 | 6,250 |
| 300 | 230 | 730 | 970 | 1,455 | 2,185 | 3,640 | 6,070 |
| 400 | 200 | 705 | 940 | 1,410 | 2,115 | 3,530 | 5,880 |
| 500 | 170 | 665 | 885 | 1,330 | 1,995 | 3,325 | 5,540 |
| 600 | 140 | 605 | 805 | 1,210 | 1,815 | 3,025 | 5,040 |
| 650 | 125 | 590 | 785 | 1,175 | 1,765 | 2,940 | 4,905 |
| 700 | 110 | 570 | 755 | 1,135 | 1,705 | 2,840 | 4,730 |
| 750 | 95 | 530 | 710 | 1,065 | 1,595 | 2,660 | 4,430 |
| 800 | 80 | 510 | 675 | 1,015 | 1,525 | 2,540 | 4,230 |
| 850 | 65 | 485 | 650 | 975 | 1,460 | 2,435 | 4,060 |
| 900 | 50 | 450 | 600 | 900 | 1,350 | 2,245 | 3,745 |
| 950 | 35 | 315 | 420 | 630 | 945 | 1,575 | 2,630 |
| 1,000 | 20 | 200 | 270 | 405 | 605 | 1,010 | 1,685 |
| 1,050 | ... | 160 | 210 | 315 | 475 | 790 | 1,315 |

NOTES:

- (1) Not to be used over 1,000°F.
- (2) Use normalized and tempered material only.
- (3) The deliberate addition of any element not listed in ASTM A 217, Table 1 is prohibited, except that Ca and Mg may be added for deoxidation.

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

| Nominal Designation | Forgings | | | Castings | | Plates | |
|---|---------------------------------|-----|-------|--------------------------|-------|---------------------------|-------|
| 1 ¹ / ₄ Cr– ¹ / ₂ Mo | ... | | | A 217 Gr. WC6 (1)–(3) | | ... | |
| 1 ¹ / ₄ Cr– ¹ / ₂ Mo–Si | A 182 Gr. F11 Cl. 2 (1), (4) | | | ... | | A 387 Gr. 11 Cl. 2 (4) | |
| Working Pressures by Classes, psig | | | | | | | |
| Temp., °F | Class | | | | | | |
| | 150 | 300 | 400 | 600 | 900 | 1500 | 2500 |
| –20 to 100 | 290 | 750 | 1,000 | 1,500 | 2,250 | 3,750 | 6,250 |
| 200 | 260 | 750 | 1,000 | 1,500 | 2,250 | 3,750 | 6,250 |
| 300 | 230 | 720 | 965 | 1,445 | 2,165 | 3,610 | 6,015 |
| 400 | 200 | 695 | 925 | 1,385 | 2,080 | 3,465 | 5,775 |
| 500 | 170 | 665 | 885 | 1,330 | 1,995 | 3,325 | 5,540 |
| 600 | 140 | 605 | 805 | 1,210 | 1,815 | 3,025 | 5,040 |
| 650 | 125 | 590 | 785 | 1,175 | 1,765 | 2,940 | 4,905 |
| 700 | 110 | 570 | 755 | 1,135 | 1,705 | 2,840 | 4,730 |
| 750 | 95 | 530 | 710 | 1,065 | 1,595 | 2,660 | 4,430 |
| 800 | 80 | 510 | 675 | 1,015 | 1,525 | 2,540 | 4,230 |
| 850 | 65 | 485 | 650 | 975 | 1,460 | 2,435 | 4,060 |
| 900 | 50 | 450 | 600 | 900 | 1,350 | 2,245 | 3,745 |
| 950 | 35 | 320 | 425 | 640 | 955 | 1,595 | 2,655 |
| 1,000 | 20 | 215 | 290 | 430 | 650 | 1,080 | 1,800 |
| 1,050 | ... | 145 | 190 | 290 | 430 | 720 | 1,200 |
| 1,100 | ... | 95 | 130 | 190 | 290 | 480 | 800 |
| 1,150 | ... | 65 | 85 | 130 | 195 | 325 | 545 |
| 1,200 | ... | 40 | 55 | 80 | 125 | 205 | 345 |

NOTES:

- (1) Use normalized and tempered material only.
- (2) Not to be used over 1,100°F.
- (3) The deliberate addition of any element not listed in ASTM A 217, Table 1 is prohibited, except that Ca and Mg may be added for deoxidation.
- (4) Permissible but not recommended for prolonged use above 1,100°F.

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

| Nominal Designation | Forgings | | | Castings | | Plates | |
|--------------------------------------|-------------------------|-----|-------|-----------------------|-------|------------------------|-------|
| 2 ¹ / ₄ Cr–1Mo | A 182 Gr. F22 Cl. 3 (1) | | | A 217 Gr. WC9 (2)–(4) | | A 387 Gr. 22 Cl. 2 (1) | |
| Working Pressures by Classes, psig | | | | | | | |
| Temp., °F | Class | | | | | | |
| | 150 | 300 | 400 | 600 | 900 | 1500 | 2500 |
| –20 to 100 | 290 | 750 | 1,000 | 1,500 | 2,250 | 3,750 | 6,250 |
| 200 | 260 | 750 | 1,000 | 1,500 | 2,250 | 3,750 | 6,250 |
| 300 | 230 | 730 | 970 | 1,455 | 2,185 | 3,640 | 6,070 |
| 400 | 200 | 705 | 940 | 1,410 | 2,115 | 3,530 | 5,880 |
| 500 | 170 | 665 | 885 | 1,330 | 1,995 | 3,325 | 5,540 |
| 600 | 140 | 605 | 805 | 1,210 | 1,815 | 3,025 | 5,040 |
| 650 | 125 | 590 | 785 | 1,175 | 1,765 | 2,940 | 4,905 |
| 700 | 110 | 570 | 755 | 1,135 | 1,705 | 2,840 | 4,730 |
| 750 | 95 | 530 | 710 | 1,065 | 1,595 | 2,660 | 4,430 |
| 800 | 80 | 510 | 675 | 1,015 | 1,525 | 2,540 | 4,230 |
| 850 | 65 | 485 | 650 | 975 | 1,460 | 2,435 | 4,060 |
| 900 | 50 | 450 | 600 | 900 | 1,350 | 2,245 | 3,745 |
| 950 | 35 | 385 | 515 | 775 | 1,160 | 1,930 | 3,220 |
| 1,000 | 20 | 265 | 355 | 535 | 800 | 1,335 | 2,230 |
| 1,050 | ... | 175 | 235 | 350 | 525 | 875 | 1,455 |
| 1,100 | ... | 110 | 145 | 220 | 330 | 550 | 915 |
| 1,150 | ... | 70 | 90 | 135 | 205 | 345 | 570 |
| 1,200 | ... | 40 | 55 | 80 | 125 | 205 | 345 |

NOTES:

- (1) Permissible but not recommended for prolonged use above 1,100°F.
- (2) Use normalized and tempered material only.
- (3) Not to be used over 1,100°F.
- (4) The deliberate addition of any element not listed in ASTM A 217, Table 1 is prohibited, except that Ca and Mg may be added for deoxidation.

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

| Nominal Designation | Forgings | | | Castings | | Plates | |
|------------------------------------|----------|-----|-------|----------|-------|------------------|-------|
| C- ¹ / ₂ Mo | ... | | | ... | | A 204, Gr. C (1) | |
| Working Pressures by Classes, psig | | | | | | | |
| | Class | | | | | | |
| Temp., °F | 150 | 300 | 400 | 600 | 900 | 1500 | 2500 |
| -20 to 100 | 290 | 750 | 1,000 | 1,500 | 2,250 | 3,750 | 6,250 |
| 200 | 260 | 750 | 1,000 | 1,500 | 2,250 | 3,750 | 6,250 |
| 300 | 230 | 730 | 970 | 1,455 | 2,185 | 3,640 | 6,070 |
| 400 | 200 | 705 | 940 | 1,410 | 2,115 | 3,530 | 5,880 |
| 500 | 170 | 665 | 885 | 1,330 | 1,995 | 3,325 | 5,540 |
| 600 | 140 | 605 | 805 | 1,210 | 1,815 | 3,025 | 5,040 |
| 650 | 125 | 590 | 785 | 1,175 | 1,765 | 2,940 | 4,905 |
| 700 | 110 | 570 | 755 | 1,135 | 1,705 | 2,840 | 4,730 |
| 750 | 95 | 530 | 710 | 1,065 | 1,595 | 2,660 | 4,430 |
| 800 | 80 | 510 | 675 | 1,015 | 1,525 | 2,540 | 4,230 |
| 850 | 65 | 485 | 650 | 975 | 1,460 | 2,435 | 4,060 |
| 900 | 50 | 450 | 600 | 900 | 1,345 | 2,245 | 3,745 |
| 950 | 35 | 280 | 375 | 560 | 845 | 1,405 | 2,345 |
| 1,000 | 20 | 165 | 220 | 330 | 495 | 825 | 1,370 |
| 1,050 | ... | 165 | 220 | 330 | 495 | 825 | 1,370 |
| 1,100 | ... | 110 | 145 | 220 | 330 | 550 | 915 |
| 1,150 | ... | 80 | 110 | 165 | 245 | 410 | 685 |
| 1,200 | ... | 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 II-2-1.13 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), (2) | | ... | |
| Working Pressures by Classes, psig | | | | | | | |
| | Class | | | | | | |
| Temp., °F | 150 | 300 | 400 | 600 | 900 | 1500 | 2500 |
| –20 to 100 | 290 | 750 | 1,000 | 1,500 | 2,250 | 3,750 | 6,250 |
| 200 | 260 | 750 | 1,000 | 1,500 | 2,250 | 3,750 | 6,250 |
| 300 | 230 | 730 | 970 | 1,455 | 2,185 | 3,640 | 6,070 |
| 400 | 200 | 705 | 940 | 1,410 | 2,115 | 3,530 | 5,880 |
| 500 | 170 | 665 | 885 | 1,330 | 1,995 | 3,325 | 5,540 |
| 600 | 140 | 605 | 805 | 1,210 | 1,815 | 3,025 | 5,040 |
| 650 | 125 | 590 | 785 | 1,175 | 1,765 | 2,940 | 4,905 |
| 700 | 110 | 570 | 755 | 1,135 | 1,705 | 2,840 | 4,730 |
| 750 | 95 | 530 | 710 | 1,065 | 1,595 | 2,660 | 4,430 |
| 800 | 80 | 510 | 675 | 1,015 | 1,525 | 2,540 | 4,230 |
| 850 | 65 | 485 | 650 | 975 | 1,460 | 2,435 | 4,060 |
| 900 | 50 | 375 | 500 | 745 | 1,120 | 1,870 | 3,115 |
| 950 | 35 | 275 | 365 | 550 | 825 | 1,370 | 2,285 |
| 1,000 | 20 | 200 | 265 | 400 | 595 | 995 | 1,655 |
| 1,050 | ... | 145 | 190 | 290 | 430 | 720 | 1,200 |
| 1,100 | ... | 100 | 135 | 200 | 300 | 495 | 830 |
| 1,150 | ... | 60 | 80 | 125 | 185 | 310 | 515 |
| 1,200 | ... | 35 | 45 | 70 | 105 | 170 | 285 |

NOTE:

- (1) Use normalized and tempered material only.
- (2) The deliberate addition of any element not listed in ASTM A 217, Table 1 is prohibited, except that Ca and Mg may be added for deoxidation.

Table II-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), (2) | | | ... |
| Working Pressures by Classes, psig | | | | | | | |
| Temp., °F | Class | | | | | | |
| | 150 | 300 | 400 | 600 | 900 | 1500 | 2500 |
| –20 to 100 | 290 | 750 | 1,000 | 1,500 | 2,250 | 3,750 | 6,250 |
| 200 | 260 | 750 | 1,000 | 1,500 | 2,250 | 3,750 | 6,250 |
| 300 | 230 | 730 | 970 | 1,455 | 2,185 | 3,640 | 6,070 |
| 400 | 200 | 705 | 940 | 1,410 | 2,115 | 3,530 | 5,880 |
| 500 | 170 | 665 | 885 | 1,330 | 1,995 | 3,325 | 5,540 |
| 600 | 140 | 605 | 805 | 1,210 | 1,815 | 3,025 | 5,040 |
| 650 | 125 | 590 | 785 | 1,175 | 1,765 | 2,940 | 4,905 |
| 700 | 110 | 570 | 755 | 1,135 | 1,705 | 2,840 | 4,730 |
| 750 | 95 | 530 | 710 | 1,065 | 1,595 | 2,660 | 4,430 |
| 800 | 80 | 510 | 675 | 1,015 | 1,525 | 2,540 | 4,230 |
| 850 | 65 | 485 | 650 | 975 | 1,460 | 2,435 | 4,060 |
| 900 | 50 | 450 | 600 | 900 | 1,350 | 2,245 | 3,745 |
| 950 | 35 | 375 | 505 | 755 | 1,130 | 1,885 | 3,145 |
| 1,000 | 20 | 255 | 340 | 505 | 760 | 1,270 | 2,115 |
| 1,050 | ... | 170 | 230 | 345 | 515 | 855 | 1,430 |
| 1,100 | ... | 115 | 150 | 225 | 340 | 565 | 945 |
| 1,150 | ... | 75 | 100 | 150 | 225 | 375 | 630 |
| 1,200 | ... | 50 | 70 | 105 | 155 | 255 | 430 |

NOTE:

- (1) Use normalized and tempered material only.
- (2) The deliberate addition of any element not listed in ASTM A 217, Table 1 is prohibited, except that Ca and Mg may be added for deoxidation.

Table II-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. C12 A (1) | | A 387 Gr. 91 Cl. 2 | |
| Working Pressures by Classes, psig | | | | | | | |
| Temp., °F | Class | | | | | | |
| | 150 | 300 | 400 | 600 | 900 | 1500 | 2500 |
| –20 to 100 | 290 | 750 | 1,000 | 1,500 | 2,250 | 3,750 | 6,250 |
| 200 | 260 | 750 | 1,000 | 1,500 | 2,250 | 3,750 | 6,250 |
| 300 | 230 | 730 | 970 | 1,455 | 2,185 | 3,640 | 6,070 |
| 400 | 200 | 705 | 940 | 1,410 | 2,115 | 3,530 | 5,880 |
| 500 | 170 | 665 | 885 | 1,330 | 1,995 | 3,325 | 5,540 |
| 600 | 140 | 605 | 805 | 1,210 | 1,815 | 3,025 | 5,040 |
| 650 | 125 | 590 | 785 | 1,175 | 1,765 | 2,940 | 4,905 |
| 700 | 110 | 570 | 755 | 1,135 | 1,705 | 2,840 | 4,730 |
| 750 | 95 | 530 | 710 | 1,065 | 1,595 | 2,660 | 4,430 |
| 800 | 80 | 510 | 675 | 1,015 | 1,525 | 2,540 | 4,230 |
| 850 | 65 | 485 | 650 | 975 | 1,460 | 2,435 | 4,060 |
| 900 | 50 | 450 | 600 | 900 | 1,350 | 2,245 | 3,745 |
| 950 | 35 | 385 | 515 | 775 | 1,160 | 1,930 | 3,220 |
| 1,000 | 20 | 365 | 485 | 725 | 1,090 | 1,820 | 3,030 |
| 1,050 | ... | 360 | 480 | 720 | 1,080 | 1,800 | 3,000 |
| 1,100 | ... | 300 | 400 | 605 | 905 | 1,510 | 2,515 |
| 1,150 | ... | 225 | 295 | 445 | 670 | 1,115 | 1,855 |
| 1,200 | ... | 145 | 190 | 290 | 430 | 720 | 1,200 |

NOTE:

- (1) The deliberate addition of any element not listed in ASTM A 217, Table 1 is prohibited, except that Ca and Mg may be added for deoxidation.

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

| Nominal Designation | Forgings | | | | Castings | | Plates |
|-------------------------------------|------------------------------|-----|-------|-------|----------|-------|--------|
| 1Cr– ¹ / ₂ Mo | A 182 Gr. F12 Cl. 2 (1), (2) | | | | ... | ... | |
| 5Cr– ¹ / ₂ Mo | A 182 Gr. F5 | | | | ... | ... | |
| Working Pressures by Classes, psig | | | | | | | |
| Temp., °F | Class | | | | | | |
| | 150 | 300 | 400 | 600 | 900 | 1500 | 2500 |
| –20 to 100 | 290 | 750 | 1,000 | 1,500 | 2,250 | 3,750 | 6,250 |
| 200 | 260 | 735 | 980 | 1,470 | 2,210 | 3,680 | 6,135 |
| 300 | 230 | 700 | 935 | 1,400 | 2,100 | 3,495 | 5,830 |
| 400 | 200 | 670 | 890 | 1,335 | 2,005 | 3,345 | 5,570 |
| 500 | 170 | 645 | 860 | 1,290 | 1,940 | 3,230 | 5,385 |
| 600 | 140 | 605 | 805 | 1,210 | 1,815 | 3,025 | 5,040 |
| 650 | 125 | 590 | 785 | 1,175 | 1,765 | 2,940 | 4,905 |
| 700 | 110 | 570 | 755 | 1,135 | 1,705 | 2,840 | 4,730 |
| 750 | 95 | 530 | 710 | 1,065 | 1,595 | 2,660 | 4,430 |
| 800 | 80 | 510 | 675 | 1,015 | 1,525 | 2,540 | 4,230 |
| 850 | 65 | 485 | 650 | 975 | 1,460 | 2,435 | 4,060 |
| 900 | 50 | 375 | 500 | 745 | 1,120 | 1,870 | 3,115 |
| 950 | 35 | 275 | 365 | 550 | 825 | 1,370 | 2,285 |
| 1,000 | 20 | 200 | 265 | 400 | 595 | 995 | 1,655 |
| 1,050 | ... | 145 | 190 | 290 | 430 | 720 | 1,200 |
| 1,100 | ... | 95 | 130 | 190 | 290 | 480 | 800 |
| 1,150 | ... | 60 | 80 | 125 | 185 | 310 | 515 |
| 1,200 | ... | 35 | 45 | 70 | 105 | 170 | 285 |

NOTES:

- (1) Use normalized and tempered material only.
 (2) Permissible but not recommended for prolonged use above 1,100°F.

Table II-2-1.18 Pressure–Temperature Ratings for Group 1.18 Materials

| Nominal Designation | Forgings | | | | Castings | | Plates |
|----------------------------------|-------------------|-----|-------|-------|----------|-------|--------|
| 9Cr–2W–V | A 182 Gr. F92 (1) | | | | ... | ... | |
| Working Pressures by Class, psig | | | | | | | |
| | Class | | | | | | |
| Temp., °F | 150 | 300 | 400 | 600 | 900 | 1500 | 2500 |
| –20 to 100 | 290 | 750 | 1,000 | 1,500 | 2,250 | 3,750 | 6,250 |
| 200 | 260 | 750 | 1,000 | 1,500 | 2,250 | 3,750 | 6,250 |
| 300 | 230 | 730 | 970 | 1,455 | 2,185 | 3,640 | 6,070 |
| 400 | 200 | 705 | 940 | 1,410 | 2,115 | 3,530 | 5,880 |
| 500 | 170 | 665 | 885 | 1,330 | 1,995 | 3,325 | 5,540 |
| 600 | 140 | 605 | 805 | 1,210 | 1,815 | 3,025 | 5,040 |
| 650 | 125 | 590 | 785 | 1,175 | 1,765 | 2,940 | 4,905 |
| 700 | 110 | 570 | 755 | 1,135 | 1,705 | 2,840 | 4,730 |
| 750 | 95 | 530 | 710 | 1,065 | 1,595 | 2,660 | 4,430 |
| 800 | 80 | 510 | 675 | 1,015 | 1,525 | 2,540 | 4,230 |
| 850 | 65 | 485 | 650 | 975 | 1,460 | 2,435 | 4,060 |
| 900 | 50 | 450 | 600 | 900 | 1,350 | 2,245 | 3,745 |
| 950 | 35 | 385 | 515 | 775 | 1,160 | 1,930 | 3,220 |
| 1,000 | 20 | 365 | 485 | 725 | 1,090 | 1,820 | 3,030 |
| 1,050 | 20 | 360 | 480 | 720 | 1,080 | 1,800 | 3,000 |
| 1,100 | 20 | 325 | 430 | 645 | 965 | 1,610 | 2,685 |
| 1,150 | 20 | 275 | 365 | 550 | 825 | 1,370 | 2,285 |
| 1,200 | 20 | 205 | 275 | 410 | 620 | 1,030 | 1,715 |

NOTE:

(1) Application above 1,150°F is limited to tubing of maximum outside diameter of 3½ in.

Table II-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) | | | |
| 18Cr–8Ni | A 182 Gr. F304H | A 351 Gr. CF8 (1) | | A 240 Gr. 304H | | | |
| Working Pressures by Classes, psig | | | | | | | |
| Temp., °F | Class | | | | | | |
| | 150 | 300 | 400 | 600 | 900 | 1500 | 2500 |
| –20 to 100 | 275 | 720 | 960 | 1,440 | 2,160 | 3,600 | 6,000 |
| 200 | 230 | 600 | 800 | 1,200 | 1,800 | 3,000 | 5,000 |
| 300 | 205 | 540 | 715 | 1,075 | 1,615 | 2,690 | 4,480 |
| 400 | 190 | 495 | 660 | 995 | 1,490 | 2,485 | 4,140 |
| 500 | 170 | 465 | 620 | 930 | 1,395 | 2,330 | 3,880 |
| 600 | 140 | 440 | 590 | 885 | 1,325 | 2,210 | 3,680 |
| 650 | 125 | 430 | 575 | 865 | 1,295 | 2,160 | 3,600 |
| 700 | 110 | 420 | 565 | 845 | 1,265 | 2,110 | 3,520 |
| 750 | 95 | 415 | 550 | 825 | 1,240 | 2,065 | 3,440 |
| 800 | 80 | 405 | 540 | 810 | 1,215 | 2,030 | 3,380 |
| 850 | 65 | 395 | 530 | 790 | 1,190 | 1,980 | 3,300 |
| 900 | 50 | 390 | 520 | 780 | 1,165 | 1,945 | 3,240 |
| 950 | 35 | 380 | 510 | 765 | 1,145 | 1,910 | 3,180 |
| 1,000 | 20 | 355 | 470 | 710 | 1,065 | 1,770 | 2,950 |
| 1,050 | ... | 325 | 435 | 650 | 975 | 1,630 | 2,715 |
| 1,100 | ... | 255 | 345 | 515 | 770 | 1,285 | 2,145 |
| 1,150 | ... | 205 | 275 | 410 | 615 | 1,030 | 1,715 |
| 1,200 | ... | 165 | 220 | 330 | 495 | 825 | 1,370 |
| 1,250 | ... | 135 | 180 | 265 | 400 | 670 | 1,115 |
| 1,300 | ... | 115 | 150 | 225 | 340 | 565 | 945 |
| 1,350 | ... | 95 | 125 | 185 | 280 | 465 | 770 |
| 1,400 | ... | 75 | 100 | 150 | 225 | 380 | 630 |
| 1,450 | ... | 60 | 80 | 115 | 175 | 290 | 485 |
| 1,500 | ... | 40 | 55 | 85 | 125 | 205 | 345 |

NOTES:

- (1) At temperatures over 1,000°F, use only when the carbon content is 0.04% or higher.
 (2) Not to be used over 800°F.

Table II-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) | | |
| 16Cr–12Ni–2Mo | 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 | | | | | | | |
| Temp., °F | Class | | | | | | |
| | 150 | 300 | 400 | 600 | 900 | 1500 | 2500 |
| –20 to 100 | 275 | 720 | 960 | 1,440 | 2,160 | 3,600 | 6,000 |
| 200 | 235 | 620 | 825 | 1,240 | 1,860 | 3,095 | 5,160 |
| 300 | 215 | 560 | 745 | 1,120 | 1,680 | 2,795 | 4,660 |
| 400 | 195 | 515 | 685 | 1,025 | 1,540 | 2,570 | 4,280 |
| 500 | 170 | 480 | 635 | 955 | 1,435 | 2,390 | 3,980 |
| 600 | 140 | 450 | 600 | 900 | 1,355 | 2,255 | 3,760 |
| 650 | 125 | 440 | 590 | 885 | 1,325 | 2,210 | 3,680 |
| 700 | 110 | 435 | 580 | 870 | 1,305 | 2,170 | 3,620 |
| 750 | 95 | 425 | 570 | 855 | 1,280 | 2,135 | 3,560 |
| 800 | 80 | 420 | 565 | 845 | 1,265 | 2,110 | 3,520 |
| 850 | 65 | 420 | 555 | 835 | 1,255 | 2,090 | 3,480 |
| 900 | 50 | 415 | 555 | 830 | 1,245 | 2,075 | 3,460 |
| 950 | 35 | 385 | 515 | 775 | 1,160 | 1,930 | 3,220 |
| 1,000 | 20 | 365 | 485 | 725 | 1,090 | 1,820 | 3,030 |
| 1,050 | ... | 360 | 480 | 720 | 1,080 | 1,800 | 3,000 |
| 1,100 | ... | 305 | 405 | 610 | 915 | 1,525 | 2,545 |
| 1,150 | ... | 235 | 315 | 475 | 710 | 1,185 | 1,970 |
| 1,200 | ... | 185 | 245 | 370 | 555 | 925 | 1,545 |
| 1,250 | ... | 145 | 195 | 295 | 440 | 735 | 1,230 |
| 1,300 | ... | 115 | 155 | 235 | 350 | 585 | 970 |
| 1,350 | ... | 95 | 130 | 190 | 290 | 480 | 800 |
| 1,400 | ... | 75 | 100 | 150 | 225 | 380 | 630 |
| 1,450 | ... | 60 | 80 | 115 | 175 | 290 | 485 |
| 1,500 | ... | 40 | 55 | 85 | 125 | 205 | 345 |

NOTES:

- (1) At temperatures over 1,000°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 1,000°F.

Table II-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–13Ni–3Mo | A 182 Gr. F317L | ... | ... | | | | |
| 18Cr–8Ni | A 182 Gr. F304L (1) | ... | A 240 Gr. 304L (1) | | | | |
| Working Pressures by Classes, psig | | | | | | | |
| Temp., °F | Class | | | | | | |
| | 150 | 300 | 400 | 600 | 900 | 1500 | 2500 |
| –20 to 100 | 230 | 600 | 800 | 1,200 | 1,800 | 3,000 | 5,000 |
| 200 | 195 | 510 | 680 | 1,020 | 1,535 | 2,555 | 4,260 |
| 300 | 175 | 455 | 610 | 910 | 1,370 | 2,280 | 3,800 |
| 400 | 160 | 420 | 560 | 840 | 1,260 | 2,100 | 3,500 |
| 500 | 150 | 395 | 525 | 785 | 1,180 | 1,970 | 3,280 |
| 600 | 140 | 370 | 495 | 745 | 1,115 | 1,860 | 3,100 |
| 650 | 125 | 365 | 485 | 730 | 1,095 | 1,825 | 3,040 |
| 700 | 110 | 360 | 480 | 720 | 1,080 | 1,800 | 3,000 |
| 750 | 95 | 355 | 470 | 705 | 1,060 | 1,765 | 2,940 |
| 800 | 80 | 345 | 460 | 690 | 1,035 | 1,730 | 2,880 |
| 850 | 65 | 340 | 450 | 675 | 1,015 | 1,690 | 2,820 |

NOTE:

(1) Not to be used over 800°F.

Table II-2-2.4 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) | | | | |
| 18Cr–10Ni–Ti | 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 | 1,440 | 2,160 | 3,600 | 6,000 |
| 200 | 250 | 650 | 865 | 1,295 | 1,945 | 3,240 | 5,400 |
| 300 | 230 | 595 | 795 | 1,190 | 1,785 | 2,975 | 4,960 |
| 400 | 200 | 550 | 735 | 1,105 | 1,655 | 2,760 | 4,600 |
| 500 | 170 | 515 | 690 | 1,030 | 1,550 | 2,580 | 4,300 |
| 600 | 140 | 485 | 650 | 975 | 1,460 | 2,435 | 4,060 |
| 650 | 125 | 475 | 635 | 950 | 1,425 | 2,375 | 3,960 |
| 700 | 110 | 465 | 620 | 930 | 1,395 | 2,330 | 3,880 |
| 750 | 95 | 460 | 610 | 915 | 1,375 | 2,290 | 3,820 |
| 800 | 80 | 450 | 600 | 900 | 1,355 | 2,255 | 3,760 |
| 850 | 65 | 445 | 595 | 895 | 1,340 | 2,230 | 3,720 |
| 900 | 50 | 440 | 590 | 885 | 1,325 | 2,210 | 3,680 |
| 950 | 35 | 385 | 515 | 775 | 1,160 | 1,930 | 3,220 |
| 1,000 | 20 | 365 | 485 | 725 | 1,090 | 1,820 | 3,030 |
| 1,050 | ... | 360 | 480 | 720 | 1,080 | 1,800 | 3,000 |
| 1,100 | ... | 310 | 415 | 625 | 935 | 1,560 | 2,600 |
| 1,150 | ... | 235 | 315 | 475 | 710 | 1,185 | 1,970 |
| 1,200 | ... | 185 | 245 | 370 | 555 | 925 | 1,545 |
| 1,250 | ... | 140 | 185 | 280 | 420 | 705 | 1,170 |
| 1,300 | ... | 110 | 145 | 220 | 330 | 550 | 915 |
| 1,350 | ... | 85 | 115 | 170 | 255 | 430 | 715 |
| 1,400 | ... | 65 | 85 | 130 | 195 | 325 | 545 |
| 1,450 | ... | 50 | 70 | 105 | 155 | 255 | 430 |
| 1,500 | ... | 40 | 50 | 75 | 115 | 190 | 315 |

NOTES:

(1) Not to be used over 1,000°F.

(2) At temperatures over 1,000°F, use only if the material is heat treated by heating to a minimum temperature of 2,000°F.

Table II-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) | | | | |
| 18Cr–10Ni–Cb | A 182 Gr. F347H (2) | ... | A 240 Gr. 347H (2) | | | | |
| 18Cr–10Ni–Cb | A 182 Gr. F348 (1) | ... | A 240 Gr. 348 (1) | | | | |
| 18Cr–10Ni–Cb | A 182 Gr. F348H (2) | ... | A 240 Gr. 348H (2) | | | | |
| Working Pressures by Classes, psig | | | | | | | |
| Temp., °F | Class | | | | | | |
| | 150 | 300 | 400 | 600 | 900 | 1500 | 2500 |
| –20 to 100 | 275 | 720 | 960 | 1,440 | 2,160 | 3,600 | 6,000 |
| 200 | 255 | 660 | 885 | 1,325 | 1,985 | 3,310 | 5,520 |
| 300 | 230 | 615 | 820 | 1,235 | 1,850 | 3,085 | 5,140 |
| 400 | 200 | 575 | 770 | 1,150 | 1,730 | 2,880 | 4,800 |
| 500 | 170 | 540 | 725 | 1,085 | 1,625 | 2,710 | 4,520 |
| 600 | 140 | 515 | 690 | 1,030 | 1,550 | 2,580 | 4,300 |
| 650 | 125 | 505 | 675 | 1,015 | 1,520 | 2,530 | 4,220 |
| 700 | 110 | 495 | 660 | 995 | 1,490 | 2,485 | 4,140 |
| 750 | 95 | 490 | 655 | 985 | 1,475 | 2,460 | 4,100 |
| 800 | 80 | 485 | 650 | 975 | 1,460 | 2,435 | 4,060 |
| 850 | 65 | 485 | 645 | 970 | 1,455 | 2,425 | 4,040 |
| 900 | 50 | 450 | 600 | 900 | 1,350 | 2,245 | 3,745 |
| 950 | 35 | 385 | 515 | 775 | 1,160 | 1,930 | 3,220 |
| 1,000 | 20 | 365 | 485 | 725 | 1,090 | 1,820 | 3,030 |
| 1,050 | ... | 360 | 480 | 720 | 1,080 | 1,800 | 3,000 |
| 1,100 | ... | 325 | 430 | 645 | 965 | 1,610 | 2,685 |
| 1,150 | ... | 275 | 365 | 550 | 825 | 1,370 | 2,285 |
| 1,200 | ... | 205 | 275 | 410 | 620 | 1,030 | 1,715 |
| 1,250 | ... | 180 | 245 | 365 | 545 | 910 | 1,515 |
| 1,300 | ... | 140 | 185 | 275 | 410 | 685 | 1,145 |
| 1,350 | ... | 105 | 140 | 205 | 310 | 515 | 860 |
| 1,400 | ... | 75 | 100 | 150 | 225 | 380 | 630 |
| 1,450 | ... | 60 | 80 | 115 | 175 | 290 | 485 |
| 1,500 | ... | 40 | 55 | 85 | 125 | 205 | 345 |

NOTES:

- (1) Not to be used over 1,000°F.
 (2) For temperatures over 1,000°F use only if the material is heat treated by heating to a minimum temperature of 2,000°F.

Table II-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, psig | | | | | | | |
| Temp., °F | Class | | | | | | |
| | 150 | 300 | 400 | 600 | 900 | 1500 | 2500 |
| –20 to 100 | 275 | 720 | 960 | 1,440 | 2,160 | 3,600 | 6,000 |
| 200 | 240 | 630 | 840 | 1,260 | 1,895 | 3,155 | 5,260 |
| 300 | 225 | 580 | 775 | 1,160 | 1,740 | 2,905 | 4,840 |
| 400 | 200 | 545 | 725 | 1,090 | 1,635 | 2,725 | 4,540 |
| 500 | 170 | 520 | 690 | 1,035 | 1,555 | 2,590 | 4,320 |
| 600 | 140 | 500 | 665 | 1,000 | 1,500 | 2,495 | 4,160 |
| 650 | 125 | 490 | 655 | 985 | 1,475 | 2,460 | 4,100 |
| 700 | 110 | 485 | 645 | 970 | 1,455 | 2,425 | 4,040 |
| 750 | 95 | 480 | 640 | 960 | 1,440 | 2,400 | 4,000 |
| 800 | 80 | 475 | 630 | 945 | 1,420 | 2,365 | 3,940 |
| 850 | 65 | 465 | 620 | 930 | 1,395 | 2,330 | 3,880 |
| 900 | 50 | 450 | 600 | 900 | 1,350 | 2,245 | 3,745 |
| 950 | 35 | 385 | 515 | 775 | 1,160 | 1,930 | 3,220 |
| 1,000 | 20 | 365 | 485 | 725 | 1,090 | 1,820 | 3,030 |
| 1,050 | ... | 355 | 470 | 705 | 1,060 | 1,765 | 2,945 |
| 1,100 | ... | 260 | 345 | 520 | 780 | 1,305 | 2,170 |
| 1,150 | ... | 190 | 250 | 375 | 565 | 945 | 1,570 |
| 1,200 | ... | 135 | 185 | 275 | 410 | 685 | 1,145 |
| 1,250 | ... | 105 | 135 | 205 | 310 | 515 | 855 |
| 1,300 | ... | 75 | 100 | 150 | 225 | 375 | 630 |
| 1,350 | ... | 60 | 80 | 115 | 175 | 290 | 485 |
| 1,400 | ... | 45 | 60 | 90 | 135 | 225 | 370 |
| 1,450 | ... | 35 | 45 | 70 | 105 | 170 | 285 |
| 1,500 | ... | 25 | 35 | 50 | 75 | 130 | 215 |

Table II-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, psig | | | | | | | |
| Temp., °F | Class | | | | | | |
| | 150 | 300 | 400 | 600 | 900 | 1500 | 2500 |
| –20 to 100 | 275 | 720 | 960 | 1,440 | 2,160 | 3,600 | 6,000 |
| 200 | 245 | 635 | 850 | 1,270 | 1,910 | 3,180 | 5,300 |
| 300 | 225 | 580 | 775 | 1,160 | 1,740 | 2,905 | 4,840 |
| 400 | 200 | 540 | 725 | 1,085 | 1,625 | 2,710 | 4,520 |
| 500 | 170 | 515 | 685 | 1,025 | 1,540 | 2,570 | 4,280 |
| 600 | 140 | 495 | 660 | 990 | 1,485 | 2,470 | 4,120 |
| 650 | 125 | 485 | 645 | 970 | 1,455 | 2,425 | 4,040 |
| 700 | 110 | 480 | 635 | 955 | 1,435 | 2,390 | 3,980 |
| 750 | 95 | 470 | 625 | 940 | 1,410 | 2,350 | 3,920 |
| 800 | 80 | 465 | 620 | 930 | 1,395 | 2,330 | 3,880 |
| 850 | 65 | 460 | 610 | 915 | 1,375 | 2,290 | 3,820 |
| 900 | 50 | 450 | 600 | 900 | 1,350 | 2,245 | 3,745 |
| 950 | 35 | 385 | 515 | 775 | 1,160 | 1,930 | 3,220 |
| 1,000 | 20 | 365 | 485 | 725 | 1,090 | 1,820 | 3,030 |
| 1,050 | ... | 355 | 470 | 705 | 1,060 | 1,765 | 2,945 |
| 1,100 | ... | 260 | 345 | 520 | 780 | 1,305 | 2,170 |
| 1,150 | ... | 190 | 250 | 375 | 565 | 945 | 1,570 |
| 1,200 | ... | 135 | 185 | 275 | 410 | 685 | 1,145 |
| 1,250 | ... | 105 | 135 | 205 | 310 | 515 | 855 |
| 1,300 | ... | 75 | 100 | 150 | 225 | 375 | 630 |
| 1,350 | ... | 60 | 80 | 115 | 175 | 290 | 485 |
| 1,400 | ... | 45 | 60 | 90 | 135 | 225 | 370 |
| 1,450 | ... | 35 | 45 | 65 | 100 | 165 | 275 |
| 1,500 | ... | 25 | 35 | 50 | 75 | 130 | 215 |

NOTES:

- (1) At temperatures over 1,000°F, use only when the carbon content is 0.04% or higher.
- (2) Service temperatures of 1,050°F and above should be used only when assurance is provided that grain size is not finer than ASTM 6.

Table II-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, psig | | | | | | | |
| Temp., °F | Class | | | | | | |
| | 150 | 300 | 400 | 600 | 900 | 1500 | 2500 |
| 100 | 290 | 750 | 1,000 | 1,500 | 2,250 | 3,750 | 6,250 |
| 200 | 260 | 745 | 990 | 1,490 | 2,230 | 3,720 | 6,200 |
| 300 | 230 | 665 | 890 | 1,335 | 2,000 | 3,335 | 5,560 |
| 400 | 200 | 615 | 820 | 1,230 | 1,845 | 3,070 | 5,120 |
| 500 | 170 | 580 | 775 | 1,160 | 1,740 | 2,905 | 4,840 |
| 600 | 140 | 555 | 740 | 1,115 | 1,670 | 2,785 | 4,640 |
| 650 | 125 | 545 | 730 | 1,095 | 1,640 | 2,735 | 4,560 |
| 700 | 110 | 540 | 725 | 1,085 | 1,625 | 2,710 | 4,520 |
| 750 | 95 | 530 | 710 | 1,065 | 1,595 | 2,660 | 4,430 |

NOTE:

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

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

| Nominal Designation | Forgings | Castings | Plates | | | | |
|------------------------------------|----------|----------|------------------------|-------|-------|-------|-------|
| 23Cr–12Ni | ... | ... | A 240 Gr. 309S (1)–(3) | | | | |
| 25Cr–20Ni | ... | ... | A 240 Gr. 310S (1)–(3) | | | | |
| Working Pressures by Classes, psig | | | | | | | |
| Temp., °F | Class | | | | | | |
| | 150 | 300 | 400 | 600 | 900 | 1500 | 2500 |
| –20 to 100 | 275 | 720 | 960 | 1,440 | 2,160 | 3,600 | 6,000 |
| 200 | 240 | 630 | 840 | 1,260 | 1,895 | 3,155 | 5,260 |
| 300 | 225 | 580 | 775 | 1,160 | 1,740 | 2,905 | 4,840 |
| 400 | 200 | 540 | 725 | 1,085 | 1,625 | 2,710 | 4,520 |
| 500 | 170 | 515 | 685 | 1,025 | 1,540 | 2,570 | 4,280 |
| 600 | 140 | 495 | 660 | 990 | 1,485 | 2,470 | 4,120 |
| 650 | 125 | 485 | 645 | 970 | 1,455 | 2,425 | 4,040 |
| 700 | 110 | 480 | 635 | 955 | 1,435 | 2,390 | 3,980 |
| 750 | 95 | 470 | 625 | 940 | 1,410 | 2,350 | 3,920 |
| 800 | 80 | 465 | 620 | 930 | 1,395 | 2,330 | 3,880 |
| 850 | 65 | 460 | 610 | 915 | 1,375 | 2,290 | 3,820 |
| 900 | 50 | 450 | 600 | 900 | 1,350 | 2,245 | 3,745 |
| 950 | 35 | 385 | 515 | 775 | 1,160 | 1,930 | 3,220 |
| 1,000 | 20 | 340 | 455 | 680 | 1,020 | 1,695 | 2,830 |
| 1,050 | ... | 245 | 325 | 485 | 730 | 1,215 | 2,030 |
| 1,100 | ... | 170 | 230 | 345 | 515 | 855 | 1,430 |
| 1,150 | ... | 125 | 165 | 245 | 370 | 615 | 1,030 |
| 1,200 | ... | 85 | 115 | 170 | 255 | 430 | 715 |
| 1,250 | ... | 50 | 70 | 105 | 155 | 255 | 430 |
| 1,300 | ... | 25 | 35 | 55 | 80 | 135 | 230 |
| 1,350 | ... | 15 | 25 | 35 | 50 | 85 | 145 |
| 1,400 | ... | 15 | 20 | 25 | 40 | 70 | 115 |
| 1,450 | ... | 10 | 15 | 20 | 30 | 50 | 85 |
| 1,500 | ... | 5 | 10 | 15 | 20 | 35 | 55 |

NOTES:

- (1) At temperatures over 1,000°F, use only when the carbon content is 0.04% or higher.
- (2) At temperatures above 1,000°F, use only if the material is solution heat treated to the minimum temperature specified in the specification, but not lower than 1,900°F, and quenching in water or rapidly cooling by other means.
- (3) This material should be used for service temperatures 1,050°F and above only when assurance is provided that grain size is not finer than ASTM 6.

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

| Nominal Designation | Forgings | | Castings | | Plates | | |
|------------------------------------|----------|-----|--------------------|-------|--------|-------|-------|
| 25Cr–12Ni | ... | | A 351 Gr. CH8 (1) | | ... | | |
| 25Cr–12Ni | ... | | A 351 Gr. CH20 (1) | | ... | | |
| Working Pressures by Classes, psig | | | | | | | |
| Temp., °F | Class | | | | | | |
| | 150 | 300 | 400 | 600 | 900 | 1500 | 2500 |
| –20 to 100 | 260 | 670 | 895 | 1,345 | 2,015 | 3,360 | 5,600 |
| 200 | 210 | 550 | 735 | 1,100 | 1,650 | 2,750 | 4,580 |
| 300 | 195 | 505 | 675 | 1,015 | 1,520 | 2,530 | 4,220 |
| 400 | 185 | 485 | 645 | 970 | 1,455 | 2,425 | 4,040 |
| 500 | 170 | 470 | 625 | 940 | 1,410 | 2,350 | 3,920 |
| 600 | 140 | 455 | 610 | 910 | 1,370 | 2,280 | 3,800 |
| 650 | 125 | 445 | 595 | 895 | 1,340 | 2,230 | 3,720 |
| 700 | 110 | 435 | 580 | 870 | 1,305 | 2,170 | 3,620 |
| 750 | 95 | 420 | 565 | 845 | 1,265 | 2,110 | 3,520 |
| 800 | 80 | 410 | 545 | 820 | 1,230 | 2,050 | 3,420 |
| 850 | 65 | 400 | 530 | 795 | 1,195 | 1,990 | 3,320 |
| 900 | 50 | 385 | 510 | 770 | 1,150 | 1,920 | 3,200 |
| 950 | 35 | 370 | 495 | 740 | 1,110 | 1,850 | 3,080 |
| 1,000 | 20 | 340 | 450 | 675 | 1,015 | 1,690 | 2,820 |
| 1,050 | ... | 290 | 390 | 585 | 875 | 1,455 | 2,430 |
| 1,100 | ... | 225 | 295 | 445 | 670 | 1,115 | 1,855 |
| 1,150 | ... | 170 | 230 | 345 | 515 | 855 | 1,430 |
| 1,200 | ... | 130 | 175 | 260 | 390 | 650 | 1,085 |
| 1,250 | ... | 100 | 135 | 200 | 300 | 495 | 830 |
| 1,300 | ... | 80 | 105 | 160 | 235 | 395 | 655 |
| 1,350 | ... | 60 | 80 | 125 | 185 | 310 | 515 |
| 1,400 | ... | 45 | 60 | 90 | 135 | 225 | 370 |
| 1,450 | ... | 30 | 40 | 60 | 95 | 155 | 255 |
| 1,500 | ... | 25 | 35 | 55 | 80 | 135 | 230 |

NOTE:

(1) At temperatures over 1,000°F, use only when the carbon content is 0.04% or higher.

Table II-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, psig | | | | | | | |
| Temp., °F | Class | | | | | | |
| | 150 | 300 | 400 | 600 | 900 | 1500 | 2500 |
| –20 to 100 | 275 | 720 | 960 | 1,440 | 2,160 | 3,600 | 6,000 |
| 200 | 255 | 660 | 885 | 1,325 | 1,985 | 3,310 | 5,520 |
| 300 | 230 | 615 | 820 | 1,235 | 1,850 | 3,085 | 5,140 |
| 400 | 200 | 575 | 770 | 1,150 | 1,730 | 2,880 | 4,800 |
| 500 | 170 | 540 | 725 | 1,085 | 1,625 | 2,710 | 4,520 |
| 600 | 140 | 515 | 690 | 1,030 | 1,550 | 2,580 | 4,300 |
| 650 | 125 | 505 | 675 | 1,015 | 1,520 | 2,530 | 4,220 |
| 700 | 110 | 495 | 660 | 995 | 1,490 | 2,485 | 4,140 |
| 750 | 95 | 490 | 655 | 985 | 1,475 | 2,460 | 4,100 |
| 800 | 80 | 485 | 650 | 975 | 1,460 | 2,435 | 4,060 |
| 850 | 65 | 485 | 645 | 970 | 1,455 | 2,425 | 4,040 |
| 900 | 50 | 450 | 600 | 900 | 1,350 | 2,245 | 3,745 |
| 950 | 35 | 385 | 515 | 775 | 1,160 | 1,930 | 3,220 |
| 1,000 | 20 | 365 | 485 | 725 | 1,090 | 1,820 | 3,030 |
| 1,050 | ... | 360 | 480 | 720 | 1,080 | 1,800 | 3,000 |
| 1,100 | ... | 310 | 415 | 625 | 935 | 1,560 | 2,600 |
| 1,150 | ... | 210 | 280 | 420 | 625 | 1,045 | 1,745 |
| 1,200 | ... | 150 | 200 | 300 | 455 | 755 | 1,255 |
| 1,250 | ... | 115 | 150 | 225 | 340 | 565 | 945 |
| 1,300 | ... | 75 | 100 | 150 | 225 | 375 | 630 |
| 1,350 | ... | 50 | 70 | 105 | 155 | 255 | 430 |
| 1,400 | ... | 40 | 55 | 80 | 125 | 205 | 345 |
| 1,450 | ... | 30 | 40 | 60 | 95 | 155 | 255 |
| 1,500 | ... | 25 | 35 | 55 | 80 | 135 | 230 |

NOTE:

(1) At temperatures over 1,000°F, use only when the carbon content is 0.04% or higher.

Table II-2-2.12 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 | | | | | | | |
| Temp., °F | Class | | | | | | |
| | 150 | 300 | 400 | 600 | 900 | 1500 | 2500 |
| –20 to 100 | 260 | 670 | 895 | 1,345 | 2,015 | 3,360 | 5,600 |
| 200 | 210 | 550 | 735 | 1,100 | 1,650 | 2,750 | 4,580 |
| 300 | 195 | 505 | 675 | 1,015 | 1,520 | 2,530 | 4,220 |
| 400 | 185 | 485 | 645 | 970 | 1,455 | 2,425 | 4,040 |
| 500 | 170 | 470 | 625 | 940 | 1,410 | 2,350 | 3,920 |
| 600 | 140 | 455 | 610 | 910 | 1,370 | 2,280 | 3,800 |
| 650 | 125 | 445 | 595 | 895 | 1,340 | 2,230 | 3,720 |
| 700 | 110 | 435 | 580 | 870 | 1,305 | 2,170 | 3,620 |
| 750 | 95 | 420 | 565 | 845 | 1,265 | 2,110 | 3,520 |
| 800 | 80 | 410 | 545 | 820 | 1,230 | 2,050 | 3,420 |
| 850 | 65 | 400 | 530 | 795 | 1,195 | 1,990 | 3,320 |
| 900 | 50 | 385 | 510 | 770 | 1,150 | 1,920 | 3,200 |
| 950 | 35 | 370 | 495 | 740 | 1,110 | 1,850 | 3,080 |
| 1,000 | 20 | 340 | 450 | 675 | 1,015 | 1,690 | 2,820 |
| 1,050 | ... | 325 | 435 | 650 | 975 | 1,630 | 2,715 |
| 1,100 | ... | 290 | 390 | 585 | 875 | 1,455 | 2,430 |
| 1,150 | ... | 250 | 335 | 500 | 750 | 1,250 | 2,085 |
| 1,200 | ... | 205 | 275 | 410 | 615 | 1,030 | 1,715 |
| 1,250 | ... | 165 | 220 | 330 | 495 | 825 | 1,370 |
| 1,300 | ... | 120 | 160 | 240 | 360 | 600 | 1,000 |
| 1,350 | ... | 80 | 110 | 165 | 245 | 410 | 685 |
| 1,400 | ... | 55 | 75 | 110 | 165 | 275 | 455 |
| 1,450 | ... | 40 | 50 | 75 | 115 | 190 | 315 |
| 1,500 | ... | 25 | 35 | 55 | 80 | 135 | 230 |

NOTE:

(1) At temperatures over 1,000°F, use only when the carbon content is 0.04% or higher.

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

| Nominal Designation | Forgings | | | Castings | | Plates | |
|------------------------------------|----------------------|-----|-------|----------|-------|----------------------|-------|
| 35Ni–35Fe–20Cr–Cb | B 462 Gr. N08020 (1) | | | ... | | B 463 Gr. N08020 (1) | |
| Working Pressures by Classes, psig | | | | | | | |
| Temp., °F | Class | | | | | | |
| | 150 | 300 | 400 | 600 | 900 | 1500 | 2500 |
| –20 to 100 | 290 | 750 | 1,000 | 1,500 | 2,250 | 3,750 | 6,250 |
| 200 | 260 | 740 | 990 | 1,485 | 2,225 | 3,710 | 6,180 |
| 300 | 230 | 710 | 945 | 1,420 | 2,130 | 3,550 | 5,920 |
| 400 | 200 | 680 | 910 | 1,365 | 2,045 | 3,410 | 5,680 |
| 500 | 170 | 655 | 875 | 1,310 | 1,965 | 3,275 | 5,460 |
| 600 | 140 | 605 | 805 | 1,210 | 1,815 | 3,025 | 5,040 |
| 650 | 125 | 590 | 785 | 1,175 | 1,765 | 2,940 | 4,905 |
| 700 | 110 | 570 | 755 | 1,135 | 1,705 | 2,840 | 4,730 |
| 750 | 95 | 530 | 710 | 1,065 | 1,595 | 2,660 | 4,430 |
| 800 | 80 | 510 | 675 | 1,015 | 1,525 | 2,540 | 4,230 |

NOTE:

(1) Use annealed material only.

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

| Nominal Designation | Forgings | | | Castings | | Plates | |
|------------------------------------|------------------------------|-----|-----|----------|-------|-------------------------|-------|
| 99.0Ni | B 564 Gr. N02200 (1), (2) | | | . . . | | B 162 Gr. N02200 (1) | |
| Working Pressures by Classes, psig | | | | | | | |
| Temp., °F | Class | | | | | | |
| | 150 | 300 | 400 | 600 | 900 | 1500 | 2500 |
| −20 to 100 | 185 | 480 | 640 | 960 | 1,440 | 2,400 | 4,000 |
| 200 | 185 | 480 | 640 | 960 | 1,440 | 2,400 | 4,000 |
| 300 | 185 | 480 | 640 | 960 | 1,440 | 2,400 | 4,000 |
| 400 | 185 | 480 | 640 | 960 | 1,440 | 2,400 | 4,000 |
| 500 | 170 | 455 | 605 | 905 | 1,360 | 2,270 | 3,780 |
| 600 | 140 | 415 | 550 | 825 | 1,240 | 2,065 | 3,440 |

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 II-2-3.3 Pressure–Temperature Ratings for Group 3.3 Materials

| Nominal Designation | Forgings | | | Castings | | Plates | |
|------------------------------------|----------|-----|-----|----------|-----|----------------------|-------|
| 99.0Ni–Low C | ... | | | ... | | B 162 Gr. N02201 (1) | |
| Working Pressures by Classes, psig | | | | | | | |
| Temp., °F | Class | | | | | | |
| | 150 | 300 | 400 | 600 | 900 | 1500 | 2500 |
| –20 to 100 | 90 | 240 | 320 | 480 | 720 | 1,200 | 2,000 |
| 200 | 90 | 230 | 305 | 460 | 690 | 1,150 | 1,920 |
| 300 | 85 | 225 | 300 | 450 | 675 | 1,130 | 1,880 |
| 400 | 85 | 225 | 300 | 450 | 675 | 1,130 | 1,880 |
| 500 | 85 | 225 | 300 | 450 | 675 | 1,130 | 1,880 |
| 600 | 85 | 225 | 300 | 450 | 675 | 1,130 | 1,880 |
| 650 | 85 | 225 | 300 | 445 | 670 | 1,115 | 1,860 |
| 700 | 85 | 225 | 300 | 445 | 670 | 1,115 | 1,860 |
| 750 | 85 | 220 | 295 | 440 | 660 | 1,105 | 1,840 |
| 800 | 80 | 215 | 290 | 430 | 650 | 1,080 | 1,800 |
| 850 | 65 | 210 | 280 | 420 | 635 | 1,055 | 1,760 |
| 900 | 50 | 205 | 275 | 415 | 620 | 1,030 | 1,720 |
| 950 | 35 | 195 | 260 | 395 | 590 | 985 | 1,640 |
| 1,000 | 20 | 190 | 255 | 380 | 570 | 950 | 1,580 |
| 1,050 | ... | 80 | 110 | 165 | 245 | 410 | 685 |
| 1,100 | ... | 70 | 90 | 135 | 205 | 345 | 570 |
| 1,150 | ... | 50 | 70 | 105 | 155 | 255 | 430 |
| 1,200 | ... | 40 | 55 | 80 | 125 | 205 | 345 |

NOTE:

(1) Use annealed material only.

Table II-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) | | |
| Working Pressures by Classes, psig | | | | | | | |
| Temp., °F | Class | | | | | | |
| | 150 | 300 | 400 | 600 | 900 | 1500 | 2500 |
| –20 to 100 | 230 | 600 | 800 | 1,200 | 1,800 | 3,000 | 5,000 |
| 200 | 200 | 525 | 700 | 1,050 | 1,575 | 2,630 | 4,380 |
| 300 | 190 | 490 | 655 | 980 | 1,470 | 2,450 | 4,080 |
| 400 | 180 | 475 | 630 | 945 | 1,420 | 2,365 | 3,940 |
| 500 | 170 | 475 | 630 | 945 | 1,420 | 2,365 | 3,940 |
| 600 | 140 | 475 | 630 | 945 | 1,420 | 2,365 | 3,940 |
| 650 | 125 | 475 | 630 | 945 | 1,420 | 2,365 | 3,940 |
| 700 | 110 | 470 | 625 | 940 | 1,410 | 2,350 | 3,920 |
| 750 | 95 | 465 | 620 | 930 | 1,395 | 2,330 | 3,880 |
| 800 | 80 | 460 | 610 | 915 | 1,375 | 2,290 | 3,820 |
| 850 | 65 | 375 | 505 | 755 | 1,130 | 1,885 | 3,145 |
| 900 | 50 | 275 | 365 | 550 | 825 | 1,370 | 2,285 |

NOTE:

(1) Use annealed material only.

Table II-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, psig | | | | | | | |
| Temp., °F | Class | | | | | | |
| | 150 | 300 | 400 | 600 | 900 | 1500 | 2500 |
| –20 to 100 | 290 | 750 | 1,000 | 1,500 | 2,250 | 3,750 | 6,250 |
| 200 | 260 | 750 | 1,000 | 1,500 | 2,250 | 3,750 | 6,250 |
| 300 | 230 | 730 | 970 | 1,455 | 2,185 | 3,640 | 6,070 |
| 400 | 200 | 705 | 940 | 1,410 | 2,115 | 3,530 | 5,880 |
| 500 | 170 | 665 | 885 | 1,330 | 1,995 | 3,325 | 5,540 |
| 600 | 140 | 605 | 805 | 1,210 | 1,815 | 3,025 | 5,040 |
| 650 | 125 | 590 | 785 | 1,175 | 1,765 | 2,940 | 4,905 |
| 700 | 110 | 570 | 755 | 1,135 | 1,705 | 2,840 | 4,730 |
| 750 | 95 | 530 | 710 | 1,065 | 1,595 | 2,660 | 4,430 |
| 800 | 80 | 510 | 675 | 1,015 | 1,525 | 2,540 | 4,230 |
| 850 | 65 | 485 | 650 | 975 | 1,460 | 2,435 | 4,060 |
| 900 | 50 | 450 | 600 | 900 | 1,350 | 2,245 | 3,745 |
| 950 | 35 | 365 | 485 | 725 | 1,090 | 1,815 | 3,030 |
| 1,000 | 20 | 240 | 320 | 480 | 720 | 1,200 | 2,000 |
| 1,050 | ... | 155 | 205 | 310 | 465 | 770 | 1,285 |
| 1,100 | ... | 105 | 135 | 205 | 310 | 515 | 855 |
| 1,150 | ... | 75 | 100 | 150 | 225 | 375 | 630 |
| 1,200 | ... | 70 | 90 | 135 | 205 | 345 | 570 |

NOTE:

(1) Use annealed material only.

Table II-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, psig | | | | | | | |
| Temp., °F | Class | | | | | | |
| | 150 | 300 | 400 | 600 | 900 | 1500 | 2500 |
| –20 to 100 | 275 | 720 | 960 | 1,440 | 2,160 | 3,600 | 6,000 |
| 200 | 255 | 665 | 885 | 1,330 | 1,995 | 3,325 | 5,540 |
| 300 | 230 | 640 | 850 | 1,275 | 1,915 | 3,190 | 5,320 |
| 400 | 200 | 620 | 825 | 1,240 | 1,860 | 3,095 | 5,160 |
| 500 | 170 | 600 | 805 | 1,205 | 1,805 | 3,010 | 5,020 |
| 600 | 140 | 590 | 785 | 1,175 | 1,765 | 2,940 | 4,900 |
| 650 | 125 | 580 | 770 | 1,155 | 1,735 | 2,890 | 4,820 |
| 700 | 110 | 570 | 755 | 1,135 | 1,705 | 2,840 | 4,730 |
| 750 | 95 | 530 | 710 | 1,065 | 1,595 | 2,660 | 4,430 |
| 800 | 80 | 510 | 675 | 1,015 | 1,525 | 2,540 | 4,230 |
| 850 | 65 | 485 | 650 | 975 | 1,460 | 2,435 | 4,060 |
| 900 | 50 | 450 | 600 | 900 | 1,350 | 2,245 | 3,745 |
| 950 | 35 | 385 | 515 | 775 | 1,160 | 1,930 | 3,220 |
| 1,000 | 20 | 365 | 485 | 725 | 1,090 | 1,820 | 3,030 |
| 1,050 | ... | 360 | 480 | 720 | 1,080 | 1,800 | 3,000 |
| 1,100 | ... | 325 | 430 | 645 | 965 | 1,610 | 2,685 |
| 1,150 | ... | 275 | 365 | 550 | 825 | 1,370 | 2,285 |
| 1,200 | ... | 205 | 275 | 410 | 620 | 1,030 | 1,715 |
| 1,250 | ... | 145 | 190 | 290 | 430 | 720 | 1,200 |
| 1,300 | ... | 70 | 90 | 135 | 205 | 345 | 570 |
| 1,350 | ... | 55 | 75 | 110 | 165 | 275 | 455 |
| 1,400 | ... | 40 | 50 | 75 | 115 | 190 | 315 |
| 1,450 | ... | 35 | 45 | 70 | 105 | 170 | 285 |
| 1,500 | ... | 25 | 35 | 55 | 80 | 135 | 230 |

NOTE:

(1) Use annealed material only.

Table II-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, psig | | | | | | | |
| Temp., °F | Class | | | | | | |
| | 150 | 300 | 400 | 600 | 900 | 1500 | 2500 |
| –20 to 100 | 290 | 750 | 1,000 | 1,500 | 2,250 | 3,750 | 6,250 |
| 200 | 260 | 750 | 1,000 | 1,500 | 2,250 | 3,750 | 6,250 |
| 300 | 230 | 730 | 970 | 1,455 | 2,185 | 3,640 | 6,070 |
| 400 | 200 | 705 | 940 | 1,410 | 2,115 | 3,530 | 5,880 |
| 500 | 170 | 665 | 885 | 1,330 | 1,995 | 3,325 | 5,540 |
| 600 | 140 | 605 | 805 | 1,210 | 1,815 | 3,025 | 5,040 |
| 650 | 125 | 590 | 785 | 1,175 | 1,765 | 2,940 | 4,905 |
| 700 | 110 | 570 | 755 | 1,135 | 1,705 | 2,840 | 4,730 |
| 750 | 95 | 530 | 710 | 1,065 | 1,595 | 2,660 | 4,430 |
| 800 | 80 | 510 | 675 | 1,015 | 1,525 | 2,540 | 4,230 |

NOTE:

(1) Use solution annealed material only.

Table II-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)–(5) | ... | B 443 Gr. N06625 (3)–(5) | | | | |
| 62Ni–28Mo–5Fe | ... | ... | B 333 Gr. N10001 (1), (6) | | | | |
| 70Ni–16Mo–7Cr–5Fe | ... | ... | B 434 Gr. N10003 (3) | | | | |
| 61Ni–16Mo–16Cr | ... | ... | 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 | | | | | | |
| Temp., °F | 150 | 300 | 400 | 600 | 900 | 1500 | 2500 |
| –20 to 100 | 290 | 750 | 1,000 | 1,500 | 2,250 | 3,750 | 6,250 |
| 200 | 260 | 750 | 1,000 | 1,500 | 2,250 | 3,750 | 6,250 |
| 300 | 230 | 730 | 970 | 1,455 | 2,185 | 3,640 | 6,070 |
| 400 | 200 | 700 | 930 | 1,395 | 2,095 | 3,490 | 5,820 |
| 500 | 170 | 665 | 885 | 1,330 | 1,995 | 3,325 | 5,540 |
| 600 | 140 | 605 | 805 | 1,210 | 1,815 | 3,025 | 5,040 |
| 650 | 125 | 590 | 785 | 1,175 | 1,765 | 2,940 | 4,905 |
| 700 | 110 | 570 | 755 | 1,135 | 1,705 | 2,840 | 4,730 |
| 750 | 95 | 530 | 710 | 1,065 | 1,595 | 2,660 | 4,430 |
| 800 | 80 | 510 | 675 | 1,015 | 1,525 | 2,540 | 4,230 |
| 850 | 65 | 485 | 650 | 975 | 1,460 | 2,435 | 4,060 |
| 900 | 50 | 450 | 600 | 900 | 1,350 | 2,245 | 3,745 |
| 950 | 35 | 385 | 515 | 775 | 1,160 | 1,930 | 3,220 |
| 1,000 | 20 | 365 | 485 | 725 | 1,090 | 1,820 | 3,030 |
| 1,050 | ... | 360 | 480 | 720 | 1,080 | 1,800 | 3,000 |
| 1,100 | ... | 325 | 430 | 645 | 965 | 1,610 | 2,685 |
| 1,150 | ... | 275 | 365 | 550 | 825 | 1,370 | 2,285 |
| 1,200 | ... | 205 | 275 | 410 | 615 | 1,030 | 1,715 |
| 1,250 | ... | 165 | 220 | 330 | 495 | 825 | 1,370 |
| 1,300 | ... | 120 | 160 | 240 | 360 | 600 | 1,000 |

NOTES:

- (1) Use solution annealed material only.
- (2) Not to be used over 1,250°F.
- (3) Use annealed material only.
- (4) Not to be used over 1,200°F. Alloy N06625 in the annealed condition is subject to severe loss of impact strength at room temperatures after exposure in the range of 1,000°F to 1,400°F.
- (5) Grade 1.
- (6) Not to be used over 800°F.
- (7) Not to be used over 1,000°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 1,000°F to 1,250°F.

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

| Nominal Designation | Forgings | | Castings | | Plates | | |
|------------------------------------|-------------------------|-----|----------|-------|-------------------------|-------|-------|
| 47Ni–22Cr–9Mo–18Fe | ... | | ... | | B 435 Gr. N06002 (1) | | |
| 21Ni–30Fe–22Cr–18Co–3Mo–3W | B 572 Gr. R30556 (1) | | ... | | B 435 Gr. R30556 (1) | | |
| Working Pressures by Classes, psig | | | | | | | |
| Temp., °F | Class | | | | | | |
| | 150 | 300 | 400 | 600 | 900 | 1500 | 2500 |
| –20 to 100 | 290 | 750 | 1,000 | 1,500 | 2,250 | 3,750 | 6,250 |
| 200 | 260 | 750 | 1,000 | 1,500 | 2,250 | 3,750 | 6,250 |
| 300 | 230 | 690 | 920 | 1,380 | 2,075 | 3,455 | 5,760 |
| 400 | 200 | 640 | 850 | 1,275 | 1,915 | 3,190 | 5,320 |
| 500 | 170 | 595 | 795 | 1,190 | 1,785 | 2,975 | 4,960 |
| 600 | 140 | 565 | 750 | 1,130 | 1,690 | 2,820 | 4,700 |
| 650 | 125 | 550 | 735 | 1,105 | 1,655 | 2,760 | 4,600 |
| 700 | 110 | 540 | 725 | 1,085 | 1,625 | 2,710 | 4,520 |
| 750 | 95 | 530 | 710 | 1,065 | 1,595 | 2,660 | 4,430 |
| 800 | 80 | 510 | 675 | 1,015 | 1,525 | 2,540 | 4,230 |
| 850 | 65 | 485 | 650 | 975 | 1,460 | 2,435 | 4,060 |
| 900 | 50 | 450 | 600 | 900 | 1,350 | 2,245 | 3,745 |
| 950 | 35 | 385 | 515 | 775 | 1,160 | 1,930 | 3,220 |
| 1,000 | 20 | 365 | 485 | 725 | 1,090 | 1,820 | 3,030 |
| 1,050 | ... | 360 | 480 | 720 | 1,080 | 1,800 | 3,000 |
| 1,100 | ... | 325 | 430 | 645 | 965 | 1,610 | 2,685 |
| 1,150 | ... | 275 | 365 | 550 | 825 | 1,370 | 2,285 |
| 1,200 | ... | 205 | 275 | 410 | 620 | 1,030 | 1,715 |
| 1,250 | ... | 180 | 245 | 365 | 545 | 910 | 1,515 |
| 1,300 | ... | 140 | 185 | 275 | 410 | 685 | 1,145 |
| 1,350 | ... | 105 | 140 | 205 | 310 | 515 | 860 |
| 1,400 | ... | 75 | 100 | 150 | 225 | 380 | 630 |
| 1,450 | ... | 60 | 80 | 115 | 175 | 290 | 485 |
| 1,500 | ... | 40 | 55 | 85 | 125 | 205 | 345 |

NOTE:

(1) Use solution annealed material only.

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

| Nominal Designation | Forgings | | | Castings | | Plates | |
|------------------------------------|----------|-----|-------|----------|-------|----------------------|-------|
| 25Ni–47Fe–21Cr–5Mo | ... | | | ... | | B 599 Gr. N08700 (1) | |
| Working Pressures by Classes, psig | | | | | | | |
| | Class | | | | | | |
| Temp., °F | 150 | 300 | 400 | 600 | 900 | 1500 | 2500 |
| –20 to 100 | 290 | 750 | 1,000 | 1,500 | 2,250 | 3,750 | 6,250 |
| 200 | 260 | 750 | 1,000 | 1,500 | 2,250 | 3,750 | 6,250 |
| 300 | 230 | 685 | 910 | 1,370 | 2,050 | 3,420 | 5,700 |
| 400 | 200 | 640 | 850 | 1,275 | 1,915 | 3,190 | 5,320 |
| 500 | 170 | 615 | 820 | 1,235 | 1,850 | 3,085 | 5,140 |
| 600 | 140 | 595 | 790 | 1,185 | 1,780 | 2,965 | 4,940 |
| 650 | 125 | 570 | 760 | 1,140 | 1,715 | 2,855 | 4,760 |

NOTE:

(1) Use solution annealed material only.

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

| Nominal Designation | Forgings | | | Castings | | Plates | |
|------------------------------------|---------------------------|-----|-----|----------|-------|----------------------|-------|
| 44Fe–25Ni–21Cr–Mo | B 479 Gr. N08904 (1), (2) | | | . . . | | A 240 Gr. N08904 (1) | |
| Working Pressures by Classes, psig | | | | | | | |
| Temp., °F | Class | | | | | | |
| | 150 | 300 | 400 | 600 | 900 | 1500 | 2500 |
| –20 to 100 | 285 | 745 | 990 | 1,490 | 2,230 | 3,720 | 6,200 |
| 200 | 230 | 600 | 805 | 1,205 | 1,805 | 3,010 | 5,020 |
| 300 | 210 | 545 | 725 | 1,090 | 1,635 | 2,725 | 4,540 |
| 400 | 190 | 500 | 665 | 1,000 | 1,500 | 2,495 | 4,160 |
| 500 | 170 | 455 | 610 | 910 | 1,370 | 2,280 | 3,800 |
| 600 | 140 | 425 | 570 | 855 | 1,280 | 2,135 | 3,560 |
| 650 | 125 | 420 | 555 | 835 | 1,255 | 2,090 | 3,480 |
| 700 | 110 | 410 | 545 | 820 | 1,230 | 2,050 | 3,420 |

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 II-2-3.12 Pressure–Temperature Ratings for Group 3.12 Materials

| Nominal Designation | Forgings | Castings | Plates | | | | |
|------------------------------------|-------------------------|------------------------|-------------------------|-------|-------|-------|-------|
| 26Ni–43Fe–22Cr–5Mo | ... | ... | B 620 Gr. N08320 (1) | | | | |
| 47Ni–22Cr–20Fe–7Mo | ... | ... | 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, psig | | | | | | | |
| | Class | | | | | | |
| Temp., °F | 150 | 300 | 400 | 600 | 900 | 1500 | 2500 |
| –20 to 100 | 260 | 670 | 895 | 1,345 | 2,015 | 3,360 | 5,600 |
| 200 | 240 | 620 | 830 | 1,245 | 1,865 | 3,110 | 5,180 |
| 300 | 225 | 585 | 780 | 1,165 | 1,750 | 2,915 | 4,860 |
| 400 | 200 | 540 | 715 | 1,075 | 1,615 | 2,690 | 4,480 |
| 500 | 170 | 500 | 665 | 1,000 | 1,500 | 2,495 | 4,160 |
| 600 | 140 | 475 | 630 | 945 | 1,420 | 2,365 | 3,940 |
| 650 | 125 | 460 | 615 | 920 | 1,380 | 2,305 | 3,840 |
| 700 | 110 | 450 | 600 | 900 | 1,355 | 2,255 | 3,760 |
| 750 | 95 | 440 | 590 | 885 | 1,325 | 2,210 | 3,680 |
| 800 | 80 | 430 | 575 | 865 | 1,295 | 2,160 | 3,600 |

NOTE:

(1) Use solution annealed material only.

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

| Nominal Designation | Forgings | | Castings | | Plates | | |
|------------------------------------|-------------------------|-----|----------|-------|-------------------------|-------|-------|
| 49Ni–25Cr–18Fe–6Mo | ... | | ... | | B 582 Gr. N06975 (1) | | |
| Ni–Fe–Cr–Mo–Cu–Low C | B 564 Gr. N08031 (2) | | ... | | B 625 Gr. N08031 (2) | | |
| Working Pressures by Classes, psig | | | | | | | |
| | Class | | | | | | |
| Temp., °F | 150 | 300 | 400 | 600 | 900 | 1500 | 2500 |
| –20 to 100 | 290 | 750 | 1,000 | 1,500 | 2,250 | 3,750 | 6,250 |
| 200 | 260 | 705 | 940 | 1,405 | 2,110 | 3,515 | 5,860 |
| 300 | 230 | 665 | 885 | 1,330 | 1,995 | 3,325 | 5,540 |
| 400 | 200 | 630 | 840 | 1,260 | 1,885 | 3,145 | 5,240 |
| 500 | 170 | 595 | 795 | 1,190 | 1,785 | 2,975 | 4,960 |
| 600 | 140 | 560 | 750 | 1,125 | 1,685 | 2,810 | 4,680 |
| 650 | 125 | 550 | 735 | 1,100 | 1,650 | 2,750 | 4,580 |
| 700 | 110 | 540 | 720 | 1,080 | 1,620 | 2,700 | 4,500 |
| 750 | 95 | 530 | 710 | 1,065 | 1,595 | 2,660 | 4,430 |
| 800 | 80 | 510 | 675 | 1,015 | 1,525 | 2,540 | 4,230 |

NOTES:

(1) Use solution annealed material only.

(2) Use annealed material only.

Table II-2-3.14 Pressure-Temperature Ratings for Group 3.14 Materials

| Nominal Designation | Forgings | Castings | Plates | | | | |
|------------------------------------|---------------------------|----------|---------------------------|-------|-------|-------|-------|
| 47Ni-22Cr-19Fe-6Mo | ... | ... | B 582 Gr. N06007 (1) | | | | |
| 40Ni-29Cr-15Fe-5Mo | B 462 Gr. N06030 (1), (2) | ... | B 582 Gr. N06030 (1), (2) | | | | |
| 58Ni-33Cr-8Mo | B 462 Gr. N06035 (1), (2) | ... | B 575 Gr. N06035 (1), (2) | | | | |
| Working Pressures by Classes, psig | | | | | | | |
| Temp., °F | Class | | | | | | |
| | 150 | 300 | 400 | 600 | 900 | 1500 | 2500 |
| -20 to 100 | 275 | 720 | 960 | 1,440 | 2,160 | 3,600 | 6,000 |
| 200 | 250 | 650 | 865 | 1,295 | 1,945 | 3,240 | 5,400 |
| 300 | 230 | 600 | 800 | 1,200 | 1,800 | 3,000 | 5,000 |
| 400 | 200 | 565 | 750 | 1,130 | 1,690 | 2,820 | 4,700 |
| 500 | 170 | 540 | 715 | 1,075 | 1,615 | 2,690 | 4,480 |
| 600 | 140 | 520 | 690 | 1,035 | 1,555 | 2,590 | 4,320 |
| 650 | 125 | 510 | 680 | 1,020 | 1,535 | 2,555 | 4,260 |
| 700 | 110 | 505 | 675 | 1,015 | 1,520 | 2,530 | 4,220 |
| 750 | 95 | 500 | 670 | 1,005 | 1,505 | 2,510 | 4,180 |
| 800 | 80 | 500 | 665 | 1,000 | 1,500 | 2,495 | 4,160 |
| 850 | 65 | 485 | 650 | 975 | 1,460 | 2,435 | 4,060 |
| 900 | 50 | 450 | 600 | 900 | 1,350 | 2,245 | 3,745 |
| 950 | 35 | 385 | 515 | 775 | 1,160 | 1,930 | 3,220 |
| 1000 | 20 | 365 | 485 | 725 | 1,090 | 1,820 | 3,030 |

NOTES:

(1) Use solution annealed material only.

(2) Not to be used over 800°F.

Table II-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, psig | | | | | | | |
| Temp., °F | Class | | | | | | |
| | 150 | 300 | 400 | 600 | 900 | 1500 | 2500 |
| –20 to 100 | 230 | 600 | 800 | 1,200 | 1,800 | 3,000 | 5,000 |
| 200 | 210 | 550 | 735 | 1,105 | 1,655 | 2,760 | 4,600 |
| 300 | 200 | 520 | 695 | 1,040 | 1,560 | 2,605 | 4,340 |
| 400 | 190 | 490 | 655 | 980 | 1,470 | 2,450 | 4,080 |
| 500 | 170 | 465 | 620 | 925 | 1,390 | 2,315 | 3,860 |
| 600 | 140 | 440 | 585 | 880 | 1,320 | 2,195 | 3,660 |
| 650 | 125 | 430 | 575 | 860 | 1,290 | 2,150 | 3,580 |
| 700 | 110 | 420 | 555 | 835 | 1,255 | 2,090 | 3,480 |
| 750 | 95 | 410 | 545 | 820 | 1,230 | 2,050 | 3,420 |
| 800 | 80 | 400 | 535 | 800 | 1,200 | 2,005 | 3,340 |
| 850 | 65 | 395 | 525 | 785 | 1,180 | 1,970 | 3,280 |
| 900 | 50 | 385 | 515 | 775 | 1,160 | 1,930 | 3,220 |
| 950 | 35 | 380 | 505 | 760 | 1,140 | 1,895 | 3,160 |
| 1,000 | 20 | 365 | 485 | 725 | 1,090 | 1,820 | 3,030 |
| 1,050 | ... | 350 | 465 | 700 | 1,050 | 1,750 | 2,915 |
| 1,100 | ... | 325 | 430 | 645 | 965 | 1,610 | 2,685 |
| 1,150 | ... | 275 | 365 | 550 | 825 | 1,370 | 2,285 |
| 1,200 | ... | 205 | 275 | 410 | 620 | 1,030 | 1,715 |
| 1,250 | ... | 180 | 245 | 365 | 545 | 910 | 1,515 |
| 1,300 | ... | 140 | 185 | 275 | 410 | 685 | 1,145 |
| 1,350 | ... | 105 | 140 | 205 | 310 | 515 | 860 |
| 1,400 | ... | 75 | 100 | 150 | 225 | 380 | 630 |
| 1,450 | ... | 60 | 80 | 115 | 175 | 290 | 485 |
| 1,500 | ... | 40 | 55 | 85 | 125 | 205 | 345 |

NOTE:

(1) Use solution annealed material only.

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

| Nominal Designation | Forgings | | | Castings | | Plates | |
|--|----------|-----|-----|----------|-------|----------------------|-------|
| 35Ni–19Cr–1 ¹ / ₄ Si | ... | | | ... | | B 536 Gr. N08330 (1) | |
| Working Pressures by Classes, psig | | | | | | | |
| Temp., °F | Class | | | | | | |
| | 150 | 300 | 400 | 600 | 900 | 1500 | 2500 |
| –20 to 100 | 275 | 720 | 960 | 1,440 | 2,160 | 3,600 | 6,000 |
| 200 | 245 | 635 | 850 | 1,270 | 1,910 | 3,180 | 5,300 |
| 300 | 225 | 595 | 790 | 1,185 | 1,780 | 2,965 | 4,940 |
| 400 | 200 | 555 | 740 | 1,115 | 1,670 | 2,785 | 4,640 |
| 500 | 170 | 530 | 705 | 1,055 | 1,585 | 2,640 | 4,400 |
| 600 | 140 | 505 | 670 | 1,010 | 1,510 | 2,520 | 4,200 |
| 650 | 125 | 495 | 660 | 990 | 1,485 | 2,470 | 4,120 |
| 700 | 110 | 480 | 645 | 965 | 1,445 | 2,410 | 4,020 |
| 750 | 95 | 475 | 630 | 945 | 1,420 | 2,365 | 3,940 |
| 800 | 80 | 465 | 620 | 925 | 1,390 | 2,315 | 3,860 |
| 850 | 65 | 455 | 605 | 905 | 1,360 | 2,270 | 3,780 |
| 900 | 50 | 445 | 590 | 890 | 1,330 | 2,220 | 3,700 |
| 950 | 35 | 385 | 515 | 775 | 1,160 | 1,930 | 3,220 |
| 1,000 | 20 | 365 | 485 | 725 | 1,090 | 1,820 | 3,030 |
| 1,050 | ... | 345 | 455 | 685 | 1,030 | 1,715 | 2,855 |
| 1,100 | ... | 265 | 355 | 535 | 800 | 1,335 | 2,230 |
| 1,150 | ... | 205 | 275 | 410 | 615 | 1,030 | 1,715 |
| 1,200 | ... | 160 | 215 | 320 | 485 | 805 | 1,345 |
| 1,250 | ... | 130 | 175 | 260 | 390 | 650 | 1,085 |
| 1,300 | ... | 105 | 140 | 215 | 320 | 530 | 885 |
| 1,350 | ... | 80 | 110 | 165 | 245 | 410 | 685 |
| 1,400 | ... | 60 | 80 | 125 | 185 | 310 | 515 |
| 1,450 | ... | 50 | 70 | 105 | 155 | 255 | 430 |
| 1,500 | ... | 40 | 50 | 75 | 115 | 190 | 315 |

NOTE:

(1) Use solution annealed material only.

Table II-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, psig | | | | | | | |
| Temp., °F | Class | | | | | | |
| | 150 | 300 | 400 | 600 | 900 | 1500 | 2500 |
| –20 to 100 | 230 | 600 | 800 | 1,200 | 1,800 | 3,000 | 5,000 |
| 200 | 200 | 520 | 690 | 1,035 | 1,555 | 2,590 | 4,320 |
| 300 | 180 | 465 | 620 | 930 | 1,395 | 2,330 | 3,880 |
| 400 | 160 | 420 | 565 | 845 | 1,265 | 2,110 | 3,520 |
| 500 | 150 | 390 | 520 | 780 | 1,165 | 1,945 | 3,240 |
| 600 | 140 | 360 | 480 | 720 | 1,080 | 1,800 | 3,000 |

NOTE:

(1) Use solution annealed material only.

Table II-2-3.19 Pressure–Temperature Ratings for Group 3.19 Materials

| Nominal Designation | Forgings | | | Castings | | Plates | |
|----------------------------------|------------------|-----|-------|----------|-------|------------------|-------|
| 57Ni-22Cr-14W-2Mo-La | B 564 Gr. N06230 | | | . . . | | B 435 Gr. N06230 | |
| Working Pressures by Class, psig | | | | | | | |
| Temp., °F | Class | | | | | | |
| | 150 | 300 | 400 | 600 | 900 | 1500 | 2500 |
| -20 to 100 | 290 | 750 | 1,000 | 1,500 | 2,250 | 3,750 | 6,250 |
| 200 | 260 | 750 | 1,000 | 1,500 | 2,250 | 3,750 | 6,250 |
| 300 | 230 | 730 | 970 | 1,455 | 2,185 | 3,640 | 6,070 |
| 400 | 200 | 705 | 940 | 1,410 | 2,115 | 3,530 | 5,880 |
| 500 | 170 | 665 | 885 | 1,330 | 1,995 | 3,325 | 5,540 |
| 600 | 140 | 605 | 805 | 1,210 | 1,815 | 3,025 | 5,040 |
| 650 | 125 | 590 | 785 | 1,175 | 1,765 | 2,940 | 4,905 |
| 700 | 110 | 570 | 755 | 1,135 | 1,705 | 2,840 | 4,730 |
| 750 | 95 | 530 | 710 | 1,065 | 1,595 | 2,660 | 4,430 |
| 800 | 80 | 510 | 675 | 1,015 | 1,525 | 2,540 | 4,230 |
| 850 | 65 | 485 | 650 | 975 | 1,460 | 2,435 | 4,060 |
| 900 | 50 | 450 | 600 | 900 | 1,350 | 2,245 | 3,745 |
| 950 | 35 | 385 | 515 | 775 | 1,160 | 1,930 | 3,220 |
| 1,000 | 20 | 365 | 485 | 725 | 1,090 | 1,820 | 3,030 |
| 1,050 | 20 | 360 | 480 | 720 | 1,080 | 1,800 | 3,000 |
| 1,100 | 20 | 325 | 430 | 645 | 965 | 1,610 | 2,685 |
| 1,150 | 20 | 275 | 365 | 550 | 825 | 1,370 | 2,285 |
| 1,200 | 20 | 205 | 275 | 410 | 620 | 1,030 | 1,715 |
| 1,250 | 20 | 180 | 245 | 365 | 545 | 910 | 1,515 |
| 1,300 | 20 | 140 | 185 | 275 | 410 | 685 | 1,145 |
| 1,350 | 20 | 105 | 140 | 205 | 310 | 515 | 860 |
| 1,400 | 20 | 75 | 100 | 150 | 225 | 380 | 630 |
| 1,450 | 20 | 60 | 80 | 115 | 175 | 290 | 485 |
| 1,500 | 20 | 40 | 55 | 85 | 125 | 205 | 345 |

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

| NPS | Maximum Radial Projection of Imperfections That Are No Deeper Than the Bottom of the Serrations, in. | Maximum Depth and Radial Projection of Imperfections That Are Deeper Than the Bottom of the Serrations, in. |
|----------------|--|---|
| $\frac{1}{2}$ | 0.12 | 0.06 |
| $\frac{3}{4}$ | 0.12 | 0.06 |
| 1 | 0.12 | 0.06 |
| $1\frac{1}{4}$ | 0.12 | 0.06 |
| $1\frac{1}{2}$ | 0.12 | 0.06 |
| 2 | 0.12 | 0.06 |
| $2\frac{1}{2}$ | 0.12 | 0.06 |
| 3 | 0.18 | 0.06 |
| $3\frac{1}{2}$ | 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 II-4 Dimensions of Facings (Other Than Ring Joints, All Pressure Rating Classes)

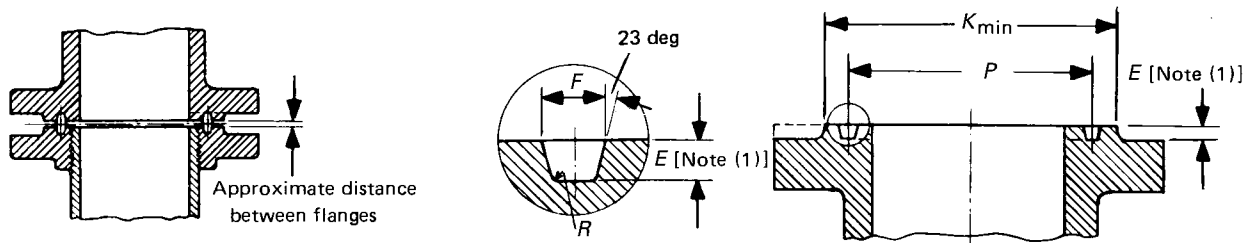
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 1 | |
|-------------------------|--|-----------------------------------|-----------------------|---|---|--|-------------------------------------|-----------------------|---|---------------------------------------|---|---|----------------------------------|---|-------------------------|--|
| Nominal Pipe Size | Outside Diameter | | | Inside Diameter | | Outside Diameter | | | Inside Diameter | | Height | | | Minimum Outside Diameter of Raised Portion | | |
| | Raised Face Large Male and Large Tongue, R | Small Male, S [Note (1)] | Small Tongue, T | Diameter of Large and Small Tongue, U | Diameter of Small Male [Note (1)] | Large Female and Large Groove, W | Small Female, X [Note (1)] | Small Groove, Y | Diameter of Large and Small Groove, Z | Raised Face [Notes (2), (3)] | Large and Small Male and Tongue [Notes (2), (4)] | Depth of Groove or Female [Notes (2), (5)] | Notes (6), (7)] | | | |
| | | | | | | | | | | | | | Small Female and Groove, K | Large Female and Groove, L | Nominal Pipe Size | |
| | | | | | | | | | | | | | | | | |
| 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 and flanged fittings, see paras. 6.3 and 6.4 and Fig. II-7.
- For facing requirements for lapped joints, see para. 6.4.3 and Fig. II-7.
- 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 ensure 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. The inside diameter of the fitting should match the inside diameter of the pipe as specified by the Purchaser. Threaded companion flanges for small male and female joints are furnished with plain face and are threaded with American National Standard Lock-nut Thread (NPSL).
- See para. 6.4.3 and Fig. II-7 for thickness and outside diameters of laps.
- The height of the raised face is either 0.06 in. or 0.25 in. (see para. 6.4.1).
- The height of the large and small male and tongue is 0.25 in.
- The depth of the groove or female is 0.19 in.
- The raised portion of the 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 II-5 Dimensions of Ring-Joint Facings (All Pressure Rating Classes)

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
|-------------------|--------------|----------------------|--------------|----------------------|------------|------------|-------------------|-------------------|---------------------|----------|---------------------|
| Nominal Pipe Size | | | | | | | Groove Dimensions | | | | |
| Class 150 | Class 300 | Class 400 [Note (2)] | Class 600 | Class 900 [Note (3)] | Class 1500 | Class 2500 | Groove Number | Pitch Diameter, P | Depth, E [Note (1)] | Width, F | Radius at Bottom, R |
| ... | 1/2 | ... | 1/2 | ... | ... | ... | R11 | 1.344 | 0.219 | 0.281 | 0.03 |
| ... | ... | ... | ... | ... | 1/2 | ... | 12 | 1.562 | 0.250 | 0.344 | 0.03 |
| ... | 3/4 | ... | 3/4 | ... | ... | 1/2 | 13 | 1.688 | 0.250 | 0.344 | 0.03 |
| ... | ... | ... | ... | ... | 3/4 | ... | 14 | 1.750 | 0.250 | 0.344 | 0.03 |
| 1 | ... | ... | ... | ... | ... | ... | 15 | 1.875 | 0.250 | 0.344 | 0.03 |
| ... | 1 | ... | 1 | ... | 1 | 3/4 | 16 | 2.000 | 0.250 | 0.344 | 0.03 |
| 1 1/4 | ... | ... | ... | ... | ... | ... | 17 | 2.250 | 0.250 | 0.344 | 0.03 |
| ... | 1 1/4 | ... | 1 1/4 | ... | 1 1/4 | 1 | 18 | 2.375 | 0.250 | 0.344 | 0.03 |
| 1 1/2 | ... | ... | ... | ... | ... | ... | 19 | 2.562 | 0.250 | 0.344 | 0.03 |
| ... | 1 1/2 | ... | 1 1/2 | ... | 1 1/2 | ... | 20 | 2.688 | 0.250 | 0.344 | 0.03 |
| ... | ... | ... | ... | ... | ... | 1 1/4 | 21 | 2.844 | 0.312 | 0.469 | 0.03 |
| 2 | ... | ... | ... | ... | ... | ... | 22 | 3.250 | 0.250 | 0.344 | 0.03 |
| ... | 2 | ... | 2 | ... | ... | 1 1/2 | 23 | 3.250 | 0.312 | 0.469 | 0.03 |
| ... | ... | ... | ... | ... | 2 | ... | 24 | 3.750 | 0.312 | 0.469 | 0.03 |
| 2 1/2 | ... | ... | ... | ... | ... | ... | 25 | 4.000 | 0.250 | 0.344 | 0.03 |
| ... | 2 1/2 | ... | 2 1/2 | ... | ... | 2 | 26 | 4.000 | 0.312 | 0.469 | 0.03 |
| ... | ... | ... | ... | ... | 2 1/2 | ... | 27 | 4.250 | 0.312 | 0.469 | 0.03 |
| ... | ... | ... | ... | ... | ... | 2 1/2 | 28 | 4.375 | 0.375 | 0.531 | 0.06 |
| 3 | ... | ... | ... | ... | ... | ... | 29 | 4.500 | 0.250 | 0.344 | 0.03 |
| ... | [Note (4)] | ... | [Note (4)] | ... | ... | ... | 30 | 4.625 | 0.312 | 0.469 | 0.03 |
| ... | 3 [Note (4)] | ... | 3 [Note (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 II-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 150 | Class 300 400 600 | Class 900 | Class 1500 | Class 2500 | Class 150 | Class 300 | Class 400 | Class 600 | Class 900 | Class 1500 | Class 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 II-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 Pipe Size | | | | | | | Groove Dimensions | | | | |
| Class 150 | Class 300 | Class 400 [Note (2)] | Class 600 | Class 900 [Note (3)] | Class 1500 | Class 2500 | Groove Number | Pitch Diameter, <i>P</i> | Depth, <i>E</i> [Note (1)] | Width, <i>F</i> | Radius at Bottom, <i>R</i> |
| ... | ... | ... | ... | ... | ... | 8 | 51 | 11.000 | 0.562 | 0.906 | 0.06 |
| 10 | ... | ... | ... | ... | ... | ... | 52 | 12.000 | 0.250 | 0.344 | 0.03 |
| ... | 10 | 10 | 10 | 10 | ... | ... | 53 | 12.750 | 0.312 | 0.469 | 0.03 |
| ... | ... | ... | ... | ... | 10 | ... | 54 | 12.750 | 0.438 | 0.656 | 0.06 |
| ... | ... | ... | ... | ... | ... | 10 | 55 | 13.500 | 0.688 | 1.188 | 0.09 |
| 12 | ... | ... | ... | ... | ... | ... | 56 | 15.000 | 0.250 | 0.344 | 0.03 |
| ... | 12 | 12 | 12 | 12 | ... | ... | 57 | 15.000 | 0.312 | 0.469 | 0.03 |
| ... | ... | ... | ... | ... | 12 | ... | 58 | 15.000 | 0.562 | 0.906 | 0.06 |
| 14 | ... | ... | ... | ... | ... | ... | 59 | 15.625 | 0.250 | 0.344 | 0.03 |
| ... | ... | ... | ... | ... | ... | 12 | 60 | 16.000 | 0.688 | 1.312 | 0.09 |
| ... | 14 | 14 | 14 | ... | ... | ... | 61 | 16.500 | 0.312 | 0.469 | 0.03 |
| ... | ... | ... | ... | 14 | ... | ... | 62 | 16.500 | 0.438 | 0.656 | 0.06 |
| ... | ... | ... | ... | ... | 14 | ... | 63 | 16.500 | 0.625 | 1.062 | 0.09 |
| 16 | ... | ... | ... | ... | ... | ... | 64 | 17.875 | 0.250 | 0.344 | 0.03 |
| ... | 16 | 16 | 16 | ... | ... | ... | 65 | 18.500 | 0.312 | 0.469 | 0.03 |
| ... | ... | ... | ... | 16 | ... | ... | 66 | 18.500 | 0.438 | 0.656 | 0.06 |
| ... | ... | ... | ... | ... | 16 | ... | 67 | 18.500 | 0.688 | 1.188 | 0.09 |
| 18 | ... | ... | ... | ... | ... | ... | 68 | 20.375 | 0.250 | 0.344 | 0.03 |
| ... | 18 | 18 | 18 | ... | ... | ... | 69 | 21.000 | 0.312 | 0.469 | 0.03 |
| ... | ... | ... | ... | 18 | ... | ... | 70 | 21.000 | 0.500 | 0.781 | 0.06 |
| ... | ... | ... | ... | ... | 18 | ... | 71 | 21.000 | 0.688 | 1.188 | 0.09 |
| 20 | ... | ... | ... | ... | ... | ... | 72 | 22.000 | 0.250 | 0.344 | 0.03 |
| ... | 20 | 20 | 20 | ... | ... | ... | 73 | 23.000 | 0.375 | 0.531 | 0.06 |
| ... | ... | ... | ... | 20 | ... | ... | 74 | 23.000 | 0.500 | 0.781 | 0.06 |
| ... | ... | ... | ... | ... | 20 | ... | 75 | 23.000 | 0.688 | 1.312 | 0.09 |
| 24 | ... | ... | ... | ... | ... | ... | 76 | 26.500 | 0.250 | 0.344 | 0.03 |
| ... | 24 | 24 | 24 | ... | ... | ... | 77 | 27.250 | 0.438 | 0.656 | 0.06 |
| ... | ... | ... | ... | 24 | ... | ... | 78 | 27.250 | 0.625 | 1.062 | 0.09 |
| ... | ... | ... | ... | ... | 24 | ... | 79 | 27.250 | 0.812 | 1.438 | 0.09 |

Table II-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 150 | Class 300 400 600 | Class 900 | Class 1500 | Class 2500 | Class 150 | Class 300 | Class 400 | Class 600 | Class 900 | Class 1500 | Class 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:

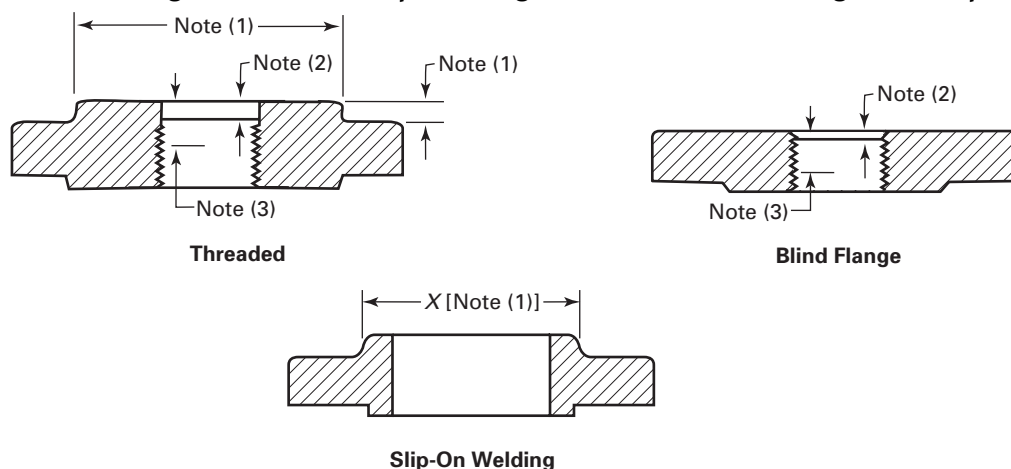
- (a) Dimensions are in inches.
 (b) For facing requirements for flanges and flanged fittings, see para. 6.4.1 and Fig. II-7.
 (c) For facing requirements for lapped joints, see para. 6.4.3 and Fig. II-7.
 (d) See para 4.2.7 for marking requirements.

NOTES:

- (1) The height of the 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) $\pm \frac{1}{2}$ deg

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

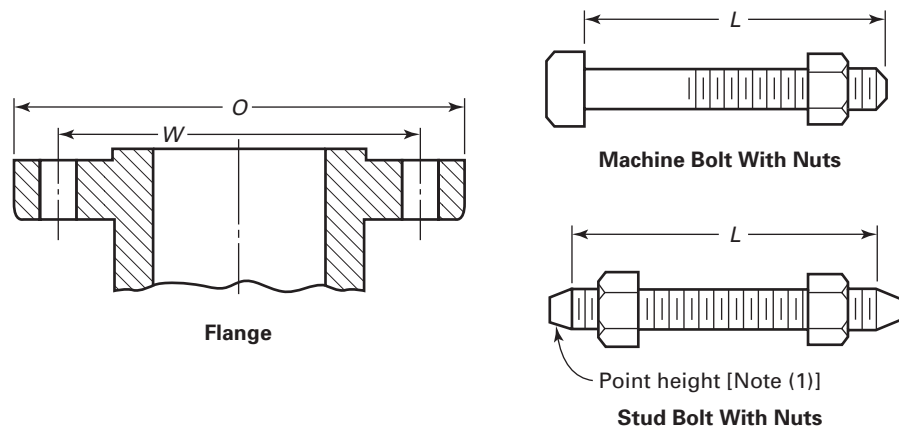
| 1 | 2 | 3 | 4 | 5 | 6 |
|---------------------------------|--|---------------------------------|--|---------------------------------|--|
| Nominal Pipe Size [Note (4)] | Smallest Size of Reducing Outlet Requiring Hub Flanges [Note (1)] | Nominal Pipe Size [Note (4)] | Smallest Size of Reducing Outlet Requiring Hub Flanges [Note (1)] | Nominal Pipe Size [Note (4)] | Smallest Size of Reducing Outlet Requiring Hub Flanges [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 a 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) The minimum length of effective threads shall be at least equal to dimension T of the corresponding pressure class threaded flange as shown in the tables but does not necessarily extend for the face of the flange. For thread of threaded flanges, see para. 6.9.
- (4) For the method of designating reducing threaded and reducing slip-on flanges, see para. 3.3 and the example below.

EXAMPLES:

- (1) 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 II-12.
- (2) The size designation is NPS 6×2 — Class 300 reducing threaded flange. Use regular NPS 6 Class 300 blind flange tapped with NPS 2 taper pipe thread (ASME B1.20.1).

Table II-7 Templates for Drilling Class 150 Pipe Flanges and Flanged Fittings

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|---------------------------------|---|---|---------------------------|--------------------|--|--------------------------|---------------|-------------------------|
| | | | | | Length of Bolts, <i>L</i> [Note (4)] | | | |
| Nominal Pipe Size, NPS | Outside Diameter of Flange, <i>O</i> | Drilling [Notes (2), (3)] | | | | Stud Bolts [Note (1)] | | Machine Bolts |
| | | Diameter of Bolt Circle, <i>W</i> | Diameter of Bolt Holes | Number of Bolts | Diameter of Bolts | Raised Face 0.06 in. | Ring Joint | Raised Face 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 |

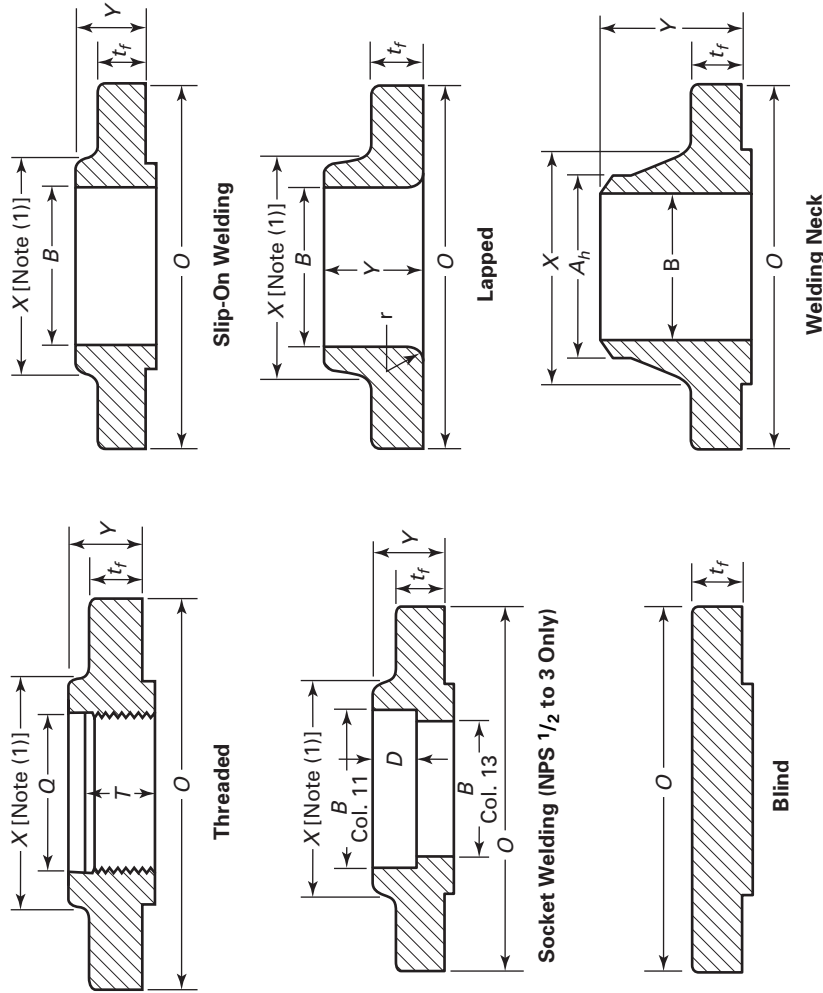
GENERAL NOTES:

- (a) Dimensions are in inches.
 (b) For other dimensions, see Tables II-8 and II-9.

NOTES:

- (1) The length of the 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 Nonmandatory Appendix C (see para. 6.10.2).

Table II-8 Dimensions of Class 150 Flanges



| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
|-------------------|-------------------------------|------------------------------------|--------------------------------|--------------------|--|------------------------------------|------------------------------|-----------------|-----------------------------------|-----------------------------------|------------------------|--------------------------------|--|--------------------|
| Nominal Pipe Size | Outside Diameter of Flange, O | Minimum Thickness of Flange, t_f | Minimum Thickness of Lap Joint | Diameter of Hub, X | Diameter Beginning of Chamfer of Welding Neck, A_h | Threaded Slip-On Socket Welding, Y | Length Through Hub Lapped, Y | Welding Neck, Y | Minimum Thread Length Threaded, T | Minimum Slip-On Socket Welding, B | Bore Minimum Lapped, B | Welding Neck/Socket Welding, B | Corner Radius of Lapped Flange and Pipe, r | Depth of Socket, D |
| $1/2$ | 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 |
| $3/4$ | 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 |
| $1 1/4$ | 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 |
| $1 1/2$ | 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 II-8 Dimensions of Class 150 Flanges (Cont'd)

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
|----------------------|--|--|--------------------------------------|----------------------------|--|--|----------------|-------------------------|---|---|---------------------------|--|---|-------------------------------|
| Nominal Pipe Size | Outside Diameter of Flange, O | Minimum Thickness of Flange, t_f [Notes (2)–(4)] | Minimum Thickness of Lap Joint | Diameter of Hub, X | Diameter Beginning of Chamfer Welding Neck, A_h [Note (5)] | Length Through Hub | | | Minimum Thread Length Threaded, T [Note (6)] | Bore | | | Corner Bore Radius of Lapped Flange and Pipe, r | Depth of Socket, D |
| | | | | | | Threaded Slip-On Socket Welding, Y | Lapped, Y | Welding Neck, Y | | Minimum Slip-On Socket Welding, B | Minimum Lapped, B | Welding Socket Welding, B [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 | Note (8) | 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 | Note (8) | 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 | Note (8) | 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 | Note (8) | 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 | Note (8) | 0.50 | ... |

Table II-8 Dimensions of Class 150 Flanges (Cont'd)**GENERAL NOTES:**

- (a) Dimensions are in inches.
- (b) For tolerances, see section 7.
- (c) For facings, see para. 6.4.
- (d) For flange bolt holes, see para. 6.5 and Table II-7.
- (e) For spot facing, see para. 6.6.
- (f) For reducing threaded and slip-on flanges, see Table II-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 the large end of the 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 3½ and smaller, is slightly greater than the thickness of flanges on fittings, Table II-9, 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. II-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. The 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.
- (8) To be specified by the Purchaser.

Table II-9 Dimensions of Class 150 Flanged Fittings

| Nominal Pipe Size, NPS | Outside Diameter of Flange, O | Minimum Thickness of Flange, t_f [Notes (1)-(3)] | Minimum Wall Thickness of Fitting, t_m | Inside Diameter of Fitting, d | 0.06-in. Raised Face (Flange Edge) [Note (4)] | | | | | | | | | | | |
|---------------------------------|--|--|--|--|--|--|--|--|--|---|--------------------------|--|--|--|------------|--|
| | | | | | Center-to- Contact Surface of Raised Face Elbow, Tee, Cross, and True "Y," AA | Center-to- Contact Surface of Raised Face Long Elbow, BB | Center-to- Contact Surface of Raised Face 45-deg Elbow, CC | Center-to- Contact Surface of Raised Face Long Elbow, EE | Short Center-to- Contact Surface of Raised Face Lateral and True "Y," FF | Contact Surface-to- Contact Surface of Raised Face Reducer, GG | Ring Joint [Note (4)] | | Center-to-End Elbow Tee, Cross, and True "Y," HH | | [Note (6)] | |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | ... | | ... | | ... | |
| 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 | | ... | |

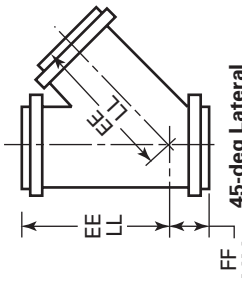
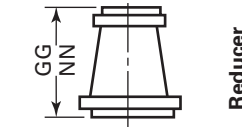
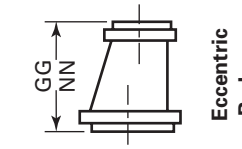
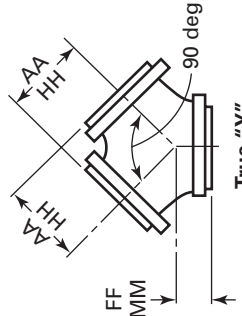
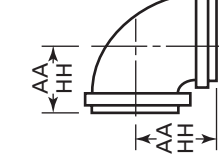
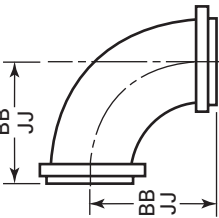
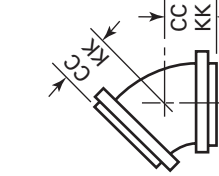
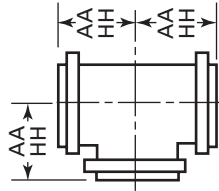
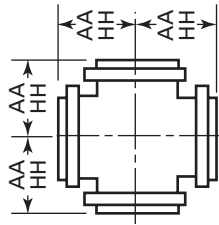


Table II-9 Dimensions of Class 150 Flanged Fittings (Cont'd)

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
|------------------------------------|--|--|--|--|---|--|--|--|--|--|--------------------------|
| 0.06-in. Raised Face (Flange Edge) | | | | | | | | | | | |
| [Note (4)] | | | | | | | | | | | |
| Nominal Pipe Size, NPS | Outside Diameter of Flange, O | Minimum Thickness of Flange, t_f [Notes (1)–(3)] | Minimum Wall Thickness of Fitting, t_m | Inside Diameter of Fitting, d | Center-to- | | | | Short | | Ring Joint [Note (4)] |
| | | | | | Center-to- Contact Surface of Raised Face Long Radius Elbow, BB | Center-to- Contact Surface of Raised Face 45-deg Elbow, CC | Center-to- Contact Surface of Raised Face Lateral, EE | Center-to- Contact Surface of Raised Face Lateral and True "Y," FF | Center-to- Contact Surface of Raised Face Reducer, GG | Center-to-End Elbow Tee, Cross, and True "Y," HH | |
| 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 II-9 Dimensions of Class 150 Flanged Fittings (Cont'd)

| | | | | | | | | | | | | | | |
|--|---|--|---|--|---|--|--|--|---|---------------------------------|---------------------------------|-----|-----|-------|
| <p>Flanged Fitting</p> <p>Round Base</p> <p>Square Base</p> <p>Four bolt holes</p> <p>Base Elbow</p> <p>Base Tee</p> | | | | | | | | | | | | | | |
| 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 1 | | | |
| Ring Joint [Note (4)] | | | | | | | | | | | | | | |
| Center-to-End Long Radius Elbow, JJ [Note (6)] | Center-to-End 45-deg Elbow, KK [Note (6)] | Long Center- to-End Lateral, LL [Note (6)] | Short Center- to-End Lateral and True "Y," MM [Note (6)] | End-to-End Reducer, NN [Note (6)] | Center-to- Base, R [Notes (7)–(9)] | Diameter of Round Base or Width of Square Base, S [Note (7)] | Thickness of Base, T [Notes (7)–(10)] | Thickness of Ribs, U [Note (7)] | Base Drilling [Note (11)] | | Nominal Pipe Size, NPS | | | |
| | | | | | | | | | Bolt Circle or Bolt Spacing, W | Diameter of Drilled Holes | | | | |
| | | | | | | | | | | | | ... | ... | 1/2 |
| | | | | | | | | | | | | ... | ... | 3/4 |
| | | | | | | | | | | | | ... | ... | 1 |
| | | | | | | | | | | | | ... | ... | 1 1/4 |
| | | | | | | | | | | | | ... | ... | 1 1/2 |
| | | | | | | | | | | | | ... | ... | 2 |
| | | | | | | | | | | | | ... | ... | 2 1/2 |
| | | | | | | | | | | | | ... | ... | ... |
| ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | 3 1/2 | | | |
| ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | ... | 4 | | | |

Table II-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)] | | | | | | | | | | | |
| 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 | Base Drilling [Note (11)] | | Nominal Pipe Size, NPS |
| | | | | | | | | | [Note (6)] | [Note (6)] | |
| 10.50 | 4.75 | 13.75 | 3.75 | Notes (5), (6) | 6.25 | 7.00 | 0.69 | 0.65 | 5.50 | 3/4 | 5 |
| 11.75 | 5.25 | 14.75 | 3.75 | Notes (5), (6) | 7.00 | 7.00 | 0.69 | 0.65 | 5.50 | 3/4 | 6 |
| 14.25 | 5.75 | 17.75 | 4.75 | Notes (5), (6) | 8.38 | 9.00 | 0.94 | 0.94 | 7.50 | 3/4 | 8 |
| 16.75 | 6.75 | 20.75 | 5.25 | Notes (5), (6) | 9.75 | 9.00 | 0.94 | 0.94 | 7.50 | 3/4 | 10 |
| 19.25 | 7.75 | 24.75 | 5.75 | Notes (5), (6) | 11.25 | 11.00 | 1.00 | 1.00 | 9.50 | 7/8 | 12 |
| 21.75 | 7.75 | 27.25 | 6.25 | Notes (5), (6) | 12.50 | 11.00 | 1.00 | 1.00 | 9.50 | 7/8 | 14 |
| 24.25 | 8.25 | 30.25 | 6.75 | Notes (5), (6) | 13.75 | 11.00 | 1.00 | 1.00 | 9.50 | 7/8 | 16 |
| 26.75 | 8.75 | 32.25 | 7.25 | Notes (5), (6) | 15.00 | 13.50 | 1.12 | 1.12 | 11.75 | 7/8 | 18 |
| 29.25 | 9.75 | 35.25 | 8.25 | Notes (5), (6) | 16.00 | 13.50 | 1.12 | 1.12 | 11.75 | 7/8 | 20 |
| 34.25 | 11.25 | 40.75 | 9.25 | Notes (5), (6) | 18.50 | 13.50 | 1.12 | 1.12 | 11.75 | 7/8 | 24 |

GENERAL NOTE:

- Dimensions of Table II-9 are in inches.
- For tolerances, see section 7.
- For facings, see para. 6.4.
- For flange bolt holes, see para. 6.5 and Table II-7.
- 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:

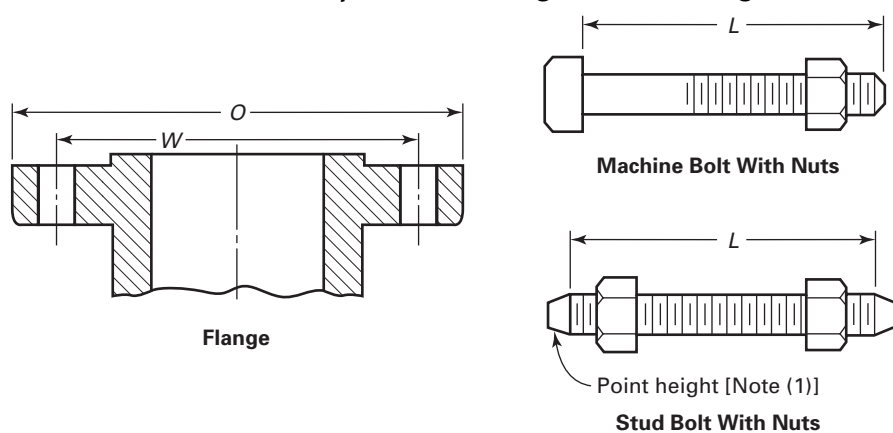
- The thickness of flange minimum dimensions for loose flanges, Table II-9, sizes NPS 3½ and smaller, are slightly heavier than for flanges on these fittings, which are reinforced by being cast integral with the body of the fitting.
- These fittings may be supplied with a flat face flange. The flat face 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 the flange dimension illustrated is for regularly furnished 0.06-in. raised face (except lapped); for thickness requirements of other facings, see Fig. II-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 0.06-in. raised face (flange edge) for the largest opening, and add the proper height to provide for ring joint groove applying to each flange. See Table II-5 for ring joint facing dimensions.

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

NOTES (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.

Table II-10 Templates for Drilling Class 300 Flanges



| Nominal Pipe Size | Outside Diameter of Flange, O | Drilling [Notes (2), (3)] | | | | Length of Bolts, L [Note (4)] | | |
|----------------------|--|------------------------------------|---------------------------|--------------------|----------------------|---------------------------------------|------------|-------------------------|
| | | Diameter of Bolt Circle, W | Diameter of Bolt Holes | Number of Bolts | Diameter of Bolts | Stud Bolts [Note (1)] | | Machine Bolts |
| | | | | | | Raised Face 0.06 in. | Ring Joint | Raised Face 0.06 in. |
| | | | | | | | | |
| $\frac{1}{2}$ | 3.75 | 2.62 | $\frac{5}{8}$ | 4 | $\frac{1}{2}$ | 2.50 | 3.00 | 2.25 |
| $\frac{3}{4}$ | 4.62 | 3.25 | $\frac{3}{4}$ | 4 | $\frac{5}{8}$ | 3.00 | 3.50 | 2.50 |
| 1 | 4.88 | 3.50 | $\frac{3}{4}$ | 4 | $\frac{5}{8}$ | 3.00 | 3.50 | 2.50 |
| $1\frac{1}{4}$ | 5.25 | 3.88 | $\frac{3}{4}$ | 4 | $\frac{5}{8}$ | 3.25 | 3.75 | 2.75 |
| $1\frac{1}{2}$ | 6.12 | 4.50 | $\frac{7}{8}$ | 4 | $\frac{3}{4}$ | 3.50 | 4.00 | 3.00 |
| 2 | 6.50 | 5.00 | $\frac{3}{4}$ | 8 | $\frac{5}{8}$ | 3.50 | 4.00 | 3.00 |
| $2\frac{1}{2}$ | 7.50 | 5.88 | $\frac{7}{8}$ | 8 | $\frac{3}{4}$ | 4.00 | 4.50 | 3.25 |
| 3 | 8.25 | 6.62 | $\frac{7}{8}$ | 8 | $\frac{3}{4}$ | 4.25 | 4.75 | 3.50 |
| $3\frac{1}{2}$ | 9.00 | 7.25 | $\frac{7}{8}$ | 8 | $\frac{3}{4}$ | 4.25 | 5.00 | 3.75 |
| 4 | 10.00 | 7.88 | $\frac{7}{8}$ | 8 | $\frac{3}{4}$ | 4.50 | 5.00 | 3.75 |
| 5 | 11.00 | 9.25 | $\frac{7}{8}$ | 8 | $\frac{3}{4}$ | 4.75 | 5.25 | 4.25 |
| 6 | 12.50 | 10.62 | $\frac{7}{8}$ | 12 | $\frac{3}{4}$ | 4.75 | 5.50 | 4.25 |
| 8 | 15.00 | 13.00 | 1 | 12 | $\frac{7}{8}$ | 5.50 | 6.00 | 4.75 |
| 10 | 17.50 | 15.25 | $1\frac{1}{8}$ | 16 | 1 | 6.25 | 6.75 | 5.50 |
| 12 | 20.50 | 17.75 | $1\frac{1}{4}$ | 16 | $1\frac{1}{8}$ | 6.75 | 7.25 | 5.75 |
| 14 | 23.00 | 20.25 | $1\frac{1}{4}$ | 20 | $1\frac{1}{8}$ | 7.00 | 7.50 | 6.25 |
| 16 | 25.50 | 22.50 | $1\frac{3}{8}$ | 20 | $1\frac{1}{4}$ | 7.50 | 8.00 | 6.50 |
| 18 | 28.00 | 24.75 | $1\frac{3}{8}$ | 24 | $1\frac{1}{4}$ | 7.75 | 8.25 | 6.75 |
| 20 | 30.50 | 27.00 | $1\frac{3}{8}$ | 24 | $1\frac{1}{4}$ | 8.00 | 8.75 | 7.25 |
| 24 | 36.00 | 32.00 | $1\frac{5}{8}$ | 24 | $1\frac{1}{2}$ | 9.00 | 10.00 | 8.00 |

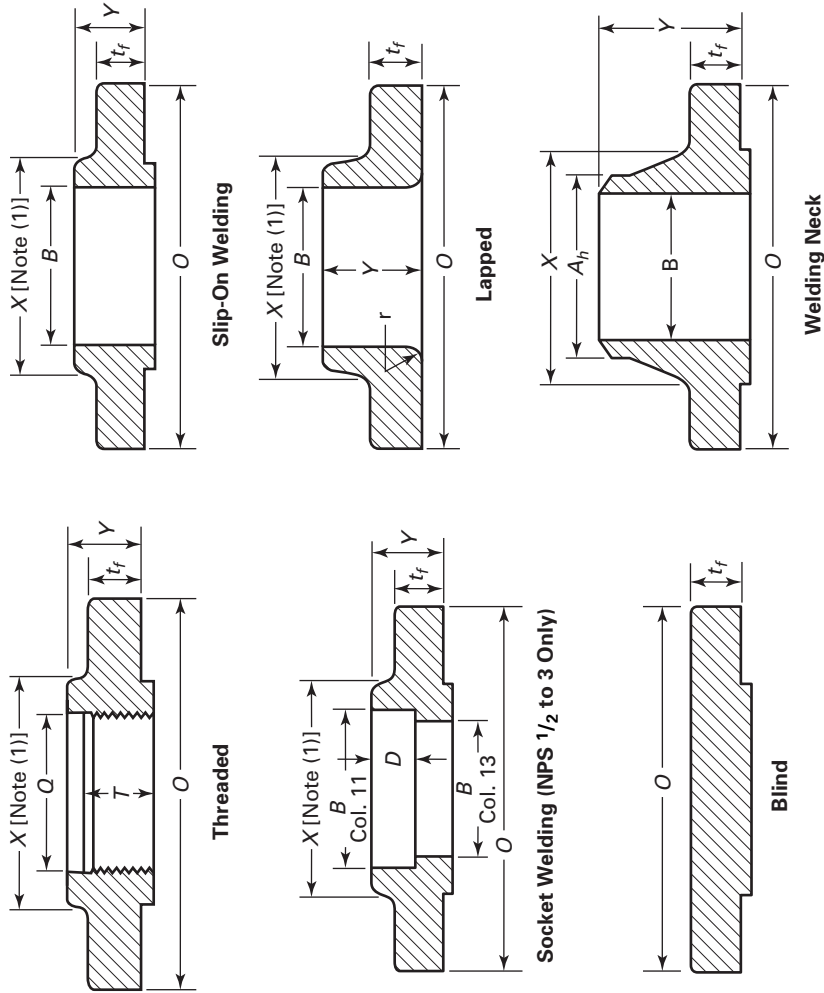
GENERAL NOTES:

- (a) Dimensions are in inches.
 (b) For other dimensions see, Tables II-11 and II-12.

NOTES:

- (1) The length of the 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 Nonmandatory Appendix C (see para. 6.10.2).

Table II-11 Dimensions of Class 300 Flanges



| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 |
|-------------------|-------------------------------|--|-------------------------------|--------------------|---|------------------------------------|-------------------------------|-----------------|--|-----------------------------------|------------------------|---|---|---|--------------------|
| Nominal Pipe Size | Outside Diameter of Flange, O | Minimum Thickness of Flange, t_f [Notes (2)-(4)] | Thickness of Lap Joint, t_f | Diameter of Hub, X | Diameter Beginning of Chamfer, Welding Neck, A_h [Note (5)] | Threaded Slip-On Socket Welding, Y | Length Through Hub, Lapped, Y | Welding Neck, Y | Minimum Thread Length Threaded, T [Note (5)] | Minimum Slip-On Socket Welding, B | Bore Minimum Lapped, B | Welding Neck/Socket Welding, B [Note (6)] | Corner Bore Radius of Lapped Flange and Pipe, r | Minimum Counter-bore Threaded Flange, Q | Depth of Socket, D |
| 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 |

Table II-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 Pipe Size | Outside Diameter of Flange, O | Minimum Thickness of Flange, t _f [Notes (2)–(4)] | Minimum Thickness of Lap Joint, t _l | Diameter of Hub, X | Beginning of Chamfer Welding Neck, A _h [Note (5)] | Threaded Slip-On Socket Welding, Y | Lapped, Y | Welding Neck, Y | Minimum Thread Length Threaded, T [Note (5)] | Minimum Slip-On Socket Welding, B | Bore | Welding Neck/ Socket Welding, B [Note (6)] | Corner Bore Radius of Lapped Flange and Pipe, r | Minimum Counter- bore Threaded Flange, Q | Depth of Socket, D |
| 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 | Note (7) | 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 | Note (7) | 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 | Note (7) | 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 | Note (7) | 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 | Note (7) | 0.50 | 24.19 | ... |

GENERAL NOTES:

- (a) Dimensions of Table II-11 are in inches.
 (b) For tolerances, see section 7.
 (c) For facings, see para. 6.4.
 (d) For flange bolt holes, see para. 6.5 and Table II-10.
 (e) For spot facing, see para. 6.6.
 (f) For reducing threaded and slip-on flanges, see Table II-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.

Table II-11 Dimensions of Class 300 Flanges (Cont'd)**NOTES:**

- (1) This dimension is for the large end of the 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 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 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.
- (7) To be specified by the Purchaser.

Table II-12 Dimensions of Class 300 Flanged Fittings

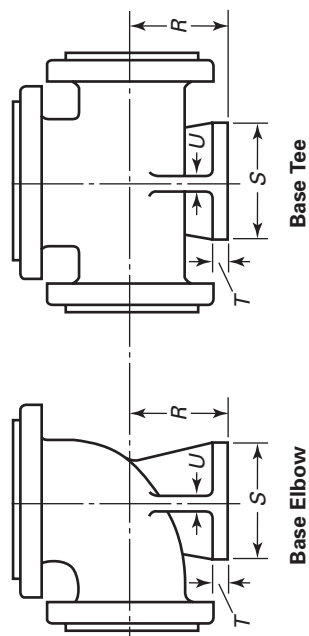
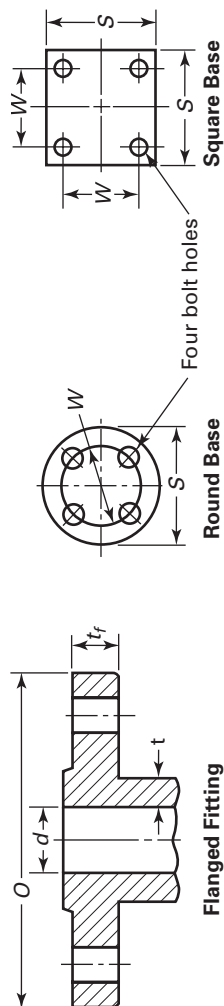
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
|------------------------|---|-------|-------|---|-------|---|-------|---|---|----|----|----|
| Nominal Pipe Size, NPS | | | | | | | | | | | | |
| | 1 | 1 1/4 | 1 1/2 | 2 | 2 1/2 | 3 | 3 1/2 | 4 | 5 | 6 | 8 | 10 |

| Nominal Pipe Size, NPS | Outside Diameter of Flange, O | Minimum Thickness of Flange, t _f [Notes (1)–(3)] | Minimum Wall Thickness of Fitting, t _m | Inside Diameter of Fitting, d | 0.06-in. Raised Face (Flange Edge) [Note (4)] | | | | | | | | | | Ring Joint [Note (2)] |
|------------------------|-------------------------------|--|---|-------------------------------|--|------|------|-------|------|---|------|---|--|--|-----------------------|
| | | | | | Center-to-Contact Surface of Raised Face Elbow, Tee, Cross, and True “Y,” AA | | | | | Short Contact Surface-to-Contact Surface of Raised Face Reducer, GG FF True “Y,” EE Face Lateral, CC 45-deg Elbow, BB Face Long Radius | | | | | |
| 1 | 4.88 | 0.62 | 0.19 | 1.00 | 4.00 | 5.00 | 2.25 | 6.50 | 2.00 | 4.50 | 4.25 | End Elbow Tee, Cross, and True “Y,” HH [Note (4a)] | | | |
| 1¼ | 5.25 | 0.69 | 0.19 | 1.25 | 4.25 | 5.50 | 2.50 | 7.25 | 2.25 | 4.50 | 4.50 | | | | |
| 1½ | 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 | | | | |
| 2½ | 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 | | | | |
| 3½ | 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 II-12 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 | Minimum Thickness of Flange, t_f [Notes (1)–(3)] | Minimum Wall Thickness of Fitting, t_m | Inside Diameter of Fitting, d | 0.06-in. Raised Face (Flange Edge) [Note (4)] | | | | | | |
| | | | | | Center-to-Contact | | Center-to-Contact | | Short | | Ring Joint [Note (2)] |
| | | | | | 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 | Center-to-Contact Surface of Raised Face Lateral and True "Y," FF | Contact Surface-to-Contact Face Reducer, GG | Center-to-End Elbow Tee, Cross, and True "Y," HH [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 II-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)] | | | | | | | | | | | |
| Center-to-End Long Radius Elbow, JJ [Note (6)] | Center-to-End 45-deg Elbow, KK [Note (6)] | Long Center-to-End Lateral, LL [Note (6)] | Short Center-to-End Lateral and True "Y," MM [Note (6)] | End-to-End Reducer, NN [Notes (4), (6)] | Center-to-Base, R [Notes (7)–(9)] | Diameter of Round Base or Width of Square Base, S [Note (7)] | Thickness of Base, T [Notes (7)–(10)] | Thickness of Ribs, U [Note (7)] | Base Drilling [Note (11)] | | Nominal Pipe Size, NPS |
| | | | | | | | | | Bolt Circle or Bolt Spacing, W | Diameter of Drilled 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 II-12 Dimensions of Class 300 Flanged Fittings (Cont'd)

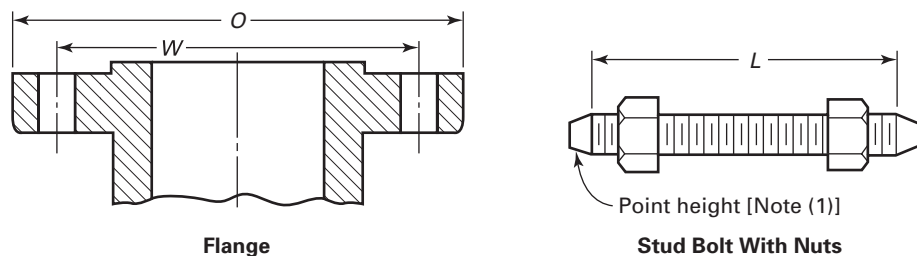
| 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 1 |
|---|--|--|--|--|--------------------------------------|---|--|------------------------------------|--------------------------------|---------------------------|------------------------|
| Ring Joint [Note (4)] | | | | | | | | | | | |
| Center-to-End Long Radius Elbow, JJ [Note (6)] | Center-to-End 45-deg Elbow, KK [Note (6)] | Long Center-to-End Lateral, LL [Note (6)] | Short Center-to-End Lateral and True "Y," MM [Note (6)] | End-to-End Reducer, NN [Notes (4), (6)] | Center-to-Base, R [Notes (7)–(9)] | Diameter of Round Base or Width of Square Base, S [Note (7)] | Thickness of Base, T [Notes (7)–(10)] | Thickness of Ribs, U [Note (7)] | Base Drilling [Note (11)] | | |
| | | | | | | | | | Bolt Circle or Bolt Spacing, W | Diameter of Drilled Holes | Nominal Pipe Size, NPS |
| | | | | | | | | | | | |
| 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 II-12 are in inches.
- For tolerances, see section 7.
- For facings, see para. 6.4.
- For flange bolt holes, see para. 6.5 and Table II-10.
- 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 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 the flange dimension illustrated is for regularly furnished 0.06-in. raised face (except lapped); for thickness requirements of other facings, see Fig. II-7.
- 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 that are reinforced by being cast integral with the body of fitting.
- For contact surface-to-contact surface and end-to-end dimensions of reducers and eccentric reducers, see para. 6.2.3.
- 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 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 the largest opening, and add the proper height to provide for the ring joint groove applying to each flange. See Table II-5 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.

Table II-13 Templates for Drilling Class 400 Flanges

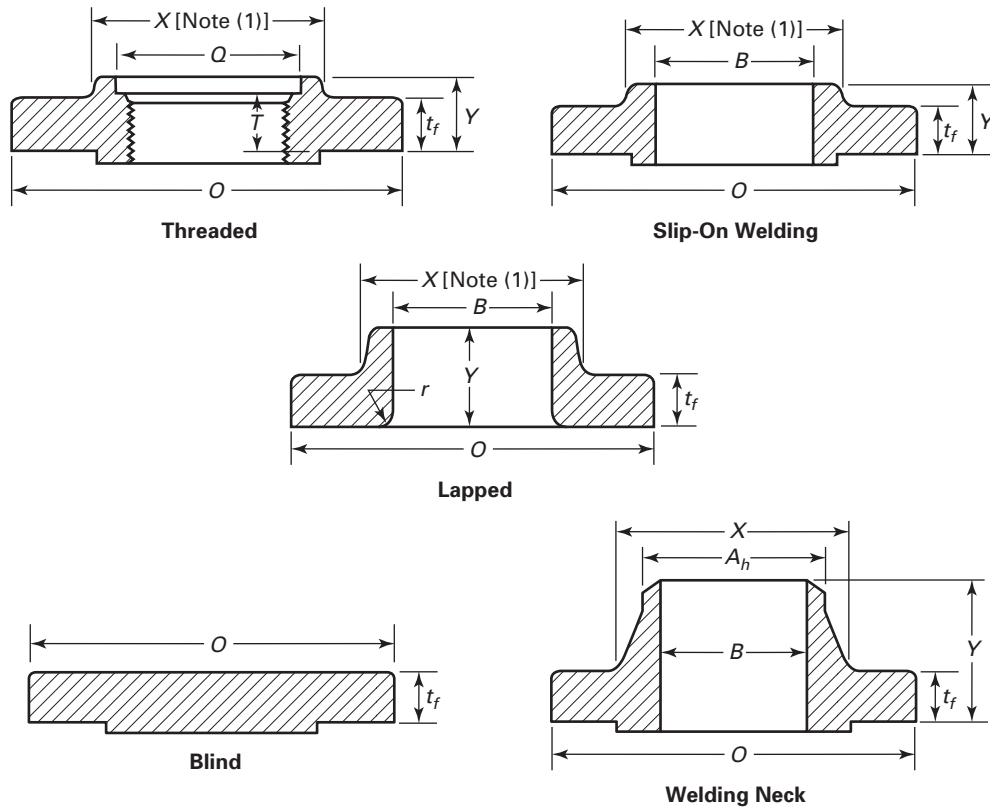
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|---|---|----------------------------------|---------------------------|--------------------|----------------------|---|---|---------------|
| Nominal Pipe Size | Outside Diameter of Flange, O | Drilling [Notes (2), (3)] | | | | Length of Bolts, L [Notes (1), (4)] | | |
| | | 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 |
| | | | | | | | | |
| 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 II-14.

NOTES:

- (1) The length of the 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 Nonmandatory Appendix C (see para. 6.10.2).

Table II-14 Dimensions of Class 400 Flanges

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 |
|--|------------------------------|---------------------------------|-------------------|--|-----------------------|-------------|-------------------|---|-------------------|------------------|-------------------|---|--|
| Nom. Pipe Size | Outside Diam. of Flange, O | Min. Thickness of Flange, t_f | Diam. of Hub, X | Hub Diam. Beginning of Chamfer of Neck, A_h [Note (2)] | Length Through Hub | | | Minimum Thread Length Threaded Flange, T [Note (3)] | Bore | | | Corner Bore Radius of Lapped Flange and Pipe, r | Minimum Counterbore Threaded Flange, Q |
| | | | | | Threaded Slip-On, Y | Lapped, Y | Welding Neck, Y | | Min. Slip-On, B | Min. Lapped, B | Welding Neck, B | | |
| $\frac{1}{2}$ | | | | | | | | | | | | | |
| $\frac{3}{4}$ | | | | | | | | | | | | | |
| 1 | | | | | | | | | | | | | |
| $1\frac{1}{4}$ | | | | | | | | | | | | | |
| $1\frac{1}{2}$ | | | | | | | | | | | | | |
| 2 | | | | | | | | | | | | | |
| $2\frac{1}{2}$ | | | | | | | | | | | | | |
| 3 | | | | | | | | | | | | | |
| $3\frac{1}{2}$ | | | | | | | | | | | | | |
| Use Class 600 dimensions in these sizes [Note (4)] | | | | | | | | | | | | | |
| 4 | 10.00 | 1.38 | 5.75 | 4.50 | 2.00 | 2.00 | 3.50 | 1.44 | 4.57 | 4.60 | Note (5) | 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 | Note (5) | 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 | Note (5) | 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 | Note (5) | 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 | Note (5) | 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 | Note (5) | 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 | Note (5) | 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 | Note (5) | 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 | Note (5) | 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 | Note (5) | 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 | Note (5) | 0.50 | 24.19 |

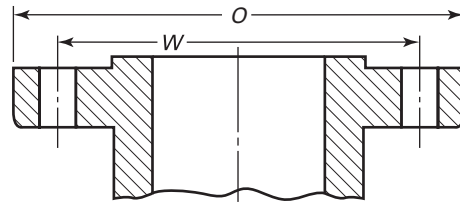
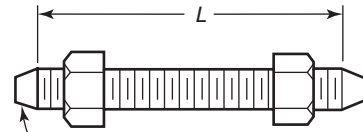
Table II-14 Dimensions of Class 400 Flanges (Cont'd)

GENERAL NOTES:

- (a) Dimensions are in inches.
- (b) For tolerances, see section 7.
- (c) For facings, see para. 6.4.
- (d) For flange bolt holes, see para. 6.5 and Table II-13.
- (e) For spot facing, see para. 6.6.
- (f) For reducing threaded and slip-on flanges, see Table II-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 the large end of the hub, which may be straight or tapered. Taper shall not exceed 7 deg on threaded, slip-on, and lapped flanges.
- (2) For welding end bevel, see para. 6.7.
- (3) For thread in threaded flanges, see para. 6.9.
- (4) Socket welding flanges may be provided in NPS $\frac{1}{2}$ through $2\frac{1}{2}$ using Class 600 dimensions.
- (5) To be specified by the Purchaser.

Table II-15 Templates for Drilling Class 600 Pipe Flanges and Flanged Fittings**Flange**

Point height [Note (1)]

Stud Bolt With Nuts

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|----------------------|---|---|---------------------------|--------------------|----------------------|--|---------------------------------------|------------|
| Nominal Pipe Size | Outside Diameter of Flange, <i>O</i> | Drilling [Notes (2), (3)] | | | | Length of Bolts, <i>L</i> [Notes (1), (4)] | | |
| | | Diameter of Bolt Circle, <i>W</i> | Diameter of Bolt Holes | Number of Bolts | Diameter of Bolts | Raised Face 0.25 in. | Male and Female/ 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 |

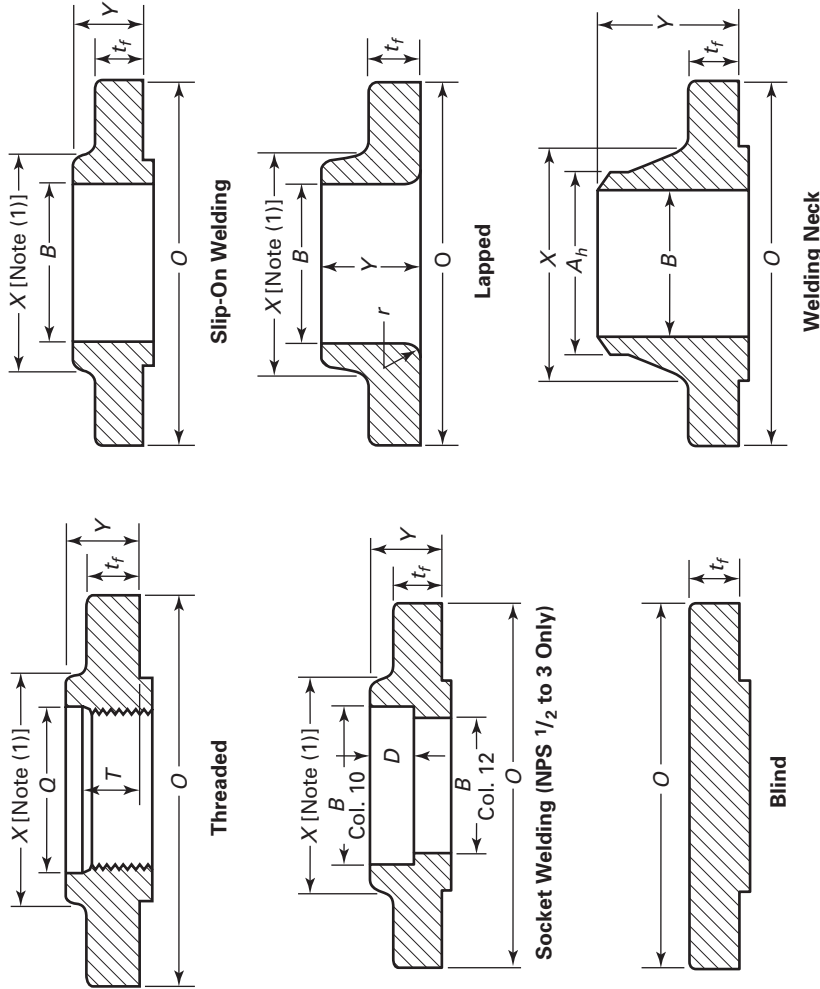
GENERAL NOTES:

- (a) Dimensions are in inches.
 (b) For other dimensions, see Table II-16.

NOTES:

- (1) The length of the 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 Nonmandatory Appendix C (see para. 6.10.2).

Table II-16 Dimensions of Class 600 Flanges



| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | |
|----------------------|---|--|---------------------------------|--|--------------------|---|---------------------|--|------------------------------|--|--|--|--|------------------------------------|--------------------------------|
| Nominal Pipe Size | Outside Diameter of Flange, <i>O</i> | Minimum Thickness of Flange, <i>t_f</i> | Diameter of Hub, <i>X</i> | Hub Diameter Beginning of Chamfer Welding Neck, <i>A_h</i> [Note (2)] | Length Through Hub | | | Minimum Thread Length Threaded Flange, <i>T</i> [Note (3)] | Bore | | Welding Neck/ Socket Welding, <i>B</i> | Corner Bore Radius of Lapped Flange and Pipe, <i>r</i> | Minimum Counter- bore Threaded Flange, <i>Q</i> | Depth of Socket, <i>D</i> | |
| | | | | | Threaded | Slip-On Socket Welding, <i>Y</i> | Lapped, <i>Y</i> | | Welding Neck, <i>Y</i> | Minimum Slip-On Socket Welding, <i>B</i> | | | | | Minimum Lapped, <i>B</i> |
| | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | |
| 1½ | 3.75 | 0.56 | 1.50 | 0.84 | 0.88 | 0.88 | 2.06 | 0.62 | 0.88 | 0.90 | Note (4) | 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 | Note (4) | 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 | Note (4) | 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 | Note (4) | 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 | Note (4) | 0.25 | 1.99 | 0.62 | |

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

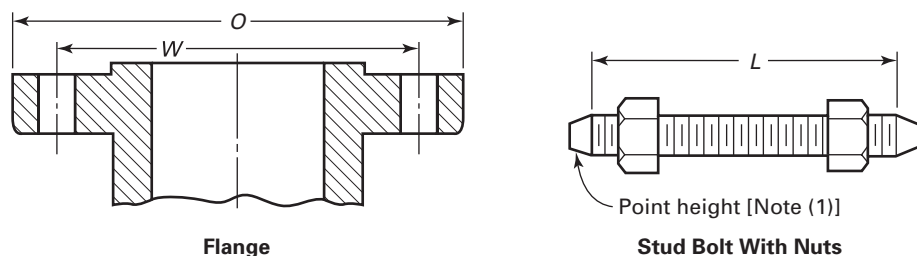
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
|----------------------|---|--|---------------------------------|--|--------------------|---|---------------------|--|--|--|--|--|------------------------------------|------|
| Nominal Pipe Size | Outside Diameter of Flange, <i>O</i> | Minimum Thickness of Flange, <i>t_f</i> | Diameter of Hub, <i>X</i> | Hub Diameter Beginning of Chamfer Welding Neck, <i>A_h</i> [Note (2)] | Length Through Hub | | | Minimum Thread Length Threaded Flange, <i>T</i> [Note (3)] | Bore | | Corner Bore Radius of Lapped Flange and Pipe, <i>r</i> | Minimum Counter- bore Threaded Flange, <i>Q</i> | Depth of Socket, <i>D</i> | |
| | | | | | Threaded | Welding Neck, <i>Y</i> | | | Minimum Slip-On Socket Welding, <i>B</i> | Welding Neck/ Socket Welding, <i>B</i> | | | | |
| | | | | | | Slip-On Socket Welding, <i>Y</i> | Lapped, <i>Y</i> | | | | | | | |
| | | | | | | | | | | | | | | |
| 2 | 6.50 | 1.00 | 3.31 | 2.38 | 1.44 | 1.44 | 2.88 | 1.12 | 2.44 | 2.46 | Note (4) | 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 | Note (4) | 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 | Note (4) | 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 | Note (4) | 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 | Note (4) | 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 | Note (4) | 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 | Note (4) | 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 | Note (4) | 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 | Note (4) | 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 | Note (4) | 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 | Note (4) | 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 | Note (4) | 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 | Note (4) | 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 | Note (4) | 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 | Note (4) | 0.50 | 24.19 | ... |

GENERAL NOTES:

- Dimensions are in inches.
- For tolerances, see section 7.
- For facings, see para. 6.4.
- For flange bolt holes, see para. 6.5 and Table II-15.
- For spot facing, see para. 6.6.
- For reducing threaded and slip-on flanges, see Table II-6.
- 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 the large end of the 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.
- To be specified by the Purchaser.

Table II-17 Templates for Drilling Class 900 Pipe Flanges and Flanged Fittings

| 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 |

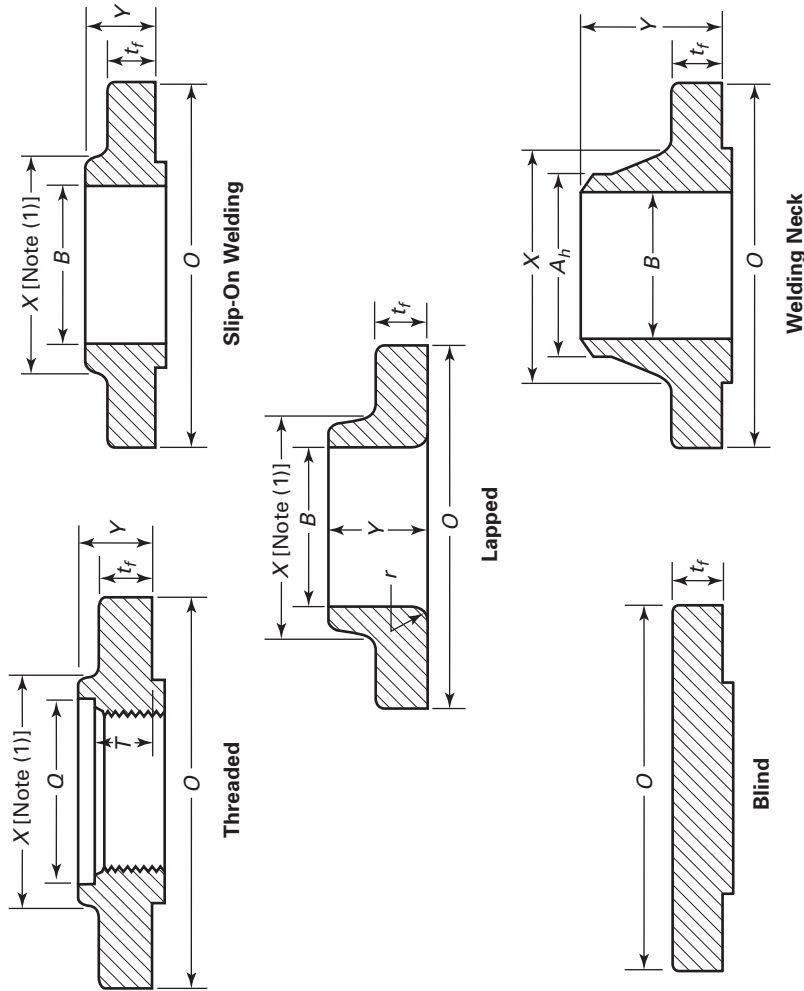
GENERAL NOTES:

- (a) Dimensions are in inches.
 (b) For other dimensions, see Table II-18 and II-19.

NOTES:

- (1) The length of the 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 Nonmandatory Appendix C (see para. 6.10.2).

Table II-18 Dimensions of Class 900 Flanges



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

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

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

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 |
|----------------------|---|---|----------------------------|---|-----------------------------|----------------|-------------------------|--|----------------------------|---------------------------|-------------------------|--|--|
| Nominal Pipe Size | Outside Diameter of Flange, O | Minimum Thickness of Flange, t_f | Diameter of Hub, X | Hub Diameter Beginning of Chamfer Welding Neck, A_h [Note (2)] | Length Through Hub | | | Minimum Thread Length Threaded Flange, T [Note (3)] | Bore | | Welding Neck, B | Corner Bore Radius of Lapped Flange and Pipe, r | Minimum Counterbore Threaded Flange, Q |
| | | | | | Threaded Slip-On, Y | Lapped, Y | Welding Neck, Y | | Minimum Slip-On, B | Minimum Lapped, B | | | |
| 3 | 9.50 | 1.50 | 5.00 | 3.50 | 2.12 | 2.12 | 4.00 | 1.62 | 3.57 | 3.60 | Note (5) | 0.38 | 3.63 |
| 4 | 11.50 | 1.75 | 6.25 | 4.50 | 2.75 | 2.75 | 4.50 | 1.88 | 4.57 | 4.60 | Note (5) | 0.44 | 4.63 |
| 5 | 13.75 | 2.00 | 7.50 | 5.56 | 3.12 | 3.12 | 5.00 | 2.12 | 5.66 | 5.69 | Note (5) | 0.44 | 5.69 |
| 6 | 15.00 | 2.19 | 9.25 | 6.63 | 3.38 | 3.38 | 5.50 | 2.25 | 6.72 | 6.75 | Note (5) | 0.50 | 6.75 |
| 8 | 18.50 | 2.50 | 11.75 | 8.63 | 4.00 | 4.50 | 6.38 | 2.50 | 8.72 | 8.75 | Note (5) | 0.50 | 8.75 |
| 10 | 21.50 | 2.75 | 14.50 | 10.75 | 4.25 | 5.00 | 7.25 | 2.81 | 10.88 | 10.92 | Note (5) | 0.50 | 10.88 |
| 12 | 24.00 | 3.12 | 16.50 | 12.75 | 4.62 | 5.62 | 7.88 | 3.00 | 12.88 | 12.92 | Note (5) | 0.50 | 12.94 |
| 14 | 25.25 | 3.38 | 17.75 | 14.00 | 5.12 | 6.12 | 8.38 | 3.25 | 14.14 | 14.18 | Note (5) | 0.50 | 14.19 |
| 16 | 27.75 | 3.50 | 20.00 | 16.00 | 5.25 | 6.50 | 8.50 | 3.38 | 16.16 | 16.19 | Note (5) | 0.50 | 16.19 |
| 18 | 31.00 | 4.00 | 22.25 | 18.00 | 6.00 | 7.50 | 9.00 | 3.50 | 18.18 | 18.20 | Note (5) | 0.50 | 18.19 |
| 20 | 33.75 | 4.25 | 24.50 | 20.00 | 6.25 | 8.25 | 9.75 | 3.62 | 20.20 | 20.25 | Note (5) | 0.50 | 20.19 |
| 24 | 41.00 | 5.50 | 29.50 | 24.00 | 8.00 | 10.50 | 11.50 | 4.00 | 24.25 | 24.25 | Note (5) | 0.50 | 24.19 |

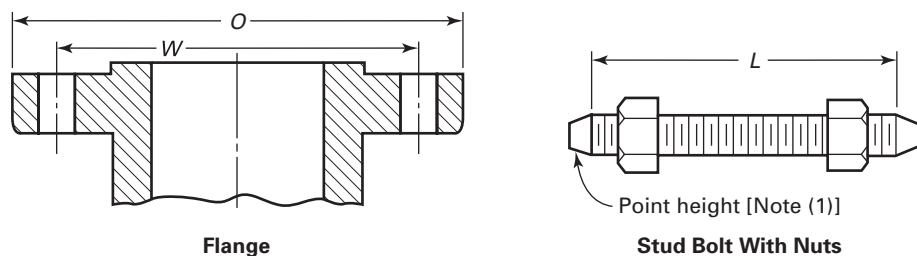
GENERAL NOTES:

- Dimensions are in inches.
- For tolerances, see section 7.
- For facings, see para. 6.4.
- For flange bolt holes, see para. 6.5 and Table II-17.
- For spot facing, see para. 6.6.
- For reducing threaded and slip-on flanges, see Table II-6.
- 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 the large end of the 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 $\frac{1}{2}$ through 2 $\frac{1}{2}$ using Class 1500 dimensions.
- To be specified by the Purchaser.

Table II-19 Templates for Drilling Class 1500 Pipe Flanges



| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|----------------------|---|---|---------------------------|--------------------|----------------------|--|---------------------------------------|------------|---|
| | | | | | | Length of Bolts, <i>L</i> [Notes (1), (4)] | | | |
| | Drilling [Notes (2), (3)] | | | | | | | | |
| Nominal Pipe Size | Outside Diameter of Flange, <i>O</i> | Diameter of Bolt Circle, <i>W</i> | Diameter of Bolt Holes | Number of Bolts | Diameter of Bolts | Raised Face 0.25 in. | Male and Female/ 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 | 11.75 | |
| 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 | |

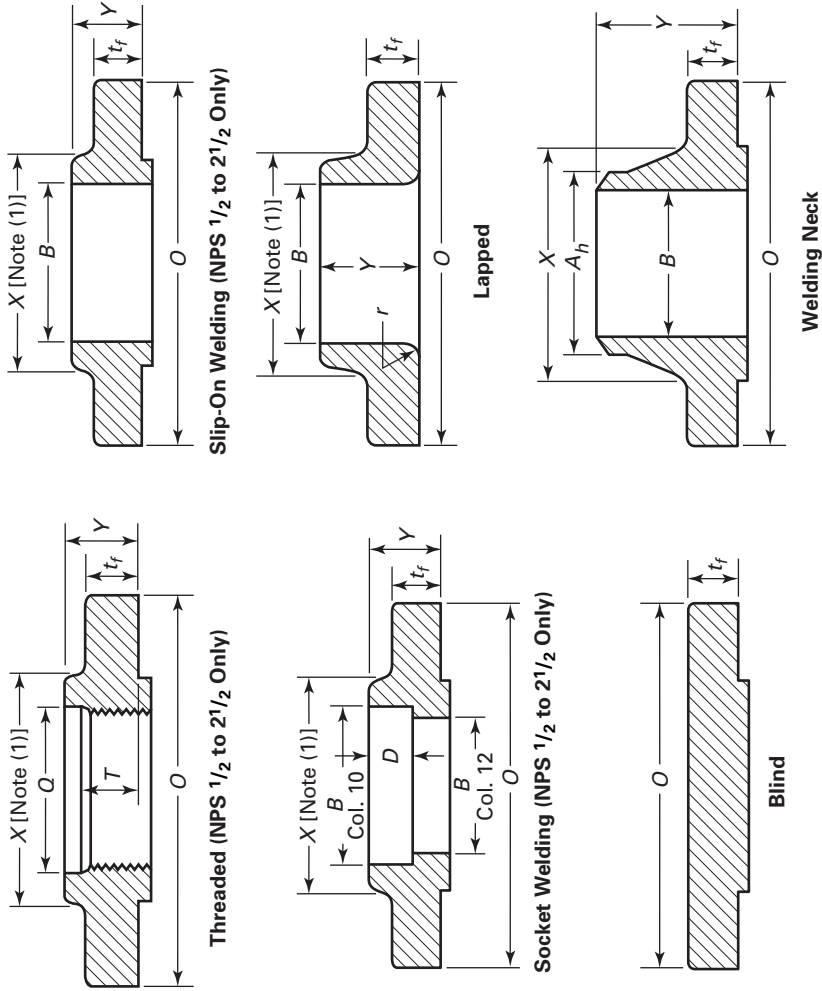
GENERAL NOTES:

- (a) Dimensions are in inches.
 (b) For other dimensions, see Table II-20.

NOTES:

- (1) The length of the 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 Nonmandatory Appendix C (see para. 6.10.2).

Table II-20 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 | Minimum Thickness of Flange, t _f | Diameter of Hub, X | Hub Diameter Beginning Chamfer, A _h | Length Through Hub | Threaded Slip-On Socket | Welding Neck, Y | Threaded Flange, T | Minimum Slip-On Socket Welding, B | Bore Minimum Lapped, B | Welding Neck/Socket Welding, B | Corner Bore Radius of Lapped Flange and Pipe, r | Minimum Counterbore Threaded Flange, 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 | Note (4) | 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 | Note (4) | 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 | Note (4) | 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 | Note (4) | 0.19 | 1.75 | 0.56 |

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

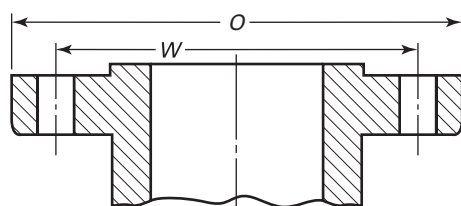
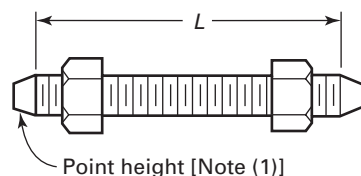
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | |
|----------------------|--|--|---------------------------------|---|---|---|--------------------|------------------------------|---|--|--------------------------------|---|---|---------------------------------|--|
| Nominal Pipe Size | Outside Diameter of Flange, <i>O</i> | Minimum Thickness of Flange, <i>t_f</i> | Diameter of Hub, <i>X</i> | Hub Diameter | | Length Through Hub | | | Minimum Thread Length Threaded Flange, <i>T</i> [Note (3)] | Bore | | Corner Bore Radius of Lapped Flange and Pipe, <i>r</i> | Minimum Counterbore Threaded Flange, <i>Q</i> | Depth of Socket, <i>D</i> | |
| | | | | Beginning of Chamfer <i>A_n</i> [Note (2)] | Welding Neck, <i>A_n</i> [Note (2)] | Threaded Slip-On Socket Welding, <i>Y</i> | Lapped <i>Y</i> | Welding Neck, <i>Y</i> | | Minimum Slip-On Socket Welding, <i>B</i> | Minimum Lapped, <i>B</i> | | | | Welding Neck/ Socket Welding, <i>B</i> |
| | | | | | | | | | | | | | | | |
| 1½ | 7.00 | 1.25 | 2.75 | 1.90 | 1.75 | 1.75 | 3.25 | 1.25 | 1.95 | 1.97 | Note (4) | 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 | Note (4) | 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 | Note (4) | 0.31 | 3.00 | 0.75 | |
| 3 | 10.50 | 1.88 | 5.25 | 3.50 | ... | 2.88 | 4.62 | ... | ... | 3.60 | Note (4) | 0.38 | ... | ... | |
| 4 | 12.25 | 2.12 | 6.38 | 4.50 | ... | 3.56 | 4.88 | ... | ... | 4.60 | Note (4) | 0.44 | ... | ... | |
| 5 | 14.75 | 2.88 | 7.75 | 5.56 | ... | 4.12 | 6.12 | ... | ... | 5.69 | Note (4) | 0.44 | ... | ... | |
| 6 | 15.50 | 3.25 | 9.00 | 6.63 | ... | 4.69 | 6.75 | ... | ... | 6.75 | Note (4) | 0.50 | ... | ... | |
| 8 | 19.00 | 3.62 | 11.50 | 8.63 | ... | 5.62 | 8.38 | ... | ... | 8.75 | Note (4) | 0.50 | ... | ... | |
| 10 | 23.00 | 4.25 | 14.50 | 10.75 | ... | 7.00 | 10.00 | ... | ... | 10.92 | Note (4) | 0.50 | ... | ... | |
| 12 | 26.50 | 4.88 | 17.75 | 12.75 | ... | 8.62 | 11.12 | ... | ... | 12.92 | Note (4) | 0.50 | ... | ... | |
| 14 | 29.50 | 5.25 | 19.50 | 14.00 | ... | 9.50 | 11.75 | ... | ... | 14.18 | Note (4) | 0.50 | ... | ... | |
| 16 | 32.50 | 5.75 | 21.75 | 16.00 | ... | 10.25 | 12.25 | ... | ... | 16.19 | Note (4) | 0.50 | ... | ... | |
| 18 | 36.00 | 6.38 | 23.50 | 18.00 | ... | 10.88 | 12.88 | ... | ... | 18.20 | Note (4) | 0.50 | ... | ... | |
| 20 | 38.75 | 7.00 | 25.25 | 20.00 | ... | 11.50 | 14.00 | ... | ... | 20.25 | Note (4) | 0.50 | ... | ... | |
| 24 | 46.00 | 8.00 | 30.00 | 24.00 | ... | 13.00 | 16.00 | ... | ... | 24.25 | Note (4) | 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 II-19.
- For spot facing, see para. 6.6.
- For reducing threaded and slip-on flanges, see Table II-6.
- 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 the large end of the 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.
- To be specified by the Purchaser.

Table II-21 Templates for Drilling Class 2500 Pipe Flanges**Flange****Stud Bolt With Nuts**

| 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 |
| 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 |

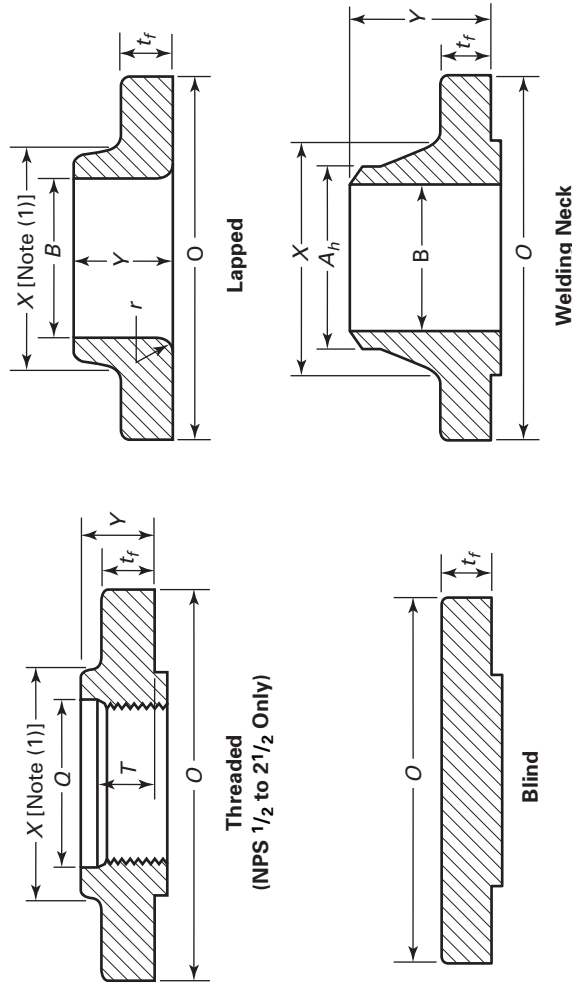
GENERAL NOTES:

- (a) Dimensions are in inches.
 (b) For other dimensions, see Table II-22.

NOTES:

- (1) The length of the 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 Nonmandatory Appendix C (see para. 6.10.2).

Table II-22 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 | Minimum Thickness of Flange, t_f | Diameter of Hub, X | Hub Diameter Beginning of Chamfer, A_h | Length Through Hub | Length Through Hub | Welding Neck, Y | Minimum Threaded Flange, T | Minimum Lapped, B | Bore | Corner Bore Radius of Lapped Flange and Pipe, r | Minimum Counterbore Threaded Flange, Q |
| | | | | [Note (2)] | Threaded, Y | Lapped, Y | | [Note (3)] | | Welding Neck, B | | |
| 1/2 | 5.25 | 1.19 | 1.69 | 0.84 | 1.56 | 1.56 | 2.88 | 1.12 | 0.90 | Note (4) | 0.12 | 0.93 |
| 3/4 | 5.50 | 1.25 | 2.00 | 1.05 | 1.69 | 1.69 | 3.12 | 1.25 | 1.11 | Note (4) | 0.12 | 1.14 |
| 1 | 6.25 | 1.38 | 2.25 | 1.32 | 1.88 | 1.88 | 3.50 | 1.38 | 1.38 | Note (4) | 0.12 | 1.41 |
| 1 1/4 | 7.25 | 1.50 | 2.88 | 1.66 | 2.06 | 2.06 | 3.75 | 1.50 | 1.72 | Note (4) | 0.19 | 1.75 |
| 1 1/2 | 8.00 | 1.75 | 3.12 | 1.90 | 2.38 | 2.38 | 4.38 | 1.75 | 1.97 | Note (4) | 0.25 | 1.99 |
| 2 | 9.25 | 2.00 | 3.75 | 2.38 | 2.75 | 2.75 | 5.00 | 2.00 | 2.46 | Note (4) | 0.31 | 2.50 |
| 2 1/2 | 10.50 | 2.25 | 4.50 | 2.88 | 3.12 | 3.12 | 5.62 | 2.25 | 2.97 | Note (4) | 0.31 | 3.00 |
| 3 | 12.00 | 2.62 | 5.25 | 3.50 | ... | 3.62 | 6.62 | ... | 3.60 | Note (4) | 0.38 | ... |
| 4 | 14.00 | 3.00 | 6.50 | 4.50 | ... | 4.25 | 7.50 | ... | 4.60 | Note (4) | 0.44 | ... |
| 5 | 16.50 | 3.62 | 8.00 | 5.56 | ... | 5.12 | 9.00 | ... | 5.69 | Note (4) | 0.44 | ... |
| 6 | 19.00 | 4.25 | 9.25 | 6.63 | ... | 6.00 | 10.75 | ... | 6.75 | Note (4) | 0.50 | ... |
| 8 | 21.75 | 5.00 | 12.00 | 8.63 | ... | 7.00 | 12.50 | ... | 8.75 | Note (4) | 0.50 | ... |
| 10 | 26.50 | 6.50 | 14.75 | 10.75 | ... | 9.00 | 16.50 | ... | 10.92 | Note (4) | 0.50 | ... |
| 12 | 30.00 | 7.25 | 17.38 | 12.75 | ... | 10.00 | 18.25 | ... | 12.92 | Note (4) | 0.50 | ... |

Table II-22 Dimensions of Class 2500 Flanges (Cont'd)

GENERAL NOTES:

- (a) Dimensions are in inches.
- (b) For tolerances, see section 7.
- (c) For facings, see para. 6.4.
- (d) For flange bolt holes, see para. 6.5 and Table II-21.
- (e) For spot facing, see para. 6.6.
- (f) For reducing threaded and slip-on flanges, see Table II-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 the large end of the 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.
- (4) To be specified by the Purchaser.

MANDATORY APPENDIX III

REFERENCES

The following is a list of standards and specifications referenced in this Standard. Products covered by each ASTM specification are listed for convenience. (See specifications for exact titles and detailed contents.)

ASME B1.1, Unified Inch Screw Threads (UN and UNR Thread Form)
 ASME B1.20.1, Pipe Threads, General Purpose (Inch)
 ASME B16.20, Metallic Gaskets for Pipe Flanges: Ring-Joint, Spiral-Wound, and Jacketed
 ASME B16.21, Nonmetallic Flat Gaskets for Pipe Flanges
 ASME B16.25, Buttwelding Ends
 ASME B16.34, Valves—Flanged, Threaded, and Welding End
 ASME B18.2.1, Square and Hex Bolts and Screws (Inch Series)
 ASME B18.2.2, Square and Hex Nuts (Inch Series)
 ASME PCC-1, Guidelines for Pressure Boundary Bolted Flange Joint Assembly
 ASME B36.10M, Welded and Seamless Wrought Steel Pipe
 ASME B46.1, Surface Texture (Surface Roughness, Waviness, and Lay)

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) Three Park Avenue, New York, NY 10016-5990; Order Department: 22 Law Drive, P.O. Box 2300, Fairfield, NJ 07007-2300

A 105-2005, Carbon Steel Forgings for Piping Applications
 A 106-2006a, Seamless Carbon Steel Pipe for High-Temperature Service
 A 182-2007, Forged or Rolled Alloy-Steel Pipe Flanges, Forged Fittings, and Valves and Parts for High Temperature Service
 A 193-2007, Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature or High-Pressure Service and Other Special Purpose Applications
 A 194-2007a, 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 204-2003, Pressure Vessel Plates, Alloy Steel, Molybdenum

A 216-2007, Steel Castings, Carbon, Suitable for Fusion Welding, for High-Temperature Service
 A 217-2007, Steel Castings, Martensitic Stainless and Alloy, for Pressure Containing Parts, Suitable for High-Temperature Service
 A 240-2007, Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications
 A 307-2004e1, Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength
 A 320-2007, Alloy/Steel Bolting Materials for Low-Temperature Service
 A 350-2004a, Carbon and Low-Alloy Steel Forgings, Requiring Notch Toughness Testing for Piping Components
 A 351-2006, Castings, Austenitic, Austenitic-Ferritic (Duplex), for Pressure Containing Parts
 A 352-2006, Steel Castings, Ferritic and Martensitic, for Pressure-Containing Parts, Suitable for Low-Temperature Service
 A 354-2004e1, Quenched and Tempered Alloy Steel Bolts, Studs, and Other Externally Threaded Fasteners
 A 387-2006a, Pressure Vessel Plates, Alloy Steel, Chromium-Molybdenum
 A 449-2004be1, Hex Cap Screws, Bolts and Studs, Steel, Heat Treated, 120/105/90 ksi Minimum Tensile Strength, General Use
 A 453-2004e1, High-Temperature Bolting Materials, with Expansion Coefficients Comparable to Austenitic Stainless Steels
 A 515-2003, Pressure Vessel Plates, Carbon Steel, for Intermediate- and Higher-Temperature Service
 A 516-2006, Pressure Vessel Plates, Carbon Steel, For Moderated- and Lower-Temperature Service
 A 537-2006, Pressure Vessel Plates, Heat-Treated, Carbon-Manganese-Silicon-Steel
 A 540-2006, Alloy-Steel Bolting Materials for Special Applications
 B 127-2005, Nickel-Copper Alloy (UNS N04400) Plate, Sheet, and Strip
 B 160-2005, Nickel Rod and Bar
 B 162-1999 (R2005), Nickel Plate, Sheet, and Strip
 B 164-2003, Nickel-Copper Alloy Rod, Bar, and Wire
 B 166-2006, 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 168-2006, 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 333-2003, Nickel-Molybdenum Alloy Plate, Sheet, and Strip
- B 335-2003, Nickel-Molybdenum Alloy Rod
- B 408-2006, Nickel-Iron-Chromium Alloy Rod and Bar
- B 409-2006, Nickel-Iron-Chromium Alloy, Plate, Sheet, and Strip
- B 424-2005, Ni-Fe-Cr-Mo-Cu Alloy (UNS N08825 and N08821) Plate, Sheet, and Strip
- B 425-1999 (R2005), Ni-Fe-Cr-Mo-Cu Alloy (UNS N08825 and UNS N08221) Rod and Bar
- B 434-2006, Nickel-Molybdenum-Chromium-Iron Alloys (UNS N10003, UNS N10242) Plate, Sheet, and Strip
- B 435-2006, UNS N06002, UNS N06230, UNS N12160, and UNS R30556 Plate, Sheet, and Strip
- B 443-2000 (R2005), Nickel-Chromium-Molybdenum-Columbium Alloy (UNS N06625) and Nickel-Chromium-Molybdenum-Silicon Alloy (UNS N06219) Plate, Sheet, and Strip
- B 446-2003, Nickel-Chromium-Molybdenum-Columbium Alloy (UNS N06625), Nickel-Chromium-Molybdenum-Silicon Alloy (UNS N06219), and Nickel-Chromium-Molybdenum-Tungsten Alloy (UNS N06650) Rod and Bar
- B 462-2006, Forged or Rolled UNS N06030, UNS N06022, UNS N06035, UNS N06200, UNS N06059, UNS N06686, UNS N08020, UNS N08024, UNS N08026, UNS N08367, UNS N10276, UNS N10665, UNS N10675, UNS N010629, UNS N08031, UNS N06045, UNS N06025, and UNS R20033 Alloy Pipe Flanges, Forged Fittings, and Valves and Parts for Corrosive High-Temperature Service
- B 463-2004, UNS N08020, UNS N08024, and UNS N08026 Alloy Plate, Sheet, and Strip
- B 473-2007, UNS N08020, UNS N08024, and UNS N08026 Nickel Alloy Bar and Wire
- B 511-2001 (R2005), Nickel-Iron-Chromium-Silicon Alloy Bars and Shapes
- B 536-2007, Nickel-Iron-Chromium-Silicon Alloy (UNS N08330 and N08332) Plate, Sheet, and Strip
- B 564-2006a, Nickel Alloy Forgings
- B 572-2006, UNS N06002, UNS N06230, UNS N12160, and UNS R30556 Rod
- B 573-2006, Nickel-Molybdenum-Chromium-Iron Alloy (UNS N10003, N10242) Rod
- B 574-2006e1, 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 575-2006, Low-Carbon Nickel-Chromium-Molybdenum, Low-Carbon Nickel-Chromium-Molybdenum-Copper, Low-Carbon Nickel-Chromium-Molybdenum-Tantalum, Low-Carbon Nickel-Chromium-Molybdenum-Tungsten Alloy Plate, Sheet, and Strip
- B 581-2002, Nickel-Chromium-Iron-Molybdenum-Copper Alloy Rod
- B 582-2002, Nickel-Chromium-Iron-Molybdenum-Copper Alloy Plate, Sheet, and Strip
- B 599-1992 (R2003), Nickel-Iron-Chromium-Molybdenum-Columbium Stabilized Alloy (UNS N08700) Plate, Sheet, and Strip
- B 620-2003, Nickel-Iron-Chromium-Molybdenum Alloy (UNS N08320) Plate, Sheet, and Strip
- B 621-2002 (R2006), Nickel-Iron-Chromium-Molybdenum Alloy (UNS N08320) Rod
- B 625-2005, UNS N08925, UNS N08031, UNS N08932, UNS N08926, UNS N08354, and UNS R20033 Plate, Sheet, and Strip
- B 649-2006, Ni-Fe Cr-Mo-Cu-N Low-Carbon Alloys (UNS N08925, UNS N08031, UNS N08354, and UNS N08926), and Cr-Ni-Fe-N Low-Carbon Alloy (UNS R20033) Bar and Wire, and Ni-Cr-Fe-Mo-N Alloy (UNS N08936) Wire
- B 672-2002, Nickel-Iron-Chromium-Molybdenum-Columbium Stabilized Alloy (UNS N08700) Bar and Wire
- B 688-1996 (R2004), Chromium-Nickel-Molybdenum-Iron (UNS N08366 and UNS N08367) Plate, Sheet, and Strip
- E 29-2006b, Using Significant Digits in Test Data to Determine Conformance with Specifications
- Publisher: American Society for Testing and Materials (ASTM International), 100 Barr Harbor Drive, P.O. Box C700, West Conshohocken, PA 19428-2959
- ISO 9000-1:1994, Quality management and quality assurance standards — Part 1: Guidelines for selection and use
- 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 9001:2000, Quality management systems — Requirements
- 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:¹ International Organization for Standardization (ISO), ch. de la Voie-Creuse, Case postale 56, CH-1211 Genève 20, Switzerland/Suisse

MSS SP-6-2001, Finishes for Contact Faces of Pipe Flanges and Connecting-End Flanges of Valves and Fittings

¹ ISO documents are available from the American National Standards Institute (ANSI), 25 West 43rd Street, New York, NY 10036. Publications appearing above, which have been approved as American National Standards, may also be obtained from ANSI.

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-44-2006, Steel Pipeline Flanges

MSS SP-45-2003, Bypass and Drain Connections

MSS SP-55-2006, Quality Standard for Steel Casting for Valves, Flanges, and Fittings

MSS SP-61-2003, Pressure Testing of Steel Valves

Publisher: Manufacturers Standardization Society of the Valve and Fittings Industry, Inc. (MSS), 127 Park Street, NE, Vienna, VA 22180-4602

NONMANDATORY APPENDIX A

METHOD USED FOR ESTABLISHING PRESSURE-TEMPERATURE RATINGS

A-1 GENERAL CONSIDERATIONS

A-1.1 Introduction

Pressure-temperature ratings for this Standard have been determined by the procedures described in this Nonmandatory Appendix. 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.¹ 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

A-1.2 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, $P_c = 300$)

A-1.3 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).

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

¹ This method is appropriate for materials listed in Table 1A. It may not be appropriate for other materials.

where

- d = inside diameter of the fitting
- 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
- 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 (7,000 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.

A-1.4 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.

A-1.5 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.

A-2 PRESSURE-TEMPERATURE RATING METHOD

A-2.1 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_c = ceiling pressure, bar (psi), at temperature T as specified in section A-3
- 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. A-2.4 of this Nonmandatory Appendix.)
- p_t = rated working pressure, bar (psi), for the specified material at temperature T
- 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. A-2.2, A-2.3, and A-2.4.

A-2.2 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.

A-2.3 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. A-2.1 and A-2.2, except that in paras. A-2.2(a)(1) and A-2.2(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.

A-2.4 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. A-2.1, A-2.2, and A-2.3 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. A-2.1 or A-2.2, 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 (1,000°F). For values of T less than 38°C (100°F), use T equal to 38°C (100°F) in eq. (4).

A-3 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 A-1 and A-2. Ratings in excess of these ceiling values are not permitted under this Standard.

Table A-1 Rating Ceiling Pressure — p_c , bar

| Temperature °C | Class | | | | | | |
|-------------------|------------|------|------|-------|-------|-------|-------|
| | 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 |
| 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 | [Note (1)] | 25.0 | 33.3 | 49.8 | 74.8 | 124.9 | 208.0 |
| 575 | [Note (1)] | 24.0 | 31.9 | 47.9 | 71.8 | 119.7 | 199.5 |
| 600 | [Note (1)] | 21.6 | 28.6 | 42.9 | 64.2 | 107.0 | 178.5 |
| 625 | [Note (1)] | 18.3 | 24.3 | 36.6 | 54.9 | 91.2 | 152.0 |
| 650 | [Note (1)] | 14.1 | 18.9 | 28.1 | 42.5 | 70.7 | 117.7 |
| 675 | [Note (1)] | 12.4 | 16.9 | 25.2 | 37.6 | 62.7 | 104.5 |
| 700 | [Note (1)] | 10.1 | 13.4 | 20.0 | 29.8 | 49.7 | 83.0 |
| 725 | [Note (1)] | 7.9 | 10.5 | 15.4 | 23.2 | 38.6 | 64.4 |
| 750 | [Note (1)] | 5.9 | 7.9 | 11.7 | 17.6 | 29.6 | 49.1 |
| 775 | [Note (1)] | 4.6 | 6.2 | 9.0 | 13.7 | 22.8 | 38.0 |
| 800 | [Note (1)] | 3.5 | 4.8 | 7.0 | 10.5 | 17.4 | 29.2 |
| 816 | [Note (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 (1,000°F).

Table A-2 Rating Ceiling Pressure — p_c , psi

| Temperature °F | Class | | | | | | |
|-------------------|------------|-----|-------|-------|-------|-------|-------|
| | 150 | 300 | 400 | 600 | 900 | 1500 | 2500 |
| –20 to 100 | 290 | 750 | 1,000 | 1,500 | 2,250 | 3,750 | 6,250 |
| 200 | 260 | 750 | 1,000 | 1,500 | 2,250 | 3,750 | 6,250 |
| 300 | 230 | 730 | 970 | 1,455 | 2,185 | 3,640 | 6,070 |
| 400 | 200 | 705 | 940 | 1,410 | 2,115 | 3,530 | 5,880 |
| 500 | 170 | 665 | 885 | 1,330 | 1,995 | 3,325 | 5,540 |
| 600 | 140 | 605 | 805 | 1,210 | 1,815 | 3,025 | 5,040 |
| 650 | 125 | 590 | 785 | 1,175 | 1,765 | 2,940 | 4,905 |
| 700 | 110 | 570 | 755 | 1,135 | 1,705 | 2,840 | 4,730 |
| 750 | 95 | 530 | 710 | 1,065 | 1,595 | 2,660 | 4,430 |
| 800 | 80 | 510 | 675 | 1,015 | 1,525 | 2,540 | 4,230 |
| 850 | 65 | 485 | 650 | 975 | 1,460 | 2,435 | 4,060 |
| 900 | 50 | 450 | 600 | 900 | 1,350 | 2,245 | 3,745 |
| 950 | 35 | 385 | 515 | 775 | 1,160 | 1,930 | 3,220 |
| 1,000 | 20 | 365 | 485 | 725 | 1,090 | 1,820 | 3,030 |
| 1,050 | [Note (1)] | 360 | 480 | 720 | 1,080 | 1,800 | 3,000 |
| 1,100 | [Note (1)] | 325 | 430 | 645 | 965 | 1,610 | 2,685 |
| 1,150 | [Note (1)] | 275 | 365 | 550 | 825 | 1,370 | 2,285 |
| 1,200 | [Note (1)] | 205 | 275 | 410 | 620 | 1,030 | 1,715 |
| 1,250 | [Note (1)] | 180 | 245 | 365 | 545 | 910 | 1,515 |
| 1,300 | [Note (1)] | 140 | 185 | 275 | 410 | 685 | 1,145 |
| 1,350 | [Note (1)] | 105 | 140 | 205 | 310 | 515 | 860 |
| 1,400 | [Note (1)] | 75 | 100 | 150 | 225 | 380 | 630 |
| 1,450 | [Note (1)] | 60 | 80 | 115 | 175 | 290 | 485 |
| 1,500 | [Note (1)] | 40 | 55 | 85 | 125 | 205 | 345 |

NOTE:

(1) Ratings of flanges and flanged fittings terminate at 1,000°F (538°C).

NONMANDATORY APPENDIX B

LIMITING DIMENSIONS OF GASKETS OTHER THAN RING JOINT GASKETS

B-1 GASKET MATERIALS AND CONSTRUCTION











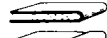

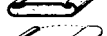


Classification of gasket materials and types is shown in Table B-1. Other gaskets that result in no increase in bolt loads or flange moment over those resulting from the gaskets included in the respective groups may be used (see para. 5.4).

B-2 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.

Table B-1 Gasket Groups and Typical Materials

| Gasket Group Number | Gasket Material | Sketches |
|---------------------|---|---|
| Ia | Self-energizing types: 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 |  |
| | |  |
| | |  |
| IIIa and IIIb | Grooved metal |  |
| | Solid flat soft aluminum |  |
| | Solid flat metal | |
| | Ring joint | |

NONMANDATORY APPENDIX C

METHOD FOR CALCULATING BOLT LENGTHS¹

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:

(a) For ring joint groove facing

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

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

(b) For other than ring joint facing

$$L_{CSB} = A - F + (\text{Table C-1 thicknesses}) + n$$

$$L_{CMB} = B - F + (\text{Table C-1 thicknesses}) + n$$

where

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

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

¹ The equations used in this Nonmandatory Appendix 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)

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

$F =$ total height of facings or depth of ring joint groove for both flanges (see Table C-2)

$G = 3.0\text{-mm}$ (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 II-5 of Mandatory Appendix II)

$L_{CMB} =$ 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 underside of head to end, including end point), which is L_{CMB} rounded off to the nearest 5-mm (0.25 in.) increment (see Fig. C-2)

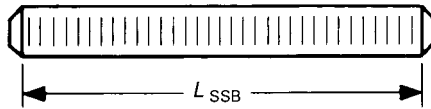
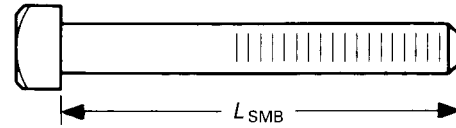
$L_{SSB} =$ specified stud bolt length (effective thread length, excluding end points), which is L_{CSB} rounded off to the nearest 5-mm (0.25 in.) increment (see Fig. C-1)

$n =$ negative tolerance on bolt length (see Table C-3)

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

$t =$ plus tolerance for flange thickness (see para. 7.4)

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

Fig. C-1 Specified Stud Bolt Length**Fig. C-2 Specified Machine Bolt Length****Table C-1 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.) |

Table C-2 *F* Values

| Class | Total Height of Facings or Depth of Ring Joint Groove for Both Flanges, <i>F</i> , mm (in.) | | | |
|-------------|---|-------------------------|--|------------------|
| | Type of Flange Facing [Note (1)] | | | Ring Joint |
| | 2 mm Raised 0.06 in. | 7 mm Raised 0.25 in. | Male and Female or Tongue and Groove | |
| 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. II-8 of Mandatory Appendix II) and Tables 4 and 5 (Tables II-4 and II-5 of Mandatory Appendix II).

Table C-3 *n* Values

| Dimensions | Negative Tolerance on Bolt Lengths, <i>n</i> , mm (in.) | Length, mm (in.) |
|--|---|------------------------|
| Stud Bolt | | |
| <i>A</i> | | |
| or | 1.5 (0.06) | ≤305 (≤12) |
| [<i>A</i> + (pipe thickness for each lap)] | 3.0 (0.12) | >305 (>12), ≤460 (≤18) |
| or | | |
| [<i>A</i> − <i>F</i> + (Table C-1 thickness)] | 7.0 (0.25) | >460 (>18) |
| Machine Bolt | | |
| <i>B</i> | | |
| or | | |
| [<i>B</i> + (pipe thickness for each lap)] | For <i>n</i> values, use negative length tolerances per ASME B18.2.1 | |
| or | | |
| [<i>B</i> − <i>F</i> + (Table C-1 thickness)] | | ... |

NONMANDATORY APPENDIX D

QUALITY SYSTEM PROGRAM

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.¹ A determination of the need for registration and/or certification of the product

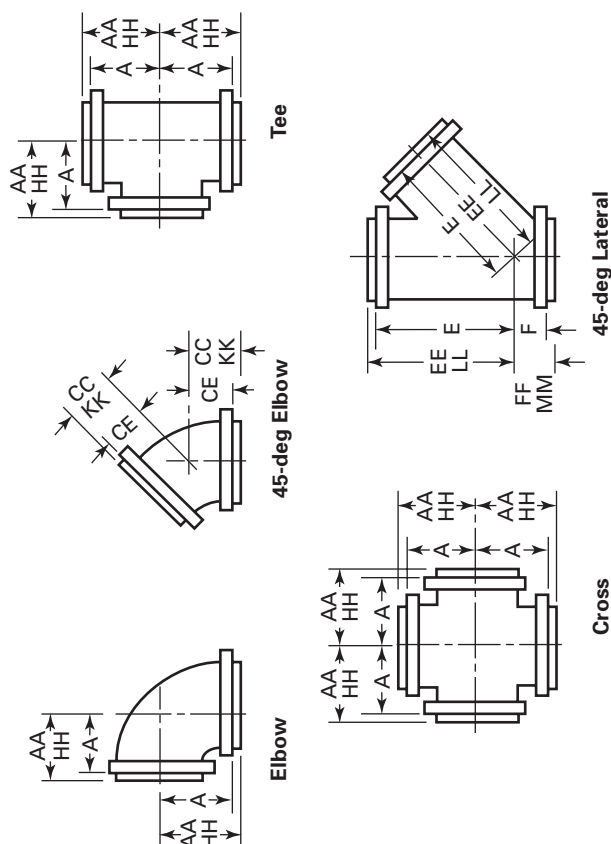
¹ The series is also available from the American National Standards Institute (ANSI) and the American Society for Quality Control (ASQC) as American National Standards that are identified by a prefix "Q," replacing the prefix "ISO." Each standard of the series is listed under Mandatory Appendix III.

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.

NONMANDATORY APPENDIX E
DIMENSIONS OF CLASSES 400, 600, 900, 1500, AND 2500
FLANGED FITTINGS IN U.S. CUSTOMARY UNITS

This Nonmandatory Appendix contains Tables E-1 through E-5.

Table E-1 Dimensions of Class 400 Flanged Fittings



| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 |
|-------------------------|---|--|---|---|---|--|---|--|---|--|--|---|---|
| Flange Edge | | | | | | | | | | Raised Face 0.25 in. [Note (1)] | | | |
| Nominal Pipe Size | Outside Diameter of Flange, <i>O</i> | Minimum Thickness of Flange, <i>t_f</i> | Minimum Wall Thickness of Fitting, <i>t_m</i> | Inside Diameter of Fitting, <i>d</i> | Center-to- Flange Edge, Tee, Elbow, and True “Y,” <i>A</i> | Center-to- Flange Edge, 45-deg Elbow, <i>C</i> | Long Center-to- Flange Edge, Lateral, <i>E</i> | Short Center-to- Flange Edge, Lateral, and True “Y,” <i>F</i> | Flange Edge-to- Flange Edge, Reducer, <i>G</i> | 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 |
| | $\frac{1}{2}$ | | | | | | | | | | | | |
| | $\frac{3}{4}$ | | | | | | | | | | | | |
| | 1 | | | | | | | | | | | | |
| | $1\frac{1}{4}$ | | | | | | | | | | | | |
| $1\frac{1}{2}$ | | | | | | | | | | | | | |
| 2 | | | | | | | | | | | | | |
| $2\frac{1}{2}$ | | | | | | | | | | | | | |
| 3 | | | | | | | | | | | | | |
| $3\frac{1}{2}$ | | | | | | | | | | | | | |

Use Class 600 dimensions in these sizes

Use Class 600 dimensions in these sizes

Table E-1 Dimensions of Class 400 Flanged Fittings (Cont'd)

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 |
|-------------------------|--|---|--|--|--|---|--|---|--|--|--|--|--|
| Nominal Pipe Size | Outside Diameter of Flange, O | Minimum Thickness of Flange, t_f | Minimum Wall Thickness of Fitting, t_m | Inside Diameter of Fitting, d | Flange Edge | | | | | | | | |
| | | | | | Center-to- Flange Edge, Tee, Elbow, and Cross, and True "Y," A | Center-to- Flange Edge, 45-deg Elbow, C | Long Center-to- Flange Edge, Lateral, E | Short Center-to- Flange Edge, Lateral, and True "Y," F | Flange-to- Edge-to- Flange Edge, Reducer, G | Center-to- Contact Surface of Raised Face Elbow, Tee, Cross, and True "Y," AA | Raised Face 0.25 in. [Note (1)] | | |
| | | | | | | | | | | | 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 |
| 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 E-1 Dimensions of Class 400 Flanged Fittings (Cont'd)

[illegible]

Table E-1 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 | | | | | | | | | | | | |
| 0.25 in. [Note (1)] | | | | | | | | | | | | |
| Contact Surface-to-Contact Surface of Raised Face Reducer, GG | Center-to-End Elbow, Tee, Cross, and True "γ," HH | | Center-to-End, Lateral, and True "γ," LL | | Short Center-to-End, Lateral and True "γ," MM | | 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)] | |
| | [Note (3)] | [Note (3)] | [Note (3)] | [Note (3)] | [Notes (4)–(6)] | [Note (4)] | | | | | Bolt Spacing, W | Diameter of Drilled Holes |
| [Note (2)] | [Note (3)] | [Note (3)] | [Note (3)] | [Note (3)] | NN | [Notes (4)–(6)] | [Note (4)] | [Notes (4), (7)] | [Note (4)] | | | |
| 8.25 | 8.06 | 5.56 | 16.06 | 4.56 | Notes (2), (3) | 6.00 | 6.50 | 0.88 | 0.62 | 5.00 | 0.75 | 4 |
| 9.25 | 9.06 | 6.06 | 16.81 | 5.06 | Notes (2), (3) | 6.75 | 7.50 | 1.00 | 0.75 | 5.88 | 0.88 | 5 |
| 10.00 | 9.81 | 6.31 | 18.81 | 5.31 | Notes (2), (3) | 7.50 | 7.50 | 1.00 | 0.75 | 5.88 | 0.88 | 6 |
| 12.00 | 11.81 | 6.81 | 22.31 | 5.81 | Notes (2), (3) | 9.00 | 10.00 | 1.25 | 0.88 | 7.88 | 0.88 | 8 |
| 13.50 | 13.31 | 7.81 | 25.81 | 6.31 | Notes (2), (3) | 10.50 | 10.00 | 1.25 | 0.88 | 7.88 | 0.88 | 10 |
| 15.25 | 15.06 | 8.81 | 29.81 | 6.56 | Notes (2), (3) | 12.00 | 12.50 | 1.44 | 1.00 | 10.62 | 0.88 | 12 |
| 16.50 | 16.31 | 9.31 | 32.81 | 7.06 | Notes (2), (3) | 13.50 | 12.50 | 1.44 | 1.00 | 10.62 | 0.88 | 14 |
| 18.50 | 17.81 | 10.31 | 36.31 | 8.06 | Notes (2), (3) | 14.75 | 12.50 | 1.44 | 1.12 | 10.62 | 0.88 | 16 |
| 19.50 | 19.31 | 10.81 | 39.31 | 8.56 | Notes (2), (3) | 16.25 | 15.00 | 1.62 | 1.12 | 13.00 | 1.00 | 18 |
| 21.00 | 20.88 | 11.38 | 42.88 | 9.12 | Notes (2), (3) | 17.88 | 15.00 | 1.62 | 1.25 | 13.00 | 1.00 | 20 |
| 24.50 | 24.44 | 12.94 | 50.44 | 10.69 | Notes (2), (3) | 20.75 | 17.50 | 1.88 | 1.25 | 15.25 | 1.12 | 24 |

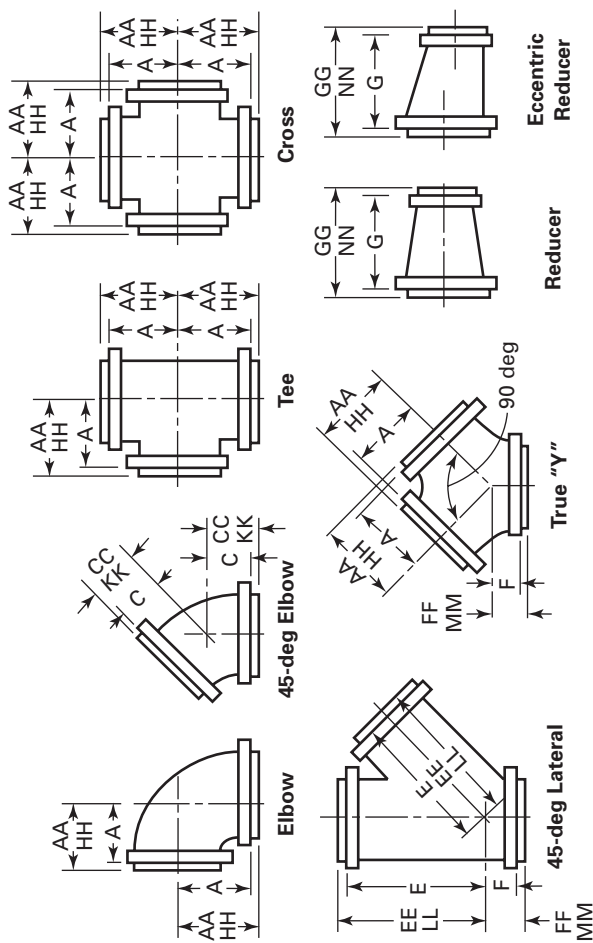
GENERAL NOTES:

- Dimensions are in inches.
- For tolerances, see section 7.
- For facings, see para. 6.4.
- For flange bolt holes, see para. 6.5 and Table II-13 of Mandatory Appendix II.
- 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 II-5 of Mandatory Appendix II for ring joint facing dimensions.
- For contact surface-to-surface and end-to-end dimensions of reducers and eccentric reducers, see para. 6.2.3.
- The base dimensions apply to all straight and reducing sizes.
- For reducing fittings, the size and center-to-face dimensions of the 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.

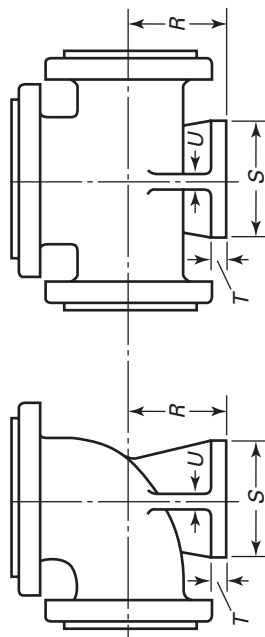
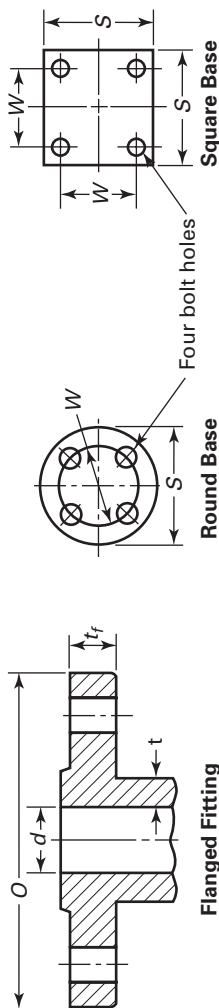
Table E-2 Dimensions of Class 600 Flanged Fittings



| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | | | | | |
|----------------------|-------------------------------------|---|--|-------------------------------------|------------------|-----------|--------------|------------------|----------------------|------------------|-------------------------------------|------------------------|----------------------------|------------------------------------|---|--|----|----|
| Flange Edge | | | | | | | | | | | | | | Raised Face 0.25 in. [Note (1)] | | | | |
| Nominal Pipe Size | Outside Diameter of Flange, O | Minimum Thickness of Flange, t _m | Minimum Wall Thickness of Fitting, t _n | Inside Diameter of Fitting, d | Center-to- | | | | | | | | | | Short Center-to- Contact Surface of Raised Face, Tee, Cross, and True "y," AA | Long Center-to- Contact Surface of Raised Face, 45-deg Elbow, CC | EE | FF |
| | | | | | Center-to-Flange | | Long Center- | | Short Center-to- | | Flange Edge- | | Center-to- | | | | | |
| | | | | | Edge, Elbow, | True "y," | Flange | to-Flange | Flange Edge, | to-Flange | Flange | to-Flange | Contact | Surface of | | | | |
| | | | | | Tee, Cross, and | True "y," | Edge, 45-deg | Edge, Lateral, | Flange Edge, | to-Flange | Edge, Tee, | to-Flange | Contact | Surface of | | | | |
| | | | | | True "y," | True "y," | Elbow, C | Edge, Lateral, E | Lateral, True "y," F | Edge, Reducer, G | Elbow, Tee, Cross, and True "y," AA | Face, 45-deg Elbow, CC | Surface of Raised Face, EE | Contact Surface of Raised Face, 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 | | | | | |

[illegible]

Table E-2 Dimensions of Class 600 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 [Note (2)] | Ring Joint [Note (1)] | | | | Center-to- Base, R [Notes (4)–(6)] | | | Diameter of Round Base or Width of Square Base, S [Note (4)] | | Base Drilling [Note (8)] | | |
| | 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)] | | | Thickness of Base, T [Notes (4), (7)] | Thickness of Ribs, U [Note (4)] | Bolt Circle or Bolt Spacing, W [Note (8)] | Diameter of Drilled Holes [Note (8)] | Nominal Pipe Size |
| | [Note (3)] | [Note (3)] | [Note (3)] | [Note (3)] | | | | | | | | |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| 5.00 | 3.22 | 1.97 | 5.72 | 1.72 | Notes (2), (3) | ... | ... | ... | ... | ... | ... | 1/2 |
| 5.00 | 3.75 | 2.50 | 6.75 | 2.00 | Notes (2), (3) | ... | ... | ... | ... | ... | ... | 3/4 |
| 5.00 | 4.25 | 2.50 | 7.25 | 2.25 | Notes (2), (3) | ... | ... | ... | ... | ... | ... | 1 |
| 5.00 | 4.50 | 2.75 | 8.00 | 2.50 | Notes (2), (3) | ... | ... | ... | ... | ... | ... | 1 1/4 |
| 5.00 | 4.75 | 3.00 | 9.00 | 2.75 | Notes (2), (3) | ... | ... | ... | ... | ... | ... | 1 1/2 |
| 6.00 | 5.81 | 4.31 | 10.31 | 3.56 | Notes (2), (3) | 4.75 | 6.12 | 0.81 | 0.62 | 4.50 | 0.88 | 2 |
| 6.75 | 6.56 | 4.56 | 11.56 | 3.56 | Notes (2), (3) | 5.25 | 6.12 | 0.81 | 0.62 | 4.50 | 0.88 | 2 1/2 |
| 7.25 | 7.06 | 5.06 | 12.81 | 4.06 | Notes (2), (3) | 5.75 | 6.50 | 0.88 | 0.75 | 5.00 | 0.75 | 3 |
| 7.75 | 7.56 | 5.56 | 14.06 | 4.56 | Notes (2), (3) | 6.50 | 6.50 | 0.88 | 0.75 | 5.00 | 0.75 | 3 1/2 |
| 8.75 | 8.56 | 6.06 | 16.56 | 4.56 | Notes (2), (3) | 7.00 | 7.50 | 1.00 | 0.75 | 5.88 | 0.88 | 4 |

Table E-2 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)] | | | | | | | | | | | | |
| Diameter of Round Base or Width of Square Base, S [Note (4)] | | | | | | | | | | | | |
| Center-to-Base, R [Notes (4)-(6)] | | | | | | | | | | | | |
| End-to-End Reducer, NN | | | | | | | | | | | | |
| Short Center-to-End, Lateral, and True "Y," MM [Note (3)] | | | | | | | | | | | | |
| Long Center-to-End, Lateral, LL [Note (3)] | | | | | | | | | | | | |
| Center-to-End Elbow, Tee, Cross, and True "Y," HH [Note (3)] | | | | | | | | | | | | |
| Center-to-End, 45-deg Elbow, KK [Note (3)] | | | | | | | | | | | | |
| Thickness of Base, T [Notes (4), (7)] | | | | | | | | | | | | |
| Thickness of Ribs, U [Note (4)] | | | | | | | | | | | | |
| Bolt Circle or Bolt Spacing, W | | | | | | | | | | | | |
| Base Drilling [Note (8)] | | | | | | | | | | | | |
| Diameter of Drilled Holes | | | | | | | | | | | | |
| Nominal Pipe Size | | | | | | | | | | | | |
| GG | [Note (2)] | [Note (3)] | [Note (3)] | [Note (3)] | [Note (3)] | [Notes (4)-(6)] | [Note (4)] | [Notes (4), (7)] | [Note (4)] | | | |
| 10.25 | 10.06 | 7.06 | 19.56 | 6.06 | Notes (2), (3) | 8.25 | 10.00 | 1.25 | 0.75 | 7.88 | 0.88 | 5 |
| 11.25 | 11.06 | 7.56 | 21.06 | 6.56 | Notes (2), (3) | 9.00 | 10.00 | 1.25 | 0.75 | 7.88 | 0.88 | 6 |
| 13.25 | 13.06 | 8.56 | 24.56 | 7.06 | Notes (2), (3) | 11.00 | 12.50 | 1.44 | 1.00 | 10.62 | 0.88 | 8 |
| 15.75 | 15.56 | 9.56 | 29.56 | 8.06 | Notes (2), (3) | 12.50 | 12.50 | 1.44 | 1.00 | 10.62 | 0.88 | 10 |
| 16.75 | 16.56 | 10.06 | 31.56 | 8.56 | Notes (2), (3) | 13.25 | 15.00 | 1.62 | 1.12 | 13.00 | 1.00 | 12 |
| 17.75 | 17.56 | 10.81 | 34.31 | 9.06 | Notes (2), (3) | 14.75 | 15.00 | 1.62 | 1.12 | 13.00 | 1.00 | 14 |
| 19.75 | 19.56 | 11.81 | 38.56 | 10.06 | Notes (2), (3) | 16.00 | 15.00 | 1.62 | 1.25 | 13.00 | 1.00 | 16 |
| 21.75 | 21.56 | 12.31 | 42.06 | 10.56 | Notes (2), (3) | ... | ... | ... | ... | ... | ... | 18 |
| 23.75 | 23.62 | 13.12 | 45.62 | 11.12 | Notes (2), (3) | ... | ... | ... | ... | ... | ... | 20 |
| 27.75 | 27.69 | 14.94 | 53.19 | 13.19 | Notes (2), (3) | ... | ... | ... | ... | ... | ... | 24 |

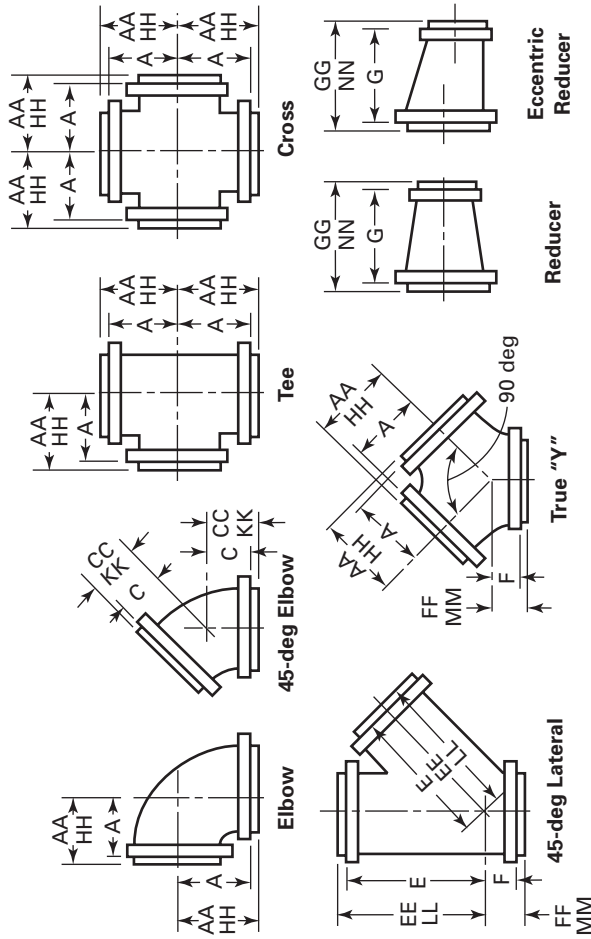
GENERAL NOTES:

- Dimensions are in inches.
- For tolerances, see section 7.
- For facings, see para. 6.4.
- For flange bolt holes, see para. 6.5 and Table II-15 of Mandatory Appendix II.
- 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 II-5 of Mandatory Appendix II 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 the 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 E-3 Dimensions of Class 900 Flanged Fittings



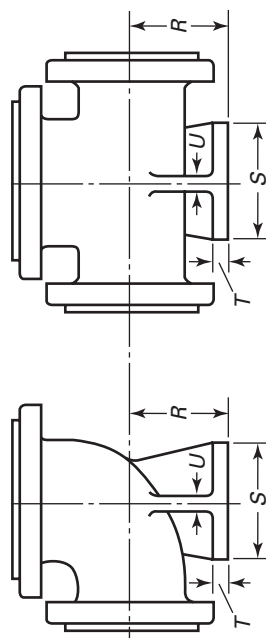
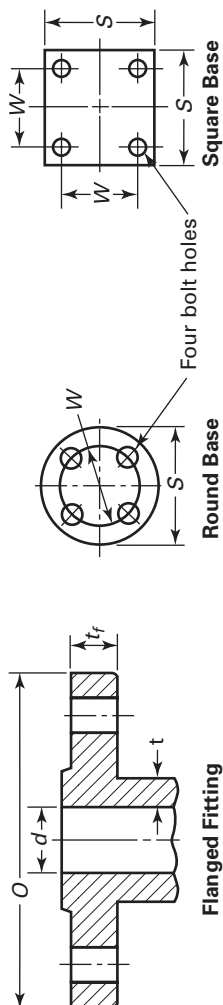
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 |
|-------------------------|---|--|---|---|---|---|---|---|--|---|---|--|--|
| Nominal Pipe Size | Outside Diameter of Flange, O | Minimum Thickness of Flange, t _f | Minimum Wall Thickness of Fitting, t _m | Inside Diameter of Fitting, d | Flange Edge | | | | | | | | |
| | | | | | Raised Face 0.25 in. [Note (1)] | | | | | | | | |
| | | | | | Center-to- Flange Edge, Elbow, Tee, Cross, and True "Y," A | Center-to- Flange Edge, 45-deg Elbow, C | Long Center- to-Flange Edge, Lateral, E | Short Center- to-Flange Edge, and Lateral, and True "Y," F | Flange Edge-to- Flange Edge, Reducer, G | 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 |
| 1/2 | 4.75 | 0.88 | 0.16 | 0.50 | | | | | | | | | |
| 3/4 | 5.12 | 1.00 | 0.19 | 0.69 | | | | | | | | | |
| 1 | 5.88 | 1.12 | 0.22 | 0.88 | | | | | | | | | |
| 1 1/4 | 6.25 | 1.12 | 0.25 | 1.12 | | | | | | | | | |
| 1 1/2 | 7.00 | 1.25 | 0.28 | 1.38 | | | | | | | | | |
| 2 | 8.50 | 1.50 | 0.31 | 1.88 | | | | | | | | | |
| 2 1/2 | 9.62 | 1.62 | 0.34 | 2.25 | | | | | | | | | |

Use Class 1500 dimensions in these sizes

Table E-3 Dimensions of Class 900 Flanged Fittings (Cont'd)

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 |
|---------------------------------|--|--|---|--|--|---|--|--|--|--|---|---|---|
| Nominal Pipe Size | Outside Diameter of Flange, <i>O</i> | Minimum Thickness of Flange, <i>t_f</i> | Minimum Wall Thickness of Fitting, <i>t_m</i> | Inside Diameter of Fitting, <i>d</i> | Flange Edge | | | | | | | | |
| | | | | | Center-to- Flange Edge, Elbow, Tee, Cross, and True “Y,” <i>A</i> | Center-to- Flange Edge, 45-deg Elbow, <i>C</i> | Long Center- to-Flange Edge, Lateral, <i>E</i> | Short Center- to-Flange Edge, Lateral, and True “Y,” <i>F</i> | Flange Edge-to- Flange Edge Reducer, <i>G</i> | Center-to-Contact | | | |
| | | | | | | | | | | Surface of Raised Face Elbow, Tee, Cross, and True “Y,” <i>AA</i> | Surface of Raised Face, 45-deg Elbow, <i>CC</i> | Long Center- to-Contact Surface of Raised Face, Lateral, <i>EE</i> | Short Center- to-Contact Surface of Raised Face, Lateral, and True “Y,” <i>FF</i> |
| | | | | | | | | | | | | | |
| | | | | | | | | | | | | | |
| Raised Face 0.25 in. [Note (1)] | | | | | | | | | | | | | |
| 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 E-3 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 [Note (2)] | Ring Joint [Note (1)] | | | | End-to-End Reducer, NN [Notes (4), (5)] | Center-to-Base, S [Notes (6)] | 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)] | | |
| | 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)] | | | | | | Bolt Circle or Bolt Spacing, W | Diameter of Drilled Holes | Nominal Pipe Size |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| 7.75 9.25 | 7.56 9.06 | 5.56 6.56 | 14.56 17.56 | 4.56 5.56 | Notes (2), (3) Notes (2), (3) | 5.75 7.00 | 6.50 7.50 | 0.88 1.00 | 0.75 0.75 | 5.00 5.88 | 0.75 0.88 | 3 4 |
| 11.25 12.25 | 11.06 12.06 | 7.56 8.06 | 21.06 22.56 | 6.56 6.56 | Notes (2), (3) Notes (2), (3) | 8.25 9.00 | 10.00 10.00 | 1.25 1.25 | 0.75 0.75 | 7.88 7.88 | 0.88 0.88 | 5 6 |
| Use Class 1500 dimensions in these sizes | | | | | | | | | | | | |
| | | | | | | | | | | | | $\frac{1}{2}$ $\frac{3}{4}$ 1 $1\frac{1}{4}$ $1\frac{1}{2}$ 2 $2\frac{1}{2}$ |

Use Class 1500 dimensions in these sizes

Table E-3 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)] | | | | | End-to-End Reducer, NN | Center-to-Base, S | Thickness of Base, T | Thickness of Ribs, U | Base Drilling [Note (8)] | | |
| | 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 | Bolt Circle or Bolt Spacing, W | | | | | Diameter of Drilled Holes | Nominal Pipe Size | |
| | [Note (3)] | [Note (3)] | [Note (3)] | [Note (3)] | | | | | | | | |
| 14.75 | 14.56 | 9.06 | 27.56 | 7.56 | Notes (2), (3) | 11.00 | 12.50 | 1.44 | 1.00 | 10.62 | 0.88 | 8 |
| 16.75 | 16.56 | 10.06 | 31.56 | 8.56 | Notes (2), (3) | 12.50 | 12.50 | 1.44 | 1.00 | 10.62 | 0.88 | 10 |
| 17.75 | 19.06 | 11.06 | 34.56 | 9.06 | Notes (2), (3) | 13.25 | 15.00 | 1.62 | 1.12 | 13.00 | 1.00 | 12 |
| 19.00 | 20.44 | 11.69 | 36.69 | 9.69 | Notes (2), (3) | 14.75 | 15.00 | 1.62 | 1.12 | 13.00 | 1.00 | 14 |
| 21.00 | 22.44 | 12.69 | 40.94 | 10.69 | Notes (2), (3) | 16.00 | 15.00 | 1.62 | 1.25 | 13.00 | 1.00 | 16 |
| 24.50 | 24.25 | 13.50 | 45.75 | 12.25 | Notes (2), (3) | ... | ... | ... | ... | ... | ... | 18 |
| 26.50 | 26.25 | 14.75 | 50.50 | 13.25 | Notes (2), (3) | ... | ... | ... | ... | ... | ... | 20 |
| 30.50 | 30.88 | 18.38 | 60.38 | 15.88 | Notes (2), (3) | ... | ... | ... | ... | ... | ... | 24 |

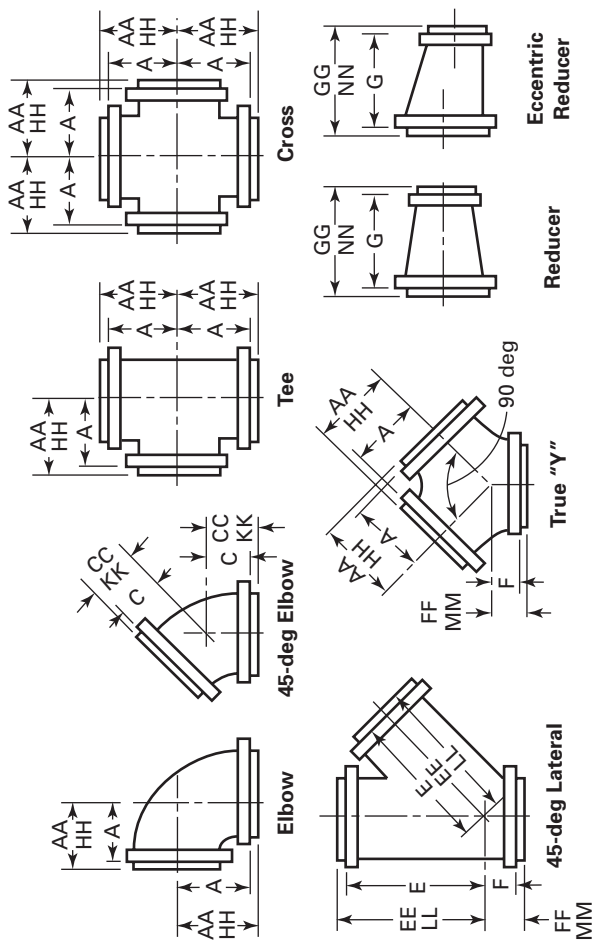
GENERAL NOTES:

- (a) Dimensions are in inches.
- (b) For tolerances, see section 7.
- (c) For facings, see para. 6.4.
- (d) For flange bolt holes, see para. 6.5 and Table II-17 of Mandatory Appendix II.
- (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) For center-to-contact surface and center-to-end dimensions of reducing fittings, see para. 6.2.3.
- (2) For contact surface-to-contact surface and center-to-end dimensions of reducers and eccentric reducers, see para. 6.2.3.
- (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 II-5 of Mandatory Appendix II for ring joint facing dimensions.
- (4) For reducing fittings, the size and center-to-face dimensions of the 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.
- (5) Bases shall be plain faced unless otherwise specified, and the center-to-base face dimension R shall be the finished dimension.
- (6) The base dimensions apply to all straight and reducing sizes.
- (7) Bases may be cast integral or attached as weldments at the option of the manufacturer.
- (8) 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 E-4 Dimensions of Class 1500 Flanged Fittings

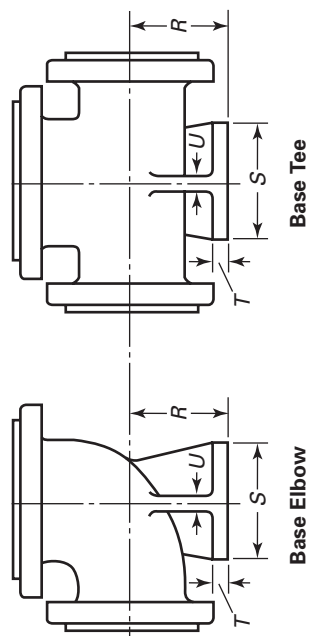
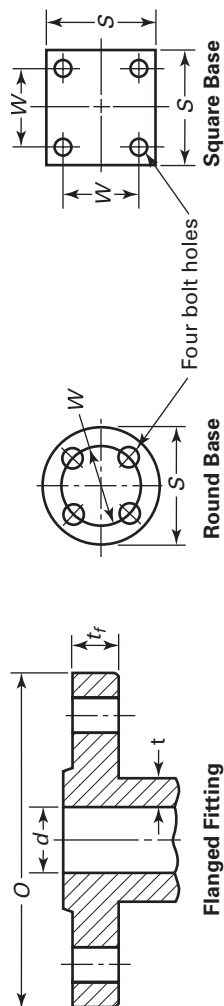


| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | |
|---------------------------------|--|--|---|--|---|---|---|---|---|---|---|--|------|--|
| Raised Face 0.25 in. [Note (1)] | | | | | | | | | | | | | | |
| Nominal Pipe Size | Outside Diameter of Flange, <i>O</i> | Minimum Thickness of Flange, <i>t_f</i> | Minimum Wall Thickness of Fitting, <i>t_m</i> | Inside Diameter of Fitting, <i>d</i> | Flange Edge | | | | | Center-to-Contact Surface of Raised Face, Tee, Cross, and True “Y,” | | | | Short Center- to-Contact Surface of Raised Face, Lateral, and True “Y,” FF |
| | | | | | Center-to- Flange Edge, Elbow, Tee, Cross, and True “Y,” A | Center-to- Flange Edge, 45-deg Elbow, C | Long Center- to-Flange Edge, Lateral, E | Short Center- to-Flange Edge, and Lateral, True “Y,” F | Flange Edge to Flange Edge Reducer, G | 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 | | |
| | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | |
| 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 E-4 Dimensions of Class 1500 Flanged Fittings (Cont'd)

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | |
|-------------------------|--|---|--|--|--|-------|---|--|---------------------------------|---|---|---|--|--|
| Nominal Pipe Size | Outside Diameter of Flange, <i>O</i> | Minimum Thickness of Flange, <i>t_f</i> | Minimum Wall Thickness of Fitting, <i>t_m</i> | Inside Diameter of Fitting, <i>d</i> | Flange Edge | | | | Raised Face 0.25 in. [Note (1)] | | | | | |
| | | | | | Center-to- Flange Edge, Elbow, Tee, Cross, and True “Y,” <i>A</i> | | Center-to- Flange Edge, 45-deg Elbow, <i>C</i> | Short Center- to-Flange Edge, and Lateral, and True “Y,” <i>F</i> | | Flange Edge to Flange Edge, Reducer, <i>G</i> | 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 |
| | | | | | | | | | | | | | | |
| 5 | 14.75 | 2.88 | 0.91 | 4.38 | 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 | 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 | 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 | 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 | 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 | 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 | 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 | 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 | 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 | 38.00 | 20.50 | 67.00 | 20.25 | 39.25 | 38.75 | 20.75 | 67.25 | 20.50 | |

Table E-4 Dimensions of Class 1500 Flanged Fittings (Cont'd)



| | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 1 |
|--|--|------------|------------|--|------------|------------------------|--|--|---------------------------------------|---|--------------------------------|---------------------------|-------------------|
| Raised Face Contact Surface of Contact Surface of Raised Face Reducer, GG [Note (2)] | Ring Joint [Note (1)] | | | | | | | | | | | | |
| | 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)] | | | Nominal Pipe Size |
| | [Note (2)] | [Note (3)] | [Note (3)] | [Note (3)] | [Note (3)] | [Note (3)] | [Note (3)] | [Note (3)] | [Note (3)] | [Note (3)] | [Note (3)] | [Note (3)] | |
| | | | | | | End-to-End Reducer, NN | 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 | |
| ... | ... | 4.25 | 3.00 | ... | ... | Notes (2), (3) | ... | ... | ... | ... | ... | ... | 1/2 |
| ... | ... | 4.50 | 3.25 | ... | ... | Notes (2), (3) | ... | ... | ... | ... | ... | ... | 3/4 |
| 5.00 | ... | 5.00 | 3.50 | 9.00 | 2.50 | Notes (2), (3) | ... | ... | ... | ... | ... | ... | 1 |
| 5.75 | ... | 5.50 | 4.00 | 10.00 | 3.00 | Notes (2), (3) | ... | ... | ... | ... | ... | ... | 1 1/4 |
| 6.25 | ... | 6.00 | 4.25 | 11.00 | 3.50 | Notes (2), (3) | ... | ... | ... | ... | ... | ... | 1 1/2 |
| 7.25 | ... | 7.31 | 4.81 | 13.31 | 4.06 | Notes (2), (3) | 5.50 | 6.50 | 0.88 | 0.75 | 5.00 | 0.75 | 2 |
| 8.25 | ... | 8.31 | 5.31 | 15.31 | 4.56 | Notes (2), (3) | 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 | Notes (2), (3) | 6.50 | 7.50 | 1.00 | 0.75 | 5.88 | 0.88 | 3 |
| 10.75 | ... | 10.81 | 7.31 | 19.31 | 6.06 | Notes (2), (3) | 7.75 | 10.00 | 1.25 | 0.75 | 7.88 | 0.88 | 4 |
| 13.75 | ... | 13.31 | 8.81 | 23.31 | 7.56 | Notes (2), (3) | 9.00 | 10.00 | 1.25 | 0.75 | 7.88 | 0.88 | 5 |
| 14.50 | ... | 14.00 | 9.50 | 25.00 | 8.25 | Notes (2), (3) | 9.75 | 12.50 | 1.44 | 1.00 | 10.62 | 0.88 | 6 |
| 17.00 | ... | 16.56 | 11.06 | 30.06 | 9.31 | Notes (2), (3) | 11.50 | 12.50 | 1.44 | 1.00 | 10.62 | 0.88 | 8 |

Table E-4 Dimensions of Class 1500 Flanged Fittings (Cont'd)

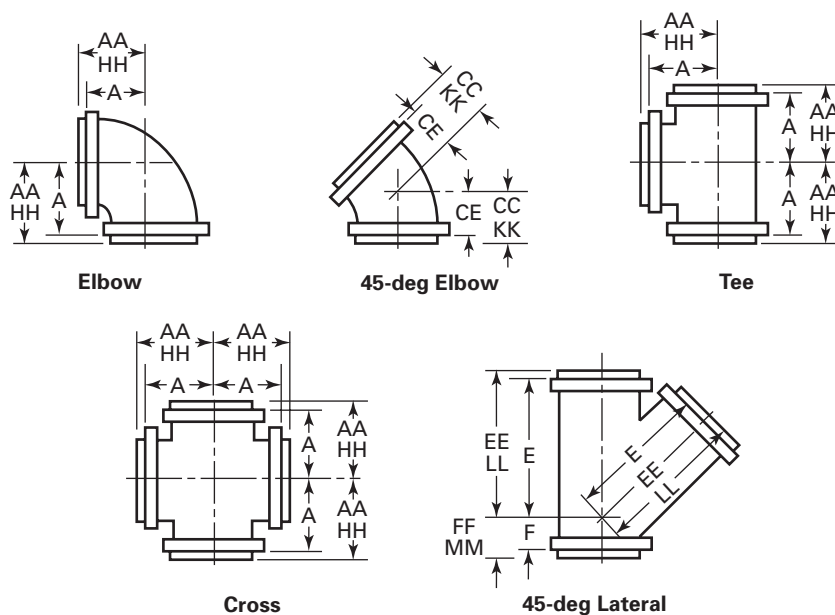
| 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 1 |
|--|--|-------|--|-------|---|-------|---|------|-----------------------------------|-------|-----------------------------------|----|
| Ring Joint [Note (1)] | | | | | | | | | | | | |
| Raised Face | | | | | | | | | | | | |
| 0.25 in. [Note (1)] | | | | | | | | | | | | |
| 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)] | | [Note (4)] | |
| 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 | | | |
| | [Note (4)] | | [Note (4)] | | [Note (4)] | | [Note (4)] | | [Note (4)] | | | |
| 20.25 | 19.69 | 12.19 | 36.19 | 10.44 | Notes (2), (3) | 13.75 | 15.00 | 1.62 | 1.12 | 13.00 | 1.00 | 10 |
| 23.00 | 22.56 | 13.56 | 41.06 | 12.31 | Notes (2), (3) | 15.50 | 15.00 | 1.62 | 1.12 | 13.00 | 1.00 | 12 |
| 25.75 | 25.12 | 14.62 | 44.38 | 12.88 | Notes (2), (3) | 17.25 | 17.50 | 1.88 | 1.25 | 15.25 | 1.12 | 14 |
| 28.25 | 27.69 | 16.69 | 48.69 | 15.19 | Notes (2), (3) | 18.75 | 17.50 | 1.88 | 1.25 | 15.25 | 1.12 | 16 |
| 31.50 | 30.69 | 18.19 | 53.69 | 16.94 | Notes (2), (3) | ... | ... | ... | ... | ... | ... | 18 |
| 34.00 | 33.19 | 19.19 | 58.19 | 18.19 | Notes (2), (3) | ... | ... | ... | ... | ... | ... | 20 |
| 39.75 | 38.81 | 21.31 | 67.81 | 21.06 | Notes (2), (3) | ... | ... | ... | ... | ... | ... | 24 |

GENERAL NOTES:

- Dimensions are in inches.
- For tolerances, see section 7.
- For facings, see para. 6.4.
- For flange bolt holes, see para. 6.5 and Table II-19 of Mandatory Appendix II.
- 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.

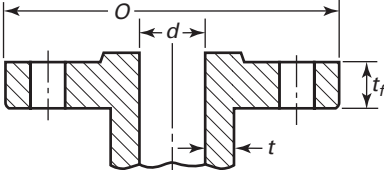
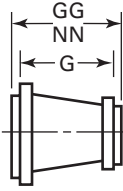
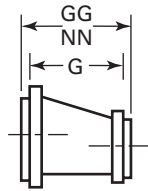
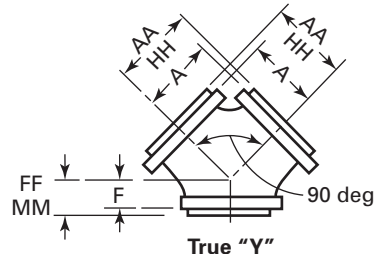
NOTES:

- 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 II-5 of Mandatory Appendix II 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 the 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 E-5 Dimensions of Class 2500 Flanged Fittings

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|----------------------|--|--|---|--|--|--|--|--|---|
| Nominal Pipe Size | Outside Diameter of Flange, <i>O</i> | Minimum Thickness of Flange, <i>t_f</i> | Minimum Wall Thickness of Fitting, <i>t_m</i> | Inside Diameter of Fitting, <i>d</i> | Flange Edge | | | | |
| | | | | | Center-to- Flange Edge, Elbow, Tee, Cross, and True “Y,” <i>A</i> | Center-to- Flange Edge, 45-deg Elbow, CE | Long Center- to-Flange Edge, Lateral, <i>E</i> | Short Center- to-Flange Edge, Lateral, and True “Y,” <i>F</i> | Flange Edge-to- Flange Edge, Reducer, <i>G</i> |
| | | | | | | | | | |
| $\frac{1}{2}$ | 5.25 | 1.19 | 0.25 | 0.44 | 4.94 | ... | ... | ... | ... |
| $\frac{3}{4}$ | 5.50 | 1.25 | 0.28 | 0.56 | 5.12 | ... | ... | ... | ... |
| 1 | 6.25 | 1.38 | 0.34 | 0.75 | 5.81 | 3.75 | ... | ... | ... |
| $1\frac{1}{4}$ | 7.25 | 1.50 | 0.44 | 1.00 | 6.62 | 4.00 | ... | ... | ... |
| $1\frac{1}{2}$ | 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 |
| $2\frac{1}{2}$ | 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 E-5 Dimensions of Class 2500 Flanged Fittings (Cont'd)

| | | | | | | | | | | |
|---|---|---|---|---|---|--|---|---|---|-------------------|
|  | | | |  | |  | |  | | |
| Flanged Fitting | | | | Reducer | | Eccentric Reducer | | True "Y" | | |
| 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, 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 [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 section 7.
- For facings, see para. 6.4.
- For flange bolt holes, see para. 6.5 and Table II-21 of Mandatory Appendix II.
- 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 II-5 of Mandatory Appendix II for ring joint facing dimensions.

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B16 AMERICAN NATIONAL STANDARDS FOR PIPING, PIPE FLANGES, FITTINGS, AND VALVES

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| Gray Iron Pipe Flanges and Flanged Fittings (Classes 25, 125, and 250) | B16.1-2005 |
| Malleable Iron Threaded Fittings: Classes 150 and 300 | B16.3-2006 |
| Gray Iron Threaded Fittings: Classes 125 and 250 | B16.4-2006 |
| Pipe Flanges and Flanged Fittings NPS 1/2 Through NPS 24 Metric/Inch Standard | B16.5-2009 |
| Factory-Made Wrought Butt welding Fittings | B16.9-2007 |
| Face-to-Face and End-to-End Dimensions of Valves | B16.10-2000 (R2003) |
| Forged Fittings, Socket-Welding and Threaded | B16.11-2009 |
| Cast Iron Threaded Drainage Fittings | B16.12-1998 (R2006) |
| Ferrous Pipe Plugs, Bushings, and Locknuts with Pipe Threads | B16.14-1991 |
| Cast Copper Alloy Threaded Fittings | B16.15-2006 |
| Cast Copper Alloy Solder Joint Pressure Fittings | B16.18-2001 (R2005) |
| Metallic Gaskets for Pipe Flanges: Ring-Joint, Spiral-Wound, and Jacketed | B16.20-2007 |
| Nonmetallic Flat Gaskets for Pipe Flanges | B16.21-2005 |
| Wrought Copper and Copper Alloy Solder Joint Pressure Fittings | B16.22-2001 (R2005) |
| Cast Copper Alloy Solder Joint Drainage Fittings: DWV | B16.23-2002 (R2006) |
| Cast Copper Alloy Pipe Flanges and Flanged Fittings: Classes 150, 300, 600, 900, 1500, and 2500 | B16.24-2006 |
| Butt welding Ends | B16.25-2007 |
| Cast Copper Alloy Fittings for Flared Copper Tubes | B16.26-2006 |
| Wrought Steel Butt welding Short Radius Elbows and Returns | B16.28-1994 |
| Wrought Copper and Wrought Copper Alloy Solder Joint Drainage Fittings — DWV | B16.29-2007 |
| Manually Operated Metallic Gas Valves for Use in Gas Piping Systems up to 125 psi (Sizes NPS 1/2 Through NPS 2) | B16.33-2002 (R2007) |
| Valves — Flanged, Threaded, and Welding End | B16.34-2004 |
| Orifice Flanges | B16.36-2006 |
| Large Metallic Valves for Gas Distribution Manually Operated, NPS 2 1/2 (DN 65) to NPS 12 (DN 300), 125 psig (8.6 bar) Maximum | B16.38-2007 |
| Malleable Iron Threaded Pipe Unions: Classes 150, 250, and 300 | B16.39-1998 (R2006) |
| Manually Operated Thermoplastic Gas Shutoffs and Valves in Gas Distribution Systems | B16.40-2008 |
| Functional Qualification Requirements for Power Operated Active Valve Assemblies for Nuclear Power Plants | B16.41-1983 (R1989) |
| Ductile Iron Pipe Flanges and Flanged Fittings: Classes 150 and 300 | B16.42-1998 (R2006) |
| Manually Operated Metallic Gas Valves for Use in Aboveground Piping Systems Up To 5 PSI | B16.44-2002 (R2007) |
| Cast Iron Fittings for Solvent® Drainage Systems | B16.45-1998 (R2006) |
| Large Diameter Steel Flanges NPS 26 Through NPS 60 Metric/Inch Standard | B16.47-2006 |
| Steel Line Blanks | B16.48-2005 |
| Factory-Made Wrought Steel Butt welding Induction Bends for Transportation and Distribution Systems | B16.49-2007 |
| Wrought Copper and Copper Alloy Braze-Joint Pressure Fittings | B16.50-2001 (R2008) |

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